Prescribed by the National Curriculum and Textbook Board as a Textbook for class IX & X from the academic year 1997

AGRICULTURAL EDUCATION
[For classes 9-10]

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Preface

Education is the key to development. A progressively improved education system largely determines the pace and the quality or national development. To reflect the hopes and aspirations or the people and the socio-economic and cultural reality in the context of the post independent Bangladesh, new textbooks were introduced in the beginning of the 1980s following the recommendations of the National Curriculum and Textbook Committee.

In 1994, in accordance with the need for change and development, the textbooks of lower secondary, secondary and higher secondary were revised and modified. The textbooks from classes VI to IX were written in 1995. In 2000, almost all the textbooks were rationally evaluated and necessary revision were made. In 2008 the Ministry or Education formed a Task Force for Education. According to the advice and guidance of the Task Force, the cover, spelling and information in the textbooks were updated and corrected.

To make assessment more meaningful and in accordance with the need of the curriculum, Creative Questions and Multiple Choice Questions are given at the end of each chapter. It is hoped that this will reduce the dependency or students on rote memorisation. The students will be able to apply the knowledge they have gained to judge, analyse and evaluate real life situation.

The economy and development of Bangladesh is dependent on Agriculture. It is important to learn the skills required to develop agriculture. In Secondary Education the learners need to acquire both theoretical and practical knowledge of Agricultural Science. Keeping this in mind the following topies have been included in the textbook there are Forestation pisiculture, gardening and crop plantation, management of livestock etc. The textbook of class IX & X will enable the learners develop respect towards labour and instill social values in them.

This book of Agricultural Education for class IX & X is the English Version of the original textbook entitled 'Mavdhamic Krishi Shiksha' written in Bangla.

We know that curriculum development is a continuous process or which textbooks are written. Any logical and formative suggestions for improvement will be considered with care. On the event of the golden jubilee of the Independence of Bangladesh in 2021, we want to be a part of the ceaseless effort to build a prosperous Bangladesh.

In spite of sincere efforts in translation. Editing and printing inadvertent errors and omissions may be found in the book. However our efforts to make it more refined and impeccable will continue.

I thank those who have assisted us with their intellect and efforts in the writing, editing and rational evaluation of this book. We hope that the book will be useful for the students for whom it is written.

Professor Mostafa Kamaluddin
Chairman
National Curriculum and Textbook Board, Dhaka.
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Part One
Crop and Horticulture
Chapter One
Agricultural Climate

Weather and Climate

It is essential at first to know the weather of a country to understand its climate. Weather means the daily condition of temperature, relative humidity, rainfall, and air flow, sunshine, atmospheric pressure, fog etc, of an area. Weather may be of any time within a day. Weather of localities changes frequently. The climate of an area may be defined as the average of 20 to 25 years weather of that area. The characteristics of climate depends mainly on the altitude, latitude, height from the mean sea level, distance from the sea, air flow, rainfall, oceanic stream, mountains and vegetation of certain area. Climate greatly influences the agricultural production of a country. The climate of an area may be understood by observing the plants and agricultural production of the place.

The climate of Bangladesh is nearly temperate in consideration of countries geographical position, height from the sea level, distance from the ocean, temperature and rainfall. Sufficient rainfall, medium winter and humid rainy season are the main characteristics of the climate of Bangladesh. This type of climate is very favorable for agricultural production.

On the basis of climate of Bangladesh the crop growing period is divided into two seasons, such as:

A. Rabi (Winter season)
B. Kharif (Summer- rainy season)

A. Rabi Season

The crop growing period from Aswin (Middle of September) to Falgun (Middle of March) Months is known as Rabi season. The main characteristics of this cropping season are low temperature, low relative humidity and low rainfall. The main vegetables of this winter season are Cauliflower, Cabbage, Radish, Carrot, Gourds, Country bean, Tomato, Boro Rice, Wheat, Potato and Mustard. Crop production in this season needs irrigation.
B. Kharif Season

The Kharif season may be divided into two seasons according to climatic parameters. These are-
1. Kharif-1
2. Kharif-2

**Kharif-1 Season**

The season starting from Chaitra month to Ashar month (from the middle of March to middle of July) is known as Kharif-I season. This season is also known as summer season. The atmospheric temperature becomes high during this season. Frequent storms are the characteristics of this season. Aus rice, Jute, lady’s finger (okra), Indian spinach, Sweet gourd, Bitter gourd, Palwal gourd, Spined gourd, Barbate etc. are mainly cultivated during this season.

Arrangement should be done for irrigation for cultivating crops during this season if the rainfall is low. The major and important fruits of this season include mango, black berry, jack fruit and papaya.

**Kharif-2 Season**

The season starting from Ashar month to Bhadra month (from the middle of June to middle of September) is known as Kharif-2 season. This season is also known as rainy season.

Torrential rain is the characteristics of this season. The atmospheric temperature remains medium during this season. Transplanted Aman rice and rainy season vegetables are mainly cultivated during this season.

The major and important fruits of this season include pummelo (lime group), palm tree fruit, late season mango, jack fruit, amlaki, olive etc are mainly available during the Kharif-2 season. Some vegetables are available in our country throughout the year. For example – Lady’s finger, Brinjal, and Red amarnth.

**The Agricultural Weather and Climate**

The daily conditions of rainfall, atmospheric temperature, humidity and pressure as important for crop production may be termed as agricultural weather. The agricultural production in Bangladesh is pre-dominantly dependent on agricultural weather.

Agricultural production plans are formulated after making thorough consideration of the existing weather and climate of an area or locality. Agricultural weather has so
BANGLADESH: Main Agricultural Region and Crops
(on the basis of climate and weather)

1. North Western
2. North-Eastern
3. Southern
much diversity according to different geographical and ecological regions of Bangladesh. Different crop plant grows well in different regions due to the variation of agricultural weather at diversified Agro Ecological Zones (AEZ).

The whole Bangladesh has been divided in to three main divisions according to the existing agricultural weather and climate. The name of these climatic regions are given below:

1. North Western Region
2. North Eastern Region
3. Southern Region

The brief descriptions of these three regions are given here:

**North Western Region**

The north and north western districts of Bangladesh are included in this region. The whole Rajshahi Division, the northern parts of Dhaka and Khulna Divisions are within this region. Both the cold and heat is high in this region. The rainfall and relative humidity is comparatively lower in this region.

Rice, wheat, potato, sugar cane, different types of vegetables, mango, jack fruit, jujube or plum, litchi, tobacco, chili or pepper, pulses etc are the most important crops for cultivation in this region.

**North Eastern Region**

This north eastern region comprises the Sylhet district, eastern parts of Dhaka and north western parts of Chittagong division. The temperature becomes very low in this region during the winter season.

This region gets scanty of rainfall. The major crops of this region are rice, jute, tea, pine apple, oilseeds and different types of vegetables.

**Southern Region**

The southern and south eastern districts and their parts are included in this southern region. The whole Barisal division, the southern areas of Khulna and Chittagong division, an some southern part of Dhaka division are included in southern region of Bangladesh. The difference of temperature between winter and summer seasons is comparatively lower in this region. As the areas is nearer to the ocean, the relative humidity of atmospheric air is comparatively higher in this region. The rainfall is also higher. The main crops and fruits of this region are Rice, Pulses, Coconut, Betel leaf, Betel nut, Banana and Onion, Chili and Potato.
Exercise

Multiple Choice Questions

1. What is the type of climate prevailing in Bangladesh?
   a. Extreme climate  
   b. Tropical 
   c. Mediterranean  
   d. Temperate 

2. Rainfall is higher in Bangladesh in -
   i. North-eastern region 
   ii. North western region 
   iii. Southern region 

Which one is correct?
   a. i and ii  
   b. ii and iii 
   c. i and iii  
   d. i, ii and iii 

Read the paragraph below and give answers to questions 3 and 4.

Sabina Begum was walking along the village road in the late evening. Suddenly stormy air and thunder started and she took shelter at a nearby place. Then extensive hail storm started in the area.

3. The season described in the paragraph is- 
   i. Rabi  
   ii. Kharif – 1  
   iii. Kharif – 2 

Which one is correct?
   a. i  
   b. ii  
   c. iii  
   d. ii and iii 

4. What are the crops which grow in the season described in the above paragraph?
   a. Cauliflower, cabbage and country bean  
   b. Red amarnth, eggplant and okra  
   c. Indian spinach, okra and sweet gourd  
   d. Tomato, radish and carrot
Creative Questions

Mr. Jabeed, an agriculturist was discussing the weather and crops in detail with local farmers at his village in Chandpur. He told that the major characteristics of the climate of Bangladesh are the sufficient rainfall, medium winter and humid summer though there are some differences according to the regions. Different types of crops grow in different region well due to the difference in agricultural climate. Thus he advised the farmer to produce crops considering the aspects of agricultural climate.

a. What is meant by climate?

b. Explain the statement- “Different types of crops grow well in regions due to the difference in agricultural weather”.

c. What probable type of crops agriculturist Mr. Jabeed advised the farmers of Chandpur to grow in the Kharif -1 season? Why?

d. Explain the feasibility of cultivating wheat in Chandpur.
Chapter Two

Soil

The Concept of Soil
Soil usually denotes the soft surface layer of the earth crust. According to the soil scientists, soil may be defined as the soft surface layer to the earth where plants grow and from which plants absorb inorganic nutrient elements. Soil is composed of various types of organic matter, inorganic, water and air.

Composition of Soil
The soil as we see it now was not same originally. It took so many years to attain this form, the earth was created from a gaseous material splinted from the sun. This gaseous materials become gradually cool while moving around the sun and big size rocks was formed on the surface of the earth. These rocks are named according to their characteristics as igneous rocks, sedimentary rock and metamorphic rocks. Due to long actions of temperature, cold, snow fall, air flow, chemical processes, and by the action of natural forces, the rocks have been disintegrated and gradually converted to a soil material. Later on, the soil has become suitable for agricultural production after mixing with plant and animal decay materials; So, soil is heterogeneous mixture of finely weathered rocks, minerals, organic matter with water and air.

Components of Soil formation.
The soil mainly composed of the following components
1. Mineral or Inorganic matter
2. Organic matter
3. Water
4. Air

1. Mineral or Inorganic Matter
The mineral matters in soil have been formed as a result of intensive weathering of parent rocks caused by direct weathering action of natural forces like temperature, rainfall, air flow, snowfall, etc. for a longer duration of time, the sand particles, clay particles, and silt particles are known as mineral matters. The mineral matters thus obtained were mixed at various proportions to form different soil texture.

Different textured soils are suitable for growing different type of crops. Different types
of soil textures are found to be suitable for different types of crop. The mineral particles of soil are clustered to form compound granules, known as soil structure. These granules make the soil porous and allow of water and air to move within it. Granulated and crumb structured soils are very suitable for agricultural production. Soil usually consists of 45 percent mineral matters.

2. Organic Matter
The matters produced as a result of rotting of plant and animal residues in soil are known as organic matter. The process of soil formation is completed with the mixing of organic matter with soil particles. Organic matter improves the physical environment of a soil. For example a soil become light, when organic matter is mixed with an originally heavy clay soil and the soil structure development is enhanced. Organic matter is known as the life of a soil. Because the soil micro-organisms become active in presence of organic matter in the soil. As a result of the decomposition of organic matter plant nutrients like carbon, nitrogen, phosphorus, sulphur, calcium etc. become available for plant's absorptions. In addition an organic complex material namely humus is formed which is most important for soil fertility. Organic matter increases the water holding capacity of soil, soil usually contains 5 percent organic matter.

3. Water
Water is an important component of soil. Water contained in soil makes the plant nutrient elements soluble and keeps the soil moistened. As a result plant absorb these nutrient elements through its root hairs. The main sources of water in the soil are the rain water and irrigation water. Water remains in soil in the inter particles spaces. Usually the moisture content of the soil is 25 percent.

Air
Air is an important component of soil. Air exists between inter particles spaces of the soil. Living organisms for their respiration utilize the oxygen present in the soil air. Till age of soil through ploughing and spading increases flow of air in soil. The composition of air in soil is 25 percent.
Soil Types

The inorganic part of the soil is formed of various types of soil particles. These particles are coarse sand, fine sand, silt and clay. The size of the soil particles according to international system of measurement are the following:

<table>
<thead>
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<th>Name of soil particle</th>
<th>Diameter (millimetre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand particles</td>
<td>0.2-2.00</td>
</tr>
<tr>
<td>Fine sand particles</td>
<td>0.02-0.2</td>
</tr>
<tr>
<td>Silt particles</td>
<td>0.002-0.02</td>
</tr>
<tr>
<td>Clay particles</td>
<td>0.002 less than</td>
</tr>
</tbody>
</table>

The soil particles mentioned are mixed in different proportions to form soil textures of varied nature. Depending on the textural variations, soil may be classified into three categories; Such as-

a. Sandy soil.  

b. Loamy soil  

c. Clay soil.

A. Sandy Soil

The soil, which contains 70 per cent or more sand particles, is known as sandy soil. Sandy soil is mostly seen in deserts, river banks, flood plain and sea beach. The sand particles are larger in size. The water holding capacity of sandy soil is very low. The sandy soil rapidly dries because of large inter particle pores contained in it. Aeration rate is also higher in the case of sandy soil. The organic matter content of sandy soil is scarce. Sandy soils are not suitable for agricultural production. Using cowdung, compost, green manure etc. in sandy soils having fine and particles, Cheena, Kaon, Futi, Watermelon and Potato may be grown.

B. Loamy Soil

When sand, silt and clay particles exist in equal proportion in a soil then the texture of the soil is termed as loamy. However, in a typical loamy soil half the composition should be sand, and the rest half silt and clay. The organic matter content of loamy soil is usually higher. The water absorption and holding capacities of loamy soil are comparatively higher. The loamy soils are most suitable for agricultural production. As a result most of the crops can grow better in this type of soil. The soil of majority
areas of Bangladesh is of loamy texture. The loamy soils are termed as ideal soil for agricultural use. For these reasons most of the crop grows well in this type, Such as:

1. Sandy loam soils
2. Silt loam soils
3. Clay loam soils

The characteristics of the loamy soil texture are described below:

1. **Sandy Loam Soils**
   The sandy soils having more sand particles are known 'as sandy loam soil. The sandy loam soil is mostly found in Tista Floodplain area. The crops mainly grown in sandy loam soil are, Radish, Tobacco, Pepper or Chili etc.

2. **Silt Loam Soils**
   The loamy soils, which contain more silt particles, are known as silt loam soils. Silty loam textured soil is mostly found in the southern regions of Bangladesh. Rice, Jute, Wheat, Sugarcane, Potato and Vegetables are commonly grown in the silt loam textured soil.

3. **Clay loam soil**
   The loam textured soil, which contain more quantities of days, are known as clay low loam soils. The flood plain sills of Ganges Riverine area are included in this class of soil texture. The crops mainly grown in the clay loom soil are rice, cotton, wheat, pulses, oil seeds etc.

C. **Clay Soils**
   The soil which contains 40 to 50 percent clay soil. Clay soil is also popularly known as heavy textured soil. The porosity of clay soil is low. As a result it's water holding capacity is very high. The drainage capacity of the type of soil is very low. The clay textured soil is very hard when dry, but become very soft when moistened. This type of soil may be converted to the soil of loamy nature by adding sufficient quantities of organic manures. The major crops grown in this type of soil texture are Rice, Jute, Sugarcane, and Vegetables.

**Practical**

**Title : Determination of Soil Texture**

**Materials :** Soil samples, soil containers and water

**Steps of Work**

1. Collect some soil from the field.
2. Crush and grind die collected soil in a container.
3. Take a hands full of soil in hand and mix some water with this soil.
4. Try to prepare a ball with this moist soil.
5. If ball can not be prepared by this then is sandy soil.
6. If a ball can be prepared and the ball can be flattend then it is clay soil.
7. If the ball breaks during flattening then the soil sample is of loamy texture.
8. Write every step of the practical work in the practical note book and show it to the teacher.

**Exercise**

**Multiple Choice Questions**

1. Which figure given below is correct as per percentage proportions of components of an ideal soil?

   a. ![Figure A]  
   b. ![Figure B]  
   c. ![Figure C]  
   d. ![Figure D]

2. In the pores of soil particles exists-
   i. Air
   ii. Water
   iii. Organic matter

   Which one is correct?

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

**Read the paragraph below and give answers to questions 3, 4 and 5.**

Murshed Mia of Dublar Char has no agricultural land other than his homestead. He was rearing two cows in his homestead. By the side of the homestead he took out a lease on one bigha land and cultivate potato there. He the cow dung in that land.
Suddenly when the land owner decided to sale the land, Murshed Mia purchased the land selling his two cows. Later on, the production of the land was less and unsatisfactory.

3. What is the reason of the reduction of yield from the land?
   a. Non-control of weeds.  
   b. Not giving irrigation  
   c. Not using chemical fertilizers  
   d. Deficit of organic manure

4. What measures should Murshed Mia take in this case?
   i. Adding sufficient cowdung  
   ii. Applying green manure  
   iii. Applying chemical fertilizers

Which one is correct?
   
   a. i and ii  
   b. i and iii.  
   c. ii. and iii.  
   d. i, ii and iii

5. The soils of Dublar Char is mainly-
   
   a. Sandy  
   b. Sandy loam  
   c. Clay loam  
   d. Clay

Creative Questions

Landless farmer Karim of Mollarchar of Gaibandha at first started boro rice cultivation taking one bigha shared land. But he has to face serious loss as the soil texture was not in favour of rice cultivation. But later he became successful by cultivating watermelon and became financially much better off.

a. What is soil?

b. Why Karim faced serious loss by cultivating rice - Explain.

c. Explain soil composition of Mollarchar.

d. Why Karim faced serious loss by cultivating boro rice - Analyze
Chapter Three

Soil Fertility and Soil Erosion

Soil Fertility

The soil fertility may be defined as the capability of a soil to supply essential plant nutrient elements as per requirement of a crops or plants. A soil is considered fertile when it contains all the essential plant nutrient elements in right proportions. Deficiency of plant nutrient elements in right proportions makes soil unfertile. Some of the major controlling factors of soil fertility are briefly mentioned below:

1. Mineral Matter

Mineral matters of soil have been formed by the physical disintegration of parent rocks, most of the plant nutrient elements are present in these mineral materials. Plants absorb these nutrient elements and thus grow and produce flower and fruit.

2. Organic Matter

Organic matter is product as a result of decomposition of plant and sandal residues, excreta and dead bodies. Organic matters get mixed with the soil and help to increase the nutrient supplying capacity of soils.

3. Unevenness of soil

The hill food and lower gentle slopes are more fertile than the hill tops.

4. Cultivation of land

Optimum cultivation of soil makes a soil soft and loose. Added organic matter and chemical fertilizer are well mixed with the soil when a soil is tilled. As a result plant roots can easily spread in the soil and can absorb plant nutrients and it increases the fertility of the soil.

5. Irrigation

Irrigation water when applied to soil makes the soil moistened. Soil moisture makes the nutrient elements soluble and absorbable to plants.

6. Application of Organic Manures

When applied to soil organic manures release nitrogen, phosphorus, potassium, calcium, magnesium, iron etc. in the soil, the micro-organisms are activated and soil fertility increased.
7. Application of Chemical Fertilizer

Soil fertilizer decreases due to continuous cropping. Urea, T.S.P. and M.P. are applied as chemical fertilizer. As a result of application of above fertilizer, Nitrogen, Phosphorus and Potash are added respectively to the soil.

Preparation of Compost and Green Manures

Preparation of Compost

The compost may be defined as the material prepared by decomposing farm and cattle wastes, straw, weeds, water hyacinth, agro wastage etc. in presence of micro-organisms. Compost is prepared by mixing and decomposing several types of organic wastes. However, compost can also be prepared by decomposing a single organic waste. Compost may be prepared by main two ways; Such as –

1. Heap method of composting and
2. Trench method of composting

These two methods of composting are briefly described below–

1. Heap Method of Composting

The site for compost preparation should be high enough so that water logging does not occurs. Farm premises or sides of cowshed are suitable places for setting compost heaps. Compost heaps may also be placed under a tree. At first a place measuring 3 metres in length and 2 metres in width should be selected. Four poles may be set at four corners and rope may be used for en circling the place. Farm straws staws, weeds etc, should be placed in layers within the boundary. The height of the first layer should be 30 cm. After the completion of the first layer the following materials should be spread over the layer-

Grounded oil cake-1 kg, urea-500 gram, triple super phosphat-200 gram. Instead of the above materials 2 kg of bio-activator many be spread over the composting materials. After that, water may be spread by a water can over the 'layer. It will help to compact the wastes which will accelerate the decomposing process. Then a layer of 5cm thickness consisting cowdung may be given. In this way 7 consecutive layers should be prepared. The surface of the 7th layer should be like a shed having slopes at both sides so that rain water can not stand there or can not enter. The heap may be covered by a polythene sheet.
Compost heap

The compost bio-activator may be prepared by mixing the flowing materials in quantities as mentioned below.

**Constituents of Compost Activators**

<table>
<thead>
<tr>
<th>Compost Activations</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fungal inoculums</td>
<td>1 kg</td>
</tr>
<tr>
<td>2. Dried and crushed cow-dung</td>
<td>7 kg</td>
</tr>
<tr>
<td>3. Crashed oil cake</td>
<td>5 kg</td>
</tr>
<tr>
<td>4. Urea</td>
<td>4 kg</td>
</tr>
<tr>
<td>5. Tripple Super Phosphate (TSP)</td>
<td>1 kg.</td>
</tr>
<tr>
<td>6. Muriate of Potash (MP)</td>
<td>1 kg.</td>
</tr>
<tr>
<td>7. Leaf decompos</td>
<td>1 kg.</td>
</tr>
<tr>
<td>Total</td>
<td>20 kg.</td>
</tr>
</tbody>
</table>
Compost fertilizers become suitable for use in crop fields in 45 to 60 days. The layers of the compost should be thoroughly turned up and down to ensure uniform and accelerated decomposition of all the layers. The upper layer should be given in the bottom and bottom layer should be given at the top. Within next month of the turning of the materials, the compost becomes ready for use in the crop field.

**Trench Method of Composting**

At first a high land site should be selected. One trench measuring 3 metres in length, 2 metres in width and 1.2 metres in depth should be dug. Similar 6 trenches may be dug side by side. Shed should be made over each trench. Five trenches should be filled with waste materials like cowdung, straw, house hold wastes etc. After filling the trenches the height of waste materials should be 30 cm above the surface. One of the trenches will be kept empty. After 4 weeks of decomposition the empty trench will be filled up with materials of nearest trench. The trench thus made empty will be filled in by another nearest trench. In this way waste materials will be transferred to the next trench and it will be fully turned. This turning will enhance the decomposition process in composting. The waste materials will be fully decomposed within 2 to 3 months. By this method compost may be prepared throughout the year in a single set of trenches.

**Benefit of Compost Fertilizers**

Compost fertilizers play an important role in increasing soil fertility. Nitrogen, Phosphorus, potassium nutrients are added to the soil through compost fertilizers. Besides, compost fertilizers make the soil more suitable for crop cultivation through improving the soil texture and structure. Water holding capacity and soil aeration is also increased due to compost application. The cost for compost production is also low. For these reasons use of compost is beneficial and profitable.

**Preparation of Green Manures**

The manure prepared by decomposing green crops grown at young stage within soil through ploughing is known as green manure. Sesbania or Dhaincha, Cowpea, Sunhemp, Kalai, Crotalaria when mixed with the soil before flowering through ploughing starts decomposing. After that when soil is pulverized thoroughly by 3 to 4 ploughings, cross ploughing and laddering. Then these materials are completely decomposed within two weeks. One of the benefit of green manure is that it is used in the place where it is grown.
Cultivation and Preparation of Sesbania Green Manure

Sesbania or Dhaincha may be cultivated in any types of soil. After one or two ploughing fertilizer should be applied to the soil at the rate of 70 gm of Triple Super Phosphate and 50 gm of Muriate of Potash per one decimal of land. Then Dhaincha seed should be shown at rate of 200 gm. 200 gms of Dhaincha seeds in one decimal of land. It will result very thick population of Dhaincha seedling. Within 75 days after seed sowing flowering will start. At this stage the plants will be mixed with the soil by ploughing. If the plant, become too tall it may be cut into pieces by Dao or sickle. The Dhaincha plants will be fully decomposed of three ploughing are done after two weeks of initiation of rottening, 350 to 450 gm of nitrogen and 12 to 100 kg organic matter are added to one decimal of land from such green manuring.

Benefits of Green Manure:
Green manure influences soil fertility and conservation of soil in many ways. Some of the important benefits are as follows-

1. Green manure increases the fertility and productivity of soil.
2. Green manure supplies sufficient amount of organic matter in the soil.
3. Green manure increases the nitrogen content of soil.
4. Green manure rapidly activates the soil micro-organisms.
5. Green manure conserves plant nutrients in soil.

Soil Erosion and Conservation

Soil erosion may be defined as the transportation of surface soil by the direct action of natural forces like water stream, air flow, etc. Plant nutrients are usually stored within the 15 to 20 cm depth of soil. Soil erosion causes the loss of these surface soil nutrients. As a result agricultural soil become unfertile gradually.

Types of Soil Erosion

Soil erosion is mainly of two types. Such as -

A. Water erosion
B. Wind erosion

A. Water Erosion

Water erosion may be defined as the transportation of soils from one place to another by the action of water stream. Water erosion may be of the following types-

1. Sheet Erosion

Sheet erosion may be defined as the process of soil removal in a thin sheet due to rainfall and irrigation water flows at mild slopes of land. The soft, loose and surface
soil is removed by this process. Slopy land is very vulnerable to sheet erosion. Sheet erosion is very slow in flat land.

2. Rill Erosion
Rill erosion is the second phase of sheet erosion. When the speed and volume of water stream increases, the soil is removed forming narrow surface rills. This is known as rill erosion.

3. Channel Erosion
Channel erosion is the phase of erosion, which is next to rill erosion. The process of channel erosion may be defined as the transportation of soil through the channel formed by enlarging the form and structure of rills. Usually the uncared rills are transformed to channels. The land suffering from channel erosion losses its fertility and productivity rapidly.

4. River Bank Erosion
River bank erosion may be defined as the loss of river bank soil due to strong flow of stream causing damage of land. The intensity of river bank erosion is high at the beginning and at the end of flooding. Farmers frequently loose their land and houses due to river bank erosion every year in Bangladesh. Thus they become landless and poor.

5. Sea Shore Erosion
Sea shore erosion may be defined as the loss of sea shore soil and land due to tidal upsurge and waves. The coastal area and the islands of the sea are seriously affected by this type of sea shore erosion.

B. Wind Erosion
Like water stream wind of low also causes significant soil erosion. Wind erosion may be defined as the movement of soil from one place to another by the direct action of strong wind. Wind erosion causes the movement of sand of deserts off to hundred miles and makes the fertile soil unproductive.

Causes of Soil Erosion
The major causes of, soil erosion are:
1. Excessive rainfall
2. Land slope and Topography
3. Soil texture
4. Cultivation techniques or cropping system
5. Flow or air
6. Human activity

1. Excessive Rainfall
The torrential rain directly and seriously heat the soil. As a result the soil particles are broken. Rainfall for a longer duration cause flow of water on the soil surface. The flow of this excess water carries fertile soil along with from the surface and makes the soil as unproductive.

2. Slope of the Land
Erosion is found to be accelerated in sloppy land. The speed of water run off become higher when the slope of the land is higher.

3. Soil Texture
The porosity of heavy texture or clay soil is less. The infiltration of water is also less in case of heavy clay type soil. A light rainfall even can cause water logging in clay soil. If the land is slopy then the water flows to the lower ends. On the other hand more organic matter is less vulnerable to soil erosion because of its higher water holding capacity and higher porosity.

4. Cultivation Techniques or (cropping systems):
a. Soil with shallow rooted crops vulnerable to soil
b. When cultivated along the slope of hillyareas, the erosion becomes accelerated.
c. Intensive cultivation of soil cause soil erosion due to influence of water and wind.

5. Air Flow
Wind causes removal of loose surface soil of agricultural lands.

6. Human Activity
Vegetation and forest are the gift of nature. If these vegetation or forests are destroyed by human activities the soil erosion gets accelerated. Loss of forest encourages soil transportation from one place to another.

Affect of Soil Erosion
Plant nutrients and soil fertility ingredients are mainly stored in the soils of 15 to 20 cm depth. Soil erosion dominantly causes the loss of this fertile surface soil. The plant nutrient elements and level of soil fertility are thus reduced due to soil erosion. The gradual loss of soil fertility makes the soil unsuitable for crop production after certain time.
The process of soil erosion gradually results in the silting of channels, rivers, basins, and other waterways. Char lands are raising in rivers. These Char lands seriously hamper navigation during the dry season and cause floods during the rainy season.

**Soil Conservation.**

Long term occurrence of soil erosion causes loss of agricultural land. So it is important to follow scientific conservational practices to protect the soil from erosion. Some of the important soil conservation practices are described here:

**Controlling Water Stream Velocity**

Soil erosion may be controlled by reducing the speed of water flow or stream. The speed of water stream may be reduced by the following ways:

a. Preparing dikes or ails across the water run off in the land.

b. Leveling the small rills and channels.

c. Allowing the growth of submerged weeds and putting appropriate wire nets at the end of channels.

The land will be improved through removal of rills and channels if the above practice are regularly followed.

**2. Right Arrangement for Drainage**

Soil may be protected from erosion taking appropriate measures for drainage. The sub soil tile drainage system is very suitable for draining out of excess rainfall water. Water drainage speed should be slow enough so that it cannot cause soil erosion.

**3. Increasing Organic Matter Content of Soil**

Application of organic matter increases the water absorption and water holding capacity of soil. More absorption of water from the soil surface reduces water run off. In this way increased use of organic matter will soil erosion.

**4. Terrace Cultivation**

Water streams can not move so fast in hill slopes if terrace are prepared for crop cultivation cross the slope. By adopting this most important technique soil fertility may be conserved in slopy hill areas.

**5. Cultivation in Contours**

Cultivation of crops directly across the slope is known as contour method. Soil may satisfactorily be conserved by cultivating perennial crops in the contour method.
6. Segmentation of Field Plots
The soil with moderate slopes may be segmented according to the nature of land to reduce downwards of soil transportation. Then one type of crop may be cultivated in one small plot without loss of considerable soil materials.

7. Establishing Forest on Open Hand
Growing plants or afforestation always reduces water run off and thus helps to control soil erosion.

**Practical**

**Subject: Preparation of compost**

**Materials**

**Steps of works**
1. Select a piece of highland near your school or at a corner of the school campus.
2. Measure a place 3 metres in length and 2 metres in width with the tape metre scale.
3. Put 4 sticks at the 4 corners of the selected and measured place.
4. Give a temporary boundary with a rope binding it with the corner poles in a rectangular shape.
5. Then arrange the waste materials including straws, weeds, decomposable materials etc. in layers maintaining a height of 30 cm.
6. After the preparation of the first layer add 1 kg crushed oil cake, 500 gm Urea, and 200 gm Triple Super Phosphate. Instead of the above materials 2 kg of compost activator may be spread over the layer.
7. Add some water on the surface of the waste materials.
8. Then add a 3 cm layer of cow-dung with prescribed amount of Urea and, Triple super Phosphate. Instead activator at the rate of 1 kg per layer may be spread over the moistened waste materials.
9. Arrange 7 layers one above another following the same procedure adding cow-dung, Triple Super Phosphate or activator as described earlier.
10. Give the seventh layer a shape of shed covered by a polythene sheet so that rain water does not stands.

11. Add water in the compost heap regularly.

12. Turn the compost layers to accelerate the decomposition process after one month. Add 10 kg activator in total at different layers while turning.

13. Following this process compost may be prepared within 45 to 60 days. Break the compost heap. Dry, crush, and keep the material in sack.

Write the procedure of compost preparation as you have followed in the practical note book.

Exercise

Multiple Choice Questions

1. Dhaincha is cultivated for preparing green mixer because—
   i. Dhaincha leaves are more green.
   ii. Dhaincha rapidly decomposes after mixing with the soil.
   iii. Dhaincha adds nitrogen to the soil.

Which one is correct?
   a. i  b. i and ii  c. i and iii  d. ii and iii

Read the paragraph answers below and give to the questions 2 and 3.

Soil erosion is one of the major causes of soil fertility depletion. Among the types of soil erosion in Bangladesh erosion of river banks and sea coasts is very tough to control. However, erosion of hill soils can be easily controlled by adopting specialized methods.

2. Which the is method of controlling hill soil erosion?
   a. Cultivating rubber on the hill slopes
   b. Cross cultivation in the hill slopes
   c. Cultivating crops with less roots
   d. Cultivating the hill soil frequently
3. Which type of soil erosion is more probable in the Karnaphuli river bank soil?
   a. Rill erosion  
   b. Sea shore erosion  
   c. River-bank erosion  
   d. Gully /channel erosion

**Creative Questions**

Goni Mia is a farmer having vast land. His lands remain fallow at the end of the rainy season for about one month every year. He has 20 bullocks for cultivation purpose. Besides 15-16 day laborious work in his house regularly. His house remains dirty due to household and farm wastes. Recently when he was not getting satisfactory yields, he went to the Agricultural officer. Agricultural officer advised him to use green manure and compost.

a. What is compost fertilizer?

b. Why was the production decreasing in the land of Goni Mia?

c. Describe how Goni Mia can produce compost.

d. Analyze the advantages of using compost by Goni Mia.
3. Which type of soil erosion is more probable in the Karnaphuli river bank soil?
   a. Rill erosion
   b. Sea shore erosion
   c. River-bank erosion
   d. Gully/channel erosion

The elements absorbed by plant from soil, air and water for their growth and development are known as plant nutrient elements. A plant can not grow in a soil deficient in plant nutrients. It is essential to apply deficient plant nutrient elements as Goni Mia is a farmer having vast land. His lands remain fallow at the end of the rainy season for about one month every year. He has 20 bullocks for cultivation purpose. Besides 15-16 day laborious work in his house regularly. His house remains dirty due to household and farm wastes. Recently when he was not getting satisfactory yields, he went to the Agricultural officer. Agricultural officer advised him to use green symptoms of nutrient elements to understand the nutrition system of a plant. manure and compost.

**Creative Questions**

a. What is compost fertilizer?

b. Why was the production decreasing in the land of Goni Mia?

c. Describe how Goni Mia can produce compost.

d. Analyze the advantages of using compost by Goni Mia.

**Classification of Plant Nutrient Element**

1. **Major or Macro Nutrient Elements**
   The elements which are required for plant nutrition in large amount are known as major nutrient elements. The number of major plant nutrient elements is 9. These are:
   1. Carbon
   2. Hydrogen
   3. Oxygen
   4. Nitrogen
   5. Phosphorus
   6. Potassium
   7. Calcium
   8. Magnesium
   9. Sulphur

2. **Micronutrient Elements**
   The elements, which are required for plant nutrition only in trace amount, are known as micronutrient elements. The number of micronutrient elements is 8. These are:
   1. Iron
   2. Manganese
   3. Molybdenum
   4. Copper
   5. Zinc
   6. Boron
   7. Cobalt
   8. Chlorine

Though required in only small quantity, the micronutrients are essential for plant growth and development.
Sources of Plant Nutrients

The main source of plant nutrients is two. these are—
1. Natural sources 2. Artificial sources

Soil, air and water are the main 3 natural sources of plant nutrients. The artificial sources of plant nutrients are the organic manure and chemical fertilizer.

Natural Sources

A. Soil
Excluding carbon, hydrogen and oxygen the rest of the 14 plant nutrient elements are absorbed by plants from soil.

B. Air
Plant mostly absorb carbon and oxygen from the air.

C. Water
Plant absorb hydrogen and oxygen from water. Besides, plant can absorb other mineral elements which are found to stay in water in soluble form.

Artificial Sources

A. Organic Manure
Most the nutrients required for plant nutrition are found in organic manure. Cowdung, compost, organic wastes, straw and weeds after decomposition may be used as organic manure.

B. Chemical Fertilizer
Urea, Triple Super Phosphate, Muriate of potash etc. are the examples of chemical fertilizers. A chemical fertilizer normally supplies the major plant nutrient elements such as nitrogen, phosphorus and potassium.

Functions of Nutrient Elements

The nutrient elements are known to perform many functions to complete the life cycle of a plant. Some of the nutrients directly help in growth of plant, some help in preventive diseases. While some other help in maturity and ripening of seed. Some nutrients also help in absorption of other nutrient elements. The combined influence of the above mentioned functions determine the quality and quantity of yield, in addition to the beneficial effects, some of the elements also exerts detrimental role when present in excess amounts. Plant nutrients when applied in balanced form show beneficial effects. Otherwise, application in excess or deficient amount show negative results. Some important functions of plant nutrient elements are described here.
Nitrogen
The influence of nitrogen in fulfilling the life cycle and optimum growth of plant is most important. Urea fertilizer is used to supply nitrogen to crop plants in Bangladesh. The nitrogen content of urea is about 46 percent.

Functions of Nitrogen in plants
1. Gives a deep green colour to the plant.
2. Helps in photosynthesis, metabolism and respiration of plants
3. Results in rapid growth of leaf and stem.
4. Improves the quality of areal grain crops, fodder and leafy vegetables.
5. Helps in production of tiller in cereal grain crops.

Phosphorus
The most important phosphatic fertilizers are triple super phosphate and diammonium phosphate. Triple Super Phosphate contains about 45 percent phosphate (P2O5)

Functions of Phosphorus in Plants
1. Participates in the division of plant cells.
2. Accelerates the growth of plants.
3. Forms the root system of plant.
4. Helps in flowering of plant in right time and ripening of fruits.
5. Improves the quality of crop products.
6. Supply energy and strengthens plant structure.

Potassium
Muriate of potash is most important among the potassium fertilizers. Muriate of photash contains about 60 percent potash.

Function of Potassium in Plants
1. Increases the disease resistance power of plants.
2. Helps in cell division in plants.
3. Helps in carbohydrate production in plant leaves.
4. Controls, movement of carbohydrate and other biochemical compounds within the plant.
5. Keep balance in the uptake of nitrogen and phosphorus in plants.
Sulphur

Gypsum or calcium sulphate is the most important sulphur fertilizer. Gypsum contains about 14 percent sulphur.

**Functions of Sulphur in Plants**
1. Increases the yield of oil seed crops
2. Helps in increasing the nodulation in roots of the leguminous crop plants.

Zinc

Zinc sulphate is one of the most popular zinc fertilizers. Zinc sulphate contains up to 36 percent zinc and 17 percent sulphur.

**Functions of Zinc in Plants**
1. Helps in protein formation and plant growth.
2. Helps in flower and fruit production of plants.

Calcium

Gypsum or calcium sulphate may be applied for calcium supplement in crop fields. Calcium sulphate contains about 22 percent calcium.

**Functions of Calcium in Plants.**
1. Strengthens walls of the plant cells.
2. Helps in growth and development of plant roots.
3. Make the plant cells strong and elastic.
4. Increases the yield of pulse crops.

Iron

Ferrous sulphate is most important among the iron fertilizer. This ferrous sulphate fertilizer may be applied both in the soil and in the plant as spray.

**Functions of Iron in Plant**
1. Forms the green chlorophyll of plant leaves
2. Helps in absorption of nitrogen by plant
3. Acts as catalyst for activating different enzymes.
Nutrient Deficiency Symptoms

Pants when grown in soil having deficiency in plant nutrient elements show definite symptoms in their leaves, stems and in their formation and sizes. Some important nutrients deficiency symptoms are briefly described below.

Symptoms due to Nitrogen Deficiency in Plants
1. At first the leaves become light green in colour.
2. In case of progressive deficiency the leaves become gradually yellow.
3. Normal growth of the plant is stunted.
4. Tillering is reduced in cereal grain crops.
5. Yield is drastically reduced.
6. The seeds are found to be immature.
7. Leaf-drop occurs in fruit plants.
8. The buds and twigs gradually die.

Symptoms of Phosphorus Deficiency Plants
1. The normal growth and development of shoot and root of plants are seriously affected by phosphorus deficiency.
2. Cell division is hampered in absence of phosphorus.
3. Lack of phosphorus causes delayed growth of plants.
4. Phosphorus deficiency reduces the number and size of leaves.
5. The protein content of plant is reduced in absence of sufficient phosphorus.
6. Flowering is greatly by affected by phosphorus deficiency.
7. Phosphorus deficiency results in dropping of fruit and the size of fruit become small.

Symptoms of Potassium Deficiency Plants
1. The resistance power of plant is reduced ill absence of sufficient potassium.
2. Potassium deficiency increases pest infestation in crop plants.
3. Lack of potassium reduces the rate of photosynthesis.
4. Growth is stunted in potassium deficiency plants.
5. Potassium deficiency is responsible for bronze colouration of leaves.
7. Drought resistance power of crop plant is decreased by potassium deficiency.
Symptoms of Sulphur Deficiency in Plants
1. Cell division is seriously hampered in absence of sulphur.
2. Plants get dwarf structure when deficient in sulphur.
3. Size of leaves becomes small and found to be discoloured.
4. Plant maturity is delayed due to sulphur insufficiency.
5. The stems and branches of plants become narrow when sulphur is a limiting factor.
6. The yield of oil seed crops are greatly reduced when grown in sulphur deficient soil.

Symptoms of Zinc Deficiency in Plants
1. Whitish spots appear at the base of rice leaves when zinc deficiency becomes prominent.
2. The interveinal spaces of maize and cotton leaves are discoloured if zinc deficiency occurs.
3. Growth of leaf is stunted.
4. The older leaves of rice plant found to show a rust colour if zinc deficiency is severe.
5. Curling of lemon leaf is common system of zine deficiency.

Symptoms of Calcium Deficiency in Plants
1. The apex of young it laves show abnormal formation when plants suffer from calcium deficiency.
2. The symptoms of chlorosis occur in leaf when calcium supply in plant is inadequate.
3. The midrib and the leaf margins are found to show yellow and brown shades when calcium nutrition is limiting.
4. The plant leaves get smaller size in case of calcium deficiency.
5. Plants a dwarf structure due to the lack of calcium.

Symptoms of Iron Deficiency in Plants
1. At first chlorosis occurs in the young leaf due to iron deficiency.
2. The interveinal spaces show chlorotic symptoms when iron is lacking. This chlorosis then spread gradually over the whole leaf.
3. The leaves become brownish when the deficiency of iron in plant is severe.
Practical

Subject: Identification of Fertilizer

Materials
1. Different type of fertilizer
2. Pot for keeping fertilizer
3. Paper and pencil
4. Water
5. Lime

Steps of Works

Sample No. A
1. Take in hand some amount of fertilizer from the sample.
2. Observe keenly the colour and grain size.
3. Feel the odour or smell of the fertilizer.
4. If the colour of the fertilizer is shape is like odour is pungent, then it is Urea.
5. Mix some lime with the fertilizer. If it is observed to have the odour of & ammonia then be sure that it is Urea.
6. Write the working procedure and test results in the practical notebook.

Sample No. B
1. Take in hand some amount of fertilizer from the supplied sample.
2. Observe the colour and shape of fertilizer grains keenly.
3. Feel the odour of the sample
4. If the colour of the sample is gray, grain is like rate soil and the odour is less or not pungent, when the sample fertilizer is Triple Super Phosphate.
5. Write the working procedure and test results in the practical notebook.

Sample No. C
1. Take in hand some amount of fertilizer from the supplied sample:
2. Observe keenly the colour and shape of the fertilizer grains.
3. Feel the odour of the fertilizer.
4. If the fertilizer looks like small brick dust or reddish or whitish and the grain is like table salt the sample fertilizer is muriate of potash.
5. Write the working producer and test results in the practical notebook.
Exercise

Multiple Choice Questions

1. Which are the micronutrient elements?
   a. Iron, boron and sulphur
   b. Potassium, magnesium, sulphur
   c. Iron, manganese, molybdenum
   d. Copper, zinc, magnesium

2. If in a field 23 kg of nitrogen is required. How much the urea should be applied?
   a. 25 kg         b. 50 kg
   c. 75 kg        d. 100 kg

Read the paragraph below and give answers to questions 3 and 4.

Sagir Mia, a farmer of the village Laksmipur, went to the local Agricultural Officer to know what to do for increasing production of rice. The Officer made him understood the functions of nutrient elements at different stage of the rice life cycle. Lastly he advised to use improved variety seed and balanced fertilizer for getting higher yields. Sagir Mia got expected results by following the advice.

3. What type of fertilizer does the Agricultural Officer advise for increasing rice yields?
   a. Urea          b. T S P
   c. M P          d. Gypsum

4. It is more required to get expected yields of rice—
   i. Improved-variety seeds
   ii. Applying fertilizers in right quantities
   iii. Giving irrigation in time

Which one is correct?
   a. i       b. ii
   c. iii      d. i, ii and iii
Creative Questions

Mehedi Hasan, the agriculture teacher took the Class X students to the field in order to give practical knowledge on nutrient deficiency symptoms. With the students he went to visit crop fields in the Govindapur village. There he observed that the base of the young leaves of rice become whitish, and the older leaves become rusty. The leaves of potato become yellow. The flowering of mustard is also reduced. Then he gave detailed description to the students about the importance of essential nutrient elements.

a. What is a plant nutrient element?
b. Explain the causes of developing whitish colour of young rice leaves.
c. How the yellowing of potato leaves may be controlled.
d. Analyze the cause of reduced flowering in mustard.
Chapter Five

Seed

Concept of Seed
Generally the leaving medium used for plant propagation is called seed. In order to get clear conception about seed it is necessary to know two definitions from two different points of view such as –

A. According to Botanical Theory
A seed is a fertilized and matured ovule such as– Rice, Wheat, Mustard, Mango, Jackfruit etc. Only the flowering plants can produce such types of seeds.

B. According to Agronomical Theory
Any part of a plant, which can propagate, under favorable environment, plants of same variety is called seed. In this case branch, root, leaf bud etc. are used as seed, Pieces of sugarcane, potato, sweet potato, root of spined gourd, graft of mango, and erum of aroid are the examples of this type of seed.

Qualities of Seed
Characteristics seeds mean the essential qualities is of seeds. The characteristics of good seeds are mentioned as under –

1. Purity of Seed
Purity of seed means the quantity of pure seed in a particular sample of seeds. If seeds are preserved in controlled condition the seeds retain their viability for the definite period. If seeds contain seeds of other verities, weed seeds and stones, their qualities are lost. During seed production, care should be taken. So that the seeds are not mixed with seeds of other verities of the same crop, dirty material or weed seeds.

2. Varietal Purity of Seeds
Purity of seed is lost when the seed sample contain other materials in mixed condition. Purity of seed is maintained when production and processing are done under controlled condition.

3. Germination Capacity of Seed
The quality of seed is measured by determining the percentage of germination of seeds in a particular sample. When germination percentage of a particular sample of seed is 70-80% then the seeds are considered to be good.
4. Vigour of Seeds
When the seeds of the sample are active, living and healthy and can grow rapidly even under adverse condition, then those seeds are called as seeds of high vigour.

5. Shape and Size of Seeds
Good seed will always be matured healthy and of normal size

b. Moisture content of the Seed
The initial percent of moisture contained in the seed is the seed moisture.

7. Freeness from Diseases
Seed should be free from disease and pest

Classes of Seeds
According to Bangladesh seed rule 1980 seeds can the divided into 3 classes such as -
1. Breeder Seeds
2. Foundation Seeds

Breeder Seeds
The seeds production under the supervision of plant breeders maintaining all genetically qualities is called breeder seeds. Breeder seed is the first step of approved seed production process.

Foundation Seeds
Foundation seeds are produced from breeder seeds. The seeds produced in controlled condition under seed certification agency, maintaining seed production rules and purity of seeds are called foundation seeds.

Certified Seeds
Certified seeds are produced from foundation seeds. The seeds produced by the enlisted farmers of seed certification agency certify these seeds after proper examination and verification. The seeds are then supplied to the farmers for their use.
Seed Production Technology

Seed production is a complex process. In order to get improved types of seeds, seeds are to be produced by following proper techniques and methods, the similar steps should be following in case of seed production as done in case of crop production. The difference is that the seeds are produced by the enlisted farmers of seed certification agency under controlled condition.

Steps of Seed Production

The following steps are followed in case of seed production such as-

1. Selection of field for seed production
2. Separation of seed, field
3. Collection of seed
4. Determination of seed rate
5. Preparation of selected land
6. Sowing of seeds
7. Rouging
8. Inter-cultural operation

Selection of Field for Seed Production

Fertile land should be selected for seed production. The land must be weed-free and be well aerated. If would be better if some variety of seed had not been cultivated in the selected land in the previous year. The selected land should have at least 2% organic matter.

2. Separation of Seed Field

There should be a gap of definite distance between the land selected for seed production and the nearby field of same crop. The objective of this is to avoid any admixture of the desired crop seed with other varieties.

3. Collection of Seed

Seed collection is an important step of seed production. Certified seeds must be collected for seed production. The following information should be known before seed collection.

a. Name of the variety
b. Name the number of the seed producer
c. Percentage of seed of other variety
d. Germination percentage of seed

e. Moisture content of seed

f. Date of verification and testing of seeds The above mentioned informations are written in a guarantee paper are tagged with the seed bag or packet.

4. Determination of Seed Rate

Seed rate per hectare is fixed considering purity, germination percentage and size of seeds, sowing time, fertility of soils etc.

5. Preparation of Selected Land

Land preparation for a particular variety of seeds is of a particular type. For example in case of producing seeds of transplanted Aman paddy land has to be prepared by puddling. Again in case of wheat the land is to be prepared by 4-5 ploughing in dry condition and should have to be well pulverized. The fertilizer, doses also vary from seed to seed.

6. Sowing of Seeds

The selected crop seeds should be timely sown in lines. Every seed should be sown in seed bed in same depth. The depth of sowing of a particular seed depends or the size, moisture content and texture of soil.

7. Rouging

Inspite of using pure seeds for sowing some plants of other varieties and weeds may be seen in the field. So the seed field should have to be visited frequently and the undesired plants are to be uprooted. Rouging is done in three steps, such as –

a. Before flowering

b. During flowering

c. During maturity

8. Intercultural Operation

Seed production requires sufficient intercultural operation. A list of intercultural operation is given here under-

a. Application of fertilizer in balanced dose.

b. Application of organic manure.

c. Irrigating the land as and when required.

d. Draining excess irrigation and rain water of accumulates.
e. Weeding
f. Controlling diseases and pests.
g. Top dressing of fertilizer.

9. Collection of Seeds
Seeds are to be harvested soon after they show the colour of ripening or maturation. Then these are to be threshed and cleaned by winnowing.

Seed Processing
The desired seed may be mixed with the weeds and other crops seeds. After threshing and winnowing the seeds have to be graded. The graded seed should have to be sundried for few days and then have to be preserved.

Seed Preservation
Seed moisture is the main factor of keeping the seed alive. The more moisture content in the seed is the more quickly it will lose its viability. If the seeds of cereals like rice, wheat etc. contain moisture content higher than the seeds are spoiled due to attack of diseases and insects. Again if the moisture content is less than a prescribed limit, viability may also be lost.

General Principles of Seed Preservation
1. The seed godown should be in dry and cool place.
2. Seeds have to be sundried well and cooled in shade.
3. The godown should be well aerated
4. Seeds are to be preserved in any pot or polythene bag under airtight condition.
5. The seeds are to be brought out frequently from the seed godown for sun drying.
6. In order to avoid invasion by the insect pests the godown is to be fumigated.

Practical

Subject: Determination of Purity Percentage of Seeds.
Materials: Seeds and Balance

Step of Work
1. Weigh seeds of any crop to a certain quantity
2. Spread the seeds on a white sheet of paper
3. Sort out and separate pure seeds from the whole lot of seeds and weigh these. Suppose these weight is 'A' gram.
4. Sort out and separate seeds other varieties and weigh these. Suppose these weight is 'B' gram.
5. Sort out and separate stones and other inert materials and weigh these. Suppose these weight is 'C' gram.
6. Now calculate the purity percentage of the seeds as per the following formula.

\[
Purity\ percentage\ of\ seeds = \frac{A \times 100}{A+B+C}
\]

\[
Percentage\ of\ other\ seeds = \frac{B \times 100}{A+B+C}
\]

\[
Percentage\ of\ inert\ materials = \frac{C \times 100}{A+B+C}
\]

7. Following steps of above mentioned job, calculate the purity percentage of different seeds and write down in your practical note book.

**Subject- Sorting out Paddy Seeds**

**Materials :**
1. Paddy seeds-1 kg, 2. Water-13 litre
3. Bucket-1
4. Urea-500 grams or ½ kg

**Step of Work**
1. Take a tub which can hold 20 litres water
2. Take 13 litres of clean water in the tub and make a solution
3. Mix 500 gram of Urea with the water in
4. Now release the paddy seeds into the solution. Stir for sometime.
5. Observe the seeds minutely.
6. See whether the heavy, healthy and strong seeds accumulate on the bottom of the tub.
7. See whether the unhealthy seeds are floating on the water.
8. Pick-up the floating seed by means of hand or net.
9. Now take out the seeds accumulate on the bottom of the tub and after washing well 2-3 times in clean water dry in shade.
10. Sort out the paddy seeds after following the above mentioned steps.

Exercise

Multiple Choice Questions

1. Which is the Agronomic seed?

   a.  
   b.  
   c.  
   d.  

2. The general principle of seed preservation is–
   a. The seed godown should be dry and cool
   b. The godown should be air tight
   c. The seeds should be dried perfectly and cool it under shade.

Which one is correct?

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

a. What is the certified seed mentioned in the guarantee paper?

b. Explain one important reason of stating that the seal of the seed bag and the guarantee paper should not be destroyed.

c. Describe the method of testing the purity rate of the seed as mentioned in the guarantee paper.

d. Give a comparative analysis of the production methodology of seed production and general crop production.
Chapter Six

Agricultural Equipment's and Irrigation

Agricultural Equipments

The equipments used in agricultural activities are called agricultural equipments. Different equipments are required for different agricultural works. Agricultural equipments can be divided into two types. Such as:

1. Hand driven agricultural equipments
2. Power driven agricultural equipments

The main equipments used in Bangladesh for agricultural activities are described as under–

Plough

Plough is one of the agricultural equipment of Bangladesh. The plough is made by fixing a iron made time to the top of curved wood. The plough is used to cultivate the land to make shallow channels.

The main parts of a plough are –

1. Curved wood or body
2. Shear of blade made of iron
3. Peg and beam
4. Handle and bar

**Yoke**
Although a yoke is not a part of the plough, but it can be treated as a part of it. The yoke is kept on the shoulder of the ox and attached with the plough with the help of rope. A yoke is made of wood or bamboo.

**Spade**
The spade is used to cultivate completely the areas at the along te boundary lines of the plot. The spade is used to cultivate soil to make vegetables garden. The spade is advantageous in case of fruit garden or in case of land where crop are grown in lines. There are 2 parts of a spade, such as -

1. Blades or tine (A sheet made by iron)
2. Handle.

**Harrow**
A harrow is made of bamboo or wood. A harrow is used for controlling weeds, thinning of plants and loosening the soil.
Weeder or khurpi
Weeder is also used largely in crop production. Weeder is necessary of cleaning the weeds and loosening the soil of the bottom of the plant.

Sickle
A sickle is used for cutting crops.

Ladder
A ladder is made of bamboo or wood. Bamboo made ladder is largely used. A Ladder mainly does 4 things, such as –
1. Loosen the hard lump of soil
2. Crushes the weed
3. Levels the land
4. Brings compactness in soil
**Chopper or Dao**
A chopper is made of iron and is equipment used to do miscellaneous job of agriculture. A chopper is fixed with a narrow wooden handle. A chopper is heavier and thicker than a sickle.

**Hammer or Mugur**
A hammer is used to break the big lumps of soil. A hammer has two parts such, as –
1. Main part
2. Handle

**Grafting Knife**
A grafting knife is a specially prepared knife used for grafting. Generally this type of knife is used in nursery.

**Mould Board Plough**
A mould-board plough is superior to a country plough. This plough is used for deep ploughing. It has higher working capacity.

**Paddle Thresher**
It is a threshing equipment having mechanical advantage of a gear. It has got a drum fitted tines. The drum is rotated by means of the paddle. When ears of crops are kept on the rotating drum the grains are separated by the strokes of the tines, thus the threshing is done. This equipment is cheap. This can be used by our general farmers.
Knap-Sack Sprayer

It is a specially made implement used for spraying insecticide. By means of this the long spray gun having a tiger can be hold at a desirable height and water-mixed pesticide can be sprayed. The equipment can be carried on the shoulder. Pests of field crops and fruit can be controlled by spraying pesticides by this equipment.

Power Driven Equipments

Among the power driven agricultural equipments the important ones are power tiller, tractor, harrow power pump, shallow, tube-well, deep tube-well, thresher and sprayers.

Power Tiller and Tractor

A kind of rotating plough is used in both power tiller and tractor. At the time of ploughing the blades of the ploughs till the soil vehemently. This allows the soil to be well-pulverized and weeds to be destroyed. Besides using rotating ploughed with the help of the tine ploughs of a power tiller. In case of primary ploughing when rotating ploughs do not work well tine ploughs are used.
Irrigation

Artificial application of water to the field for normal growth of crops and more production is called irrigation. Irrigation is essential for modern cultivation system.

Improved cultivation cannot be thought without irrigation. The soil should have required amount of water for maintaining the life of plants. As soon as there is shortage of water in the crop field, the necessity for irrigation becomes inevitable.

Need for Irrigation

There is sufficient rain in Bangladesh but this rain is not always helpful for agriculture. So good harvest can not always be achieved if crop is cultivated depending only on rain. In our country there is sufficient rain during rainy season, but it is not so during winter. More over there is not enough rains even during rainy season in the western regions of the country. As a result the production of crop is decreased due to want of water. In these conditions irrigation is very much important in order to get increased production by cultivating crops.

Objectives of Irrigation

The followings are the objectives of irrigation -

1. To keep the plant nutrient elements in the soil in soluble form.
2. To help in decomposition of organic matters.
3. To control soil salinity
4. To control soil temperature
5. To increase crop or yield.

Irrigation Methods

There are different methods of irrigation. The method is selected depending on certain issues. The issues are –

1. Type of soil and slop of land
2. Sources of water
3. Type of crop and cropping pattern
4. Financial condition of farmer

The irrigation can be divided into main four, such as –

1. Surface irrigation method
2. Sub- soil irrigation method
3. Sprinkle or irrigation method
4. Drip irrigation method
Surface Irrigation Method

This method of irrigation is followed in almost all countries of the world. In our country surface irrigation is done in maximum case to irrigate crop-field surface irrigation is of 6 types, Such as -

1. Flood irrigation system
2. Furrow irrigation system
3. Ridge irrigation system
4. Barrage and channel irrigation system
5. Corrugation irrigation system
6. Band circular irrigation system

1. Flood Irrigation System

In this method, water is brought to the upper portion of the land with the help of main channel and then is spread evenly throughout the whole land field. Water is retained in the field by means of making ridges surrounding the field. Much area can be irrigated with minimum labour in this method.

2. Furrow Irrigation System

In this method water is supplied to the branch canals from the main channel, this system are followed in case of fields where crops are sown in lines. The main advantage of furrow irrigation system is that sufficient areas can be irrigated with some amount of water.

3. Ridge or Border System

By ridge system the land is separated into small blocks with the help of ridges and then the blocks are irrigated by flood system. In this method water can be controlled more easily.
4. Barrage and Channel/Canal etc.
This method of irrigation followed in case of slope land. Firstly some channel are dug crosswise to the slope of the land. Water is released to the higher channel from the source of water. In order to spread water throughout the whole field a sort of cross dam to be made at the end of each channel. In the barrage and canal system of irrigation water can be controlled very easily.

5. Corrugation Irrigation System
In corrugation irrigation system channels are dug in the land. These channels are made at such distances that the land between two can get sufficient water. This system is very advantageous in case of clay type of soils.

6. Bank or Circular Irrigation System
This system is applicable for the plant which lives years together. In this system first of all, main channel is dug in between the rows of trees. Then circular channel are dug centering the bottom of each tree. Afterwards the circular are connected with the main ones by digging small channels. This channel type of irrigation is done in fruit orchards.

Sub-Soil Irrigation System
Sub-soil irrigation is a special type of irrigation. In this system irrigation is done to the root areas of the plants with the help of tubes. The main advantage of this system is that the top soil don't form crust.

Sprinkling Irrigation System
The method by which irrigation is done in the form of rain is called sprinkling irrigation. In this system water is supplied with the help of pipes and is sprinkled in all directions with the help of a nozzle. This system is good in case of uneven and slope land.

Drip System of Irrigation
The method by which water is supplied to the base of the plant by drops, is called drip system of irrigation.
As water is supplied always to the base of the plant by drops. It is also called constant irrigation. By irrigating though this system, there will be no want of moisture in the soil.

**Time of Irrigation to the Crop Field**

Irrigation is to be after determining moisture of the soil. Because when irrigation is done in presence of moisture in the field, there will be wastage of water and the soil will be waterlogged. Both are detrimental. Again irrigation water will not help the crop when it is done after soil is extremely dried. Hence timely irrigation is to be done for the normal growth and increased production of crops. If the soil collected from areas 10 to 25 cm beneath the surface forms ball when pressed with hands, then it can be ascertained. The soil has got moisture. And if the soil becomes powder then it can be ascertained that is the time for irrigation.

**Irrigation Projects of Bangladesh**

There are many irrigation projects in different places of the country. The projects are implemented by Bangladesh water development Board. The names of main irrigation projects and areas under each project are shown in the following table.

<table>
<thead>
<tr>
<th>Name of irrigation projects</th>
<th>Areas under the project (Hectar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ganges-kafotak irrigation Project (G.K)</td>
<td>1,40,000</td>
</tr>
<tr>
<td>2. Barisal irrigation project (BIP)</td>
<td>1,06,000</td>
</tr>
<tr>
<td>3. Bhola irrigation project</td>
<td>52,000</td>
</tr>
<tr>
<td>4. Thakurgaon deep tube-well irrigation project</td>
<td>46,000</td>
</tr>
<tr>
<td>5. Chandpur irrigation project (CIP)</td>
<td>29,000</td>
</tr>
<tr>
<td>6. Muhuri irrigation project (MIP)</td>
<td>27,000</td>
</tr>
<tr>
<td>7. Pabna IRD</td>
<td>25,000</td>
</tr>
<tr>
<td>8. Meghna- Dhanagoda irrigation project</td>
<td>17,000</td>
</tr>
<tr>
<td>9. Karnaphuli irrigation project (KIP)</td>
<td>18,000</td>
</tr>
</tbody>
</table>

In these project areas Boro, Aus, Aman, Jute, Wheat, Potato, Vegetables, Fruits, and other crops are produced by providing irrigation.
Irrigation Equipments

Different equipments are used in Bangladesh for irrigating crop fields. Description of some of the equipments are given here under.

1. Sheuti

The triangular Sheuti is made of Bamboo, cane or tin. Sheuti has been in use in this country from ancient time.

2. Don

Don is made of the basal portion of palm tree or of wood which looks like slender boat. This has also been in use in this country from ancient time.

3. Treadle Pump

A treadle pump is a one or two cylinder pump having plastic lids. A bamboo having a filter is inserted under the soil. Then the pump is connected with the mouth of the pipe of the bamboo. Afterwards two bamboos are fixed to the pump like lever. Water is raised by operating the lever instrument with the leg just like a treadle husking equipment. This is a very popular pump.
4. Centrifugal Pump

This is a very widely used power driven irrigation equipment. Irrigation is done by lifting water from rivers and subsoil by using centrifugal pumps with low lift pumps (LLP), Shallow tube-wells (STW), and deep tube wells (DTW).

Drainage of Water

This is a method of allowing the excess water to go out from the crop field. Excess water is very harmful for the crop. Hence excess rain or irrigation water should be drained out from the land as soon as possible.

Importance of Drainage

Although plain, most lands of Bangladesh are uneven. During rainy season when there is excessive rain water stands on these lands. As a result timely cultivation becomes impossible. Moreover, every year vast areas remain waterlogged due to flood. If timely cultivation is to be done in these lands the accumulated water is to be drained out. Water accumulated mostly in case of lands of following characteristics.
1. Land having day soils
2. Uneven land stope
3. Land having hard layer In order to increase crop production timely draining out of water is necessary.

Harmful Affects of Excess Water

1. Hinders plant growth
2. Spreads diseases and pests
3. Plant root can not spread well
4. Beneficial micro-organisms can not increases their population
5. Plant nutriments are destroyed
6. Soil temperature is decreased.
Methods of Water Drainage

Drainage can be done in two methods, such as –
1. Open canal method
2. Closed canal method

Open Canal Method

Generally in our country drainage of water from cultivated land is done by open canal.
In this method first of all canals are dug in advantageous places. Draining out of water, Canals are to be dug maintaining slopes. Small canals can be connected with the main canal required.

Closed Canal Method

The method by which canal is dug inside the soil under covered condition and draining out of water is done through that canal is called closed canal method of drainage. The main advantage of closed canal method is that no land is wasted in this method. This method is of three types, such as -

1. Tile drainage
2. Box drainage
3. Stone drainage

1. Tile Drainage Systems

The excess water is drained out especially from crop field by setting appropriate tiles and pipes.

2. Box Drainage Systems

In this method system, after digging a rectangular canal is dug and stones are set in two sides. After wards stones are set in the canal which are then covered with soil.

3. Stone Drainage Systems

Like box canal system, after digging a rectangular it is filled with small and big stones which are then covered with soil. Water is drained out through the spaces between the stones.
Practical

**Subject: 1. Determining of Soil Moisture**

**Materials:** Weeder or spade

**Steps of Work**

1. Go to a crop field either of wheat or vegetables.

2. Dig a hole of 15-20 cm. deep.

3. Take a hand full of soil and press in clutch. If the palm becomes wet, then it can be ascertained that the soil has got water. There is no need of irrigation at this time or stage.

4. After pressing in the hand if the soil form clod, then throw the clod to the ground. If the clod breaks it can be ascertained that there is want of moisture in the soil. Irrigation will have to be done within 2-3 days.

5. If the soils do not break even after pressing in the hand. Then it can be ascertained that the soil is very dry. It requires immediate irrigation.
Subject: 2. Observation of Agricultural Equipments and their Identification

Materials: Different types of agricultural equipments

Steps of Work
1. Observe all the agricultural equipments
2. Go to the school ground or to the adjacent farmer's house with your teacher.
3. Draw the pictures of the equipments by comparing with the drawings of the book.
4. Identify all the implements and write down the names of the implements on a sheet of paper.
5. Write down specific activities of each implement.


Materials:
1. One plough 2. Paper and pencil

Steps of Work
1. Observe the plough on the school ground.
2. Identify the main parts with the pictures drawn in the book.
3. Compare the parts with the pictures drawn in the book.
4. Draw the picture of a plough in the practical note book and label the identified parts.
5. Write down the activities of different parts of the plough in the practical note book.
Exercise

Multiple Choice Questions

1. Which of the following is a paddle implement?

2. In which crop the ring irrigation is suitable?
   c. Fruit garden.          d. Tea garden.

3. Which of the implement illustrated below is used for weeding?
   a. Fig-1    b. Fig-2
   c. Fig-3    d. Fig-4

Read the paragraph below and give answers to questions 4 and 5.

Nazrul Islam, the new farmer of Sadar Upazila of Pabna is now ready for sowing jute seeds in the Kharif-1 season. But as there was no probability of rainfall he became bound to irrigate the land. For this situation he had to wait for another 15-20 days. In this way a negative attitude was created in his mind towards jute cultivation.

4. Nazrul Islam had to wait for another 15-20 days, because-
   a. Giving irrigation to the land without measuring the existing soil moisture.
   b. Failing to control excess irrigation.
   c. Failing to arrange a power tiller.
Which one is correct?

a. i and ii  

b. i and iii  

c. ii and iii  

d. i, ii and iii  

5. In addition to jute, all the crops of which row can Mr. Islam cultivate in this season?

a. Aus rice, jute, ground nut  

b. Eggplant, amlaki, olive  

c. Jute, aus rice, bitter gourd  

d. Sweet gourd, palwal gourd, palmyra palm  

Creative Questions

Jamal Mia irrigates his litchi garden every year using power driven irrigation implements. He also irrigates his potato fields using the same implement. But this year his potato land became waterlogged due to excess rainfall. He then arranged to drain out the excess water from the potato field.

a. What is irrigation?

b. Why did Jamal Mia drain out excess water from his potato field?

c. Explain with figure the method Jamal Mia applied to irrigate his potato field.

d. Explain the justification of using power driven irrigation equipment in the context of Bangladesh.
Chapter Seven

Plant Protection

Managing of protecting field from the attack of insect pests, diseases, rats etc. called plant protection. Insect pests, mites, disease, pests, and rats are the main enemies of crop. These pests destroy a considerable part of the produced crop. But the amount of destruction can be minimized by proper management.

Along with harmful insects, there are various beneficial insects too, in the crop field. They help in pollination of flowers and by eating the eggs and larvae of harmful insects. It is therefore, essential to control harmful insects by protecting the beneficial ones.

Integrated Pest Control Management

Control of harmful insects by following certain control measures at a time, protection the beneficial insects, is called integrated pest control management. The main objective of integrated pest control management is to prevent pest invasion by decreasing the dependence on pesticides and by following with the fact that one control measures at a time. Example can be furnished with the fact that adult Hispas can be caught and killed by hand-nets or mosquito nets. The infested tops of the rice plants having larvae of the pest can be cut and buried under soil. At the same time the branches of trees can be put in the crop field whereby the birds can sit and eat the insect pests. If pests cannot be controlled in spite of taking all these measures, only then the right pesticide can be used as the last measure.

Advantages of Integrated Pest Management (IPM)

There are many advantage keeps the environment pollution free described below -

1. Integrated pest control management keeps the environment pollution free and protects biological balance of the environment.
2. Protects beneficial insects, mites, frogs and fish.
3. Decreases use of pesticides.
4. Helps crop protection with minimum expenditure.
5. Keeps the food stuff free from the harmful influence of the pesticides.
Components of Integrated Pest Control Management

There are 4 components of integrated pest control management, such as—

1. Modern cultivation system
2. Mechanical control
3. Biological control
4. Chemical system

Modern Cultivation System

A. Deep Ploughing of land.

By deep ploughing the harmful insect pests, their eggs and grubs will be brought above the soil. By doing this some will be killed by sun shine and some will be eaten by birds.

B. Adopting Crop-rotation

One particular insect pest attacks a particular crop so if a particular crop is cultivated on the same land repeatedly, pest attack will be higher in that land. But when according to production plan, different crops are cultivated in rotation in the same piece of land, then the insect and pest invasion will be minimum. For example, when transplanted Aman is cultivated after jute, invasion of insect pest will be minimum.

C. Application of Fertilizer in Balanced Doses

The attack of insect pest and disease will be less when fertilizers are applied in balanced doses. In certain crop, when urea is applied abundantly, the top shoots and leaves of the plant become succulent. Mostly this attracts insect pests. Again when potassium fertilizers, are applied in low quantity, the attack of diseases will be higher. So fertilizer should be applied in balanced rates.

D. Irrigation Management

Some insects cut the young seedling beneath the soil, such as mole cricket. Mole cricket causes immense damage to jute crop. If flood irrigation is done in jute filled attacked by mole cricket, the pests can be controlled. Again draining out water from the rice field can control case worms.

E. Spacing of Seedlings

Planting the seedling of rice thinly can control brown plant hopper.
F. Cultivation of Improved Varieties of Crop

There are many improved varieties of crop which are resistant to diseases and pests. For example, BR-10 variety of rice is resistant to Tungru virus and blast disease. Chandina is resistant to stem borer.

Mechanical Control

Controlling insect pests by hand or trap is called mechanical control. There are several ways of mechanical control. Some of mechanical control devices are described as under -

A. Manual Catching of Insects by Hand

Collecting their eggs can control insect pests and larvae form the crop field by hand. The stem borers of rice and sugarcane can be controlled by this way. Again rice hispa and green leaf hoppers can be destroyed by collecting with hand nets.

B. Cutting of the Leaf Tips

Rice hispa and leaf rollers generally attack on the top of the leaves of rice plants. In this condition their attack can be controlled by cutting the leaf tops and then by burial under soil or by burning.

C. Uprooting of Infested Plant

The infested plant should be uprooted as soon as symptoms of attack by disease or insects are visible. By this disease and pest invasion cannot spread throughout the whole crop field.

D. Light Trap

By setting light trap insects can be attracted towards light and can be killed. At night a pan having water mixed with kerosene or pesticide should be kept in the field. If a hurricane is kept hung on that pan many insects will be attracted towards the light of that hurricane. By this the insects will fall in the pan having kerosene or pesticide and then die. Adult stem borer, ear cutting cater pillar green plant hopper and rice bugs can be controlled by setting light trap.
Biological Control

Control of harmful serious pests by using predator insects and birds is known as the biological control method: Some insects feed on other insects. These insects are called parasites or predator insects. Such as Lycosaspiders, Lady bird beetle, Mtrid bug and parasitic insects. Some of the predator insects are described as below:

**Lycosa or Nekre Spiders**

**Habitat:**

Lycosa spiders live in rice field. In most of the time, they stay in the bottom of rice plants.
**Food:** Lycosa spiders do not make nets. They attack directly on the insects. Adult spiders catch various types of insect and eat. Out of these, the moths of rice stem borer are important.

**Grass Hoppers**  
**Habitat:** Among the grass hoppers the grass hoppers having long proboscis are predators: These grass hoppers stay on leaves and ears of plants. These and found abundantly on the growing rice plants.

**Food:** This grass hopper eats sucking insects, stem borers and rice bugs. They catch preys at night.

**Damsel Flies**  
**Habitat:** The adult damsel flies fly in spaces between the leaves of rice plants. The young ones live in water. But they climb up through the leaves to eat the young plant hoppers and leaf hoppers.

**Food:** This fly eats different types of hoppers and leaf rollers.

**Lady Bird Beetle**  
**Habitat:** Lady bird beetle can be seen in all types of crops including gourd types of plants and rice field.

**Food:** Their preys are slow creeping insects. This insects eats sucking insects, stem borers and leaf roller. The young ladybird beetles can eat more insects man adult ones.
Mirid Bug

**Habitat**: Mirid bug lives in rice field. These can be found abundantly in rice field infested by plant hoppers and leaf hoppers.

**Food**: Mirid bug lives in quest of the eggs of plant hoppers in leaf sheaths and stems of rice plants. They suck the eggs by piercing their proboscis.

**Predator Birds and Frogs**

Almost all types of birds feed on insect pests of crops and thus benefit us tremendously.

Among these birds the important ones are folk-tailed shrike, magpie robin, (doel) Mayna, Martin (Shalik) and Swallow (finge). Besides these, crows, eagles, owls eats rat and thus help rat control. When wooden platforms are made by the sides of the ridges of land for gourd or beans or when branches of trees are put on the field the birds can sit on those. They help in controlling insects by eating several types of harmful insects.
Frog
The frog lives in both water and soil. Insects are their main food. Frogs can be utilized for controlled insects of the crop field.

Chemical Method
Chemical method is one of the ways of insect control in integrated pest control management. This method is applied only when the insect population is so large that mechanical or biological control becomes ineffective. Example can be furnished by saying that in rice field when 3 female moths or cluster of 3 eggs are found in one squaremetre or 10% dead ears are seen upto 40 days of transplantation, only then the chemical control method becomes necessary.

Rat Control
Rats cause damage to the houses of men and crop fields. They share human food. Rats cause 10-20% damage to the crops. Rats cut wood, clothes, furniture and crops throughout day and night. They cause damage not only to the household antics, but also spreads germs of different diseases. Rat spread plague disease. This disease,
some times, becomes epidemic. There are three varieties of rats found in crop fields or houses, such as:

1. Black rat
2. House rat
3. Brown rat

The disturbances of brown rat are tremendous in Bangladesh. One pair of rat can give birth to 800-1000 number issues in only one year.

**Symptoms of Presence of Rats**

Following are the symptoms of rats

1. **Soils of Rat**
   
   Rats dig holes in the fields and in houses and live there. Seeing the granular soils can identify presence of rats.

2. **Paths of Movement**
   
   Marks of legs can be visible when rats move on soft soils. They move by clearing the ways.

3. **Excrements**
   
   Seeing their excrement can identify the presence of rats.

4. **Smell**
   
   Rats spread bad smell. Their presence can be identified from, this smell.

5. **Symptoms of Damage**
   
   Rats cut, every thing crookedly. These cut-marks indicate their presence.

6. **Sound**
   
   When rats move a kind of rustling noise can be heard, and when they, cut some thing a sound of gnawing can be heard.

**Rat Control**

Rats can be controlled in several methods, such as:

1. Rat killing trap
2. Poison bait
3. Pouring water into the holes of rates
4. Rearing cats.
1. Rat Killing Trap
There are many types of rat traps found in markets. Rats can be killed in the traps by keeping food-baits.

2. Poison Baits
Zinc phosphide, recumin, phostoxin can be used to make poison baits and can be kept in the rat-holes or on the ways of their movement. Rats eat Rat trap those baits and die. Lanirat is another type of poison bait. When 10 grams of poisonous things kept on the way of rats, they eat it and die.

3. Pouring Water into the Holes
Rats can be killed when sufficient water is poured into their holes.

4. Rearing of Cats.
Rats can be controlled by rearing cats in the house.

Practical

Subject: Collection of insect pests of rice and their identification.
Materials:
Hand nets for catching insects, one jar for keeping insects, papers and pencils.

Steps of Work
1. Go to a rice field adjacent to your school with a hand net and a jar.
2. Catch insects by sweeping hand net.
3. Keep the insects in the jar and close the mouth of the jar with a lid.
4. Bring the jar with the insects to the class room.
5. Bring out the insects one after another from the jar. Compare with the picture given in the theoretical part of the book. Write down the name on the paper.
Exercise

Multiple Choice Questions

1. Which is within the purview of pest control in the modern cultivation methods?
   a. Catching insects by hand net   b. Cutting apex leaves
   c. Cultivating jute after rice   d. Uprooting the infected plant

2. Which is the insect eater bird?
   a. Fig - 1 and Fig- 2   b. Fig - 2 and Fig - 3
   c. Fig - 3 and Fig -4   d. Fig - 1 and Fig – 4

Read the paragraph below and give answers to questions 3 and 4.

One morning Anwar was giving deep ploughing to his land. The come birds started to come in the ploughed land. He observed that the birds were eating insects which come out of the deep layer of the soil. This inspired Anwar in controlling pests. He put tree branches in the plot so that the birds can sit and eat harmful pests.

3. The birds which eat insects are-
   i. Magpie robin, owl
   ii. Martin (shalik), parrot
   iii. Swallow (finge), eagle
Which one is correct?

a. i b. ii

c. iii d. i, ii and iii

4. What is the name of the method of controlling pests by putting tree branches in the crop fields?

a. Modern cultivation control method

b. Mechanical control method

c. Biological control method

d. Integrated control method

5. Rat damages on an average 15% of the crops per year. On the other hand pest damages about 10%. Our food production in Bangladesh is 2 crore ton. How many lac tons of additional food is damaged by rat than pest?

a. 10 lac tons b. 15 lac tons
c. 20 lac tons d. 25 lac tons

Creative Questions

The farmers of the village Rasulpur have seen the Integrated Pest Control Management practices in the ‘Agricultural’ programme. They noticed in the Rabi season infestation of different pest and rat greatly increased. They also observed that some of the insects were eating other insects. They counted the number of insect moth and egg clusters per square metre and found 4 moths and 3 egg clusters in that 1 sq m space.

a. What is Integrated Pest Control Management?

b. Some insects are eating other insects: Why?

c. How can the paddy in Rasulpur village be protected in Rabi season? Explain.

d. Evaluate the effectiveness of Integrated Pest Management in rat control.
Chapter Eight

Cultivation of Crops

Rice Cultivation

Rice is the main food crop of Bangladesh. Rice is the food of almost half of the total population of the world. Rice is cultivated in almost 80% land of our country. Bangladesh Rice Research Institute has developed many improved varieties of rice and developed many cultivation technologies. Now High Yielding Varieties (HYV) of rice have been cultivated in many areas of the country. The production of HYV rice is more than that of local varieties.

The characteristics of HYV are:

1. The leaves of HYV rice are thick, short and straight. Hence get more sun light, and the leaves become deeply green.
2. Plant do not lodge because of their stiffness and shortness
3. Plants can uptake more nutrients and hence give higher yields.
4. As the plants remain green even during ripening of paddy grain they do not suffer from shortage of nutrients
5. Production of rice is relatively higher than straw
6. Infestation of pests and diseases in HYV rice is relatively low.
7. Depending on variety it can be cultivated during any time of the year.
8. Number of tillers is higher.

Selection of Land

Rice can be cultivated well in silt loam and clay type of soil.

Varieties

The name of the HYV varieties of rice are mentioned below on the basis of seasons

**Broad Cast Aus:** Nizami and Niamat.

**Transplanted Aus:** Mala, Chandina, Purbachi, Gazi, BRRI-Balam, Biplab, Asha, Sufala, Moina, Shahibalam, Mohini.

**Transplanted Aman:** BRRI-Shail, Pragati, Mukta, Biplab, Kiran, Dishari, Dulhabhog.
**Boro:** Chandina, Gazi, Biplab, Asha, Sufala, Moina, Mohini, Shahibalam, Hashi, Shahjalal and Mangal.

**Seed Rate**

Pure and healthy seeds having 80% percent germination should be sown on seed bed. 2-3 kg of seeds are required for one decimal (40 square metre) of land.

**Seed Treatment**

There may be various germs of diseases with the rice seeds, which afterwards create various diseases on the rice field. That is why rice seed should be sown on the seed bed after making the seed free from germs. The method of disinfecting rice seeds by applying some chemicals is called seed treatment.

Some easy methods of seed treatment are described below—

1. Healthy and viable seeds should be used raising rice seedlings.

2. One kg of seeds can be treated with 20 grams of Agrosan M-20 or Agrosan GN. The seeds are to be kept 24 hours after mixing the chemical uniformly.

**Preparation of Seed Bed**

Two types of seed beds are prepared in Bangladesh, Such as –

1. Dry seed bed

2. Wet seed bed

Two seed beds can be prepared in one decimal (40 square metre) of land. In an area of 10 x 4 metre the size of seed bed will be 9.5 x 1.5 metre including drains. A space of 25 cm should be kept along all the borders and 50 cm space should be kept within 2 sub-bed of the seed bed.

Before sowing seeds in seed bed, the seeds will have to be dipped into water. Different periods are required for different varieties of rice for sprouting. Period required for Aus is 24 hours, for Aman is 48 hours. 3 kg of seeds required for 1 decimal of land will have to be sprouted by dipping into water. Such germinated seeds are to be sown in seed bed.
Nursing the Seed Bed

It is necessary to provide irrigation by keeping water always in the drains of seed bed. When weeds appear it should be uprooted. Pests and diseases will have to be controlled when infestation takes place. When the seedling becomes yellowish, then after two weeks of sowing urea should be applied to the seed bed at a rate of 410 grams.

Uprooting of Seedlings

When the seedlings attain 1 month of age then they become suitable for transplantation. Before pulling of seedlings sufficient watering should be done in the seed bed. Then the seedling should be uprooted with care so that the seedlings are not broken. The seedlings, after pulling should be tied in small bundles and then preserved.

Land Preparation

Land for rice cultivation is to be prepared by puddling the soil well. Puddle can be prepared by keeping water in the land and cross ploughing and laddering for 4-5 times.

Application of Fertilizer

Sufficient quantities of fertilizer require to be applied in case of high yielding varieties of rice.
### Amounts of fertilizers on the basis of varieties (grams per decimal of land)

<table>
<thead>
<tr>
<th>Name of the varieties of rice</th>
<th>Amount of different fertilizers gm/decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urea</td>
</tr>
<tr>
<td><strong>Broadcast Aus</strong></td>
<td></td>
</tr>
<tr>
<td>Nizami Niatmat</td>
<td>500</td>
</tr>
<tr>
<td><strong>Transplant Aus</strong></td>
<td></td>
</tr>
<tr>
<td>Biplab. Asha, Sufala, Moina, Mohini, Shahibalam</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>600</td>
</tr>
<tr>
<td><strong>Transplanted. Aman</strong></td>
<td></td>
</tr>
<tr>
<td>BRRI-shail, Pragati, Mukta, Bi lab</td>
<td>600</td>
</tr>
<tr>
<td>Kiran, Dishari (Late)</td>
<td>360</td>
</tr>
<tr>
<td><strong>Boro</strong></td>
<td></td>
</tr>
<tr>
<td>Biplab, Asha, Sufala Moina Mohini Shahibalam</td>
<td>720</td>
</tr>
<tr>
<td></td>
<td>840</td>
</tr>
<tr>
<td><strong>Hasbi, Shahjalal</strong></td>
<td></td>
</tr>
<tr>
<td>Mangal (for haor areas)</td>
<td>540</td>
</tr>
</tbody>
</table>

Fertilizers are to be applied in specific classes per hectare and per decimal.

The doses of fertilizers as mentioned above may be considered as average. The chart does not contain cow-dung or organic manure. Application of cow-dung or compost at the rate of 20 kg per decimal will give good yield. All the fertilizers except urea as mentioned above should be applied at the time of first ploughing and those are to be well-mixed with soil. Urea is to be applied in 3 instalments. At the instalments 50% of urea is to be applied after 2 weeks of transplantation. The remaining fertilizer is to be divided into two and first part is to be applied after 45 days and the remaining part is to be applied at dough stage. Applying in the way will not waste fertilizers. These plants well also get their necessary nitrogen.
General Principles of Fertilizer Application

1. The doses of MP fertilizer should be applied one and a half times in case of red sandy soils and piedmonts of hills.

2. The amount of zinc fertilizers should be increased in silty soils of the Ganges regions are in the irrigation project areas.

3. If the lands of haor areas and fertile then the amount of fertilizers needs to be decreased.

4. The doses of the above fertilizers should be half, in case of local varieties.

5. If 4-5 tons of dried well-decomposed organic manure or compost is applied per hectare, then the chemical fertilizers are to be decreased by one third. Organic manures are to be applied at the first ploughing.

6. In case of sandy structured soils M.P fertilizer should be applied in 2 instalments.

7. If in the previous crop T.S.P M.P and gypsum are applied in proper doses then the above mentioned fertilizers may be applied at the rate of 50% of the approved doses,

8. If zinc sulphate is applied in any crop then there is no necessity to apply it for next two crops.

9. The land, where green manuring has been done during the first Kharif season of crop rotation, may be supplied will half the usual does of urea for crop production.

Transplantation

Seedlings of one month of age should be transplanted to the field. The seedling should be transplanted without any delay after uprooting from the seed bed. Small quantity of water should be kept on the land and transplantation should be plant to 25 cm and hill to hill distance should be 15-20 cm. In every hill three seedlings should be transplanted.

Irrigation and Intercultural Operations

Irrigation is very important in case of HYV rice. Irrigation should be arranged when the depth of the standing water goes below 5 to 7 cm. When the seedlings attain 50 to 60 days, there should be 7 to 10 cm standing water on the field. But water should be drained out before application of urea as top dressing. The land should be irrigated again after 2 to 3 days of top dressing.
Weather and Climate

It is essential at first to know the weather of a country to understand its climate. Weather means the daily condition of temperature, relative humidity, rainfall, and air flow, sunshine, atmospheric pressure, fog etc, of an area. Weather may be of any time within a day. Weather of localities changes frequently. The climate of an area may be defined as the average of 20 to 25 years weather of that area. The characteristics of climate depends mainly on the altitude, latitude, height from the mean sea level, distance from the sea, air flow, rainfall, oceanic stream, mountains and vegetation of certain area. Climate greatly influences the agricultural production of a country. The climate of an area may be understood by observing the plants and agricultural production of the place.

The climate of Bangladesh is nearly temperate in consideration of countries geographical position, height from the sea level, distance from the ocean, temperature and rainfall. Sufficient rainfall, medium winter and humid rainy season are the main characteristics of the climate of Bangladesh. This type of climate is very favorable for agricultural production.

On the basis of climate of Bangladesh the crop growing period is divided into two seasons, such as:

A. Rabi (Winter season)
B. Kharif (Summer- rainy season)

A. Rabi Season

The crop growing period from Aswin (Middle of September) to Falgun (Middle of March) Months is known as Rabi season. The main characteristics of this cropping season are low temperature, low relative humidity and low rainfall. The main vegetables of this winter season are Cauliflower, Cabbage, Radish, Carrot, Gourds, Country bean, Tomato, Boro Rice, Wheat, Potato and Mustard. Crop production in this season needs irrigation.
B. Kharif Season

The Kharif season may be divided into two seasons according to climatic parameters. These are-
1. Kharif-1
2. Kharif-2

Kharif-1 Season

The season starting from Chaitra month to Ashar month (from the middle of March to middle of July) is known as Kharif-I season. This season is also known as summer season. The atmospheric temperature becomes high during this season. Frequent storms are the characteristics of this season. Aus rice, Jute, lady's finger (okra), Indian spinach, Sweet gourd, Bitter gourd, Palwal gourd, Spined gourd, Barbate etc. are mainly cultivated during this season.

Arrangement should be done for irrigation for cultivating crops during this season if the rainfall is low. The major and important fruits of this season include mango, black berry, jack fruit and papaya.

Kharif -2 Season

The season starting from Ashar month to Bhadra month (from the middle of June to middle of September) is known as Kharif-2 season. This season is also known as rainy season.

Torrential rain is the characteristics of this season. The atmospheric temperature remains medium during this season. Transplanted Aman rice and rainy season vegetables are mainly cultivated during this season.

The major and important fruits of this season include pummelo (lime group), palm tree fruit, late season mango, jack fruit, amlaki, olive etc are mainly available during the Kharif-2 season. Some vegetables are available in our country through out the year. For example – Lady’s finger, Brinjal, and Red amarnth.

The Agricultural Weather and Climate

The daily conditions of rainfall, atmospheric temperature, humidity and pressure as important for crop production may be termed as agricultural weather. The agricultural production in Bangladesh is pre-dominantly dependent on agricultural weather.

Agricultural production plans are formulated after making thorough consideration of the existing weather and climate of an area or locality. Agricultural weather has so
BANGLADESH: Main Agricultural Region and Crops
(on the basis of climate and weather)

1. North Western
2. North-Eastern
3. Southern
much diversity according to different geographical and ecological regions of Bangladesh. Different crop plants grow well in different regions due to the variation of agricultural weather at diversified Agro Ecological Zones (AEZ).

The whole Bangladesh has been divided into three main divisions according to the existing agricultural weather and climate. The name of these climatic regions are given below:

1. North Western Region
2. North Eastern Region
3. Southern Region
The brief descriptions of these three regions are given here:

**North Western Region**

The north and north western districts of Bangladesh are included in this region. The whole Rajshahi Division, the northern parts of Dhaka and Khulna Divisions are within this region. Both the cold and heat is high in this region. The rainfall and relative humidity is comparatively lower in this region.

Rice, wheat, potato, sugar cane, different types of vegetables, mango, jack fruit, jujube or plum, litchi, tobacco, chili or pepper, pulses etc are the most important crops for cultivation in this region.

**North Eastern Region**

This north eastern region comprises the Sylhet district, eastern parts of Dhaka and north western parts of Chittagong division. The temperature becomes very low in this region during the winter season.

This region gets scanty of rainfall. The major crops of this region are rice, jute, tea, pine apple, oilseeds and different types of vegetables.

**Southern Region**

The southern and south eastern districts and their parts are included in this southern region. The whole Barisal division, the southern areas of Khulna and Chittagong division, an some southern part of Dhaka division are included in southern region of Bangladesh. The difference of temperature between winter and summer seasons is comparatively lower in this region. As the areas is nearer to the ocean, the relative humidity of atmospheric air is comparatively higher in this region. The rainfall is also higher. The main crops and fruits of this region are Rice, Pulses, Coconut, Betel leaf, Betel nut, Banana and Onion, Chili and Potato.
Exercise

Multiple Choice Questions

1. What is the type of climate prevailing in Bangladesh?
   a. Extreme climate    b. Tropical
   c. Mediterranean      d. Temperate

2. Rainfall is higher in Bangladesh in -
   i. North-eastern region
   ii. North western region
   iii. Southern region

Which one is correct?
   a. i and ii  b. ii and iii
   c. i and iii  d. i, ii and iii

Read the paragraph below and give answers to questions 3 and 4.
Sabina Begum was walking along the village road in the late evening. Suddenly stormy air and thunder started and she took shelter at a nearby place. Then extensive hail storm started in the area.

3. The season described in the paragraph is-
   i. Rabi
   ii. Kharif – 1
   iii. Kharif – 2

Which one is correct?
   a. i  b. ii
   c. iii  d. ii and iii

4. What are the crops which grow in the season described in the above paragraph?
   a. Cauliflower, cabbage and country bean
   b. Red amarnth, eggplant and okra
   c. Indian spinach, okra and sweet gourd
   d. Tomato, radish and carrot
Creative Questions

Mr. Jabeed, an agriculturist was discussing the weather and crops in detail with local farmers at his village in Chandpur. He told that the major characteristics of the climate of Bangladesh are the sufficient rainfall, medium winter and humid summer though there are some differences according to the regions. Different types of crops grow in different region well due to the difference in agricultural climate. Thus he advised the farmer to produce crops considering the aspects of agricultural climate.

a. What is meant by climate?

b. Explain the statement- “Different types of crops grow well in regions due to the difference in agricultural weather”.

c. What probable type of crops agriculturist Mr. Jabeed advised the farmers of Chandpur to grow in the Kharif -1 season? Why?

d. Explain the feasibility of cultivating wheat in Chandpur.
Chapter Two

Soil

The Concept of Soil
Soil usually denotes the soft surface layer of the earth crust. According to the soil scientists, soil may be defined as the soft surface layer to the earth where plants grow and from which plants absorb inorganic nutrient elements. Soil is composed of various types of organic matter, inorganic, water and air.

Composition of Soil
The soil as we see it now was not same originally. It took so many years to attain this form, the earth was created from a gaseous material splinted from the sun. This gaseous materials become gradually cool while moving around the sun and big size rocks was formed on the surface of the earth. These rocks are named according to their characteristics as igneous rocks, sedimentary rock and metamorphic rocks. Due to long actions of temperature, cold, snow fall, air flow, chemical processes, and by the action of natural forces, the rocks have been disintegrated and gradually converted to a soil material. Later on, the soil has become suitable for agricultural production after mixing with plant and animal decay materials; So, soil is heterogeneous mixture of finely weathered rocks, minerals, organic matter with water and air.

Components of Soil formation.
The soil mainly composed of the following components
1. Mineral or Inorganic matter
2. Organic matter
3. Water
4. Air

1. Mineral or Inorganic Matter
The mineral matters in soil have been formed as a result of intensive weathering of parent rocks caused by direct weathering action of natural forces like temperature, rainfall, air flow, snowfall, etc. for a longer duration of time, the sand particles, clay particles, and silt particles are known as mineral matters The mineral matters thus obtained were mixed at various proportions to form different soil texture.

Different textured soils are suitable for growing different type of crops. Different types
of soil textures are found to be suitable for different types of crop. The mineral particles of soil are clustered to form compound granules, known as soil structure. These granules make the soil porous and allow of water and air to move within it. Granulated and crumb structured soils are very suitable for agricultural production. Soil usually consists of 45 percent mineral matters.

2. Organic Matter
The matters produced as a result of rotting of plant and animal residues in soil are known as organic matter. The process of soil formation is completed with the mixing of organic matter with soil particles. Organic matter improves the physical environment of a soil. For example a soil become light, when organic matter is mixed with an originally heavy clay soil and the soil structure development is enhanced. Organic matter is known as the life of a soil. Because the soil micro-organisms become active in presence of organic matter in the soil. As a result of the decomposition of organic matter plant nutrients like carbon, nitrogen, phosphorus, sulphur, calcium etc. become available for plant's absorptions. In addition an organic complex material namely humus is formed which is most important for soil fertility. Organic matter increases the water holding capacity of soil, soil usually contains 5 percent organic matter.

3. Water
Water is an important component of soil. Water contained in soil makes the plant nutrient elements soluble and keeps the soil moistened. As a result plant absorb these nutrient elements through its root hairs. The main sources of water in the soil are the rain water and irrigation water. Water remains in soil in the inter particles spaces. Usually the moisture content of the soil is 25 percent.

Air
Air is an important component of soil. Air exists between inter particles spaces of the soil. Living organisms for their respiration utilize the oxygen present in the soil air. Till age of soil through ploughing and spading increases flow of air in soil. The composition of air in soil is 25 percent.
Varieties of Potato

Potato has got many local and foreign varieties, such as

**Improved Varieties**

- BARI Alu -1 (Heera)
- BARI Alu -4 (Alisa)
- BARI Alu- 7 (Diamant)
- BARI Alu-8 (Cardinal)
- BARI Alu- 11 (Chamak)
- BARI Alu- 12 (Dheera)
- BARI Alu- 13 (Granola)
- BARI Alu-15 (Binella)

**True Potato seeds (TPS)**

- BARI TPS-1
- BARI TPS-2

True potato seeds (TPS) are produced for multiplication for BARI TPS-1 and BARI TPS- 2. In previous days potato were cultivated from tuber seeds. But now a days due to use to true potato seeds. The production of potato has been increased.

**Sowing Time**

Potato is winter crop. Full October month (mid Aswin to mid Agrahayan) is suitable for sowing potato seeds. For early harvest potato is also sown during mid August to mid September (Bhadra) But there is risk of crop damage due to heavy shower.

**Land Preparation**

Soft and will pulverized soils are requited for potato cultivation. There should not be any lump of soil in potato field. The lump, if any, should be broken with ladder and hammer. The land should be deeply ploughed for 4-5 times. The land should be made plain as for as possible.

**Application of Fertilizers**

Sufficient fertilizers should be applied to potato cultivation. Dose of fertilizer per hectare necessary is given here under.
<table>
<thead>
<tr>
<th>Name of fertilizer</th>
<th>Requirement of fertilizer/hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow-dung</td>
<td>8-10 ton</td>
</tr>
<tr>
<td>Urea</td>
<td>220-250 kg</td>
</tr>
<tr>
<td>T.S.P</td>
<td>120-150 kg</td>
</tr>
<tr>
<td>M.P</td>
<td>220-250 kg</td>
</tr>
<tr>
<td>Gypsum</td>
<td>100-120 kg</td>
</tr>
<tr>
<td>Zinc Sulphate</td>
<td>8-10 kg</td>
</tr>
<tr>
<td>Magnesium Sulphate (for acidic sandy soil)</td>
<td>80-100 kg</td>
</tr>
<tr>
<td>Boron (for sandy texture soil)</td>
<td>8-10 kg</td>
</tr>
</tbody>
</table>

**Application of Fertilizers Method**

Total quantities of cow dung Triple Super Phosphate (TSP), Muriate of Potash (MP), Gypsum Zinc Sulphate (as per requirement) and leaf the quantity of urea mixed with the surface soil at the time of land preparation. The rest amount should be applied after 30-35 days of seed planting that is at the time of second earthing up operation. For acidic sandy soils 80-100kg per hectare should be applied. Application of amount of 8-10 kg boron per hectare produces very good potato crop when it is applied in sandy nature soil.

**Selection of Seed and Seed Requirement**

Whole potato can be used as seed or eyes of potatoes can be cut and used as seeds. But whole seed is more dependable. The cut seeds can be affected by germs and can be spoiled. Besides this, the full seed gives higher yield than that of cut seed.

The requirement of seeds is determined by the size of seed and distance of sowing. Per hectare seed requirement is between 1 ton to 1.5 ton.

**Sowing Method**

Potato seeds are generally sown in lines. The distance between lines depends on fertility of soil, irritation facilities and varieties. Line to line distance should be 60cms and in lines seeds should be sown at a distance of 25cms. After well preparation of the land small canal are made from one end to another of the field by pulling plough at a required distance. Each canal should be 10- 12 cm. deep. Seeds should be sown in
each canal at a distance of 20 cm. and then covered with soils. If moisture contents in
the soils are low then the seeds are to be sown a bit deeply. Distance for line to line
and seed to seed for cut seed potato are 45 cm. x 15 cm. respectively.

**Seed Treatment**

Seed must be treated before sowing. The improved certified seeds do not require
treatment. The seeds of farmers can be treated before sowing by submerging the seeds
in a solution of mercuric chloride for 1-2 hours when germs of seed coats are
destroyed. The mixture is prepared by mixing 1 gram. with every litre of water.

**Intercultural Operations**

**Irrigation:** First irrigation should be given within 20-25 days after seed planting
during the emergence of stolen). The second irrigation should be given with 40/45
days and the third irrigation should be given within 60-65 days after seed planting.
Irrigation should be given at an interval of 4-10 day to get a higher yield of potato at
an interval of 8-10 day to get a higher yield of potato in the northern region of
Bangladesh.

**Weeding**

When the plants attain a bight of 15 cms. the soils in between lines are to be loosened
by spade or weeder. Then these loose soils are to be pulled and given to the bottoms
parts of the plants. When soils are dried after every irrigation, soils are to be loosened
with spade.

**Other Cultural Operations**

**Late Blight Diseases of Potato**

The late blight disease of potato is caused by are fungal pathogen namely
phytophthora infestans. At first small wet lesions are produced on the leaf twig and
the stem. The lesion become gradually bigger and cover the whole leaves twigs and
part of the stem. When the relative humidity of the atmospheric air is higher then the
disease spreads very rapidly to the whole of the field within 2-3 days. The causal
fungal may be seen white powdery material on the lower surface of the leaf. Some rest
of burning smell may be felt surrounding the affected field. The affected field shows
alike bum plant materials lying on soil surface.

**Remedies :**

1. Disease free seeds should be used for is cultivation
2. Irrigation may be stopped as far as possible in the disease affected potato field.
3. Ridomil (0.2%) Dithane M-45 (0.2%) etc. fungicides should be sprayed at the approved rates at an interval of 10-12 days at the very beginning of the exposing symptoms of the diseases.

**Controlling Early Blight Discuss of Potato**

The early blight disease of potato is caused by an pathogenic fungal organism whose name is alternaria solani. At first small conical brown colour damp spots are product on the lower surface of the potato leaves. Blackish circular ring like light brown boundary spots are also seen along the infected spots areas. The spots on the leaf petiole and on the stem seems slightly elongated. The other major consequence to this disease are yellowing of the leaves and the plants, shedding of leaves and premature death of the plant.

**Remedial Measures**

1. Application of balanced fertilizer and timely appropriate irrigation schedule must be ensured.

2. Rovral fungicide at the rate of 2 grams per litre of water should be applied at the initial stage of disease infestation at an interval of 7 to 10 days. The fungicide like Dithane M-45 may also be applied at the same rates and following the same produce.

3. The early maturing varieties of potato may be cultivated.

**Potato Stem and Tuber Rot Disease**

The potato stem and tuber rot disease is known to be caused by a pathogenic fungas namely Schlerotium rolfsii. The base of potato plant stem is encircled by a brown banded spots due to the infection by this disease, The plant show curling symptoms specially the lower leaves become yellow due to this disease. While reticular fungal spores may be seen on the surface of soil around the base of the diseased plant after some day schlerotia or fungal fruiting bodies (nodules) are farmed which shows like mustard seeds. Water is exuted from the potato plant and rottening starts. Gradually the potatos are damaged due to rottening of the down stem base and the tubers.

**Remedial Measures**

1. The infected plant should be uprooted with the surrounding soil and to be removed from the field.

2. The soils of the land of potato plot should be ploughed deeply.

3. Well decomposed organic matter should be used in potato fields
Cut Worn Potato

The larvae of potato cut worm is very strong 40 to 50 millimetre in length. The colour of the upper surface is blackish brown, the sides have black stripes and its colour is grayish green, the body is soft and oily. The young barva of the cut worm cut the potato seedling plant at the base of the stem. It also make holes on the potato tuber and damage the potato crop field. The larvae of cut worm remain hidden beneath the surface soil at day time. The cut plant of potato are usually seen to remain at the side of the cut plant.

Remedial Measures

1. If the infestation of potato cut worm in not so high, than the larvae may be physically damaged identifying its presence near the cut plant and finding it by up turning the soil.

2. If the infestation seen to be very high, than insecticides should be applied. Chloropyrophos (Dursban) 20 EC may be sprayed at the rate of 5 millimetre per litre of water waiting the soil and stem base of the potato plant. The spray should be given 30-40 days potato tuber planting.

Potato Wire Worm

The moth of the potato wire worm in small the wings are narrow, the colour being grey brown having very small having feather like materials. The fall grown larvae is whitish or light pinkish in colour. Its length is 15 to 20 millimetre, the worm dig holes within the tuber and damage making it undoable. The potato tubers stored in the farmers homesteads in Bangladesh are greatly damaged by its potato wire worm.

Remedial Measures

1. The potato tubers stored at the homestead level should be uniformly covered by dry sands, wood ash, rice husks are sawmill dusts (0.5 centimetre layer over the potato tubers)

2. Before storing the potato tubers, the wire worm infected tubers should be, identified and removed.

Harvesting Potato Crop

The potato crop become ready for harvested after 3 to 4 months of planting. It is to be understood that it the leaves of potato plant starts getting aging yellow colour, it is becoming time for crop harvest. But the crop is better to harvest when the whole plants are getting dry after yellowing. The potato should be harvested in a manner that
the tubers do not get any physical cut wound or damage. The tubers with cut damage get rotten rapidly.

**Potato Storage**

The best place for potato storage is the cold storage system. However, it is required to store large quantities of tubers at the farmers homestead locally during the peak harvest period. For these reasons and situations careful attention must be given to certain important points at the time of local potato tuber storing. As a result potato may be successfully stored for a period to 5 to 6 months at the homestead and maximum economic benefit may be obtained selling it 3 to 4 months after harvest points need careful consideration while potato tubers are required to be stored in the homestead, the important points are:

- It will not be a right decision to harvest potato in cloudy weather or at a rainy day. Potato tubers should be homestead at the morning shift.

- The potato tubers should be harvested after getting its full maturity, the Halm killing (drying to potato plant in the field) should be done in the field before 7 to 10 days at harvest by culling its plant at the base, above soil surface.

- Careful attention should be given so that the potato tubers do not get any physical infusing through plough are spading cuts.

- After harvest of the potato tubers it in better to use gunny bag container for its transport to house from the field.

- It is usually wise to use bowls or buskets make of plastic while tilling the gunny bags by potato tubers. It bamboo buskets are used for the purpose, than the inside of the buskets should be layered by gunny bag pieces sewing it properly.

- The potato tubers must be transported to house as soon as it is harvested from the field. If it is required to keep the harvested tubers in the field of some time, than the let should be covered by light cloth or stores spreading tubers in a thin layer in shaded cool place.

- Bringing it to home the potato should be kept in dry cool should place after clearing it thoroughly. Careful attention should be given at the time of pouring tubers form the gunny to the home floor. It is not wise to pour tubers forcibly or from a greater height.
Sowing Time
Mustard is a winter crop in Bangladesh. It can be cultivated from mid-October to November.

Land Preparation
Land for sowing mustard should be so finely prepared that the seeds can easily germinate. The selected land should be pulverized by 5-6 ploughing and laddering. The big lumps of the mustard field should be broken to make it plain so as to avoid water-logged condition in parts of the land. There should be drain so that excess water can out.

Application of Fertilizers
The following fertilizers are to be applied to the mustard field. Variety-wise fertilizer dose are given in the table.

<table>
<thead>
<tr>
<th>Requirement of fertilizer/decimal (40 sq. metre)</th>
</tr>
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<tr>
<td>Name of fertilizer</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Cow dung</td>
</tr>
<tr>
<td>Urea</td>
</tr>
<tr>
<td>T.S.P (Triple Super Phosphate)</td>
</tr>
<tr>
<td>MP (Muriate of Potash)</td>
</tr>
<tr>
<td>Gypsum</td>
</tr>
<tr>
<td>Zinc Sulphate</td>
</tr>
</tbody>
</table>

Before final ploughing, half of urea and all of other fertilizers are to be applied and mixed well with soils. The rest of urea is to be applied as top-dressing during flowering time. During top-dressing care must be taken so that urea is not applied when leaves are wet. That is why urea is to be applied at 10-11 am when the leaves are sun-dried. If in the previous crop zinc sulphate was applied then there is no need of applying Zinc fertilizer to mustard crop.

Deficiency symptoms of boron have been revealed in Dinajpur, Rangpur and Jamalpur.
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Deficiency symptoms of boron have been revealed in Dinajpur, Rangpur and Jamalpur.
region. In these areas Boric acid at the rate of 16-24 gm per decimal should be applied before final ploughing.

**Seed Rate:**

Seed rates of different varieties of Mustard are given below.

<table>
<thead>
<tr>
<th>Name of variety</th>
<th>Seed rate /decimal (40 sq. metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tori-7 and Kalyania</td>
<td>32 gm.</td>
</tr>
<tr>
<td>Sonali Sarisha and Sampad</td>
<td>36 gm.</td>
</tr>
<tr>
<td>Rai Sarisha and Daulat</td>
<td>28 gm.</td>
</tr>
</tbody>
</table>

**Sowing Method**

Generally mustard is sown by broadcasting. Seeds are sown during final ploughing and covered with soil by laddering. Mustard can be sown in line also. In this method line to line distance should be 25-30 cm. and seed to seed distance should be 4-5 cm. The seeds are to be sown in 2-4 cm. deep. The seeds will germinate within 2-3 days if the soils have moisture.

**Intercultural Operation**

The intercultural operations for mustard should be done as follows:

**Irrigation**

If moisture content of the soil of mustard field is sufficient, then there is not need of any irrigation. Depending on soil moisture 2-3 irrigation will give good yield. First irrigation is to be given after 20-25 days of sowing and the second one is to be done during fruiting state. If the soil is dry before sowing then land preparation is to be done after a light irrigation. Mustard can not withstand waterlogged condition. So irrigation water should not be allowed to stand for more than 5-6 hours.

**Thinning of Plants**

If the plants are densely populated then thinning has to be done. In case of germination is hampered in any part of the field, seed should again be sown. Thinning work should done within 10-15 days of germination.
Weed Control
As soon as weeds are seen in the mustard field. Those are to be weeded out. Weeds can be controlled during thinning.

Disease Control
Mustard is frequently attacked by alternaria disease. Black spots appear on the affected leaves. In order to prevent this disease, seeds are to be treated with fungicide called captan. For treating 1 kg. of seeds 2.5 gm. of captan is required, or in the field, 20 gms of fungicide Dithane M-45 is to be mixed with 10 litres of water and have to be sprayed after every 10-15.

Control of Insect Pests
Aphids are most harmful insect pest. All parts of the plant are affected by this insect. Outbreak of this insect pest takes place when the plant is in flowering stage.

To prevent the attack of aphids, Malathion-57 should be sprayed at the rate of 2 cc of insecticide mixed with one litre of water. In order to save the beneficial insect like honey bee, insecticide is to be sprayed during evening.

Control of Parasites
A parasite called 'Orobanch' grows in the root of mustard plant. When "Orobanchy" is seen in mustard field, it should be uprooted.

Crop Harvesting
When 80% mustard fruits become, straw-coloured and leaves of the plants become yellow, then it is the proper time for harvesting, it is good to harvest the crop, moistened with dew, in the cold weather of the morning.

The crop can be collected by uprooting the plants or by cutting with sickles. But uprooting is the best method.

Threshing and Drying
After harvesting the crop should be sun-dried for 3-4 days and then to be threshed. After threshing the seeds are to be cleaned by winnowing and sun-dried for 3-4 days. Some immature seeds may be there. These immature seeds are to be graded out.

Yield
Production per decimal (40 square metre) are Tori-7.5kg Kalyania-7 kg. Rai Sarisha-4 kg. Sonali Sarisha-9 kg. and Daulat-6 kg.

Preservation
The seeds can be kept for 1-2 years when preserved in clean dry pot.
Cultivation of Pulse Lentil

Lentil is the main source of vegetable protein. The importance of lentil as food is revealed by the words Dal-bhat' (pulse-rice). This pulse is also called the meat of poor. In our country lentil has been cultivated from ancient time in Rajshahi, Jessore, Pabna and Faridpur, districts.

Selection of Land

Lentil is somewhat drought tolerant crop. Its yield is good in rain dependent areas. Loamy soils where water does not stand are suitable for lentil cultivation.

Variety

Utafal (L-5) Mukdia- 15 Jamalpur-2 are the main approved varieties of lentil.

Teme of Cultivation

The month of kartik (Mid Oct. - Mid Nov) is the proper teme for sowing lentil.

Land Preparation

Land for lentil cultivation is prepared generally by 2-3 cross ploughing and laddering. Drains are to be made to take out water accumulates form excessive showers.

Application of Fertilizers

Requirements of fertilizers (40 sq. metre) per decimal are shown below. All fertilizers should be evenly spread to the land before final ploughing.

<table>
<thead>
<tr>
<th>Name of Fertilizer</th>
<th>Dose per decimal of land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow dung</td>
<td>8 kg.</td>
</tr>
<tr>
<td>Urea</td>
<td>180 gms.</td>
</tr>
<tr>
<td>T.S.P (Triple Super Phosphate)</td>
<td>460 gms.</td>
</tr>
<tr>
<td>MP (Muriate of Potash)</td>
<td>140 gms.</td>
</tr>
<tr>
<td>Gypsum</td>
<td>340 gms.</td>
</tr>
<tr>
<td>Zinc fertilizers</td>
<td>45 gms.</td>
</tr>
</tbody>
</table>

Seed rate

Seed rate of lentil per decimal (40 square metre ) is 120-160 gms.
Sowing Method
After the land is well-ploughed, the seeds are to be evenly broadcasted and then be covered with soil by laddering. Seeds should be sown in lime so that weeding becomes easier. Line to line distance should be 20 cms. Seeds should be sown 2.5-3 cm deep.

Intercultural Operations
The lentil field needs different intercultural operations. These are as follows:

Weeding
Weeds should not be allowed to grow lentil field. Weeding should be done within 30-40 days sowing of seeds.

Irrigation
Generally in our country irrigation does not require in cultivating lentil pulse. But if the soils do not have enough moisture then the land should be lightly irrigated before sowing seeds.

Control of Insect Pests
Many types of pests can attack the lentil field. Out of these, aphids are most harmful. This insect-past attacks the leaves, buds, flowers and pods and sucks juice. Aphid spread its generation very rapidly. So at the beginning of attack malation 0.05% should be sprayed after mixing with water.

Control of Disease
There may be outbreak of several diseases in lentil crop. Out of these diseases like wilting, stem rot, root rot etc. are notable.

These should be controlled by following right crop, rotation in cultivation. The seeds should be treated with vitavex-200 at the rate of 2 gm per 1 kg seed before sowing.

Corp Harvesting, Threshing and Preservation
The crop is to be cut when the pods of lentil become yellow or brown colour. After crop cutting these are to be sun-dried well for 3-4 days and threshed. After threshing, winnowing and cleaning are to be done. Lastly preservation should be done in clean tin or polybag.

Yield
Production of lentil is 1.5-2 metre ton per hectare and 35-50 kg per decimal (40 sq. metre).
Practical

Subject-1: Preparation of seed-bed for paddy

Materials :

Steps of Work

1. Go to the reselected farmers field with the teacher of the agriculture subject.
2. Clearly observe whether the land is high, wander of sun light and air or not.
3. Depending on available land measure on area of 40 sq. metre (10 metre x 4 metre)
4. Mark the area by putting 4 sticks at 4 corners.
5. Open the land by spadding 2-3 times and supply required amount of water to the land and pond it. Wait for one week.
6. After one week apply 80 kg. cow-dung and plough for 2-3 times and prepare the land thorough puddling.
7. Prepare drain of size 10 cm deep and 25 breadth, along the boundary of the land. Throw the soils from the drain towards inside rather than throwing outside.
8. Keeping aside 25 for drain measure 1.5 metres from inner side of breadth and make it. In the some inner measure 1.5 metre from opposite direction and mark it.
9. Afterwards make so can wide drain having depth of 10 cm. keep the soils on the both side of the drain.
10. Now see one seed bed having two piece have been prepared, the length and breadth of each piece are 9.5 metre and 1.5 metre respectively.
11. On this seed bed broadcast 3 kg. of sprouted seeds.
12. Finally write down each step of work in your practical note book.

Subject-2: Jute Rotting

Materials
1. Jute plants for rotting 2. Stick and rope
Steps of Work

1. Select waterbody having slight current and clean water.
2. Take a rectangular area from the waterbody and pot 4 sticks at 4 corners. Tie a beam horizontally 60 cms beneath the water.
3. Now arrange a layer by putting the bottoms and tops of the bundles of the defoliated jute plants side by side on the beam of the pole and tie the layer with the pole so that current of water can not take it away,
4. Arrange more such layers
5. Immerse the layers so that 30cm. of water remains above the layer of the 'jag'
6. Spread straw or water hyacinth on the jag and press by putting weight.
7. You will see that rotting will be complete within 12-15 days.
8. Write down the steps of works in your practical note book.

Subject-3: Cultivation of Transplanted Aman

Materials


Steps of work

1. Take one piece of rice field one decimal in size during transplanted Aman season.
2. Cultivate the land well with plough or spade.
3. Puddle the soil with rain or irrigation water.
5. Collect rice seedling of BRI- Shail from an area of 2 sq. metre of a seedbed.
6. Supply water to the land so as to make a thin layer and make line with the help of a rope. Then plant three seedlings in one hole. Take care so that line to line distance is 25 cms and hole to hole distance is 20 cms.
7. Arrange for irrigation as per requirement.
8. Control the weeds.
9. Control insect pests as per instruction of the Agriculture teachers. Record the type of insect which has attacked the field.
10. If symptoms of disease are revealed take record. Arrange control measures.

11. Apply 100 gms. of urea when the seedlings are of 2 weeks. After 45 days of this apply 125 gm. of urea and during dough stage apply 125 gms of urea.

12. If all things are correct and right, paddy will ripe during Agrahayan month (mid Nov. to mid dec.)

13. As soon as the colour of rice becomes golden cut it with sickle and tie the bundles and bring home.

14. Then after threshing and winnowing measure your rice.

15. Write down works of every step in your practical note book and describe the result.

**Exercise**

**Multiple Choice Questions**

1. Which are the pests of rice?
   a. Rice hispa, gall midge, rice stem borer
   b. Rice stem borer, mole cricket, weevil
   c. Rice hispa, brown plant hopper, aphid
   d. Rice hispa, brown plant hopper, green leaf hopper

2. Responsible for rice tungu disease-
   a. Virus
   b. Brown plant hopper
   c. Green leaf hopper

Which one is correct?
   a. i  
   b. ii
   c. iii
   d. i and iii
Read the paragraph below and give answers to questions 3 and 4.

The fertilizer doses for rice are given in the chart:

<table>
<thead>
<tr>
<th>Rice varieties</th>
<th>Quantities</th>
<th>Decimal (40 square metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urea</td>
<td>T S P</td>
</tr>
<tr>
<td>Transplant Aman</td>
<td>600 gram</td>
<td>360 gram</td>
</tr>
</tbody>
</table>

All the fertilizer other than urea should be spread and mixed with the soil at the time of last ploughing of the land. The urea fertilizer should be applied in three splits as top dressing. The first split consisting half of the recommended dose should be applied two weeks after transplanting. The rest of the urea fertilizer should be divided into two equal splits. One part should be applied after 15 days of applying the first split and the rest portion should be applied at the booting stage.

3. Urea fertilizer is applied in three splits. Because: –
   i. Urea is not available at a time.
   ii. Loss of fertilizer is less in this method.
   iii. The fertilizer requirement of rice is different at different growth stages.

Which one is correct?

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

4. How much urea is to be applied in the last split per decimal?
   - a. 150 gram
   - b. 125 gram
   - c. 100 gram
   - d. 75 gram
Creative Questions

The fertilizer doses per hectare recommended for potato is as below:

<table>
<thead>
<tr>
<th>Name of the fertilizer</th>
<th>Quantities of fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>220-250 kg</td>
</tr>
<tr>
<td>T S P</td>
<td>120-150 kg</td>
</tr>
<tr>
<td>M P</td>
<td>220-250 kg</td>
</tr>
<tr>
<td>Cow dung</td>
<td>8-10 ton</td>
</tr>
</tbody>
</table>

a. Mention the optimum time of planting potato.

b. State the importance of M P fertilizer for potato cultivation.

c. Prepare a fertilizer dose chart using the above table of fertilizer doses for potato production in 15 decimal land.

d. Potato cultivation can play a very important role in meeting the food deficiency in the present context of Bangladesh. Evaluate.
In general, the large areas of land covered by trees are known as forests. Though plants of diverse types are found, the forest are usually covered by large trees. Besides trees, different animals, birds and insects are the integral parts of forest, and all, these in combination create the typical environment of the forests.

The forests may be natural or artificial. The forest which has been developed without the direct participation, of men is known as natural forest. The Sundarban, Bhawal and Modhupur Shalban are the typical examples of natural forests. The forests of newly create by planting trees are known as artificial forests.

Forest department created Segun forest of Chittagong, Kaora and Byne forests of coastal are the examples of artificial forests.

**Importance of Forests**

Forest is playing a very important role in the development of human civilization. Forests were the source of food and shelter for man in the ancient period. Still to day the contribution of forest plants in our daily life is great. We can directly measure some of the contributions as well. The examples are, furniture wood, fuel wood, vegetables, fruits and medicinal plants. The economic values of these forest materials can easily calculated too. On the other hand some of the contribution cannot be measured in terms of money. For example:

1. Forests preserve the balance in the natural environment.
2. Forests reduce the erosion of fertile soil increase water storage and increase the flow of river stream.

The importance of forests may be divided into 4 classes on the basic of contributions.

1. Economic importance
2. Environment importance
3. Bio-diversity
4. Recreation.
1. Economic Importance

The importance of forest is extensive in our daily life. The construction timber fuel wood, bamboo, raw materials for industries and medicinal plants are collected from forests. The economic importance of these materials are discussed below.

**Timber Wood**

The role of timber and materials wood in our daily life is very important. Wood is indispensable of construction of house and furniture. Weed is utilized for preparing large number of materials including boats, agricultural implements and its parts and scientific instruments. Millions of people of the country earn their livelihood depending on the employment in the wood works. So wood is playing and important role in solving employment problems and elevation of poverty.

**Fuel Wood**

Majority of inhabitant of Bangladesh use wood materials as fuel for cooking. The present requirement of fuel wood in the country is about 300 million cubic metre. Its price is about Tk. 150 billion according to market price. About 1 million working people are involved in the collection and business of wood materials and thus have become dependent for there livelihood. Considering these things the fuel wood is playing and important role in the economy of the country. The demand for fuel wood is increasing day by day with the increase of population. As a result problem due to scarcity of fuel wood is also increasing. The rural people are burning cowdung and crop products at an increased rate. If cowdung and cropresidues are used as manure for the crop lands. The soil ferility and crop production would increase. The organic matter content of the soils would be maintained on the other hand. So it is possible to contribute more to the national economy by producing and supplying more fuel wood.

**Bamboo**

Bamboos of different types are collected from the forest areas of Bangladesh. Large quantities of Bamboos are also harvested from the rural household bush. Bamboo has extensive use as a raw material for industries. Both green and ripe bamboos are used for construction of house. Million of people are engaged in the bamboo production and utilization activities for their livelihood.

**Raw Materials for Industries**

The major raw materials for industries like paper, rayon, matches, tea packing, hard boards etc. are coming from forests. Forest based wood and bamboo are raw materials for the two largest paper mills of the country.
Khulna Hard board Mill, Chondraghona Royon Mill, Sylhet Pillps and Paper Mill and match factories of the country are basically dependent on the wood supplied from the forests. The supply of raw materials for the small and cottage industries also come from the forest trees. Million of labours technicians and professionals are employed these industries.

**Cottage Industries**

The cottage industries like making furniture and making handicrafts from bamboo and cane have considerable importance in the economy of the country. These handicraft products are also exported to other countries now-a-days. Cottage industries also help increasing employment and simultaneously earning foreign currencies.

**Medicinal Plants**

Medicinal plants are treated as important resource of our country from the ancient time. The major portion of the medicinal plants are collected from the forests. Forest is the source of the popular medicinal plants like Amlaki, Bohera, Haritaki and some others useful plants. The major raw material of Ayurvedic phannaceutical industries are the medicinal plants of the country. The general people of the country are being benefited by getting employment in the industry by taking these types of Ayurvedic medicines.

1. **Miscellaneous Materials**

Large quantities of honey, wax and roof materials like Golpata are collected from the Sundarban. The nearby, inhabitants collects fruits and vegetables from the forest to meet up their food requirement. These forests also help in solving the nutritional problem of man.

2. **Environmental Importance**

The forest plays a very great role in preserving the balance of the natural environment. We know that a country should have 25 percent of the area covered under forest, for balancing the enviroment. The main points of the mechanism of balancing environment by forest are briefly discussed below;

1. The forest trees assimilate the excess carbondioxide and oxygen in the atmospheric air.
2. Plants through transpiration increase moisture percentage or humidity of the atmospheric air. These moisture helps in making rainfall.

3. Reduce the extremeties of the weather conditions.

4. Control the speed of wind.

5. Protects the soil from erosion and land slip. Increases the under ground water reserve. Control the flow of river water.

6. Increase fertility of soils.

7. Gives shelter to wild animals, birds and insects and also supplies food.

8. Protects the habitats from natural disasters like tornado and flood.

3. Biodiversity

Biodiversity may be defined as the presence and distribution of various forms of plant, animal and microorganisms in a certain ecological niche. Many crops which are now commercially cultivated were known to be originally collected from wild species grown in the forest. These crop species have been developed and made adapted suitably for cultivation in fields through scientific research. Likewise, more plant species may be needed in future which might be collected from the forest environments. So it is very important and we should carefully conserve the biodiversity of the forest environments. So it is very necessary to concern natural forests to protects the biodiversity.

4. Recreation

The forest environments plays vital role in the recreation of busy social life. Open and pure air, green plants, diverse wild animal, flowing river and fountain etc. of the forest are the major attractive components of human recreation. It attributes long term influence on human life. For these reasons recreation in natural forest environment is something different, diverse and in believable. Well designed plantation areas for recreation activities has not yet been fully developed in Bangladesh. The national parks have been established at Bhawal and Modhupur near Dhaka. Peoples rush to these recreational facilities in the Bhawal National Park during winter season. Modhupur National Park and Dhaka Botanical Garden are also important as recreational centres. Several other forest based recreational centre have been established at different regions of the country. Himchari and Teknaf of Cox's bazar, Jointia of Sylhet, Ramsagar of Dinajpur and Hiron point of Sundarban are the major regional centres. These forest based recreational centre may be modernized by, providing more facilities.
**Distribution of Forest**

The forest land area of Bangladesh is about 24.6 lacs hectare comprising 17% of the total land area. But the forest areas are not well distributed throughout the country. The major forests are situated in the eastern, southeastern and south western regions of the country. Forest is scarce in the large areas of northern and north western regions. The forest areas of the country are illustrated in the following map. The forests of Bangladesh and its distribution may be divided into three classes according to land type and physiography. These are—

1. **Hill forest**
2. **Plain land forest**
3. **Mangrove or tidal forest**

**1. Hill Forest**

More than half of forest areas of Bangladesh are distributed only in the hilly areas. Chittagong, Chittagong hill-tracts, Cox's bazar and Sylhet are the major places of hill forests. The total area of hill forest land is about 13.16 lac. The major trees of the hill forest are Shegun, Garjan, Chapalish, Koroi, Telsur, Gamar, Jarul, and Champa.

Besides, huge quantities of bamboo are available in these forests. The important wild animals of the hill forest areas include elephant, deer, tiger, monkey, bear, wild fowl, and others.

<table>
<thead>
<tr>
<th>Type of Forest</th>
<th>Natural forest</th>
<th>Created forest</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hill forest</td>
<td>11.06</td>
<td>2.10</td>
<td>13.16</td>
</tr>
<tr>
<td>Coastal saline soil forest</td>
<td>6.16</td>
<td>1.34</td>
<td>7.50</td>
</tr>
<tr>
<td>Level land forest</td>
<td>0.87</td>
<td>0.36</td>
<td>1.23</td>
</tr>
<tr>
<td>Rural plantations forests</td>
<td>-</td>
<td>2.70</td>
<td>2.70</td>
</tr>
</tbody>
</table>

**2. Plain land Forest**

Mainly the Shalban of greater Dhaka, Mymensingh, Tangail, Rangpur, Dinajpur, Rajshahi, and Comilla is known as plainland forest. Total area of the plain land forest is about 1.231 lac hectares. The major forest tree species is Shal, Gajarj. Other trees are Jarul, Koroi, Babla. These forests are situated near human habitations. As a result
peoples heavily cut forest trees to meet up their daily life and business needs. Many pieces of forest lands have been illegally cleared and houses were installed. The forest lands are being covered to crop land. As it result the natural forest are becoming tree less day by day. However, presently the deforested areas are being replanted with the participation of local peoples. Such participatory plantation include tree species like Akashmani, Eucalyptus and Arjun.

3. Mangrove Forest or Tidal Forest

The natural mangrove forest, or tidal forests are seen in Khulna, Satkhira and Bagerhat. This famous forest is known as SUNDARBON. Sundarban is the largest and the most resourceful mangrove forest of the world. The forest is daily flooded by tidal water as it lies near to the Bay of Bengal. The types and nature of the tree species of the mangrove tidal forest is different from other common trees of the country. SUNDARI is the major free of the forest.

The name Sundarban has been given to this forest after the name of the Sundari, tree. Among others the trees like Gaoa, Goran Pashur, Kaora, Bain, and Kakra are important. 'Golpata' is one of the important plant species of Sundarban. The golpata leaf is used in making roof of rural' katcha houses. The honey produced in Sundarban in very nutritious and tasty. The world famous 'Royal Bengal Tiger' lives this Sundarban forest. Other animals of this forest are deer, wild pig monkey. Python, crocodile and various birds. Besides Sumdarban, the newly raised coastal charlands are being continuously planted. The main tree species of the man made coastal plantation is Kaora. Bain and Jhao trees are also planted in some areas.
FOREST REGION OF BANGLADESH

Plain Land Forest

Plain Land Forest

Mangrove Forest

Mountain Forest

BAY OF BENGAL

Scale:

0 25 25 mile

0 25 25 km

North
The amount of wood-stock in the forest

Surveys have been carried out to determine the amount of wood stock in different forests of Bangladesh. The trees of forests that are stocked are called growing stock. The forest management planning is developed on the basis of how much growing stock are there in the forests. The amount of wood that has been measured through different survey is as follows:

The wood stock in different forests are 88.91 million cubic metre in amount.

<table>
<thead>
<tr>
<th>Kind of forest</th>
<th>Amount of wood stock (in million cubic metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hilly forest</td>
<td>20.71</td>
</tr>
<tr>
<td>Coastal saline water forest</td>
<td>12.32</td>
</tr>
<tr>
<td>Level land forest</td>
<td>1.20</td>
</tr>
<tr>
<td>Rural forest</td>
<td>54.68</td>
</tr>
<tr>
<td>Total</td>
<td>88.91</td>
</tr>
</tbody>
</table>

Forest Act and Wild Life Act

There are two specific acts for the management of forest resources and wild animals. For managing wild life one of this acts is Bangladesh forest act 1927 "Amended 1990" and the other is 'Wild Life Conservation act 1974.

Forest Act

Illegal intrusion, capturing government forest land and construction of house or cultivating lands are punishable crimes. Cutting trees without permission from appropriate authorities, removal and transport are also punishable crimes. The persons doing such crimes may be given minimum one year imprisonment along with a fine of Taka Five Thousand. The accused may be given two years imprisonment and a fine of Taka Fifty Thousand as the highest punishment. Besides, punishments may also be given to the persons who carries government forest materials without due permission. Such cases are dealt in the court of a first class magistrate.
Wild Life Act

Catching, hunting and killing by posion of wild animals without permission are also punishable crimes. Husbandry of wild animal as pet is also a punishable activity. Imprisonment for minimum 6 months and of Taka Two Thousand may be imposed to the accused such illegal activities. The maximum imprisonment may be up to 2 months. The trial of cases are conducted in the court of the first class magistrates.

Practical

Subject: Introduction to forest

The teacher along with the students will visit the forest (area) nearest their school or the catchment areas where many trees or are planted.

Materials

Note book for field observation, pen, pencil etc.

Steps of works

1. Enlist and describe the ecological characteristics areas.
2. Give a description of tree composition estimated numbers and existence of different types of trees plants herbs, shrubs, climbing, vines etc.
3. Make a list of some important trees and write about the traditional use of the trees.
4. Give a description of birds and animals which you have been observed.
5. Write all these descriptions sequentially in your preactical khata.

Exercise

Multiple Choice Questions

1. What are the main trees of the man made coastal forests?
2. The different artificial forests of Bangladesh are-
   i. Kaora forest of the coastal region
   ii. Shal forest of Comilla
   iii. Teak forest of Chittagong

Which one is correct?
   a. i and ii    b. i and iii
   c. ii and iii  d. i, ii and iii

Read the paragraph below and give answers to questions 3 and 4.

Mr. Wadud, a Forest Officer, one day while visiting Sundarban noticed that some people hunted a deer and carrying it to their own place. He called upon the people and described the bad affects of hunting wild animals and make them understood that these are punishable crimes as per law. The people then asked pardon for their illegal activities and they committed not to do such crimes in future.

3. In which court are the judiciary activities relating wild animal hunting/ killing executed?
   a. First class Magistrate’s court.
   b. Second class Magistrate’s court
   c. District Judge’s court
   d. Special court of the Forest Department

4. Which is the most effective way of increasing public awareness against wild animal/ killing crimes?
   a. Arranging meetings and seminars
   b. Ballot postering
   c. Organizing workshops
   d. Doing propaganda through radio and television
Creative Questions

Mr. Asaduzzaman, an agricultural teacher went on an educational excursion with students of class X to Bouddo Bihar and Shal forest of Moynamati of Comilla district. The students became very happy seeing the natural beauty of the forest. He told them about different resources of forest. But the students could not see any wild animal though they have seen some birds. In the situation they wanted to know from their teacher that why they did not see any wild animal. The teacher then explained the reasons for the situation.

a. What is the type of the forest the student visited?

b. Mention one important difference between the natural forest and artificial forest.

c. Explain the appropriate type of forest you need for excursion and entertainment

d. “The forest based entertainment centers should be limited in order to protect the interest of Biodiversity”. Give comments in favour of the above statement.
Chapter Two

Forest Nursery

The place where forest sapling are produced, cultured and maintained till planting is known as forest nursery. The major objectives of producing sapling or seedling in the nursery are the following:

1. Doing cultural operations easily.
2. Raising seedling according to the requirement of planting.
3. Producing good quality healthy seedling of expected or selected species or varieties.
4. Ensuring production and supply of seedling of different varieties and at different ages as per requirement.
5. Gaining advantages through reducing cost of production, distribution and marketing.

There are seeds which are to be sown within 1-2 days after harvest from the trees. These type of seed can not be stored. So, it is required to sow this seeds in the nursery and may be planted suitably later on. Besides saplings are also produced from plant parts like stem and root in the nursery scientifically.

Nursery Planning

Nursery is essentially required for producing seedling. A good plan is required for establishing a nursery. The important points to be considered while establishing a nursery are mentioned below:

1. Selection of site
2. Measurement of the land area
3. Land development and making boundary protection
4. Nursery design and layout.

1. Selection of Site

Selection of site is of prime importance while establishing nursery. The nursery will be an economically loosing concern if inappropriate site is selected for the purpose.
So, the following points must be considered while selecting a site for a nursery:

1. The land should be such that rain water do not stand and flood water can not reach.
2. Drainage system of the land is perfect.
3. The area is open to sufficient air and sun light.
4. Communication system is good for the transport of seedling and nursery materials.
5. Water is available for irrigation or irrigation system can be developed easily.
6. The soil is of loam texture and fertile.

2. Determining the Land Area.

The total land area required for a nursery depends on the types and number of seedling to be produced per year. The required area for a nursery can be determined considering the following data:

<table>
<thead>
<tr>
<th>Size of Polybag</th>
<th>No. of seedling per square metre</th>
<th>No. of stumps per square metre</th>
</tr>
</thead>
<tbody>
<tr>
<td>15cm X 9cm</td>
<td>225</td>
<td>4cm X 4cm 625</td>
</tr>
<tr>
<td>25cm X 15cm</td>
<td>100</td>
<td>5cm X 5cm 400</td>
</tr>
<tr>
<td>30cm X 25cm</td>
<td>36</td>
<td>10cm X 10cm 200</td>
</tr>
</tbody>
</table>

Polybag made of polythene approved by the Government of Bangladesh mentioning required thickness, composition and colour (mostly black). About an equal area of land required for seedling production is needed in making roads and drains in the nursery. Housing and physical structures need about 10 percent total nursery area.

3. Land Development and Protection Boundary

The land selected for nursery should be cleaned and to be kept always weed free. Large stumps of trees or rocks if present should be removed from the area. Land should be leveled. Earth filling may be made if necessary. However, terracing may be
done in case of establishing nursery in the hilly areas. Protection boundary should be given around the nursery. Such protection may be given by bamboo, brick wall, barbed wire fences or iron wire net. Live hedge can also be established by growing Kata Mehedi plant putting thickly in line.

4. Layout Design Plan

The most important work of establishing nursery is its planning and layout design. The layout design mostly consists of size, shapes and sites of nursery beds, roads, drains, housing and physical facilities. The site for growing various types of seedling should be mentioned in design plan. The whole nursery may be divided into several blocks according to the nature and types of seedling planned to be produced, nursery should also have some specific place for doing day to day miscellaneous works. The usual size of a nursery bed measure 12 metre x 1.2 metres. However, the measurements may slightly vary according to the size and shape of the selected place within the nursery. A space of measuring 45-50 cm may be kept free in between two nursery beds. The width of main and lateral inspection roads should be 3-4 metre and 1-2 metre respectively. The nursery should have one main channel for draining out of excess water. The lateral drains will be connected with the main channel. The lateral drains may be prepared at the side of the inspection roads. Ponds, earthen wells, tubewells should be prepared or dug a channels may be made for supplying irrigation in the nursery. A general layout plan of a nursery is given here.

Methods of Producing Seedling

Seedling may be produced in nurseries mainly in two methods. These are -

1. Production of seedling directly in soil or bed.
2. Production of seedling in polybag or pot.

Preparation of Bed for Producing Seedlings

The selected land should be spaded at a depth of 15-20 cm for production of seedling directly in the soil or bed. The grasses, weeds, stumps, pebbles, etc. should be cleared off from the soil bed. Some loamy soils may be collected from another place and should be mixed with bed soil if the texture of the soil seems to be clay type.

Compost: 200 kg or Cow dung

Fertilizer: 1300 gram. At the ratio of Urea : TSP : MP : 6 : 2:4
Layout Design of Nursing
The surface of the seed bed should be levelled. The size and shape of the beds may be according to the nature of land available for the purpose.

The bed should be raised 10-15 cm above ground by putting soil on it from the space in between two beds. The space between the beds will thus turned to be a channel for draining excess water. If the soils of the channel is not sufficient to raise the seed bed, then some soils may be collected from other places.

The side drain of a seed bed should be connected with the middle drains. The side of the seed bed should be bounded thin bamboo sticks of 35- 40 cm length should be put at the side of the bed. Then bamboo ribs may be bound with the sticks at the height of 10-15 cm in a crosswise pattern. The side of seedbed can also be bounded by wooden plunk or bricks.

**Preparation of Bed in Polybag for Producing Seedlings**

Producing seedling in pots and poly bag, ploughing the soil, of bed is not necessary. The bed should raised 10-15 cm above ground putting soils from the space in between two beds. The side of the bed are bounded by bamboo or bricks as available.

**Materials of Seedling Production in Nursery**

The materials needed for seedling production in the nursery mostly include polybag, seed, soil, fertilizers and inputs needed for preparation of seedbed and intercultural operations. Inputs needed for seed bed preparation and cultural practices include spade, sickle, dao, khurpi, water can, bricks, bamboo, wood plunks, basket, rope, and sprayer machines for applying plant protection chemicals.

**Seeds and Seed Tree**

Good seeds are essentially required for raising quality seedlings in the nursery. Good seed plants are needed to produce good quality seeds. So, it is important to know the characteristics of the good seed plant for collecting good seeds.

The characteristics of the good seed plant are:

1. The plant should be vigorous and strong
2. The plant should be of middle age
3. The plant should have a wider canopy with branches and sub-branches.
4. The plant should be free from disease, devoid of any canker symptom and should have sufficient foliage.
A seed plant having the characteristics as mentioned above is called 'Mother plant' or Model Seed plant. Disease free ripened seeds should be collected from such model seed plants for producing seedling in the nursery. The collected seeds may be fully sun dried and stored. The seeds, which cannot be stored for a long time, should be planted as soon as possible after harvest. The time of seed collection, storage and germination period are mentioned here in a table.

**The time of seed collection, sowing and germination of forest tree.**

<table>
<thead>
<tr>
<th>Name of Species</th>
<th>Time of seed collection</th>
<th>Time of sowing</th>
<th>Germination period species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mehgoni</td>
<td>January-February</td>
<td>March-April</td>
<td>20-30 days</td>
</tr>
<tr>
<td>Garjan</td>
<td>May-June</td>
<td>May-June</td>
<td>10-20 days</td>
</tr>
<tr>
<td>Shegun</td>
<td>November-December</td>
<td>March-April</td>
<td>10-20 days</td>
</tr>
<tr>
<td>Neem</td>
<td>June-July</td>
<td>June-July</td>
<td>7-10 days</td>
</tr>
<tr>
<td>Koroi</td>
<td>January-March</td>
<td>March-May</td>
<td>5-15 days</td>
</tr>
<tr>
<td>Shal</td>
<td>June-July</td>
<td>June-July</td>
<td>4-10 days</td>
</tr>
<tr>
<td>Shishu</td>
<td>October-February</td>
<td>February-March</td>
<td>15-20 days</td>
</tr>
<tr>
<td>Gamar</td>
<td>May-June</td>
<td>May-June</td>
<td>10-20 days</td>
</tr>
</tbody>
</table>

**Seed Collection and Storage**

The seeds of fleshy fruits such as mango, black berry, jack fruit, hog plum, papaya etc. should be collected from ripened fruits. Then the seeds should be planted considering its germination periods. The seeds having shorter germination period should be planted immediately after collection. The examples of such types of plants are Shal, Garjan, Telsur, Bamboo, Chapalish and Jackfruit. The storing of collected seeds till planting is known as seed storage or preservation. Seeds are damaged if these are not rightly stored because of infestation by insect pests and diseases. The seeds also loose its germination capacity. The seeds of Shishu, Mehgoni, Babla, Date palm may be stored in gunny bag after drying and winnowing. But the seeds of Guava, Koroi, Krishna Chura, and other small seeds should be kept in air-tight pots or fully closed bags. Insecticides and fungicides should be used in the seeds when it is needed to store the seeds for a longer period. A name tag having name of the seed, place of collection, name of the collector and date should be kept in each pot or bag.
**PolyBag**

Poly Bag (Made of govt. approved thick polythene)

The usual size of polybags used in the nursery are of the following sizes:

- 15 cm x 10 cm (6 inches x 4 inches)
- 25 cm x 15 cm (10 inches x 6 inches)

Every polybag have one end open and the other end tightly closed. Small holes numbering 8-10 should be mad in the lower part of the polybags of all sizes. Excess water if any within the polybag will come out through the holes.

**Soil**

Sandy loam and loam soils are good for nursery. Sandy loam soil is good for filling in polybag. Generally surface soils of the forests are good for producing seedling in polybag. Forest soils contain decomposed litre on its surface and then these are fertilizer soils. A forest soils are not available, soils may be collected from bushes.

**Soil Treatment**

Soils are required to be disinfected through treatment in many cases, specially when soils are used in germination trays. Soil treatment protects the tiny seedling from diseases. Soil treatment may be done in two ways, such as heat treatment or chemical treatment. Chemical like formalin may be used for soil treatment.

**Preparation of Soil**

The collected soil and composts may be mixed for filling polybag in the ratio 3:1. Triple Super Phosphate (T.S.P) and Muriate of Potash (M.P) should be applied in the
mixture in the ratio of 2:1. The dozes of these fertilizer may be determined as per fertility of the soil. This soil-fertilizer mixture should be kept for 15 days under shade or may be covered by polythene sheet. Then the soil should be crushed and sieved for making it suitable for filling in polybags.

**Filling in Polybags with Soil**

Polybag with holes should be filled in with the soil. The polybag should be in good condition. The polybag should hold by left hand and soil should be put in the polybag slowly by the right hand. The soil within the polybag should be slightly compacted by giving pressure with the help of hand or a round end bamboo peg. Then the polybag should be shaken for 2-3 times holding the upper side of the polybag by hand. Some quantity of soil should be given again and thus the polybag will be completely filled in by soil and ready for seed sowing. The seedling become weak and curved if the polybag is not filled completely with soil-fertilizer mixture.

![Filling in polybags with soil](image)

**Setting the Polybag in the Bed**

The polybags are to be set and arranged in a bed after filling it with soil. Before placing the polybag, the bed should be compacted and leveled by hammering. Then the polybag should be placed keeping it straight. The polybag setting should be started from one side. The bags should be arranged very closely. Care should be taken so that the polybags always stands up right. The loosely held polybags produce weak and curved seedlings.
Seed sowing in polybag

Correct system
Setting seedling in polybag
Wrong system

Setting of polybags in nursery bed
Seed Sowing and Transplanting in Polybags

Comparatively larger seeds can be held by hand. Usually 2 seeds per polybag are sow directly. The examples of the types of seeds are Koroi, Raintree, Mehgoni, Shal, Garjan and Debdaru, etc. If seed of any polybag do not germinate then seedling from another polybag having two strong seedling may transferred to the empty polybag. For transplanting in the polybag seedlings may be produced in a separate germination bed or germination tray. Seeds are usually broadcasted in the germination beds or trays.

Sowing Seeds in Germination Bed or Tray

If the seeds are too small then seedling are produced in germination bed or germination trays. The trays should have few small holes at the bottom. At first a piece of cloth or a polythene sheet with holes or 2 to 3 fold newspapers should be placed at the bottom of the germination tray. Some broken bricks or pebble should be given on it. Then the germination tray should be filled with treated soil mixture. Then tray with the soil should be kept on a pot filled with pure water so that the soil can absorb water through the holes and gets fully moistured. Then the seeds mixed with double quantity of ash should be uniformly and thinly sown on the surface. Some water may also be sprayed carefully on the surface of seed bed or tray if needed. If the soil clods are comparatively larger, then it should be finely ground before sowing small seeds. Then the seedling is plant in polybag. Seedling germinated in trays having two parts of leaves may be carefully transplanted in the polybag. Before uprooting, the soils of the germination tray should be moistened. Before transplanting the soils of polybag should also be moistened.

Production of Seedling Directly in Soil or Bed

Seeds of many plants are directly sown in soil bed. For this purpose at first the bed is to be prepared by ploughing and mixing fertilizer with it. Broadcasting sown seeds over the soil. Seeds may also be sown in line. It is always better to sow seeds in line. The seed to seed distance in a line should be 5 cm for short duration seedlings and 10 cm long term duration. Sowing seed in dual line is also good. The distance between one dual line to another will be 20 cm. In this way 4 dual lines may be accommodated in a single seed bed.

Production of Grafts

Seedling may be produced from the vegetative part, such as branch, tuber, leaf and root of many tree species. This is known as vegetative propagation. Grafts, cutting, trench, layering, eye budding, air layering etc. are main examples of vegetative
propagation. Vegetative propagation methods are followed in case of plants like mango, litchi, sapota, pomegranate, plum, lemon etc. Branches or cutting are used for multiplication of Sajna, Mandar, Simul and Jiga plants while planting in the homestead area. The underground tubers or stumps are used for cultivation of bamboo and cane in rural areas of Bangladesh from ancient times. However, this method is costly and sometimes production of sufficient number of propagates is not possible. Presently methods of producing bamboo from twigs have been developed through research and are being adopted in Bangladesh cost effectively and successfully. Pati pata is now cultivated using its stumps.

After Care and Control of Diseases

Appropriate care should be taken after sowing seeds or transplanting seedlings in seed bed or polybag. Expected number of healthy and strong seedlings can not be obtained without doing appropriate cultural practices. Cultural practices usually required to be done in a nursery are mentioned below:

1. Giving shade
2. Mulching
3. Irrigation
4. Clearing weeds
5. Thinning
6. Fertilizer application
7. Pruning of roots
8. Classification or grading of seedlings
9. Control of pests and diseases
10. Hardening of seedlings

Giving Shade

The seedlings of many tree species after germination can not tolerate direct sun. Shade or cover protects the tiny seedlings just after germination from the direct sun and heat. It also helps in conservation of soil moisture. Usually shade or cover are not required for Shegun and Gamar tree seedlings.

Seed bed shades are generally prepared by strow, sun grass, bamboo chips and thatches. The height of the shade may be about 1 metre from the soil level. The shade
may be placed or attached with structured frames made of bamboo, wood or iron. If the bed is longer in the east west direction, then the shade should have mild slope in the south direction.

**Mulching**

Mulching may be termed as the activity of covering the seedbed by waste materials, half decomposed compost, straw, sun grass, leaves etc. Mulching helps in conservation of soil moisture. It preserves the temperature of the soil. Mulching may successfully be used in the seedlings of Coconut, Betel nut, Flog plum and Mehgoni. Mulching increases the rate of germination of seedlings and reduces the irrigation requirement.

**Irrigation**

Irrigation should regularly be given in the polybag after seed sowing and transplanting. At the preliminary stage, light irrigation should be given just enough to wet soil. Irrigation enhances the germination process. But excess irrigation may create water logging causing rottening of the seeds. No irrigation is required in the rainy season, if rainfall occurs regularly. Irrigation should be given in the morning and evening time.

**Weed Control**

Care should be taken so that no weed can grow in the nursery bed or polybag. Weeds compete with the seedling for water and nutrients. Thus it hampers production of strong and vigorous seedlings. Moreover it increases the possibility of disease infestation. So nursery should always be kept free from weeds. It is better to control weeds at the early growth stage. Some irrigation may be given in the nursery bed if the bed is too dry while weeding.

**Thinning and Secondary Transplanting of Seeds**

Each polybag should not contain more than one seedling. More seedlings in one polybag retards the growth of the seedlings. So keeping one healthy seedling all should be removed from the polybags. The soil of the polybag may be moistened before uprooting the seedlings. If the seedbed is densely populated then the weak seedlings, should be weeded keeping only the strong and vigorous seedlings. If there is any thinly populated spot in the seedbed; then gap filling should be done collecting seedlings from other places. The seedbed should also be moistened before uprooting seedling in such cases. It is better to perform the uprooting and transplantation of seedling in the evening or in cloudy weather.
Application of Fertilizers

Required quantity of fertilizers must be applied in the nursery for its growth along with usual weeding and irrigation. It keeps the seedling stout, accelerate growth rate and reduces attack of insect pest and diseases. Each 12 metre x 1 metre seed bed, 15 - 20 kg dried and crust cow dung or compost, Urea 220gm, TSP 120 gm, MP 160 gm mixed with 20 litre water and then sprayed by a water can, Light irrigation may be given after application of the fertilizers.

Pruning of Seedling Roots and Grading of Seedling

The roots coming out from the polybag should be pruned by sickles. After pruning of the roots seedlings should he arranged in line according to height or size. If unpruned the large seedlings will enter into the soil causing problem while uprooting.

Hardening Seedlings

Seedling grows in seedbed under most favourable environment. So seedlings die if those fail to adapt in new environment after transplantation. Normal growth of the
seedlings may be hindered. So measures should be taken from one month before transplantation, to harden the seedling so as to make it stress tolerant. This is known as hardening of seedling. The seedling may be hardened, by performing the following intercultural operations.

1. The polybag should be kept in shade for 4-5 days after transfer.
2. The shade given over the seedlings should be gradually removed so that seedling age exposed to sunlight gradually.
3. Seedlings should be arranged in the seedbed according to their height.
4. The roots growing out of the polybag should be pruned.

Control of Pests

The fungal diseases of the seedling may be controlled in two ways. These are the part of disease protection. Root and stem rot is a common fungal disease of forest tree seedlings. Many seedlings die within one or two months after seed germination due to rotting at the base of the seedling. Seedlings of Eucalyptus, Mahogoni, Koroi, Garjan, Shegun, etc. controlling are morally attacked by this fungal disease. The preventive measures of controlling this disease are treat the soil and seed. The remedial measures when the seedling are infested include application of fungicides. The active and important fungicides are Cupravit, Dithane M-45 and Bordeaux mixture.

Harmful insects frequently attack the seedlings in the nursery. Insects attack the twigs and young leaves of the seedling at the primary stage. If the infestation is low then the infested leaves or the seedlings may be uprooted and buried in the soil. But if the infestation is high then insecticides should be sprayed. Usually Diazinon 50 EC, Nogos 100 EC, Dieldrin 40 Sumithion 50 EC and Heptachlor 40 are used in controlling nursery insects.

Transport of Seedlings.

The tree seedlings should carefully be transported from the nursery to the field. If the stem and leaves of the seedlings are damaged or dehydrated they mostly die after transplantation in the land. So the seedlings should be transported to the field carefully and rapidly after taking it from the nursery. Carrying of polybag seedlings are more advantageous. However, sometimes open seedlings with a lump of soil at the base and roots are also transported. Transportation of this type of non-polybag open seedlings should be done, only for a short distance:
**Practical**

**Subject : Introducing Forest Tree Seeds**

**Materials** : Seeds of Koroi, Mehgoni, Neem, jack fruit, Arjun, Jarul, Shal, Shishu Akashmoni, Nagkswar, Debdaru, Ipil-ipil, Champa, Pitraj, Eucalyptus, Kadam, Shimul etc.

**Steps of Works**

1. Observe the supplied sample seeds minutely and write its name.
2. Observe and write the size, shape and colour of the supplied sample seeds in the practical notebook and draw the seeds.
3. Write the time (months) when the seeds mature.
4. Write the time of planting of seeds.

**Subject : Sowing Tree Seeds**

**Materials**: seed samples, loamy soil, cowdung/compost, polybag of 15 cm x 10 cm and watercan.

**Steps of Work**

1. Finely crush the soil clods.
2. Mix one part of cowdung or compost with three parts of the prepared soil.
3. Make 8 holes in two lines at two lines at the bottom and base of the polybag.
4. Fill the polybag with soil. Shake the poly bag during soil fillings so, that no folds, occur in the polybag.
5. Arrange and keep the polybag standing in line in the levelled seedbed under partial shade.
6. Make two holes on the surface of the polybag soil by finger or by a small stick.
7. Sow one seed at each hole.
8. Fully cover the seed with finely crushed soil
9. Give a light irrigation in the polybag after sowing of the seeds.
10. Record the date of sowing.
11. Irrigate the polybags daily in the morning and evening by water can.
12. Record the date of germination of the seeds.
13. Observe the seedling until it grows to a height of 15cm.
Exercise

Multiple Choice Questions

1. Which chemical is used to treat soils of nursery?
   a. Malathion  
   b. Diazinon  
   c. Formalin  
   d. Sumithion

2. The seedling may be hardened using the following method -
   i. Keeping the seedlings under partial sunlight gradually removing the seed bed shade.
   ii. Binding strongly the seedling with the hard stick put along the seedling
   iii. Pruning roots coming out of the polybag

Which one is correct?
   a. i and ii  
   b. i and iii  
   c. ii and iii  
   d. i, ii and iii

Read the paragraph below and give answers to questions 3 and 4.

Poverty became the regular phenomenon of the share cropping farmer Salam. So he tried to bring about economic solvency in his family, planting trees in the homestead and culturing fish in his fallow pond. He became self sufficient within a few years and brought about happiness in the family.

3. Which point is more important in case of planting trees in the homestead of Salam and pond banks?
   a. Economic importance  
   b. Environmental importance  
   c. Biodiversity importance  
   d. Entertainment importance

4. Tree planting in the homestead and pond bank of Salam is a type of-
   i. Conventional forestry
   ii. Social forestry
   iii. Artificial forestry
Which one is correct?

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

Creative Questions

Tahmid being aware of and motivated about the importance of social forestry, took an initiative to establish one nursery at the northern side of their two storied building. He prepared bed for producing seedlings in polybags and started working to produce seedlings of Neem, Mahgoni and Shishu. At a certain stage of getting failure in tree seedling production he consulted the matter with the agricultural teacher of the school. The teacher visited the nursery of Tahmid and gave some advice on what to do. Then Tahmid started to plan and work with a new concept as per the advice of the teacher.

a. What is a forest nursery?
b. Explain one important advantage of establishing nursery in polybag method.
c. Explain what precautionary measure you will take according to the experiences gained from the work of Tahmid.
d. “The establishment of nursery is the precondition of Social forestry” Evaluate the statement.
Chapter Three

Afforestation

With the view of increasing forest resources, planting trees in scientific ways, taking care after planning and proper management of the related activities are usually known as afforestation. The demand for forest materials has increased due to increasing rate of population and standard of living. The forest resources are decreasing at a rapid rate due to a faster rate of harvesting forest materials to meet the increased rate of demand; The environmental balance is thus seriously disturbed. So, to meet up the deficit of forest resources and to keep balance in the environment, the importance of afforestation is greatly increasing day by day.

Afforestation System

The afforestation systems may be divided into two divisions as follows—

1. Traditional afforestation
2. Social afforestation

1. Traditional Afforestation

Afforestation programmes have been containing along with the harvest of forest trees or deforestation. In the past, afforestation were done in the forest areas, which were under the control of government, considering only the economic aspects. Afforestation programme was started at first in Bangladesh in 1873 with the establishment of Shegun plantation in Chittagong Hill Tracts.

The major objectives of these forest plantations were to raise valuable trees and to ensure supply of raw materials for industries. The rural people were deprived of the benefits of such government owned forests. As a result rural people deforested in an uncontrolled way this valuable natural resource and harvested forest trees to meet up their demand. Due to shortage of agricultural land, many forest lands have been converted to crop lands. For these reasons afforestation have been started in the deforested areas, coastal and new char lands. Under this programme plantation garden has been established in Chittagong, Chittagong Hill Tracts, Sylhet and Cox' Bazar with trees like Shegun, Garjan, Mehgoni, Gamar, Eucalyptus, Akashmoni, etc.
2. Social Afforestation

The forests of Bangladesh are not uniformly distributed throughout the country. Most of the forests are situated at the east, southeast and south-west regions of the country. So, a greater population of the country is deprived of the benefits of forests resources. So, rural people of the deprived areas are thus meeting their need of wood by cutting homestead trees and bushes. As a result the rural homestead forest are getting rapidly reduced. In the context, planting forest trees in the homestead surrounding, side of roads and embankments through the direct participation of rural people with the objective of increasing forest production is known as social afforestation.

Objectives of Social Afforestation

The major objectives of the social forestry are as follows—

1. Increasing the supply of timber wood, fire wood and raw materials for industries.
2. Establishing cottage industries and supplying raw materials to the cottage industries.
3. Creating employment opportunity for the rural people and enhancing the economic development.
4. Eradication of poverty.
5. Improvement of the environment.
6. Ensuring production and optimum use of the land

Ways of Increasing Forest Resources

The forest resources of country may be increased by the following ways through social afforestation:

1. Planting trees in the homestead and surrounding areas.
2. Planting tree species on the banks of pond and water bodies.
3. Planting forest trees on the sides of roads and highways, rail ways, embankments, rivers and canals.
4. By extending agro-forestry,
5. By creating participatory forests in the forest lands.
Social Afforestation Programmes in Bangladesh

Social afforestation programmes in Bangladesh were initiated in the late seventy. Extensive social forestry programmes were initiated under the community forestry project in the north-western regions of Bangladesh in the early eighties. Presently this programmes have been extended to the whole country including greater Dhaka, Mymensingh and Tangail districts. Mainly short duration multipurpose tree species are planted in this programme. The side of roads and highways, railways and embankments plants trees. Besides, trees are planted at the homestead, schools college and premises of the industrial factories, offices and other institutes.

Social Forestry Plan

Well thought and perfect plan is a pre-requisite for successful execution of any programme. Afforestation is not an exception to it. The social forestry programmes may be outlined and described mainly on the basis of the following points:

1. Selection of site and identification of beneficiaries.
2. Selection of appropriate tree species.
3. Preparation of land
4. Planting tree seedling.
5. After care of the seedling and tree
6. Tree felling or harvesting.

Selection of Site and Identification of Beneficiaries

Before undertaking a programme, one has to assess where and how much land suitable for afforestation is available. After locating the area, year wise planting programme and number of trees to be planted are to be determined and beneficiaries are to be identified.

Selection of Tree Species

The success of afforestation is largely dependent on the appropriate selection of tree species. The following two points should be considered in detail while selecting a tree species suitable for social afforestation,

1. Trees which can not tolerate water logging like Jackfruit, Shal Shegun and Gamar should not be planted in the flood prong areas.
2. The use of the planted tree that is for what purpose the produced tree will be used should be ascertained. Such as, the planted tree may be use for electric pole, housing pole, fuel wood, furniture and construction or as raw materials for cottage industries.

**Land Preparation**

Tree seedlings are usually planted at the beginning of the rainy season. But before planting trees the land or the site should be well prepared. In forest plantation, land preparation includes clearing the selected site and marking the site with poles or pegs. There are certain methods, which should be strictly followed while planting at the sides of roads and highways, railways and embankments.

**Planting of Seedlings**

The distance from tree to tree will vary according to the type of species. However, seedlings are planted at a distance of two metres in gardens. The size of the pit will depend on the type of species and size of the seedlings to be planted. Usually a pit of 50 cm x 50 cm x 50 cm is recommended for a seedling.

Setting seedling in the pit

Right method

Wrong method

System of setting seeding
whose age is one year or less. The pit should be made before the rainy season starts. The soil of the upper part of the pit should be kept at one side and the soil of the lower part of the pit at the other side. About 5 kg cow dung or compost 20 gm T S P and 20 gm MP fertilizer should be mixed with the soil of the upper portion at least 15 days before planting and put in to the pit at first. Then the soil of the pit should be well pulverized before planting the seedling. The surface of the pit should levelled and a hole should be made at the centre according to the size of the polybag. Just before planting the polythene sheet of the polybag should be cut by a blade or knife and removed. If the seedling is in a pot, then the seedling may be removed breaking the pot. Then the seedling should be placed upright in the pit hole in such a way that the base of the seedling remains at the original ground level. After placing the seedling the empty sides of the hole may be filled in by putting soil from the surrounding. The soil of the pit should be mildly compacted by pressing the surface loose soil by hand. One stick should be placed by the side of the seedling and he seedling should be loosely bound with that stick. The seedling after planting should be irrigated by watering can after planting.

**Afforestation of Road, Railways and Embankment Sides**

There are certain methods, which are required to be strictly followed while planting by the sides of roads and highways, railways and embankments. Usually a thick line of Arhar plants may be raised at a distance of 30 cm from the edge of the roads and embankments. First line of trees should be planted at a distance of 180 cm from the line of Arhar and second line at the same distance from the first line of trees. One line of Dhaincha may be given at a distance of 30 cm from the second line of trees. Lines of trees may be increased in this way if space is available at the side.

**After Care of the Seedling**

The main intercultural operations to be done far, a seedling are described, herebriefly:

1. After planting the seedling, the soil of the pit should be moistened giving irrigation water. The plant should be irrigated every alternate day in dry weather.
2. Weeds grown around the seedling should be cleaned as and when it is necessary.
3. In case of death of any seedling the gap should filled with new seedling immediately.
4. A fence should be given around each seedling to protect it from cattle and goats.
5. In case of road and embankment plantations one line of Arhar in the upper side and one line of Dhaincha at the lower side may be placed.
Road side agroforestry design

- Mid of the embankment
- Mirgin of the embankment
- Pigeon pea row
- Seedling planted at distance of 2 metre
- Dhaincha double row
- Outside soil level
- Pigaon pea row
- Seedling planted at a distance of 2 metre
- Dhaincha double row
Practical

Subject : Road / Embankment Plantation Planning

Materials
Map, Chart, Khata, Pencil, Scale, etc.

Steps of works
1. Draw a cross section of the road.
2. Mark in the drawing where Arhar seeds will be sown.
3. Show the first line of plants in relation to the Arhar lines in the drawing.
4. Then show the location of the second line of planting in the drawing.
5. Show the location of Dhaincha in the drawing.

Exercise

Multiple Choice Questions
1. How many types can afforestation be divided into?
   a. Two    b. Three
   c. Four   d. Five
2. Which factor is the most important in implementing the afforestation programme properly?
   a. Land development
   b. Raising improved saplings
   c. Intercultural operations of the planted sapling-
   d. Taking an effective plan
3. Social Forestry is very important because it—
   i. ensures maximum utilization of land and its production.
   ii. creates employment scope and enhances economic development of the rural people.
   iii. helps in entertainment and protection of biodiversity.
Which one is correct?

a. i. and ii               b. i. and iii

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

Creative Questions

Mr. Rahim is an inhabitant of the coastal region of Bangladesh. Once a poster having a slogan statement “Plant more trees and save the environment” drew his attention. He came to know after discussion with the Forest Officer that our forest areas are not well distributed and extensive. Forest is getting reduced by many ways. There is no alternative of creating artificial forests for increasing forestry in the country. Then Mr. Rahim being motivated on plantation of trees started an movement for social forestry with the local people.

a. What is meant by forest?

b. Explain one objective of social forestry.

c. How Mr. Rahim can create social forest? Explain

d. Analyze the appropriateness of the poster.
Chapter Four
Tree Felling and Preservation

Harvesting of forest trees that is felling of trees depends on the objectives of afforestation. When afforestation is made with the objectives of producing firewood, pulp wood and poles, then rapidly growing forest tree species are planted. This type of plants may be harvested after 10 -12 years of planting. But if the trees are planted for the purpose of producing timbers for construction and furnitures, harvesting should be done after 30-40 years of planting depending on the characteristics of the species.

However, some general rules are required to be followed when harvesting forest plantation. The harvesting rate should be determined considering the usual growth rate of the forest species. The harvesting rate from a certain plantation area should not exceed the growth rate of the forest trees. It is known as forest conservation. Conservation is very important for maintaining forest resources. Because, a forest resource or plantation can not be raised overnight.

Bamboo is harvested usually after 3 years of planting. As a result of growth and multiplication bamboos attain a form of bush. New bamboo tillers are found to grow at the outer side of the bush. That's why the older bamboos rennin in the centre of the bush, the younger shoots being at the exterior. During harvesting it is required to cut one or more outer bamboos. In this way space is created in the bush so that one can enter the inner side of the bush for cutting the matured bamboos.

The timber and material loss from trees and bamboos may be greatly reduced by cutting if appropriate scientific methods are followed. These forests harvest may be scientifically treated for ensuring its prolong use. Some of the methods of tree felling and preservation of wood and bamboo are described here.

1. Methods of Felling Trees

Felling of trees in unplanned and unskilled way results in great loss of wood. One should be very careful while cutting a tree specially for the purpose to timber and poles. A tree is required to be grown for 30-40 years to get a good quality of timber from it. To get strong pole a tree is require to be grown for 18 to 20 years. Cutting of a tree in unplanned and unskilled way may result in irregular fracture or breakage of the timber at the main base of stem. Just for a wrong decision a long grown tree may be spoiled in a moment.
Cutting trees by saw always reduces wood loss. So in order to reduce valuable woodloss, it is important to know the techniques and use of modern tools for cutting a tree.

It is very much usual that there may be houses and other trees nearby matured tree, which has been selected for cutting in a homestead. In such a situation the tree after cutting may fell on those nearby houses or other trees causing serious damage. The tree may fell in a ditch where from it may be very hard to pull or carry it. On the other hand unplanned felling of trees grown on road side or embankment, etc. may block the transports. But if the technique of tree felling is known then a tree may be cut and felled in any desired side or position.

The tree may be cut at the base of the tree 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 an elevated higher place above the soil spoils more quantities of quality wood.

At first the surrounding of the tree selected for felling should be cleared. Then the direction towards which the tree will be felled is to be decided. The selected tree should be felled on a nearly level and open space. If the land have some slope then the tree should be felled across the slope. The first cut by saw and axe should be given at that side at which the tree is planned to be felled. At first a cut measuring two third of the diametre of the plant should be given parallel to the ground. Then a tangent cut
should be given from the 15-20 cm upper surface side. Then second cut should be
given from the opposite side of first cut 12-15 cm above the first cut. The second cut
should be extended up to the end of the first parallel cut. Then a flat point peg is to be
entered to the second cut. When this peg will be pressed by the axe or hammer, the
tree will be felled at the side where first cut was given.

This first cut-second cut method of felling tree ensures fell of tree at a expected
direction or side.

2. Timber log and Sawn Wood

Forest trees after harvest are cut into pieces for easiness of transportation and sawing.
This type of round pieces is known as Long wood. The log pieces are made by cross
cut saw. The logs are then cut for sawing to give them their usable forms. Wood logs
after sawing have specific length, width and thickness of less than 4 cm is known as
wood sheets or Takta.

Measurement of Logs

The correct volume of logs may be determined with the help of Newton's Law. The
formula is:

$$\text{Volume} = 0.08 \times \frac{C_1 + (4 \times C_2) + C_3}{6} \times \text{Length}$$

Where $C_1 = \text{Circumference of the narrow end}$

$C_2 = \text{Circumference of the middle place}$

$C_3 = \text{Circumference of the broad end}$

Example : The Length of a Garjan Log is 6 metre. It's circumference of the narrow
end is 150 cm, at the middle 2.0 metre and at the broad end 2.5 metre. Calculate the
actual volume of wood.

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

$$= 0.08 \times \frac{12}{6} \times 6 \text{ cubic metre}$$

$$= 0.96 \text{ cubic metre}$$
Measurement of Usable Wood

A portion of the Log wood is always lost in the process of sawing. All the woods can be utilized to giving a regular shape. 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:

\[
\text{Volume} = \frac{\text{Middle circumference of log}^2}{4} \times \text{Length}
\]

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.

\[
\text{Volume} = \text{Length} \times \text{Width} \times \text{Thickness}
\]

If the length, width and thickness is measured in inches or foot then the unit of volume will be cubic foot. Similarly, if measurements are taken in cm and metre then the unit of volume will be cubic metre.

Seasoning and Treatment of Wood and Bamboo

The major enemies or pests of wood and bamboo are termites, fungus and ghoon. Treating them appropriately may prevent destruction, rotting or damages of wood and bamboo. Treating process may increase the longevity and durability of wood and bamboo.

Seasoning of Wood

The actual meaning of wood seasoning is reducing moisture content of wood by drying the wood to a certain range. When wood is dried to a certain range; its moisture content is reduced. As a result, attacked by insects and fungus is reduced giving the wood a longer life.

The two popular methods used in wood seasoning are given below:

A. Air drying

B. Kiln drying

A. Air Drying

Drying of wood in open air is known as air drying. But very thinly sliced woods may show fracture or may be curved when left under strong sun in open air. That's why
these types of woods are kept in shade 30-40 cm above the ground in layers. The wood layers are arranged such a way that aeration is ensured surrounding every wood piece. The wood pieces cannot be left in a disarranged manner, which may result in curving of the wood. Air drying process of wood treatment requires much time, at least one dry season in Bangladesh.

B. Kiln Drying

Kiln is a special type of room or a chamber. The temperature, relative humidity and aeration through the arranged woods in the kiln can easily be controlled. The range of temperature in the chamber are maintained within 30˚ C- 125˚ C. The expected temperature is maintained by burning fire wood or oil. The internal relative humidity is maintained by artificially entering air or steam inside the chamber. Wood seasoning by this process requires 30-45 days.

Advantages of Kiln Drying

1. Moisture content of woods may be reduced as needed.
2. Time requirement is low.
3. Seasoning defects are minimum.
Wood Treatment or Preservation

The seasoned woods may rightly be used in furniture and in other construction works. However, if comes in direct contact with soil or water the seasoned wood can also lose its durability. Because when comes in contact with water, it absorbs water and its moisture content is increased. Fungus and insects easily infest moistened woods. For this reason woods to be used in moist places or soils should be well treated. The main theme of wood and bamboo treatment is the entering of chemical or preservative into the wood or bamboo. A preservative mixture namely CCA is widely used in Bangladesh for preserving wood and bamboo. The CCA preservative is composed of 3 ingredients, such as:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromic oxide</td>
<td>47.5%</td>
</tr>
<tr>
<td>Copper oxide</td>
<td>18.5%</td>
</tr>
<tr>
<td>Arsenic penta oxide</td>
<td>34.0%</td>
</tr>
</tbody>
</table>

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. The preservative solution must be pushed deep into wood. It is recommended to push 0.4 pound of preservative into one cubic foot of wood.

Using CCA preservative may prevent the rotting of stored woods. Besides, this chemical can also prevent attacks of termites.

The following 3 points must be considered while using treated wood. These are—

1. Treated wood will be ready for use after 7 days of treatment
2. Before use, the treated wood should be dried as described earlier.
3. Extensive carpentry should not be done with treated woods.

Preservation of Bamboo

Bamboo, which is to be used in association with soil and water, do not last usually more than two years. The causal agents for rotting and damage of bamboo are fungus and insect pests. Protection of bamboos by using preservatives can greatly increase its durability. If the preservatives are rightly used, then the user need not to replace the bamboo frequently and extra costs in this regard may be avoided. Thus loss of bamboo is reduced.
Methods of Bamboo Treatment

Previously bamboos were sufficiently soaked in water for a certain period as a preservation process of treatment. This method is known as "Pinat". This process protects the bamboo from ghoon insects but can not protect the bamboo from fungus, termites and other insects, presently improved methods have been developed for bamboo preservation in Bangladesh. In this method chemical preventive for fungus and insect pests is pushed into the bamboo in the form of solution: A chemical namely CCB is widely used in Bangladesh for the purpose. The ingredients of CCB are as follows. CCB is pushed into Bamboo in two ways, such as-

A. Sap Displacement System

B. Soaking System.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper sulphate</td>
<td>2 parts</td>
</tr>
<tr>
<td>Sodium dichromate</td>
<td>2 parts</td>
</tr>
<tr>
<td>Boric acid</td>
<td>1 part</td>
</tr>
</tbody>
</table>

A. Sap Displacement System

The sap of bamboo is displaced by a 20% CCB solution by this process. The 20% solution may be prepared by diluting 2 kg of CCB in 10 litres of water. The solution is pushed into a newly cut bamboo by pressure and sap is replaced.

B. Soaking System

In soaking method the materials to be preserved are kept submerged in a 10% solution of CCB in a tank of required size.
The required duration for soaking different materials are given below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Soaking period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo pieces</td>
<td>2-3 weeks</td>
</tr>
<tr>
<td>Bamboo fences</td>
<td>1 day</td>
</tr>
<tr>
<td>Sun grass</td>
<td>12 hours</td>
</tr>
<tr>
<td>Wood</td>
<td>2-4 days</td>
</tr>
</tbody>
</table>

A more diluted solution of CCB such as 3-4 % may be used treating sun grass.

Practical

Subject: Log/Wood sheets Measurement

Materials:
Measuring tape, wood log or wood after sawing, practical Khata and pencil.

Steps of Work
1. Go to a near by wood log or wood piece
2. Measure the length of log and note in the Khata
3. Measure at different circumference of the log (mid, narrow and large)
4. Calculate volume of wood by using the formula.

Subject: Treatment of Bamboo.

Materials
Bamboo, chemical or preservatives, pump or pressure equipments, water, Dao, axe.
Steps of Work
1. Prepare the solution
2. Go to a bamboo bush.
3. Cut a bamboo and take it out from the bush.
4. Cut the base and apex of the bamboo uniformly.
5. Attached the pressure equipment as per design at the base of the bamboo.
6. Pore preservative solution in pressure machine.
7. Give sufficient pressure through manual pumping.
8. Observe whether bamboo sap is coming out at the apex of the bamboo or not
9. As soon the solution comes out through the apex, stop pumping.

Exercise

Multiple Choice Questions
1. Mostly what type of damage does occur in the environment due to deforestation?
   a. Increases soil erosion
   b. Reduces oxygen of the atmospheric air
   c. Rainfall is reduced
   d. Natural disaster increases
2. The situation where tree cutting does not affect the environment—
   i. Cutting trees for fuel wood
   ii. Cutting old trees for doing new plantation
   iii. Cutting trees for making furniture
Which one is correct?
   a. i.  
   b. ii. 
   c. i. and ii  
   d. ii. and iii

Read the paragraph below and give answers to questions 3 and 4.
The poor farmer Babar Mia decided to cut the jackfruit trees planted 20 years ago in order to meet the marriage expenditure of his daughter. In this case he got a fare price of the tree logs cutting the trees as per advice of the Sub-Assistant Agricultural Officer.
The advice Agricultural Officer gave in reducing the loss of wood is –

i. to use right type of cutting equipment
ii. to cut the tree at a higher level from the soil.
iii. to follow the correct method of tree cutting.

**Which one is correct?**

a. i. 

b. ii. 

c. i. and ii 

d. i. and iii 

4. The equipment used by Babar Mia to fell free on a level open advantageous place was—

i. Dao

ii. Axe

iii. Saw

**Which one is correct?**

a. i. 

b. ii. 

c. i. and ii 

d. ii. and iii 

**Creative Questions**

As Aziz knew the C C A method of timber wood preservation, he could make a lot of furniture from his 25 years old for his of age teak wood tree daughters marriage. The length of the teak wood log was 5 metres. The circumference of the narrow end was 2 metres, the middle circumference was 2.5 metre and circumference of the broad end was 3 meters. He was taking care of the tree for so many years for malling valuable furniture.

a. What is seasoning of timber wood?

b. What is the basic principle of wood preservation?

c. Determine the volume of wood of the wood log of Aziz.

d. State the importance of wood preservation in the C C A method with justification in Bangladesh.

Or

Explain with justification the advantage of wood preservation using the C C A method as followed by Aziz.
The principle source of protein for the peoples of Bangladesh is fish. The supply of 63 percent of protein in Bangladesh comes from fisheries. About 10 percent of the population is dependent on fisheries resources for their livelihood. The climate, soil and water of Bangladesh are very suitable for the culture fish throughout the year. So, fisheries resources have a great potential for its development. During present time, the production from fisheries sector started increasing due to the development, execution and extension of appropriate fish culture technologies. The production of fisheries during 1994-95 was 12 Lac tons. This production has been raised to about 24.40 Lac matric tons during 2006-2007. The shrimp culture has widely extended in the costal belt of Bangladesh and resulted in increased export at the satisfactory level.

Though the production from the marine and closed water sources have increased satisfactorily, the production from the inland open water sources have greatly decreased. The production of Hilsa is very important among the open water fishes. The per capita consumption of fishes has decreased to 27gm from 33 gm during the last 10 years. Now the availabity of fish consumption per capita has been increased upto 46 grams. But the necessity of fish consumptions is about 50 grams.

**The Resources of Fisheries**

Bangladesh have wider fields of fisheries resources due to natural and environmental reasons. According to the characteristics of the water bodies the sources of fisheries may be classified into two categories resources these are:

1. Inland water.
2. Marine water.

**Inland Water**

In general, the fresh water and the water of semi-saline coastal area are known as inland water. The inland water sources in Bangladesh measures to 45 Lac 75 thousand 706 hectares. The inland water bodies of Bangladesh may be categorized into two sub-classes according to its size and structural composition, these are :

1. Inland closed water
2. Inland open water
1. Inland Closed Water
An inland fresh water which is bounded by dike or high land is called inland closed water. The area of inland closed water in Bangladesh is about 5 Lac 28 thousand 390 hectare. Fisheries may be cultured scientifically in these inland closed water. About 39 percent of the total fish production comes from the inland closed water in Bangladesh.

2. Inland Open Water
The comparatively large sized fresh water not within dikes or high land boundaries are known as inland open water. Rivers, canals, Haors, Kaptai lake and flood plain are in Bangladesh are classified as inland open water. The total area of inland open water in Bangladesh is about 40 Lac 47 thousand 316 hectare. Fish is not usually cultivated in inland open water. But the naturally grown fishes are frequently harvested from such water. More than 41 per cent of the country's fish production comes from the inland open water.

3. Marine Water
The marine fisheries constitutes about 20 percent of total fish production in Bangladesh. The Bay of Bengal is on the south of Bangladesh. So many species and varieties of fishes and shrimps are found in the Bay of Bengal in large quantities. Mechanized boats and trawlers from marine water harvest the fishes.

Causes of Reduction of Fisheries Resources in Open Water
The production of fishers in open water has been reduced due to many natural and man made problems. The important causes may be summarized as follows:
1. Reduction of volume of water sources due to natural and increased of rate of siltation.
2. Inappropriate irrigation and drainage plans and embankments.
3. Indiscriminate harvest and destruction fish fries and fishes with eggs.
4. Drying of low land and Haors during the day winter season.
5. Conversion of fisheries fields to crop fields.
6. The natural habitat of fish movement and fish breeding are seriously disturbed.
7. Application of pesticides to the crop fields indiscriminately.
8. Increased pollution of water due to disposal of toxic industrial wastes in the rivers.
9. Catching small fishes by using a kind of net, which is prohibited?

Plan of Developing Fisheries Resources

Steps have been taken to conserve fisheries resources of the open water, to extend fish cultivation in closed water and to promote shrimp culture in semi saline coastal areas, besides, steps have also been taken for ensuring the expected fish production through integrated fish cultivation and management programmes.

Open Water

The inland open water is the most important source of the fisheries resources in Bangladesh. About 41 percent of the total fish production comes from inland open water. For these reasons, programmes for releasing fish fries in open water have been taken for increasing the production of fish in an experimental way. Besides the following steps have been taken for the development of fisheries resources in the open water:

1. The execution of the fisheries Act. have been strengthened so as to prohibit the use of illegal net and destruction of small size fishes.

2. The leasing system of the water resource has been stopped. The leasing of 'Khas' government water resource on the basis of the long term production plan has been introduced instead of leasing on the basis of collection of revenue.

3. The sheltered areas or 'Abhoy Asram' have been created to ensure free movement and breeding of fishes of specific and important place of water. Any sort of fishing has been prohibited in these special areas.

Closed Water

The fish cultivations have been extended in closed water through the development of appropriate technologies, involving more ponds under programme and through intensive training. The government agencies are setting demonstration ponds or fish farms for the extension of improved technologies. It has become possible to produce up to 10 tons of Rui fish per hectare of ponds under this programme, which has become a great hope for the country. The average production of fishes in ponds has increased from 1.5 to 3 tons per hectare due to the execution of these fisheries extension programmes.
Coastal Water

The cultivation of shrimp has greatly increased in the coastal areas during the last 4 to 5 years. The potential places of coastal shrimp culture have been identified. Programme for necessary infrastructural development, establishment of demonstration farms and hatcheries and farmers training are being implemented for the extension and improvement of 'Bagda' and 'Galda' shrimp culture.

Integrated Fish Culture

Steps have been taken by the government for integrated fisheries cultivation in the areas developed due to construction of irrigation, drainage, flood control, and other related infrastructure.

Fisheries Acts and Regulations

Once upon a time, the tanks, ponds, rivers, canals, lakes, Haors, Baors etc. were full of fisheries resources. But the indiscriminate harvest of fishes, mass harvest of fish fries and female fishes with eggs, use of current nets and harvest 'Nala' and 'Jatka' of without conservation of fish resources of the open water have resulted in serious deficiency of fishes in the country. In this context, it may not be possible to increase fish production unless the released fish fries are allowed to grow to a particular size.

In order to overcome these problems "Fisheries Conservation Act 1950" was passed by the government in the year 1950. Later on, the Act was modified and revised in the years 1982, 1985, 1987, 1988 and 1995 to make it more adaptive as per requirement of the country. The major points of this Fisheries Act may be mentioned as follows:

1. The natural movement of the fishes in the rivers and canals cannot be hampered.
2. Hunting or harvesting of fishes through the use of explosives, guns and arrow is prohibited.
3. The natural habitats and breeding zones of fishes can not be disturbed by using poisons, disposing toxic industrial wastes or by any other way or ways.
4. Without a view of cultivation, the fish fries of Rui, Katla, Mrigel, Kalibaus, Ghania, etc. measuring less than 23 cm cannot be harvested during July to December (Mid Ashar to Mid Poush).
5. Harvesting of Rui, Katla, Mrigel, Kalibaus and Ghania of any size is prohibited during the breeding season.
6. Harvesting of Shol, Gajar and Taki fries are prohibited in open water bodies from April to June (middle of Chaitra to middle of Jaisthya).

7. Jatka is prohibited to catch to carry and to sell during November to May.

8. Use of current net is strictly prohibited.

9. Fine or jail or, both punishments may be given to the defaulters of the laws.

Besides, Fisheries Conservation Act, the following Acts and Regulations related to development fish culture are in vogue in the country.

1. Pond Development Act. 1939
3. Fisheries Inspection and Quality Control Regulations. 1983
6. National fish strategy

By an order SRO no. 41 law/2008-20/02/08 Government has been prohibited to import, carry, culture, sell, receive or market, expose and possess any species of fish of piranha group.

**Introduction to Fishes**

A fish may be defined as an vertebrate animal living in water having cool blood, and which perform respiration through gills and move with the help of different fins.

**Types of Fishes**

The fisheries resources of Bangladesh may be classified into 3 categories according to the characteristics of the habitats. These are–

1. Fresh water fishes
2. Semi-saline water fishes
3. Saline water fishes.

**Fresh Water Fishes**

The fishes which grow in the inland closed and open water namely ponds tanks, rivers, canals, Haors, Baors, lakes, etc. are known as fresh water fishes. The examples of fresh water fishes are Rui, Katla, Shing, Magur, Puti, Koi, Taki and Boal.
Semi Saline Water Fishes

The water of the estuaries and rivers mouths are of the semi saline in nature. The fishes growing in such habitats are known as semi saline fishes. The examples of semi-saline fishes are Bhetki, Poa, Laitya and Coral.
Saline Water Fishes

The fishes growing in the salty water of coastal areas and in the Bay of Bengal are known as saline water fishes. The examples of saline water fishes are Hilsa, Rupchanda, Churi, Bele and Datina.

The Characteristics of Cultivable Fishes

Fishes having certain characteristics are suitable for cultivation in the ponds. The characteristics are the following:
1. Rapidly growing and tasty.
2. Have high nutritional value and tasty.
3. Market demand and price is higher.
4. Fish fries are easily available.
5. May be cultured in a mixed manner.
6. Can survive in a relatively unfavorable environment.
7. Resistance power of diseases is higher.
8. Fish fries may be produced through artificial breeding.
9. Fishes are not voracious.
10. Fishes those eat supplementary feed.

The fishes suitable for cultivation in ponds, among carp fish are Rui, Katla, Mrigel, Silver carp, Common carp, Grass carp, etc.

**Fishes Suitable for Cultivation**

**Rui**

Rui is basically a river fish of our country. However, Rui is very suitable for cultivation in the ponds. Rui is a very popular and tasty fish in Bangladesh.

![Rui](image)

**Morphological Characteristics:** The head of the Rui is comparatively smaller than its body. The dorsal side is more convex than the ventral. The lips are thick, ridged and have two short barbles at the apex of the lips

**Food and Feeding Habits:** Rui fish take most foods from the mid layer of the pond water. It takes planktons as food. Rui fish likes zooplankton at fry, fingerling and young stages but takes phytoplankton and decomposed organic materials as natural common feed.
Maturity and Reproduction: Rui can grow to a length of about one metre. It attains reproductive maturity in a period of three years. Under favourable environment, Rui fish release eggs in the month of mid April to mid July (Baishakh to Shraban months) in open water. Eggs may also be produced from Rui artificially. Rui does not release eggs in closed water.

Katla

Katla is a rapidly growing fish and is very suitable for cultivation in ponds. Its original habitat in this country is the open water and rivers. The growth rate of Katla in the hoar, baors, rivers and canals is very satisfactory.

Morphological Characteristics: The body is short and the head is comparatively larger. The mouth is wider and lightly curved upwards. The upper lip is thin but the lower lip is thick. The dorsal side is more convex than the ventral side. The colour of the dorsal side is dark gray, and lateral side is silvery white. The fins are blackish in colour.

Food and Feeding Habit: Katla mainly eat upper layer food of the pond. Katla basically eats zooplankton and sometimes may also eat phytoplankton.

Maturity and Reproduction: Katla fish do not release eggs in closed water on normal condition. Its length may be 1 metre. It attains maturity within 3 to 5 years. A katla fish of normal size can produce about 15 to 30 Lac eggs. Under favourable condition katla lays eggs during mid May to July (Jaistha to Sravan months) in some specific rivers. Fries of katla may be produced in hatchries by' artificial breeding.
Mrigel

Mrigel is also a river fish of this country like Rui and katla. Mrigel is very suitable for culture in ponds. It is a rapidly growing fish.

Morphological Characteristics:

The body of Mrigel is longer and straight. The upper jaw is slightly curved downwards. There are two short barbules at the tip to lip. The dorsal side is grey, while the lateral and ventral side is silvery white.

Food and Food Habits: Mrigel is a bottom dwellers. It takes food from the bottom of the pond. Mrigel likes to eat microorganisms, zooplankton and organic materials found in the bottom mud the ponds.

Maturity and Reproduction: The length of Mrigel is 1 metre and weight 8 to 9 kg. It attains reproductive maturity within two years. A female matured Mrigel can produce 1 to 5 Lac eggs. It lays eggs during the month of mid April : to mid July (Baishakh to Sraban months) in specific rives, It dose not lays eggs in stagnant water, Fries may be produce by artificial breeding.

Silver Carp 1:

Silver carp originally comes from China and Russia. Silver carp may be cultured with native carp successfully. Silver carp is a rapid growing fish.

Morphological characteristics: The body is covered with silvery white scales. The abdominal side is more convex than the dorsal side, The middle portion of the fish is wide which gradually narrowed towards the tail. The colour of the dorsal side is slightly grayish.
Food and Food Habit: Silver carp take the food from the upper layer of the pond. Generally it takes the phytoplankton as food, Silver carp also eat decomposed aquatic plant.

Maturity and Reproduction: Silver carp does not lay eggs in the pond. They lay eggs in river under normal condition. However, artificial spawning may be done and fishes may be produced in hatchery.

Grass Carp
The original habitat of Grass carp is China a Russia: It is suitable for mixed culture with other carp fishes. Grass carp can eat aquoas weeds and small plants and keeps the environment of the pond clear.

Morphological Characteristics; The shape of body of Grass carp is like Mrigel, however there is no barbles on the lips of Grass carp like Mrigel. The dorsal fin in smaller, the colour of the dorsal side is slightly greenish. Head is smaller comparatively than the body.
**Food and Food Habit:** It can eat in all layers of pond. Grass Carp likes soft aquoas weeds and green grasses.

**Maturity and Reproduction:** Grass carp does not lay eggs in closed water. It releases eggs in rivers, canals and open water. Artificially spawning may be done and fries may be produced in hatcheries.

**Common Carp**

Common Carp is known to be originated from the temper it region of Asia namely in the south China. There are two types of Common carp found in Bangladesh. These are Carpeo and Mirror carp.

![Mirror Carp]

**Morphological Characteristics:** The body of Common carp is flat. The head is comparatively smaller than the body. The body of Carpeo is covered with redish scales. There are few rows of scales on the dorsal side of Mirror carp. The colour of the dorsal side is light brown, the abdominal side is golden in colour. The scales is relatively larger than the carpeo.

**Food and Food Habit:** The Common carp is bottom dwellers of the pond. They dig hole at the bottom of the pond and take food like insects, micro-organisms as available in the mud. It also eat decomposed organic materials.

**Maturity and Reproduction:** Common carp lays eggs ponds. It lay eggs two times in a year, once in winter season and the other in summer or rainy season.
**Practical**

**Subject 1. Identification of fishes suitable for culture**

**Materials**
1. Rui, Katla, Mrigal, Silver carp and Carpeo fishes.
2. Tray, forcep, scale, pencil, etc.

**Steps of Work**
1. Collect the above mentioned fishes from a pond with the help of teachers or from a nearby market as suggested by the teacher.
2. Arrange the fishes side by side in the tray after collection.
3. Campare and study the specific morphological characters of the fishes as described in this chapter with the characters of the fishes kept in the tray.

**The characters are**—

a. presence folders in the mouth or lip  
b. presence of barbles on the lips.  
c. Shape and size of fins  
d. The colour and size of scales  
e. Then identify the Rui, Katla, Mrigel. Silver Carp and Carpeo fishes.  
f. Write down the characteristic features of the identified fishes.  
g. Draw the fishes in the practical note book and label the special features.

**Subject 2. Preservation of Fishes in Jar**

**Materials**
1. Glass jars (five numbers)  
2. Small sized fishes (15-25 cm long) namely Rui, Katla, Mrigel and Silver carp, (four numbers)  
3. Formalin  
4. Buckets  
5. Water'

**Steps of work**
1. At first carefully wash the collect fishes is bucket water.  
2. Insert the fish in the jar keeping the head below.  
3. Then pour 40% formalin is glass jar in such a quantity the whole fish remains dipped into the formalin solution.
4. Close the glass jar with a lid.

5. Put label on the Jar writing the name of the fish with date and name of the student.

**Precautions:**
Formalin in an analgesic chemical. For this reason mask may be used while working with formalin, specially the nose should be protected from formalin solution.

**Exercise**

**Multiple Choice Questions**

1. Which one of the following is the main reason for decreasing fisheries resources?
   a. Silting of water bodies
   b. Drying some of the water bodies during the winter season
   c. Unplanned construction of embankments
   d. Indiscriminate harvest of brood fishes.

2. The characteristic features of cultivable fishes are -
   i. that they grow rapidly.
   ii. attain the capability of reproduction rapidly.
   iii. they take of supplementary feed

   Which one is correct?
   a. i and ii
   b. i and iii
   c. ii and iii
   d. i, ii and iii

**Creative Questions**

Mr. Mazed Ali, the Fisheries Officer, while going home at a Jaisthyo (May), noon observed that some people were harvesting fishes the road side ditches. He stopped on the road and called the people and showed that they were catching the taki, shol, and other fishes which were broods. He then explained the bad effects of harvesting fish fries and broods and also made them understood the Fish Conservation Laws. After the explanation, they all committed not to harvest fish fries and broods.

a. What is fish fries?

b. Explain the bad effects of harvesting brood fishes.

c. What are the steps which may be taken for expansion of fisheries in the light of the given information?

d. Evaluate the fisheries conservation act in the present context of Bangladesh.
Chapter Two
Pisciculture in Ponds

The physical and chemical characteristics of the water of a pond are controlled by the structure of the basal soil, chemical characteristics and different mineral ingredients contained in soil. That is, productive capacity of any pond depends on the conditions of the basal soil of that pond. The characteristics of water influence the livelihood of the fish.

The Characteristics of Water

The Characteristics of water are divided into 3 parts, such as..

1. Physical characteristics
2. Chemical characteristics
3. Biological characteristics

Physical Characteristics of Water

The productive capacity of a pond can be ascertained by observing the physical condition of water. The physical characteristics are of following types -

A. Depth of Water: Production of fish is hampered when depth of water is too deep or too shallow. When the depth of water of a pond ranges from 1.5 metre to 3 metre fish culture becomes profitable.

B. Clearness or Transparency of Water : If the water of the pond is muddy or opaque sunrays are obstructed to enter into water. As a result production of fish food is decreased. This hinders growth of fish. The productive capacity of a pond is increased when the transparency of water becomes 5 cm.

C. Temperature : The growth of fish is also dependent on the temperature of water. Growth of fish is less during winter and more during summer. For Rui(Carps) types fish temperature ranging from 25° - 35° C is ideal.

D. Sunlight: The sunlight directly influences the production of natural food in the pond. If there are big trees on the banks of the ponds, the branches of the trees should be cut to ensure entrance of sunlight profusely into the water.
The floating water hyacinth, helencha etc. create obstruction to enter the sunlight into the water. These will have to be removed.

**Chemical Characteristics of Water**

1. **Dissolved Oxygen:** Oxygen is essential for life. Oxygen released by the process of photosynthesis by phytoplankton and aquatic plants is dissolved in water. Some amount of oxygen from air is also mixed with water directly. The fish, aquatic plants and animals living in the water respire with the help of this oxygen. Oxygen is also utilized in the decomposition process of organic matter in the bottom of the pond. In order to maintain sustainability in the production of the pond presence of required amount of oxygen is essential. For successful, fish culture it is best to have 5-8 mg of oxygen per litre of water.

2. **Dissolved Carbon dioxide:** As oxygen is essentially required for life, so carbon dioxide is also important for the preparation of natural food of fish. But if the amount of carbon dioxide is increased somehow an action of poisoning develops. If the bottom of the pond contain more organic matter and clay mud then there will be excessive carbon dioxide when temperature become high. Fish production become good with the presence, of 1-2 mg carbon dioxide per litre of water.

3. **PH Value:** pH can determine whether the water is acidic or alkalin. Relatively alkalin water is congenial for fish culture. The pH of water ranging from 6.5 -8.5 is helpful for the natural production of food.

4. **Phosphorus:** The fertility of a pond depends on the presence of phosphorus. Natural water has only small amount of phosphorus. This phosphorus is converted into phosphates. Sufficient amount of phytoplanton is produced in the water in the presence of require amount of phosphorus.

**Aquatic Plants and Animal lives of Water**

Generally aquatic plants grow in the pond. Some of the pond aquatic its plants and animals are small. Microscope is required to see these plants and animals. These small aquatic plants at animals are natural food of fish. Again some aquatic plants and animals create troubles for fish culture. The following aquatic plants and animals grow in the pond.
Floating Plants
Leaves and stems of these types of aquatic plants float on water, but the roots hang in water. Such as water-hyacinth, topa hyacinth, khude hyacinth etc. These hinder the entrance of the sunlight into the water and take the nutrients from the fertilizer used in the pond. As a result, production of the pond is decreased.

Submerged Plants
These types of aquatic plants remain at the bottom of the pond. These hinder the entrance of the sunlight into the deep water and also create obstacle in the movement of fish. Such as leaf-sedge, thorn-sedge, nazas etc.

Deep Water Aquatic Plant
Some aquatic plants have their roots in sides of the pond, but the stems and branches emerge and grow on water. Such as Arali, Dal, Kalmilata etc. Aprli plant resembles some extent to broadcast Aman plant. There are several types of Dals. These are familiar in different local names on the basis of regions of Bangladesh.
The smaller bio creatures of water, that is, small plants and animals of water are the planktons. Planktons are the natural food of the fish. The presence of sufficient plankton indicates good productivity of a pond. Planktons are of two types, such as-

1. Phytoplankton.
2. Zooplankton
**Phytoplankton:** Small aquatic plant animals are called phytoplankton. They are green in colour. Phytoplankton's are natural food of fish. Such as-Diatom, Volvox, Spyrogyra etc. Excessive growth of phytoplankton hinders the certance of sunlight into the water of the pond.

**Zooplankton:** Small aquatic animals are called zooplankton. Such as-Daphnia, Rotifera etc. Zooplankton's are natural food of fish.

**Insects:** Different types of insects live in the water and clay mud at the bottom of the pond. These are the food of fish and included in food cycle. Such as-Grubs of water hopper.

**Preparation of the Pond**

Fish culture is a cultivation process same as done in the case of crop production. As in the case of crop production, land is prepared by ploughing, irrigation, application of fertilizers etc. before plantation of seedlings. The pond has also to be prepared in the same process before releasing fish fries. The following steps will have to be followed in order to prepare a pond.

1. Pond excavation
2. Clearing out of weeds
3. Removal of voracious predator and unwanted fish
4. Application of lime
5. Application of fertilizers
6. Observation of natural food of fish in water

**Excavation or Repairing of Pond**

Excavation work of pond is the first step of pond preparation. The following are the excavation works of a pond.
Removal of Clay Mud.
If there is excessive clay mud at the bottom of the pond, then there are possibilities of remaining poisonous gas, harmful bacteria and insects. In order to improve the environment of the pond 20-25 cm. of mud should be kept at the bottom and the excess or additional mud will have to be removed. The clay mud can be removed by drying the pond.

Repairing of the Bank
If the bank of the pond is broken, fish may be going out or the pond during rainy season and at the same time unwanted and predator fish can enter into the pond which will ultimately create trouble for fish culture. For this reason the broken bank should be repaired during dry season and grass should be planted there. This will help to make the bank hard. The bank should be raised up to such height that it might not be inundated during flood.

Clearing out Weeds
The weeds extract nutrients from the fertilizers used in the pond and thus decrease natural food production of the fish. This hinders normal livelihood of fish. Weeds can be cleaned by the following methods.

1. **By Using Physical Labour:** The floating and movable weeds, such as water hyacinth, helencha, kalmilata, dal etc. can easily be removed by using physical labour.

2. **Biological Method:** After storing fish fries in the pond submerged weeds may grow. In order to control these weeds and make the environment proper the biological method is very appropriate. Grass carp and Rajputi lives on grass. If these fish are stored in ponds they can eat the submerged weeds and keep the pond environment.

3. **By Using Chemical:** Presence of excessive green algae in the pond creates hindrance to the livelihood of the fish. Fish may even die for want of oxygen due to presence of excessive moss or algae. Excessive green algae can be controlled by using 35 gm of copper sulphate per decimal for 1 metre depth.

Removal of Predator and Unwanted Fishes
The predator fish decreases the production of fish by eating the cultured fish fries and fish food. Shol, Gajar, Chital Taki etc. are predator fish. Predator and unwanted fish can be removed from the pond by the following 3 methods such as -
1. **By Drying out the Pond:** After drying out whole water of the pond, the predator and unwanted fish can be removed by catching all fish. There are possibilities of remaining predator fish and harmful creatures in the mud by hiding. When the bottom of the pond is well-dried in the sun then the harmful insects and germs are killed and productivity of the pond is increased.

2. **By Casting Net:** When the water of the pond is less predator and unwanted fish removed by casting nets again and again. Net casting should be done slowly by tying bricks or other heavy materials with the lower portion of the net.

3. **By-Using Chemical Materials:** It is not always possible to dry out a pond. Again by net caste also complete removal of predator fish, may not be possible. In such cases predator and unwanted fish and other harmful creatures, are removed by using chemicals like rotenon, phostoxin, bleaching powder etc. Here the method of usage and doses of some chemical materials are given below:

<table>
<thead>
<tr>
<th>Name of the material</th>
<th>Doses per decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotenon</td>
<td>30-35 gm</td>
</tr>
<tr>
<td>Phostoxin</td>
<td>30 gm (1 tablet)</td>
</tr>
</tbody>
</table>

After blending rotenon with water and preadling, phostoxin tablet to the pond and net castings are to be done twice or thrice. After one hour fish will be, seen to float on water, These are to be caught by pulling net.

**Application of Lime**

Lime purifies the water of pond. It is essential to apply lime to the fish culture pond. Lime supplies essential calcium for fish. It decreases acidity of the soil and water and increases alkalinity. As a result it increases fertility of water and soil. Lime destroys harmful insects and germs of diseases.

**The Doses of Lime Application:** The dose of lime application depends on the existing organic matter of the soil. Such as, red and brown coloured soils are acidic in nature. In these types of soil lime should be used in more amount than normal doses.

The dose of lime application depends on pH value of the soil. Here the doses of lime application on the basis of pH value of the soil are given below:
Quantity of lime on the basis of soil characteristics

<table>
<thead>
<tr>
<th>Soil pH</th>
<th>Condition of soil</th>
<th>Quantity of lime (kg/decimal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4</td>
<td>High acidic</td>
<td>10</td>
</tr>
<tr>
<td>4-4.5</td>
<td>Acidic</td>
<td>5</td>
</tr>
<tr>
<td>4.6-5.5</td>
<td>Medium acidic</td>
<td>3</td>
</tr>
<tr>
<td>5.6-6.5</td>
<td>Light acidic</td>
<td>2</td>
</tr>
<tr>
<td>6.6-7.5</td>
<td>Almost neutral/Light alkalin</td>
<td>1</td>
</tr>
</tbody>
</table>

Method of Lime Application: Lime should not be spread directly to the pond. Quick lime is to be soaked with water in a pan or drum and when it becomes cold, it is to be spread throughout the pond. Quick lime is more effective than powdered lime.

Application of Fertilizer: Fish production depends on the production of excess phytoplankton, nitrogen, phosphorus, potassium etc. are required. Water does not always have these materials. Besides these, the quantity of nutrient elements is decreased by fish collection, change of water and other natural reasons. That is why fertilizers are used to provide these necessary elements.

Fertilizer are of two types, such as -

1. Organic manures
2. Inorganic or chemical fertilizers

1. Organic manures: The manures derived from animals and plants are called organic manures. Such as cow-dung, excreta of poultry birds, compost, green manure etc.

2. Inorganic or chemical fertilizers: The fertilizers manufactured in mills and factories by chemical procedures are called inorganic or chemical fertilizers. Such as Urea, Triple super phosphate(TSP), Muriate of potash(M.P) etc.

Doses of fertilizers in Pond: Doses of fertilizers depend on the characteristics of the soil and nature of the pond. For examples, ponds of sandy or clay types require more fertilizers than sandy loam soil. Again the old ponds have much organic matters at the bottom, so they require less quantity of fertilizers. But application of more fertilizer is required in case of newly excavated or repaired pond.
Fertilizers are to be applied in two stages to the pond

1. Fertilizers are to be applied at the stage of pond preparation before stocking of fish fries.

2. Regular application of fertilizers are to be done after storing of fish fries upto collection of fish.

Application dose of fertilizers to ponds

<table>
<thead>
<tr>
<th>Name of Fertilizers</th>
<th>Quantity/Decimal</th>
<th>During preparation of pond (once)</th>
<th>After storing fries (Daily)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow-dung</td>
<td>5-7 kg</td>
<td>150-200 gm</td>
<td></td>
</tr>
<tr>
<td>Poultry excreta</td>
<td>3-4 kg</td>
<td>50-100 gm</td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>100-150gm</td>
<td>8-5 gm</td>
<td></td>
</tr>
<tr>
<td>TSP</td>
<td>50-75 gm</td>
<td>1-2 gm</td>
<td></td>
</tr>
<tr>
<td>Mp</td>
<td>10-15</td>
<td>0.5-1.0 gm</td>
<td></td>
</tr>
</tbody>
</table>

Method of fertilizer Application: Required quantity of fertilizer is to be kept in a pot and soaked with water three times than that of fertilizer during the previous evening. Next morning the soaked fertilizers are to be mixed with water and then to be spread to the pond.

Testing the presence of Natural Food of Fish in Water: Water enriched with abundant natural food will show light green or brown colour. After 5-7 days of application of fertilizers water of the pond is to be kept in a transparent glass and placed in sunlight. If small green or brownish insect like granular materials are visible, it is to be ascertained that the water has got natural food. In this condition the pond becomes ready for releasing fish fries.

Culture of Fries of Rui: The method of producing fries or fingerlings by releasing hatchlings are called fry culture or fry nursing. The pond where hatchings are released and reared upto fry condition is called nursery pond. And the pond where fries are nourished to produce fingerlings are called rearing pond. In our country generally fingerlings are produced by releasing hatchlings.

Management of Nursing Pond: The mortality and growth rate of fish fries in nursing pond depend largely or proper management: The important steps of this management, are described below-
**Selection of Pond:** The size of the nursing pond should be 10-15 decimals. The bank should be raised. There should not be any tree on the bank. It would be, good if there are opportunities of drying out pond waters or supply of fresh water, the water bodies of small sizes having low depth of water during fry production season or during the whole year, can be used as nursing ponds.

**Depth of Water:** At hatching stage the fries become very delicate, so if the fries are released to a pond of deep water they will die. For this reason the nursing pond should have a depth of 1-1.5 metre.

**Preparation of Pond:** Preparation of pond includes making the pond suitable for living of the fries and managing necessary food production for the growth of the fries. The pond has to be prepared as discussed earlier. Afterwards the harmful aquatic insect will have to be controlled.

**Control of Harmful Aquatic Insect:** Before the hatching are released the pest aquatic insects are to be removed. These can be controlled by polling mosquito nets of small loops or the following chemical materials can be applied for complete eradication of the harmful aquatic insects.

1. Dipterex
2. Kersoene or diesel

**Application of Dipterex:** Dipterex is to be, applied of the rate of 35 gm per decimal for 1 metre depth of water. The required amount of dipterex should be mixed with water and then to be sprinkled throughout the whole pond 24 hours. mixed with water and then to be sprinkled throughout the whole pond 24 hours before releasing the fries. By way of doing this the harmful aquatic insects will be fully removed.
Supply of Supplementary Feed

The fries are not fully nourished by natural food. For this reason supplementary food needs to be supplied daily to the frie in addition to the natural food. Fine rice bran, wheat husks, mustard oil cake, fish meal and blood of domestic animals can be supplied, as food. Here under the ratios of some mixed food fishes are given.

<table>
<thead>
<tr>
<th>Food in gradients</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mustard oil cake + Blood of animals</td>
<td>1:1</td>
</tr>
<tr>
<td>Mustard oil cake + Bran + Blood of animals</td>
<td>5:3:2</td>
</tr>
<tr>
<td>Mustard oil cake + Bran + Fish meal</td>
<td>4:3:3</td>
</tr>
</tbody>
</table>

Food is to be prepared after mixing the ingredient very well as per the ratio. The prepared food should be sprinkled daily to the pond. From 1 day after stocking of fries in nursing pond food is to be supplied as per following rate.

<table>
<thead>
<tr>
<th>Time</th>
<th>How many times of the weight of fries</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>10 times</td>
</tr>
<tr>
<td>Second</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>15 times</td>
</tr>
<tr>
<td>Third</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>20 times</td>
</tr>
<tr>
<td>Fourth</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>25 times</td>
</tr>
<tr>
<td>Fifth</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>30 times</td>
</tr>
<tr>
<td>Sixth</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>35 times</td>
</tr>
</tbody>
</table>

The required food is to be divided in to two and to be applied in the morning and in the evening.

Examining Mortality and Growth Rate of the Fries

With 7-8 days of stocking fries casting gunny-net should not be done. Once after 8-10 days and then after every 10 days mortality and growth rate the fires need to be examined by casting mosquite net.

Nursing

When the colour of the water become excusive green or there is green layer on the top portion of the water, then supply of fertilizers and food should be stopped temporarily. If the management system as discussed is followed properly then the size of the fries will become 5-10 cm. (average weight 10 gms) within 2 months. Its ability rate can also be kept above 60%. Fries of this size are suitable for sale. As finger lings and can be released to stocking pond.
Identification of Fries of Different Types of Fish.

**Rui:** The body is somewhat elongated. Black round shaped spots, are present at the base of the tail. The margin of the fin is light reddish. The upper lip is extended at the front and notched.

**Katla:** The head is bigger as compared to the body. Round black Katla spots are not present at the base of the tail. The dorsal, caudal and anal fins are of grey colour. He mouth is broad, the lip is thick but not notched.

**Mrigel:** The body is slender and elongated. There are rectangular black-spots at the tail base of the tail. There are tape-like light black marks covering the whole length of the body. The caudal fins are red colour, lips are equal and there is a barble. The mouth is curved downward.

**Silver carp:** It looks like chapila, The body is flat the colour is bright white and the fins are of grey colour. The dorsal fin is small.

**Common carp:** The body is broad and of light golden colour. The dorsal fin is spread almost the dorsal tail. The head is small, the dorsal side of the fish is raised. There is a hard spine at the dorsal fin. There are two pairs of barble at the lips.
Pisciculture at the Stocking Pond

Pisciculture is a profitable investment. Different culture practices have been developed depending on the cultures of different regions, availability of inputs, knowledge about technologies and marketing facilities. The methods of pisciculture in ponds can be divided into three such as –

1. Traditional method of pisciculture.
2. Semi-intensive method of pisciculture
3. Intensive method of pisciculture

Traditional Method of Pisciculture

In this method some fish fries are released in pond. Neither, fertilizer nor food are supplied to the pond. The fish maintains their liveligood by eating natural food produced at the fertility of the water and soil. No other nursing practices are done.

Semi-Intensive Pisciculture

Pisciculture by preparing pond properly, stocking fries on the basis of varieties and number partial application of fertilizers and supplying food occasionally is called semi-intensive pisciculture. In this method different varieties of fries are released in definite number in order to utilize the natural food at different layers. Fertilizers are applied in order to meet up the demand for natural food and more over some supplementary food are also supplied.

Intensive Fish Culture

The method of pisciculture by proper pond preparation, stocking of right number of healthy fries on the basis of varieties, regular application of fertilizers in order to supply sufficient natural food, supply of required quantity of supplementary food for balanced nutrition control of water characteristics and ensuring improved management practices is called intensive fish culture. It is aimed at achieving more production form a pond within a shortest possible time. In this method fish production can be achieved to highest productivity of the pond by adopting appropriate technologies.

Mixed Culture of Carp Fish

Rui, Katla, Mrigel, Kalibaush, Silver carp, Grass carp, Common. Carps are called carp fish. These types of fish eats foods from different layers of the pond. Fish of
different varieties are cultured in a same pond in order to get increased production by completely utilizing natural food produced in different layers. This type of fish culture is called mixed culture. Fertile land, and water, sufficient sunlight, healthy fries, fertilizers, supplementary food and good nursing are required for successful pisciculture.

The systematic steps for mixed carp culture are discussed as under-

1. Selection of pond.
2. Preparation of the pond.
4. Application of fertilizer
5. Supply supplementary food
6. Appropriate nursing

**Selection of pond**

At the time of selection of the pond the things needed to be considered are place soil characteristics, depth of water, size volume, environment etc. During the selection of pond it is to be seen that the pond is very near to dwelling houses, this will help timely supply of food and fertilizers. Ponds ranging form 30 decimal to 1 acre of size are more suitable. There should not be big trees or bushes or shrubs on the bank of the pond. The leaves of big trees fall into the pond and spoil its water. Predators and other harmful animals can live in the bush. Loam type of soil is the best for pisciculture.

**Preparation of pond**

For mixed culture of carp fish pond is to be prepared as per the method discussed earlier.

**Stocking of Fries**

Healthy strong fries are the precondition for increased production. Fries are to be stocked after growing sufficient natural food in the pond, Fries of 8-12 cm. are to be stocked in the pond. Of different varieties. of fries should be of similar size.
Number of Fries: The number of fries may be more or less depending on the management. In general, mixed culture of carp, the fries should be stocked as per following rates.

<table>
<thead>
<tr>
<th>Water layers</th>
<th>Species of fries</th>
<th>Number/Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper layer</td>
<td>Katla</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Silver carp</td>
<td>8</td>
</tr>
<tr>
<td>Middle layer</td>
<td>Rui</td>
<td>8</td>
</tr>
<tr>
<td>Lower layer</td>
<td>Mrigel</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Mirror carp/Karpeo</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>Grass carp</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Rajputi</td>
<td>3</td>
</tr>
</tbody>
</table>

The member of fries may be increased proportionately if the supply of balanced food and improved managements are ensured.

Application of Fertilizers

After stocking fries fertilizers should be applied to the pond regularly or one day in a week up to the time of fish harvest in order to supply sufficient natural food in water. It is better to apply fertilizers everyday for getting increased production. This will incur less cost too. Fertilizers are to be applied to the stocking pond as per the following rates:

<table>
<thead>
<tr>
<th>Name of fertilizers</th>
<th>Amount / Decimal/ Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow-dung</td>
<td>150-200 gm</td>
</tr>
<tr>
<td>or Poultry exercta</td>
<td>90-150 gm</td>
</tr>
<tr>
<td>Urea</td>
<td>3-5 gm</td>
</tr>
<tr>
<td>T.S.P.</td>
<td>1-2 gm</td>
</tr>
<tr>
<td>MP</td>
<td>0.5-1 gm</td>
</tr>
</tbody>
</table>

Supply of Supplementary Food

The food supplied to the fish of the pond from outside is called supplementary food. Fish are not well-nourished by only natural food. For this reason fish is to be supplied...
with balanced food daily in measured amount. Balanced food for fish can be prepared with the following ingredients:

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice bran</td>
<td>50%</td>
</tr>
<tr>
<td>Mustard oil cake</td>
<td>45%</td>
</tr>
<tr>
<td>Molasses</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Process of Preparing Food**: The measured amount of mustard oil cake is to be soaked in a pan for 10-12 hours. Then the soaked cake, bran and molasses are to be mixed together and small round balls will have to be prepared with the mixture.

**Determination of Quantity of Food**: If there is sufficient natural food in the pond, then in case of carp fish, supplementary food is to be supplied at the rate of 3 percent of the total weight of the stocked fish of the pond. During winter 2 percent will be enough.

**Method of Supply of Food**: The required quantity of food is to be divided into two and to be supplied in the morning and in the evening. Food will not be wasted or spoiled if it is supplied at a definite time and in the definite place daily. Necessary food is to be kept in a basket or a earthen pot and will have to be hung under the water with the help of a bamboo stick. Food is to be supplied at different places at the same time. This will prevent competition for food.

**Nursing or After Care**
To examine growth, health, and diseases of fish they are to be observed by net casting once in every month. The dissolved oxygen and carbon dioxide and phytoplankton and zooplankton in water are the controlling factors for aquatic environment. That is why their quantity are to be regularly observed. As discussed earlier, the amount of natural, food in water can be known by determining transparency of water: If 1-2 ml plankton is obtained by sieving through net 100 litres water. Then it is to understand that the pond has got enough natural food.

**Harvest of Fish**
Harvest of fish is an important thing of pisciculture. Fish grows rapidly upto a definite age. Afterwards although food consumption is gradually increased, but physical
growth does not take place at that proportion. So timely fish harvest is of great importance. Rui, Katla, and Mrigel become 700 gm. to 1.5 kg. within 8-12 months. Silver carp, Mirror carp and Grass carp become 1-1.5 kg within 6-7 months. After 6-7 months of stocking of fries the big fish are to be caught and sold out. At the same time same number of fries of same variety are to be released to the pond. By this, increased production can be achieved.

**Some Problems of Pisciculture and their Remedies - Green coverlet on water**

When the water of the pond remains dark green for long time or develops a green coverlet on water, supply of food or fertilizers is to be stopped temporarily. These coverlets are developed for excessive natural food. When such coverlet is created fish may die for want of oxygen.

**Gasping of Fish**

Fish tends to gasp when there is want of oxygen in the pond. In this condition if the water is disturbed by bamboo beating or by swimming, good result can be achieved. The amount of oxygen can be temporarily increased by sprinkling water in the pond like a fountain with the help of a pump. The want of oxygen can be removed by applying potassium permanganet at the rate of 100 gm for 1 metre depth of water per decimal.

**Examining Food Intake**

The places of food supply should be intermittently checked to become sure whether the supplied food has completely been consumed by fish.

**Muddy Water**

If the water of the pond remains always muddy fish production will be decreased. As a remedy 1 kg of lime per decimal is to be applied. The muddy problem can also be solved by keeping bundless of straw at a corner of the pond.

**Diseases of Fish**

Fish may be attacked by different diseases. Such as fin rot, lice, dropsy etc. Necessary treatment measures are to be undertaken after diagnosing these diseases.

**Culture of Shing and Magur**

Shing and Magur are very tasty fish. Their nutritive value is high. These fish has got
great demand in the market for their taste and for wide use as diet of the patients. These are omnivorous fish. The food of shing and magur are larvae and pupa of insects and mites, zooplankton and decomposed organic matter.

![Magur](image)

Shing and Magur are available in all the countries of South-west Asia and Africa including Bangladesh. In our country Magur may be 30-45 cm in length. Shing and Magur can be cultured in all types of ponds, small or big. But shallow and small ponds are well-suited for their culture. 2-3 metre depth of water is good. The pond may be measures from 200 sq. metre to 4000 sq. metres.

The bank of the pond may be vertical. It will be better if 30 cm brick made vertical wall or bamboo made fence can be erected on the bank of the pond. The pond for Shing and Magur is to be prepared in the same way as done in case of carp fish.

The fries of Shing and Magur can be collected from natural sources. Fries of country Magur are also available at some government and non-government farms.

In cases of Shing and Magur culture, 200-300 fries can be released for every 40 sq metre. Small amount fertilizer is applied to their ponds, if cow-dung is applied at the rate of 1 kg. per 40 sq. metre after every 7 days, then good result can be achieved. In this case rice bran, mustard oil cake and fish meal can be supplied as food. Food is to be supplied every day at the rate of 3-5% of the total body weight of fish. But from the third month of culture the entrails of cows and goats can be supplied after cutting them.

If supply of food and nursing are done regularly then in 6 months Magur can attain 130-150 gm, and a Shing 100-125 gm in weight. A harvest of Shing and Magur can be obtained in 6 months. In every harvest, production of 3-4 tons per hectare can be achieved.
Practical

Subject: 1. Determining quantity of fertilizers for application to the pond.

Materials
1. Measuring tape 2. Different types of fertilizers

Steps of Work
1. Go to the bank of a pond. Measure the length and breadth of the pond in metre with the help of the tape and write down on the notebook.
2. Multiply the length with breadth. Determine the volume of the pond in decimal by dividing the product of multiplication by 40.
3. Determine the total amount of urea on the basis of dose.
4. Determine the amount of cow-dung.
5. Determine the amount T.S.P. fertilizer.
6. Determine the amount M.P. fertilizer.
7. Write down the volume of the pond, names and quantity of fertilizers.
8. Draw a diagram on the basis of size and measurement of the pond.

Subject -2: Observation of aquatic plants and zooplankton of a pond.

Materials:

Step of Work
1. Go to the bank of the pond. Bring the floating and submerged weeds by pulling them with the help of a stick. Take the weeds into the bucket.
2. Bring water with the bucket from the pond and sieve through a plankton net. In this way bring about 100 litres of water from different places of the pond sieve through the plankton net.
Now pour out the plants and zooplankton, collected in the bottle at the end of the plankton net, to a beaker.

3. Observe the quantity of plankton in the beaker and bring the collected materials to the laboratory of the school.

4. Now take two drops of water from the beaker of plankton with the help of the dropper and put on a slide. See these though a microscope. Observe the phytoplankton and zooplanktons.

5. Observe the big weeds and classify those.

6. Draw diagrams of all the materials in the practical note book and label.

**Subject 3: Identification of culturable fries**

**Materials:**

1. Fries of Rui, Katla, Mrigel, Silver carp, Common Carp. Nilotica and Sarputi.
2. Practical notebook
3. Magnifying glass
4. Tray
5. Bucket
6. A piece of paper
7. Pencil etc.

**Steps of Work**

1. Go to a near by farm. Collect some fries from there and after taking those into the bucket cover them and bring to the school.

2. Put 4 fries on a tray. (If the fries tend to flounce you will be able to kill them by immersing into salt-water mixture).

3. Now examine the fries minutely. Observe their heads, mouth, bodies, fins, colours, scales etc.

4. Compare with the description of the text-book. Identify the fries as to what varieties they belong to and write down the characteristics.

5. Now draw diagrams of the identified fries. Mark the parts and write down the names of the fries.
Exercise

Multiple Choice Questions

1. Which factor is more important for producing natural feed of fishes in the pond?
   a. Dissolved carbon dioxide  b. Depth of water
   c. Transparency of the water  d. Sunlight

2. Which of the figure given below is of zooplankton?
   a. Fig -1  b. Fig -2
   c. Fig -3  d. Fig -4

Read the paragraph below and give answers to questions 3 and 4.

One day, the sky was cloudy from the morning. In the big pond near the house of fish farmer Rahim, the fishes suddenly started humming from 9.00 a.m.

3. Suddenly the fishes started humming, because of-
   i. absence of sunlight
   ii. thunder sounds
   iii. devoid of photosynthesis in the aquatic plants.
Which one is correct?

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

4. What should be done immediately to protect the fish in the pond?

a. Informing the Upazila Fisheries  
b. Informing the police  
c. Spraying water in the pond by pump like sprinklers  
d. Turning the pond water beating on the surface by bamboo.

Creative Questions

Mr. Santu of the village Govindaganj started fish fry cultivation for the first time in pond having the depth of 2.5 meters. He could not inspect the pond last two days due to torrential rain. The third day morning while he was visiting the pond, observe he that some of the tiny fish fries died and floating on the surface of the water. At this situation Mr. Santu immediately rushed to the Fisheries Officer. The Fisheries Officer then inspected his pond and gave him some important advice. Mr. Santu planned to prepare two separate fish-nursery ponds.

a. What is plankton?

b. Explain the main cause of death of the fish fries in the pond of Mr. Santu.

c. How did Mr. Santu prepare the new ponds?

d. Evaluate the slogan- ‘He Who catches jatka, catch him’

or

Analyze the slogan “Prepare model pond and produce more fishes”
Chapter Three

Shrimp Culture

Shrimp is an important fisheries resource. It is joint footed invertebrate aquatic animal. Out of the quantity of fish and fish products that are exported every year 90% is shrimp. Take 3352.89 crore was earned during 2006-2007 by exporting fish and shrimp. Out of this, the amount earned from shrimp is TK 2992.33 crores. At that time, the quantity of fish and fish products exported was 73,704 thousand metric ton. Out of these, the quantity of shrimp was 53,361 thousand metric ton.

Prospect of Shrimp Culture

There are 2.20 Lac hectares of land suitable for culture in coastal region of the southern part of the country. Out of these; shrimp has been cultured in almost 1.10 Lac hectares of land in traditional method, where annual average production per hectare was only 180-200 kg. During 2006-2007 the average production per hectare in a year has gone up to 399 kgs. This is very low in comparison with other countries. In one season (6 month) 5-6 tons per hectare can be produced if it is cultivated in-semi intensive system. Recently this system of cultivation has been followed in some shrimp farm of the country. If this system is extended, it will be possible to earn a few thousand crores taka of foreign exchange every year by exporting shrimp.

Galda Shrimp

Introduction of Cultivable shrimp

There are 60 species of shrimp in the reservoirs of water of Bangladesh. Out of these only a few species are profitable for cultivation. Galda prawns are cultured in fresh water. This type prawn becomes very big. One Galda can weigh up to 250-400 gm.
Out of saline water shrimps the Bagda shrimps are widely cultivated in coastal region. It is known as "Black Tiger". Chaka shrimps can also be cultivated in saline water.

**Culture of Galda Prawns**

**Habitat:** Galda lives in fresh water

**Physical Characteristics**

Galda looks like green to almond or blackish colour. 2-5 blackish crosswise belt can be found on the carapace. The rostrum is long and curved and notched in lower side. The number of notches, in case of male Galda the number of upper side and 11-14 in the lower side. In case of female Galda the number of notches is 12-13 in the upper side and 5-7 in the lower side. The cephalothoraxes of the prawn is large. The legs of Galda are long. The first and second pair of legs are spiny. The second pair of legs of male Galda is longer than that of female lobster.

**Bagda Shrimp (Tiger Shrimp)**

**Habitat:** Bagda. shrimp lives in saline water.

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Bagda Shrimp

**Physical Characteristics**

The colour of the Bagda is light almond of green. Its body has black strips like tiger. So it is called Black Tiger.

Red stains can be found from the front to the end of the, body of the, young Bangda. The colour of these stains in bigger fries light green. The rostrum of Bangda Shrimp is curved and wide. It has got 8 notches in the upper side and 3 notches in the lower side.
Chaka Shrimp

**Habitat:** This shrimp also lives in saline water.

**Physical Characteristics**
The young Chaka shrimp is light white and the tip of the rostrum is pinkish. The rostrum of the adult shrimp is erect and curved. It has got 8-10 notches in the upper side and more than 3 notches in the lower side.

**Farming with Galda Shrimp**
Galda can be cultured in the pond singly of with Ruhi, Katla as mixed culture. Here single farming of Galda is discussed.

**Selection of the Pond**
As the pond of shrimp culture requires availability of plenty of oxygen, the water of the pond needs to be changed off and on. For this, the pond area has to be selected near rivers, canals of tube wells. Loam, clay loam or clay soils are suitable of shrimp culture. There should not be big trees on the bank of the pond so that enough sunlight can enter into the pond. The area of the pond should be from 10 decimal to 1 acre-and the depth should be 1-1.5 metre.

**Preparation of the Pond**
First of all the pond should be dried. By doing this, the predator fish and other unwanted fish will be eradicated. As a result of entering sunrays to bottom of the pond poisonous gas and germs of diseases will be destroyed If the pond cannot be dries, rotenon at the rate of 3 gm. per cu metre may, be applied to eradicate the predator fish.
After predator fish are eradicated, lime at the rate of 1 kg per decimal should be applies. After 5-7 days of application of lime cow-dung at the rate of 5 kg/decimal or poultry excreta at the rate of 3 kg/decimal, urea 100 gm. TSP 50 gm. and MP 20 gm should be applied. One day after application of fertilizers the poisonous gas has to be removed by pulling "Harra"

**Stocking of Prawn Fries**

Usually 5-7 days after application of fertilizer when the colour of the water becomes light green prawn fries should be released, the number of fries to be stored depends on fertility of the soil of the pond, quality of water, supplementary food and management. In case of single culture of Galda under general management 10,000 fries can be released per acre. Fries can be stored at higher rate if good water management and balanced diet is ensured, Transportation of prawn fries and releasing system in the pond are as like as carp fish as mentioned in the previous chapter.

**Supply of Supplementary Feed**

Total nutrition can not be available from the natural food produced as a result of application of fertilizer. Supplementary food should be supplied for their quick growth and nourishment. Really the success of prawn culture depends on the supply of supplementary feed. The different ingredients and their quantity are given below to prepare 1 kg supplementary feed.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice barn or wheat husk</td>
<td>500 grams</td>
</tr>
<tr>
<td>Mustard oil cake</td>
<td>150 grams</td>
</tr>
<tr>
<td>Dried fish ground fish meal</td>
<td>1250 grams</td>
</tr>
<tr>
<td>Dust of the shell of snails and oysters</td>
<td>95 grams</td>
</tr>
<tr>
<td>Salt</td>
<td>3 grams</td>
</tr>
<tr>
<td>Vitamin mixture</td>
<td>2 grams</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000 grams or kg.</strong></td>
</tr>
</tbody>
</table>

**Amount of Daily Food Supply**

Food should be supplied daily the rate, 4% of the total weight of the stored prawn. The required food should be given in the evening. Depending on the age of the prawn the daily requirement of food 1000 young prawn is given in the following list.
<table>
<thead>
<tr>
<th>Age of prawn</th>
<th>Daily requirement of feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>First month</td>
<td>15 grams</td>
</tr>
<tr>
<td>Second month</td>
<td>75 grams</td>
</tr>
<tr>
<td>Third month</td>
<td>250 grams</td>
</tr>
<tr>
<td>Fourth month</td>
<td>400 grams</td>
</tr>
<tr>
<td>Five month</td>
<td>1 kg</td>
</tr>
<tr>
<td>Sixth month</td>
<td>2 kg</td>
</tr>
<tr>
<td>Seventh month</td>
<td>2.5-3.0 kg</td>
</tr>
</tbody>
</table>

**Application of Fertilizer**

Fertilizer should be applied to the pond to supply natural food in addition to supplying supplementary food. After every two weeks cow dung 15 kg, urea 6 kg, TSP 2.5 kg, and M.P. 1 kg. Per acre should be applied. These fertilizers should be soaked in water, 3 times in quantity of fertilizer in a pot. For 12 hours and then, after mixing properly should be spread in the pond after 2-3 hours of sunrise.

**Establishing Shelters**

The prawn becomes weak after they change their sloughs. At this there is apprehension of attack by other creatures. For this reason some leafless branches of trees and bamboo may be fixed in the ground of the pond. Shrimps take their shelters in those places.

**Prawn Collection and Marketing**

Generally prawns become suitable for marketing within 6-7 months. When 10-15 prawns weigh 1 kg. Then can be sold out. Using nets of wider loops can catch big prawns. The suitable time for catching prawns are during the time of full moon and having new moon. This time the sloughs become hard. During collection of prawns those should be kept with ice under shade and to be sold out quickly.

**Production**

Production of Galdas at the rate of 8-10 kg per decimal is possible if cultivated as per above-mentioned management.

**Shrimp Culture in Coastal-Areas**

There are vast coastal areas in the southern part of Bangladesh. This area extends from Satkhira to Cox's Bazar.
3 methods of shrimp culture are followed in the coastal regions-
1. Traditional method of culture.
2. Improved light culture.

**Traditional Method of Culture**
Culture together of the fries of shrimps and fish those come, with of tide in the coastal embankments areas is called traditional method of shrimp culture. Per decimal production, in this case, is about 700 gm. Such type of culture does not require change of water, supply of food or fertilizer. The duration of culture is 5-6 month and the area of the farm is 40-50 hectare.

**Improved Shrimp Culture**
Culture of shrimps like Bagda, Chaka etc. in saline water after controlling predator fish and other unwanted creatures is called improved light culture. In this case water is filtered through a net place in the mouth of the enclosure during high tide. The water has to be, changed off and on. The enclosure prepared by applying lime and fertilizer and afterwards food is supplied. This system is also called improved traditional method.

**Semi-intensive Shrimp Culture**
In this method fishes are cultured after controlling predator fish, the detrimental, creatures and other lives. Bagda fries are released at the rate of 7500- 15000 numbers per acre and nursed. In this case management like pond preparation, release of good young shrimps, application of required food, change of water and supply of oxygen to the water are done. This type of farming produced shrimps up to 20 kg per decimal.

**Shrimp Culture in Enclosure (Gher) by Improved Shrimp Culture Method**
It is not possible now to introduce semi-intensive or intensive culture method in the extensive areas of shrimp, culture. So attempts have been taken to increase production by improving the traditional, method of culture. This type of culture is called improved light culture.

Generally, shrimp culture is practice in big enclosure of saline water in the embankments of the southern coastal region. For effective management the big enclosure is divided into small ponds of 2-3 acres each by making ridges. This type of
pond is called enclosure of "Gher". In improved light culture method an arrangement for setting net in the entrance of the 'Gher' has to be done to avoid entry of predators or unwanted fish. The environment of the 'Gher' can be kept well if the depth of water of the 'Gher' maintained at 0.80-1 metre, After preparing the 'Gher'. by controlling predators and applying lime and fertilizer young Bagdas fries are stored. Generally young, shrimps Bagdas are stored during the month of February; Young Bagdas are stored up to 200 numbers per decimal. After storing the fries supplementary food is supplied at the same time natural food is also ensured by applying fertilizers. The water has to be changed every month to maintain the quality of water salinity and environment of the 'Gher' in right condition.

Following this method of culture 8-10 kg of Bagda shrimp per decimal can be produced in 7-8 months.

**Practical**

**Subject: Identification of Galda and Bagda Shrimp**

**Materials**

1. Galda and Bagda shrimp.
2. Tray
3. Forcep
4. Magnifying glass

**Steps of Work**

1. Collect Galda and Bagda from a market or farm bring carefully.
2. Keep the shrimps on the tray. Observe minutely its organs through magnifying glass.
3. Observe different characteristics of the shrimp such as the sizes of legs the marks on carapace, colour, spots on the body, the number of notches on the rostrum etc, and identify the shrimp.
4. Draw the diagram of Galda and Bagda and mark the characteristics.
Exercise

Multiple Choice Questions

1. What should be the depth of water in the pond for culture of Galda Shrimp?
   a. 1.00-1.50 metres  
   b. 2.00-2.50 metres  
   c. 3.00-3.50 metres  
   d. 4.00-4.50 metres

2. Cultured in saline water-
   i. Chapda shrimp  
   ii. Galda shrimp  
   iii. Bagda shrimp

Which one is correct?
   a. i and ii  
   b. i and iii  
   c. ii and iii  
   d. i, ii and iii

Read the paragraph below and give answers to questions 3 and 4.
The feed elements required to prepare one kg of supplementary feed for shrimp are give below:

<table>
<thead>
<tr>
<th>Feed elements</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice/Wheat crush</td>
<td>500 gram</td>
</tr>
<tr>
<td>Mustard oil cake</td>
<td>150 gram</td>
</tr>
<tr>
<td>Fish meal</td>
<td>250 gram</td>
</tr>
<tr>
<td>Snail/Shell grounds</td>
<td>95 gram</td>
</tr>
<tr>
<td>Salt</td>
<td>3 gram</td>
</tr>
<tr>
<td>Vitamin mixture</td>
<td>2 gram</td>
</tr>
<tr>
<td>Total</td>
<td>1000 gram</td>
</tr>
</tbody>
</table>
3. If shrimp farmer has 2.00 kg of rice bran, then how much salt will be required for preparing a balanced feed?
   a. 08 gram  
   b. 10 gram  
   c. 12 gram  
   d. 14 gram

4. How much vitamin will be required to prepare 5 kg supplementary feed?
   a. 8 gram  
   b. 10 gram  
   c. 12 gram  
   d. 14 gram

Creative Questions
The young boy Firoz harvests fries of Bagda shrimp with the help of his old father on the sea beach of Cox's Bazar. The unskilled hand of Firoz and then releases these in his gher farm. Tajul applies fertilizers and changes water along with adding supplementary feed. But doing this entire thing he could not harvest satisfactory yield.

a. In how many ways can shrimp be cultivated in the coastal areas?

b. Explain the important reasons for changing the water of the gher.

c. Identify the cause of failure of shrimp culture by Tajul. what steps can be taken to become successful in shrimp culture?

d. The unskilled collection of fries is an obstacle to bagda shrimp cultivation—Give comments in favour of the statement.
Chapter Four

Diseases of Fish and their Control

Disease is developed in the body of the fish by the joint activities of germs of diseases and environmental persecution. Generally diseases of fish can be developed for the following reasons-

1. Change of physical and chemical characteristics of water.
3. Injection by germs of diseases.
4. Attack by parasites.
5. Storing of more fish than the specified number.

When the environment of pond becomes adverse or fish is attacked by diseases the following symptoms can be seen-

1. Swimming in unusual way
2. Floating on water and gasping
3. Wearing off of the fins or development of scars on the skin.
4. Come out of eyes.
5. Swelling or dropping off of scales.
6. Development of spots on skin, fins or gills or presence of parasites.
7. Small white threading things can be seen on the body.
8. Rottening or dropping off of wings.
9. The head being bigger in comparison with the body or swelling or squeezing off of the belly.
10. Lack of general luster of growth of the fish.

**Bacterial Diseases-**

**White Spot or Futki disease.**

This is a bacterial disease.
Symptoms of the Disease
Small white round spots or dots are seen on the head, dorsal side, fins. Additional slippery substance is deposited on the surface of the body. Fish moves slothfully and does not take any food. Heavily infected fish dies readily.

Prevention
During preparation of the pond proper quantity of lime should be used.

Treatment.
1. Potassium permanganate, at the rate of 100-150 gm per I metre, of depth in every decimal of the pond, should be sprinkled after mixing with water on.
2. The infected fish should be immersed for 30. minutes under 2-3% saline water of 1 minute in 5% ammonium solution and released in the pond.

Rottening of Fins and Tail
This is a bacterial disease

Symptoms of the Disease
Firstly white spots appear on the tail and fins of fish. The web of fins tear off. The fins and the tail decay off gradually, As a result, fish losses its balance, the colour becomes pale and ultimately dies.

Prevention
This disease can be prevented by previously applying 1kg salt and, 1 kg lime per decimal.

Treatment
1. The fins of the infected fish should be cut off and should be washed in 2.5% saline solution. Or
2. The infected fish should be dipped in to solution, of 0.5 gm copper sulphate in 1 litre of water, for 1 hour and released in the pond.
Dropsy or Swelling of the Belly
This is a viral disease.

Symptoms of the Disease
Some liquid substances deposited in one or more than one organ of the body of the fish. The scales become loose and swell. Water come out through the rectum if the belly, if pressed. Majority of the infected fish die.

Prevention
During preparation of the pond 1 kg lime per decimal may be applied.

Treatment
1. Fish infected by this disease can not be cured. At the initial stage, application of potassium permanganate at the rate of 2 gm per cubic metre of water of the pond gives good result.
2. Terramycin should be mixed with food the rate of 100 mg per 1 kg of food and this should be fed for 7 days.

Fungal Disease

Gill Rot Disease
This is a fungal disease. One type of fungus enters into the gills of fish and stops blood circulation. As a result, the supply of food and oxygen to the Diseases of Fish and their control external part of the gill the stopped.

Prevention
1. Deposition of excessive organic matter in the pond should not be allowed.
2. Lime should the applied at proper dose previously.

Treatment
Generally the fish infected by this disease dies. At the initial stage, the infected fish should be dipped in to a solution, of 5 mg. copper sulphate in one litre of water for 5 minutes and released in the pond, good result can be expected from.
Parasite Disease Lice of Fish

This disease develops by the attack of a type of parasite called Argulus. Argulus cannot be seen by naked eyes. Argulus sticks to the fins or body of the fish with sucker and sucks blood.

Symptoms of the Parasites

Sores develop on the body of the fish. Fungi and bacteria infect the sores. Infected fish moves with unnatural swift speed and begin to rub its body with hard things.

Prevention

The environment of the pond should be kept clean and pollution free.

Treatment

1. For every decimal of the pond 40 mg. dipterex should be applied for 1 metre depth. This should be applied twice in an interval of 7 days. Or

2. The infected fish may be dipped into 15-20 PPM formalin solutions and then released in the pond.

Virus Caused Disease

Fish Necrotic Disease or Sore Disease.

This disease is created at the primary stage by the viral infection and laterally by fungal or bacterial infection. It is a contagious disease. This disease develops in the adverse environment of the pond.

Symptoms of the Disease

Firstly spots can be seen on the body of the fish. Scales of the infected part drop off. The red spots gradually turn into big sore. The fish floats on the water slothfully...
swims very slowly. The infected fish dies within 10-15 days.

**Prevention**
The severity of this disease can be minimised by application of proper dose of lime during preparation of the pond.

**Treatment**
1. 1 kg. lime and 1 kg salt per decimal of pond will have to be applied in the infected pond.
2. The infected fish should be dipped into 5PPM malakhite solution for 15 minutes and then released in the pond.

**Malnutrition Diseases**
When a special type of mark or symptom develops on the body of the fish for want of a particular food nutrient then it is called diseases due to malnutrition. In case of fish shortage of protein and vitamin can be noticed vigorously.

Symptoms
The growth of fish is greatly related for want of protein. As a result, the head become big in comparison to its body, some parts of the body of the fish may be curved or crippled due to shortage of vitamins. The infected fish gradually dies.

**Treatment**
The fish should be fed protein, vitamin, mineral slat mixing in proper proportion with the supplementary food.
Practical

subject: Identification of fish diseases

Materials :
1. Diseased fish       2. One tray       3. Forceps-2 number

Steps of work
1. First of all keep-the diseased fish on the tray.
2. Observe the different parts of the body of fish.
3. Observe minutely the infected organ with magnifying glass.
4. Draw a diagram of the fish in the practical note book and mark the infected part.
5. Write down the symptoms and name of the diseases.

Exercise

Multiple Choice Question

Read the paragraph below and give answers to questions 1, 2 and 3.
The experienced farmer Alam one morning saw that a few fishes in the pond were running abnormally and rubbing their body with some hard material surfaces. Saying this, he immediately took measures as per suggestions given be the fisheries Officer.
1. Some fishes were moving with abnormal speed rubbing body with hard surfaces-
   Because:
   i. Oxygen become deficit in the pond water.
   ii. Sunlight over the pond become insufficient.
   iii. Fishes were infested by parasite named argulas.

Which one is correct?
   a. i   b. ii
   c. iii  d. i and ii
2. What advice was given to Alam by the Fisheries Specialist?
   a. To apply fertilizer in the pond.
   b. To apply lime in the pond.
   c. To arrange bamboo beating on the pond water.
   d. To apply dipterex at approved rate.

3. For what deficiency may the fish become physically abnormal?
   a. Protein
   b. Vitamin
   c. Carbohydrate
   d. Feed

Creative Questions

a. What is the name of the disease of the fig-A.

b. Explain the major symptom shown in the fig-B.

c. Mention the identifying characterisation of the disease of fig-A and -B.

d. "The fish diseases including the diseases mentioned in the figures above are constraints of fish cultivation in Bangladesh" Evaluate the justification of the statement.
Chapter Five

Fish Processing

With a view to maintain the taste and quality of fish the process of transport, action, after care and preservation of fish after those are collected from the pond is called fish processing. Fish is rapidly decomposable creature.

The decomposition of fish starts at a definite time after collection and this extends rapidly. So the quality fish starts decreasing soon after their collection starting from the catching of the fish some time passes in bringing those to the market, selling and making those suitable for eating by the consumers. Fish may be decomposed and become unsuitable for consumption if these are not preserved at this time. So in order to control the quality of fish the activities. Starting from collection up to consumption like transportation, taking care and preservation should be done most carefully. There are several reasons for destroying the quality of fish or influencing the decomposition of fish. Such as-

1. Keeping dead fish in unhygienic environment.
2. Not using ice for preservation of fish in low temperature after collection
3. Using unhygienic or polluted water for washing fish
4. Utilising uncleaned transport, using small amount of ice and having no knowledge about the use of ice.
5. Having no facilities for marketing including proper transportation.

Importance of Fish and Shrimp Processing

The role of fish and shrimp are very important in the economy of Bangladesh. In the export earning the contribution of fish and shrimp occupy the third position. During 2006-2007 financial year, Foreign exchange of 3352.89 crore taka was earned by exporting fish, shrimp and fishery products and these amount was about 5% of the total export earning. The production of fish and shrimp has increased as a result of taking proper steps and at the same time the demand for quality fish and shrimp has also been increasing gradually in and outside of the country. The lack of facilities for care after collection which was existing so long, has also been improved to a great extent in international market. This progress has been achieved as a result of improving the processing activities. If this vast potential resource is exported maintaining its quality in fact after proper processing, its demand will be increased and on the other hand, the way of earning foreign exchange will also be expanded. As a result national economy will be enriched.
In the fourth 5 year plan the target of fish production was 12 lakh ton and target for export was 28 thousand ton. The target of export profit was 971 crore taka. In the last year of the plan i.e. during 1994-95, almost one and a half time more profit than the targeted amount was earned by exporting fish and shrimp.

In the context of present American food and medicine policy it has been asked to be more careful in the processing of fish and fish products. In this context if the processing facilities are improved, it will be possible to export 64000 metric tons within 2000 A.D. and from that it will be possible to earn foreign exchange of more than taka 2000 crore. It will play a vital role in strengthening economy of the country.

One fourth of the total production of fish of fish of this country is Hilsa fish. Hilsa caught abundantly in a particular time of the year. Most of these are decomposed for the want of processing. If these can be preserved properly more supply of protein in the country will be possible. So, in order to increase the standard of nutrition of the people and for economic development, the importance of fish and shrimp processing knows no bound.

**The Reason for Fish Rottening**

In order to preserve fish it is important first to know the reason for fish rottening.

1. Bacterial attack.
2. Activities of enzymes
3. Chemical activities

There are numerous bacteria in the body of the fish. They can not do any harm if the fish is alive. But when the fish dies bacteria grow rapidly and cause changes in the body of the fish. As a result there starts rottening. There are different types of enzymes in the body of the fish. They are helpful for the fish when they are alive. But in dead fish the cells are broken by the activities of these enzymes and the fish starts rottening. The fish is composed of different chemical elements. After death of fish the activities of these chemical elements result in rottening of fish.

**Symptoms of Rotted Fish**

The colour of the body of a rotted fish and its gills become pale, the muscles become soft and loose, the eyes enter into holes and mucus appears in the gills.
The Preservation System of Fish and Shrimp

The preservation systems of fish and shrimp are as follows –

1. Icing or chilling
2. Freezing
3. Drying
4. Salting

1. Icing or Chilling

Fish and shrimp should be preserved to keep those good and to protect from decomposition. Fish and shrimp begin to rot if those are kept outside for long time. So fresh fish and shrimp are required for preservation. The preservation system of fish and shrimp is described below-

There are numerous bacteria in different parts like scales, gills, entrails etc. of the fish. After the death of the fish and these germs rapidly begin to act in the dead fish. As a result, fish begins to rot. Fish can be saved from decomposition if those are covered with abundant ice soon after catching. Preservation with ice is a good method if preservation is done temporarily or for short time. Although, freezing preserves fish and shrimps, drying or putting salt, initially those are to be preserved with ice. Fish are kept fresh with abundant ice up to 5-10 days in the local village markets. The temperature of fish become low when ice is used. As a result the bacteria or germs become inactive. So fish are not decomposed easily. The portion of water in the fish remains intact when ice is used. For this reason fish remain fresh or lively.

Advantages of Fish Preservation with Ice-

1. Ice is relatively cheap
2. Easy to carry
3. Can cool fish rapidly
4. Does not cause any harm to the quality of fish.
5. Ice melting water clears the germs, blood things etc. those are stick to the body of the fish.

Method of Icing

Generally in our country fish is transported in bamboo made basket or wooden box. In these cases firstly banana leaf or mat made of grass should be placed on the bottom of the basket and then one layer of ice is to be placed. Afterwards one layer of fish one
layer ice is to be packed. In this way the basket is to be filled in with and ice. Lastly the basket will be tied with the help of banana leaves, coarse mat and Hessian so that sunlight cannot fall on the fish or the ice dose not melt quickly. The height of the basket should not be more than 40 cm. If the height is more than that, the fish may be flattened. If preserved with sufficient ice fish remains good up to 5-10 days.

2. Fish and Shrimp Preservation by Freezing

The process of preservation of dish and shrimp by lowering down their body temperature of is called freezing. By freezing the liquid between cell and tissue is converted into ice. This is a very popular method of fish and shrimp preservation. In this method shrimps can be preserved up to 1 year maintaining all the qualities of fish. In Bangladesh, mainly shrimps, frog legs, lobsters and all are exported after preserving by freezing. Mainly air blast freezer and plate freezer are used for refrigeration.

After the basket or boxes full of package fish and shrimp arrive at the ware houses, those are separated from ice and the good ones are accepted. The accepted fish and shrimps are washed well with cold water.

In case of big fishes the entrails are brought out by tearing off the belly. The head and the fins are cut off and in cases of shrimps only the heads are separated. Then the shrimps are washed well in 20 PPM chlorine solution and primary grading is done on the basis of the size. These are again washed in pressed water having 10 PPM chlorine. At this stage these are weighed and graded for export, for example one grade may include 5 per pound, another grade may include 8-12 per pound, and other grade may contain 13-15 per pound and so on. After grading these are to be washed for the last time with 5 PM chlorine water and the shrimps are arranged as blocks on germ free polythene on a tray. This tray is called panning tray. After arranging the shrimps, the tray is filled with 3-5 PPM chlorine mixed cold. Water and it is made like a parcel covered by spread out polythene. Afterwards these panning trays are placed in specific chambers of plate freezer or blast freezer and refrigerated at 38° C to 40° C. At this temperature the shrimps are refrigerated in 2-3 hours.

One of such blocks weighs up to 1-2 kg. The panning trays are brought out of the freezer and the blocks are separated. Those are dipped into cold water mixed with 3-5 PPM chlorine. This process is called glazing. Glazing process accelerates dryness of fish and hinders decomposition. The glazed shrimps are packed with wax paper, placed in big cartoons and freezed at18° C. These frozen shrimps are exported in proper time.
Fish Preservation by Salting
Salt absorbs water from the body of fish. By way of this the amount of water from the body of fish is decreased to such level that the activities of the bacteria living in the body of the fish stop. As a result fish is not decomposed. By processing in this method fish can be preserved unto 1 year.

In our country Hilsa is preserved only with salt. As there is excessive fat in Hilsa, they cannot be preserved by drying. In this case fish is preserved in two methods, such as:

1. Dry salting method
2. Solution salting method.

Dry Salting Method
Firstly scales, blood, gills, entrails, eggs etc should be removed from the body of the fish. The fish should be cut crosswise into pieces so that they are not separated from each other. The ration of fish and salt should be 4:1. That is one kg salt should be used form a fish weighing 4 kg. During salting it should be noticed that enough salt enters into the cut parts. Making holes through the eyes of the fish should also push salt. After the fish is mixed with salt it should be kept in hips on a stand or bamboo mat spread over wooden platform. In arranging the layers of fish the heads and tails should be kept alternatively in same direction. If kept in this way after salting, Hilsa becomes fully salted within 15-20 days. Fish can be preserved up to 1 year after salting.

4. Fish Drying
The process of preserving fish by removing water from the body of fish by sun heat is called fish drying. Excepting the fatty fishes, drying process can preserve all fishes big or small.

In case of small fishes, first of all those are washed well and dipped into salty water for some time. Those are picked up and water is allowed to ooze out. Then they are spread out on bamboo-made mat for sun drying. Fish becomes fully dried in 2-3 days in very hot sun. Dried fish is preserved in polythene bag.

In case of big fishes the scales, fins, entrails are removed and the fishes are washed well. Then the fishes are dissected vertically with the help of sharp knife. The dissected fish is kept dipped into saline water for sometime. Then those are picked up and hung longitudinally on a rack. By this water is allowed to ooze out and drying of fish starts. In this way the drying is completed within 5-7 days. The dried fish are kept in polythene bag and preserved in dry place.
Practical

Subject: Hilsa fish preservation by dry salting

Materials
1. Fresh Hilsa fish  
2. Knife  
3. Salt  
4. Wooden deck (Floor)  
5. Bamboo made mat

Steps of work
1. Collect 5 fresh Hilsa from the market with the help of your teacher. 
2. The scales, fins etc should be removed carefully from the collected fish. 
3. Remove the entrails from the body of the fish. Remove egg from the belly, if any and now weigh the fish. 
4. Cut the fish crosswise in such a way that the different pieces remain connected together. 
5. Take salt weighing 4 times (4:1) of the weight of the fish and smear over cut parts. Smear salt over the whole parts of the body. Tear off the eyes and push salt into it. 
6. Place a mat on a wooden platform. Arrange the adequately salted fish on the mat keeping head of one and tail of the other in the same side. 
7. If these are kept in this way for 15-20 days salting will process the fish.

Exercise

Multiple Choice Questions
1. What is the proportion of fish and salt used for fish preservation? 
   a. 1:4  
   b. 2:3  
   c. 4:1  
   d. 5:1
2. Which method of fish preservation is economically profitable for rural Bangladesh? 
   a. Salt application  
   b. Ice application  
   c. Covering by soil  
   d. Drying under sunlight
3. How can fish be preserved up to one year? 
   i. Ice preservation  
   ii. Freezing/Cold storage  
   iii. Salting
Which one is correct?

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

4. How much salt is required to preserve 80 kg of Hilsa fish by salting method?

a. 10 kg  
   b. 20 kg 
   c. 30 kg 
   d. 40 kg 

Read the paragraph below and give answers to questions 5 and 6.

Jakir cultivates galda shrimp in his own pond and sells them in the local market when the fishes attain the marketable size. One morning he harvested shrimps from his pond and went to a distant district town market hiring a pickup to get higher price. On the way the pick up got mechanical trouble and took some time to repair it and he was delayed to reach the market. meanwhile as no measure was taken to prevent the fish from rotting, most of the fishes got rotten and he had to face a very serious loss.

5. Which easy method of shrimp preservation could have saved Jakir is fish?

a. Drying  
   b. Salting 
   c. Icing 
   d. Freezing 

Creative Questions

Shuvo went to his grand father's house at a remote village at Joypurhat. Next day, when his grand fisher's pond was dewatered, they got an unexpectedly higher harvest of fishes. Then they decided that instead of selling all the raw fishes in the market they will preserve some of small and big different species of fishes through processing.

a. What is meant by fish processing?
   b. Explain one of the main reasons of rotting fishes?
   c. What steps were taken by Shuvo at his gran father's house for processing of the harvested fishes?
   d. Processing and preservation of excess harvested fish by specific methods throughout the country, as done by Shuvo at his grand father's house, can play a great role in fulfilling the fish requirement of the country. Evaluate the issue.
Part Four
Domestic Poultry Husbandry
Chapter One
Production of Poultry Chicks and Ducklings

Fertilized eggs are used for incubation. There are two systems of hatching eggs, such as:

1. Natural Method
2. Artificial method

The eggs capable of producing chicks are called fertilized eggs. Before hatching the eggs have to be selected. One cock in every 8-10 hens will have to be reared for getting fertilized eggs.

Selection of Fertilized Eggs

The following things will have to be considered in selecting eggs.

1. The Size of the Egg: Medium sized eggs are best for hatching. Eggs having unnatural size and thin shell should be avoided. Only eggs having smooth, thick and hard shell should be selected.

2. Colour of the Shell: Depending on variety, the hen lays eggs of different colour. The colour of the shell may be white, brown, black or blackish. Eggs should be selected depending on the variety, which gives the particular coloured eggs.

3. Cracked Eggs: Cracked eggs should be avoided. This may be determined by the sound developed by hitting one egg with the other.

4. The Characteristics of the Egg's Internal Composition: If the inside of the egg is transparent and the yolk is in the middle then the egg should be selected for hatching.

5. Cleanliness of the Egg: During selection it is to be ascertained whether the eggs are clean. Dirty eggs will have been cleaned with piece of cloth.

6. The Weight of the Egg: The weight of the egg of an improved variety should be 50-60 gm. The egg should never be washed in water.
7. **Age of the Egg**: The age of the egg to be hatched should never be more than 3-4 days during summer and 7-10 days during winter.

**Preservation of Selected Eggs**

Hatching process depends on the preservation methods of the eggs. So during the preservation of selected eggs, the following things must be considered.

1. **Age of the Egg**: Eggs can be preserved 7-10 days during winter and 3-4 days during summer. If preserved for more days, the eggs do not hatch.

2. **Temperature**: The ideal temperature for egg preservation is between 10°-15°C. Eggs in big hatcheries should be preserved in air conditioned room. During preservation the broad portion of the egg should be placed in the upper side and the tapering portion should be in the lower side.

3. **Relative Humidity (RH)**: The ideal humidity of egg preservation should be between 75-80%. Low humidity decreases hatching capacity.

4. **Cleanliness**: Eggs should always be preserved in clean place. Because the pores of the shell may be closed with dirty materials and this might distort respiration of the embryo.

**Methods of Hatching Eggs**

Eggs are hatched in two different ways as described below-

**Artificial Method**: Incubation of eggs in a specially manufactured instrument maintaining proper temperature is called artificial incubation. In this method a good number of eggs can be incubated. There are 2 methods of artificial incubation, such as

1. **Incubation** and
2. **Husk method**.

These methods are described here under:

**Incubation Method**: This method of incubation is the most modern and improved system. This method is followed in big poultry farms.

Incubators are of two types—

1. Kerosene incubator
2. Electric incubator

The kerosene incubator is operated with kerosene oil. 50 to 500 eggs can be hatched in this incubator. This method of incubation is followed in areas where there is no electricity. It is less costly too.
Important Issues for Incubation

Temperature : In case of Kerosene incubator temperature should be maintained at 38.3°C-39.5°C during first 2 weeks and at 38.6°C during third week after placing the eggs. In case of electric incubator 37.5°C temperature should be maintained during first 18 days and 37°C for the next 3 days.

Relative Humidity: In kerosene or electric incubator the relative humidity for the first 18 days should be 50%-60% and for the next 3 days 65%-75%.

Turning of Eggs : Turning of eggs should be done 8 times daily e.g. after every three hours. In case of improved incubator turning of egg is done automatically with the help of a timer. In case of kerosene incubator turning of egg is done with the help of "U" shaped wire.

Placing the Eggs : Eggs should be placed in incubation tray so that tapering side of the egg lies downward and the broader side lies at 45° angle

Examination of Eggs : Eggs are examined in the seventh day in a dark room with the help of a torch light or an electric bulb. If enough blood vessels are found in the middle and the side then it is to be understood that the embryo is developing, the egg is fertilized and it will hatch. Re-examination is done in the 14th day. Intake of oxygen and outlet of carbon dioxide of the egg is necessary for the development of the embryo. For this reason proper ventilation system is maintained in the incubator.
Transfer of Eggs from Setting Tray to Hatching Tray: Generally eggs are transferred from setting tray to hatching tray on the 19th day. The newly born chicks came out of the egg in this tray.

Cleanliness: After and before every incubation the incubator should be cleaned with clean water mixed with geimicide. After making germ-free the incubator should be fumigated. For, fumigation of eggs, rates measuring only third of the above mentioned doses of the incubation.

Fumigation: For an incubator of 100 cft. 80 cc (40%), formalin with 40 gm. potassium permanganate should be kept in the incubator. By this all germs of the incubator will die. The process is called fumigation.

Husk Method of Egg Incubation

This is an ancient method. This method is followed in rural areas having no electricity. In husk method the eggs of both duck and hen can be incubated. But in our country this method is mainly followed for incubating duck eggs.

Natural Method

When a hen hatches the fertilized eggs with the help of its body temperature it is called natural method of incubation. This is very old method. Natural method of incubation is followed in almost every village of Bangladesh. Country breeds of hens are used in this method. Country hens, after giving eggs for some days, become broody and tends to sit on eggs, 8-10 eggs can be kept under such a healthy broody hen. In the first stage a small basket or a bowl can be filled with straws and dried leaves. By making hole in the basket with the help of hands soft littre is prepared for the hen. This basket is to be kept in a solitary place of the house so as to avoid noise. The nest should be 37 cm. diametre and 10 cm. depth. If the area of the nest is bigger than the eggs will move more problems may arise in hatching and the eggs may be broken even.

Before the hen sits on the eggs, it should be fed with granular food and water.

To start with some bad eggs may be kept under the hen so as to make it habituated for brooding. When it will be habituated for brooding then 8-10 fertilized eggs can be kept under the hen and the bad ones should be taken out. The nest of the hen may be covered with cloth, Hessian or straw. Granular food and water should be kept near the nest of the hen. Every day at a definite time the hen should be allowed to move about.
After 8-10 days the eggs should be examined in sunlight. The presence of embryo may be indicated by a black mark in the egg. After 21 to 23 days the chicks will be coming out of the eggs. The hen looks after the chicks for 2 months. Then they will be able to move independently.

The Advantages of Natural Incubation

1. This method is less costly and provides more security.
2. Human care is not a necessity; the hen itself looks after the chicks.

Precautions

1. Hen under one year age can not be used for brooding. These hens may stop brooding after 10-15 days.
2. Only when the hen tends to brood, only then the eggs should be kept under it.
3. Hens can not be used for brooding at the time of molting.
4. The hen and its nest should be treated with insecticides like gamaxone, sodium chloride dust.
5. The house should be neat and clean.
6. The hen should be allowed to sit on eggs during night. By this, there is every possibility of hatching the eggs at night after 21 days.

The List of Hatching Time

The list of hatching time of the eggs of ducks, hens and other domestic birds is given below:

<table>
<thead>
<tr>
<th>Name of the bird</th>
<th>Hatching time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hen</td>
<td>21 days</td>
</tr>
<tr>
<td>Duck, Titir</td>
<td>28 days</td>
</tr>
<tr>
<td>Goose, Turky</td>
<td>32 days</td>
</tr>
<tr>
<td>Pigeon, Koel</td>
<td>18 days</td>
</tr>
</tbody>
</table>
Practical

Subject: Selection of egg suitable for hatching

Materials:
1. Pot for keeping eggs.
2. Collection of eggs of different size, weight and quality.
3. Number of eggs (one dozen for every class)

Steps of work
1. Put serial number on the egg.
2. Separate the eggs on the basis of the structure in order to select the fertilizer egg.
3. Hold the eggs in the light and examine the inner characteristics.
4. Separate the eggs which are not suitable for hatching, and describe the causes mentioning the serial numbers.
5. Mention how you will preserve the fertilized eggs (selected).

Exercise

Multiple Choice Questions
1. What is the time for Koel, eggs incubation?
   a. 12 days  
   b. 14 days  
   c. 16 days  
   d. 18 days

2. For the development of the embryo within the egg is required -
   i. absorbing oxygen and removing carbon dioxide
   ii. absorbing nitrogen and removing hydrogen
   iii. absorbing oxygen and removing nitrogen

Which one is correct?
   a. i  
   b. ii  
   c. iii  
   d. i and ii
Read the paragraph below and give answers to questions 3 and 4.

Rahima Khatun lives in a village. She has no good experience in selecting eggs. She attempted to incubate 10 collected eggs using a brooding hen. After 21 days she observed that 8 chicks had been hatched out. Two eggs could not produce any chick.

3. What is the probable cause of non-hatching of 2 eggs?
   a. Low temperature of the room.
   b. The colour of the eggs were different.
   c. The eggs were unfertilized.
   d. The air humidity was higher.

4. The possibility of non-hatching of eggs is higher if the eggs remain dirty at the time of its selection for incubation: because—
   i. the respiration of the embryo is impeded.
   ii. the moisture content of the egg is reduced.
   iii. the micro-pores of the egg-shell are closed.

Which one is correct?
   a. i and ii  
   b. i and iii  
   c. ii and iii  
   d. i, ii and iii

Creative Questions

a. What is the name of the method of hatching poultry eggs shown in the figure above?

b. What is the most widely used method of hatching poultry eggs in the context of rural Bangladesh? Explain.

c. Explain the steps which should be taken to incubate 20 poultry eggs for producing chicks shown in the above picture.

d. The method illustrated above plays very important role for increasing the production of poultry birds: give reasons in favour of the above statement.
Chapter Two

Poultry Husbandry

Now a days poultry farming is one of the means of living. For this purpose commercial breeds of hens are reared in farms or houses. The specialist developed the commercial breed by crossing several breeds in order to make it more productive. These cross breeds or commercial breeds produce more eggs or meat as compared to other country or foreign breeds. Among the commercial breeds the breed developed for more meat is called "broiler" the breed developed for more eggs is called 'layer'.

The American Rhode Island Red, New Hampshire, English, Australorp, Cornish, Sussex, Mediterranean White Leghorn and Egyptian Fiome are reared in our country most successfully; Besides these some commercial farms are importing I day chicks from foreign countries are distributing directly.

Establishing a Poultry Farm

Hens have been reared in the houses of Bangladesh from time immemorial. On the other hand the economic success of foreign poultry farms are encouraging for establishing poultry farms in this country. Now a days training on rearing improved breeds of hens are going on in different training centres. As a result establishment of forms has become easier. There are different types of poultry farm. Among these broiler and layer are remarkable, these type of farm are described below.

Broiler Farm

First of all capital and size of the farm are to be considered in planning to establish a broiler farm. Broiler farming is a profitable business; one can achieved his goal within a short time. The planning of the farm should be executed after properly analyzing such important matter as collection of broiler chicks, supply of balanced feed at reasonable, price, marketing after 7-8 weeks at profitable price, timely vaccination etc.

Introduction to Broiler Breed

When the chicks attain full weight at the age of 7-8 weeks and reared only for meat production they are called the broiler. This breed is developed after crossing several highly meat productive breeds. Some popular broiler strains are mentioned below.
As a result of crossing, their physical growth become rapid. Their main function is the conversion of the food materials into meat within a specific period.

**Broiler Farming Management**

The points to be considered in broiler farming management are given below –

**Site Selection** : After completing planning, the site will have to be selected for broiler farming. The area for broiler farm may be selected away from homestead area or on a high land away from sight. It is to be noticed that markets or roads should not be in front of the farm. The area should have well sewerage and drainage system. The farm area should be well ventilated.

**Housing** : The broiler house should be dry clean and well ventilated. The floor should be cemented (Pacca). The height of the house shall have to be 150 cm. For well ventilation around the house, an area of 60 cm. from the roof should be constructed with wire netting or net like fencing.

**The Floor Area** : An area of 900 sq.cm. should have to be allowed for each broiler.

**Lighting and Ventilation System** : Broiler does not like darkness hence arrangement should be done for adequate light and ventilation.

**Relative Humidity (RH)** : Relative humidity has a great influence on the skin of the broiler. There must be 60-70% relative humidity in the house.

**Temperature** : The temperature of the broiler house should be 15-25˚C.

**Food** : Broiler should be supplied with feed of such amount as they can consume. That means, food should be supplied as soon as the feeder is empty. There should be 23% protein in the initial feed 20% protein in the end broiler feed. The initial feed should be used for one to four week's duration. The duration of the end food should be used for from to eight weeks duration. The broiler chick should be supplied with balanced diet. The list of balanced diet is given below:
The food pans should be made with wood measuring 60-70 cm. length in 23 cm in breadth and 7.5 cm in height. 20 chicks can take their feed from this type of feeder from both sides of such pans.

Normal quantities of food and water per 100 broiler hen per day.

<table>
<thead>
<tr>
<th>Age of the hen</th>
<th>Quantities of feed per day</th>
<th>Quantity of water per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Week</td>
<td>1.0 kg</td>
<td>2.3 litre</td>
</tr>
<tr>
<td>Second Week</td>
<td>2.3 kg</td>
<td>5.5 litre</td>
</tr>
<tr>
<td>Third Week</td>
<td>3.9 kg</td>
<td>9.1 litre</td>
</tr>
<tr>
<td>Fourth Week</td>
<td>5.3 kg</td>
<td>12.7 litre</td>
</tr>
<tr>
<td>Fifth Week</td>
<td>6.5 kg</td>
<td>16.0 litre</td>
</tr>
<tr>
<td>Sixth Week</td>
<td>8.3 kg</td>
<td>20.0 litre</td>
</tr>
<tr>
<td>Seventh Week</td>
<td>9.3 kg</td>
<td>22.5 litre</td>
</tr>
<tr>
<td>Eighth Week</td>
<td>10.8 kg</td>
<td>26.0 litre</td>
</tr>
</tbody>
</table>

The water requirement for birds in summer water become double than it is required in the winter season.

Preventive Measures of Diseases

The following are the preventive measures for broiler chicks –

1. Prohibition of entry of outsiders into the broiler house.
2. Immediate separation of the diseased chicks from the other:

Ideal Food List for Broiler

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat /maize grain</td>
<td>50</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>11</td>
</tr>
<tr>
<td>3. Til cake (sesame)</td>
<td>16</td>
</tr>
<tr>
<td>4. Fishmeal</td>
<td>10</td>
</tr>
<tr>
<td>5. Soyabean meal</td>
<td>5</td>
</tr>
<tr>
<td>6. Protein concentrate</td>
<td>5</td>
</tr>
<tr>
<td>7. Bone meal</td>
<td>2.25</td>
</tr>
<tr>
<td>8. Vitamin mineral mixture</td>
<td>0.25</td>
</tr>
<tr>
<td>9. Salt</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
3. Selection of a particular man for nursing the broiler chicks.
4. Use of separate dress by the nursing man at the time of entry into the broiler house.
5. Washing of hands and legs with water mixed germicide before entering into the broiler house.

**Vaccination Programme for Broiler**

The vaccination programme for broiler should be followed as per the following routine.

<table>
<thead>
<tr>
<th>Age</th>
<th>Name of the disease</th>
<th>Vaccination method</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 days</td>
<td>Ranikhet</td>
<td>2 drops of B.C.R.D.V to be applied in 2 eyes with the help of a dopper</td>
</tr>
<tr>
<td>14 days</td>
<td>Gumboro</td>
<td>To be applied with drinking water as per directions of veterinary surgeon or prescriptions.</td>
</tr>
<tr>
<td>21 days</td>
<td>Ranikhet</td>
<td>B.C.R.D.V vaccine to be given in two ages at the rate of drops.</td>
</tr>
</tbody>
</table>

**The Brooding Instruments for broiler Chicks**

1. **Brooder tin**: Brooder tin may be made of hard board or wood. About 200–250 chicks can be kept under a brooder having 1-metre circumference. The brooder house can be made of straw roofing and bamboo made mat fencing. Electric heater, bulb,
kerosene lamp and hajak can be used for supplying temperature artificially. Germs of diseases can be destroyed by using infra red bulb.

2. **Brooding or supply of heat**: Brooding is a method of supplying heat to the chicks from 1 day to 21 days. Electric or kerosene furnace can also be used for controlling temperature instead of using brooder.

<table>
<thead>
<tr>
<th>Age of Broiler</th>
<th>Temperature degree Celsius °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>First week</td>
<td>35 °C</td>
</tr>
<tr>
<td>Second week</td>
<td>32.2°C</td>
</tr>
<tr>
<td>Third week</td>
<td>29.2 °C</td>
</tr>
<tr>
<td>Fourth week</td>
<td>26.6 °C</td>
</tr>
<tr>
<td>Fifth week</td>
<td>23.8 °C</td>
</tr>
<tr>
<td>Sixth week</td>
<td>21 °C</td>
</tr>
</tbody>
</table>

**After four week there is no need of supplying heat**

3. **Chick guard**: It is necessary to mate one surrounding with 45 cm high bamboo-made mat or hard board 75 cm. away from the brooder so that the chicks cannot to away. This surrounding is called chick guard. The area is to be enlarged as the chicks grown up. The chick guard is also to be made bigger gradually. After 2 weeks the chick guard is to be removed.

4. **Feeding pan**: During brooding the chicks are to be provided with food on trays for 2 days. After that small pan and after 4 weeks bigger size feed pots should be used. There should also be a pan for drinking water which should be kept clean

5. **Light**: There should be enough light in the house so as to allow the chicks to see the feeding and water pan. The day light and enough artificial light during night should be ensured.

6. **Ventilation**: There should be good arrangement for ventilation in the brooder house. So that pure air can blow inside.

**Temperature Control Principles**

1. If the chicks are found to gather like cluster near the brooder then it is to be understood that the temperature of the house is low.

2. If the chicks are found throughout the whole house, then it is to be understood that the right temperature is maintained.
3. If the chicks are found away from the brooder then it is to be understood that the house maintains a high temperature.

**The Materials for Brooder House**

The main ingredients and their description of a brooder house are given below.

**For every 100 chicks -**

1. Total area is 9 metre square
2. The area for feeding pan (0-2 weeks age) is 254 sq.cm.
3. The area for feeding pan (2-6 weeks age) is 380 sq.cm.
4. No. of water pan for 1st 10 days are 4 numbers each of 2 litres.
5. No. of water pan for 10 days to 6 weeks are 8 numbers each of 2 litres.

**Rearing Chicks of Layer Hens**

The rearing method of chicks of layer of hens is to be done as per methods given in case of broiler chicks previously.

**Rearing of Growing Layer Hen Chicks.**

The chicks of age of 2 to 4 months are called growing chicks. At this time chicks are to be reared with care. Because, egg production at later stage depends on their development during this growing period. If the layer is properly developed during the growing period, it can lay eggs for longer period. These are known as commercial layer. Name of some of the breeds of chicks, which can produce higher number of eggs, are given below.

1. Hysex Brown
2. Hysex White
3. Star cross Brown
4. Lohmann
5. Isa Brown
6. Hyline
7. Star cross-579
8. Harbard.

These breeds can lay 280 eggs a year under improved management. The weight of each egg is 60-65 gm.
A list of balanced food of growing chicken is given below (age: 8-16 week)

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>50 Percent</td>
</tr>
<tr>
<td>2. Wheat husks</td>
<td>5 Percent</td>
</tr>
<tr>
<td>3. Rice bran</td>
<td>21 Percent</td>
</tr>
<tr>
<td>4. Ground dried fish</td>
<td>9 Percent</td>
</tr>
<tr>
<td>5. Sesame oil cake</td>
<td>12 Percent</td>
</tr>
<tr>
<td>6. Oyster, shell (ground)</td>
<td>2.25 Percent</td>
</tr>
<tr>
<td>7. Salt</td>
<td>0.5 Percent</td>
</tr>
<tr>
<td>8. Vitamin mineral mixture</td>
<td>0.25 Percent</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Percent</strong></td>
</tr>
</tbody>
</table>

Each growing chicken should be given 70-80 gm of food daily. Along with the food vitamin mineral premix is to be provided to make the food complete

**What to be done for Rearing Growing Chicken**

1. The litter should be cleaned before putting growing chicken.

2. The room should be washed by water mixed with germicides like Phenyle or Lyzol.

3. New litter, rice husk or saw meal dust (wood dust) should be spread over the floor.

4. Food and water pan should be kept in order after proper cleaning. The arrangement for balanced diet and pure water should always be ensured.

5. The floor space for growing chicken should be increased considering the number of chicken.

6. Chicks cannot be kept in the room of growing chickens.

7. The hen starts laying eggs at the age of 5 months. But it may take more one month to come to full production. During this period attention must be given to die food, water and dwelling place.

8. The chicken should be vaccinated at the specified age against all contagious diseases.

9. The hen should be put to laying room as soon as it reaches the age of 4- 4 1/2 months. Before that the chicken should be given necessary medicine. To control lice at this age insecticide may be sprayed.
Rearing layer Hens

Generally the rearing period of layer remains confined to 21-76 weeks. During this time the layers should be provided with balanced diet, pure water, disease-free and clean environment in order to get maximum production. By doing this the rearing layer can be made profitable.

A list of balanced diet of layer (Age: above 16 weeks)

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>46 Percent</td>
</tr>
<tr>
<td>2. Wheat husks</td>
<td>5 Percent</td>
</tr>
<tr>
<td>3. Rice bran</td>
<td>25 Percent</td>
</tr>
<tr>
<td>4. Ground dried fish</td>
<td>8 Percent</td>
</tr>
<tr>
<td>5. Sesame oil cake</td>
<td>12 Percent</td>
</tr>
<tr>
<td>6. Oyster shell (ground)</td>
<td>3.25 Percent</td>
</tr>
<tr>
<td>7. Salt</td>
<td>0.5 Percent</td>
</tr>
<tr>
<td>8. Vitamin mineral mixture</td>
<td>0.25 Percent</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Percent</strong></td>
</tr>
</tbody>
</table>

Each layer should be provided with 110-120 gm of food up to 2 years of its age, vitamin and mineral premix are also to be added with the food. The feed to be used for layer hens should contain at best 16 percent crude protein.

What to be done for Rearing Layer Hen

1. The room and the furniture of the room are to be properly cleaned and made free from germ. New litter of thickness of 15-20 cm should be spread over the floor.

2. Every day the pan of food and water should be cleaned in such a way that not dirt remains with the pan.

3. Bulb having power of 40-60 watt should be kept on in the room of the layer.

4. When the hen attains age of 4 - 4 2 months. Then the growing chicken starts laying egg at the rate 2-4 eggs per week, the layer should be transferred to the layer house. The layer must be given balance diet from this time. To meet the deficiency of calcium, ground oyster shell is to be given with the food at this time.

5. The period of artificial lighting should be extended as soon the layer starts laying egg. Light should be provided for 16 hours out of the 24 hours of a day.
6. Eggs should be collected 2-3 times a day.
7. The layer should be given medicine for controlling worm timely.
8. The litter should be turned twice in a week. Sometime lime may be mixed with their litter.
9. Generally the layers are to be sold for meat purpose within 75-76 weeks of the age.

**Problem of farm Management**
Proper management of the farm is the pre-requisite for higher production. The farm will incur loss if there remains fault in the farm management. In Bangladesh complexities are encountered in the management of layer farm due to hot and humid climate. As a result, during this period the production is hampered.

**The Reaction of Layer During Excessively Hot Weather**

a. The layer suffer from respiratory trouble and breaths making sounds.

b. The layer takes more water as they become thirsty and they starts taking granular food in decreasing quantity.

**What to be done in excessively hot weather situation**

a. Making arrangement for movement of sufficient air in the room of the laying hens.

b. Wetting the tin roof by sprinkling water over it.

c. Putting ceiling below the roof.

d. Supplying balanced diet and clean water

e. Making arrangement for supplying electricity to the farm.

**Vaccination of layers:**

<table>
<thead>
<tr>
<th>Age of the bird</th>
<th>Name of the diseases</th>
<th>Methods of vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 days</td>
<td>Ranikhet disease</td>
<td>BC RDV to be given at the rate of one drop at one eye with the help of a dropper.</td>
</tr>
<tr>
<td>14 days</td>
<td>Chick Gumboro disease</td>
<td>To be applied as per prescription or direction of the doctor mixing it with water.</td>
</tr>
<tr>
<td>21 Days</td>
<td>Chick Ranikhet disease (Buster)</td>
<td>BCRDV to be given at the rate of one drop at one eye in the help of a dropper.</td>
</tr>
</tbody>
</table>
Practical

Subject: Making concentrated Food for Broiler and growing chicks

Food for Broiler

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed wheat/broken maize</td>
<td>5.0 kg</td>
</tr>
<tr>
<td>Rice bran</td>
<td>1.1 kg</td>
</tr>
<tr>
<td>Oil cake (ground nut, til/ sesame)</td>
<td>1.6 kg</td>
</tr>
<tr>
<td>Dried fish meal</td>
<td>1.0 kg</td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>1.0 kg</td>
</tr>
<tr>
<td>Bone meal</td>
<td>25 grams</td>
</tr>
<tr>
<td>Salt</td>
<td>50 grams.</td>
</tr>
<tr>
<td>Mineral mixture with vitamin</td>
<td>25 grams.</td>
</tr>
<tr>
<td>Total</td>
<td>10 kg.</td>
</tr>
</tbody>
</table>

Food for Growing Chicks

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed wheat/broken maize</td>
<td>5.0 kg</td>
</tr>
<tr>
<td>Rice bran</td>
<td>0.5 kg</td>
</tr>
<tr>
<td>Oil cake (ground nut, til/ sesame)</td>
<td>2.1 kg</td>
</tr>
<tr>
<td>Dried fish meal</td>
<td>1.2 kg</td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>0.9 kg</td>
</tr>
<tr>
<td>Bone meal</td>
<td>.22 grams</td>
</tr>
<tr>
<td>Salt</td>
<td>0.050 grams.</td>
</tr>
<tr>
<td>Mineral mixture with vitamin</td>
<td>0.025 grams.</td>
</tr>
<tr>
<td>Total</td>
<td>10 kg.</td>
</tr>
</tbody>
</table>

Food prepared in this proportion is called balanced food.

Materials

1. Balance
2. Tray or water can
3. Aluminium dish/bowl
Steps of Work

1. Firstly - make a chart for preparing 10 kg feed at the rate shown in the sample of feed for broiler (Table).

2. Weigh 10 kg feed ingredients as per correct measurement

3. Show the separately weighed food ingredients to the teacher with measurement.

4. Now mix the ingredients and prepare the food

Exercise

Multiple Choice Questions

1. Which one is the popular broiler?

2. The feed list for growing poultry birds is shown in the table below-

<table>
<thead>
<tr>
<th>Feed components</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed wheat</td>
<td>50 grams</td>
</tr>
<tr>
<td>Wheat husks</td>
<td>05 grams</td>
</tr>
<tr>
<td>Rice bran</td>
<td>21 grams</td>
</tr>
<tr>
<td>Dry fish grounds</td>
<td>10 grams</td>
</tr>
<tr>
<td>Sesame oil cake</td>
<td>11 grams</td>
</tr>
<tr>
<td>Oyster grounds</td>
<td>2 grams</td>
</tr>
<tr>
<td>Salt</td>
<td>1 grams</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 grams</strong></td>
</tr>
</tbody>
</table>

If 70 gram feed is required daily for each bird how much dry fish grounds will be required for 10 birds daily?

a. 50 grams  b. 60 grams  c. 70 grams  d. 80 grams
3. What required to be done in rearing layer poultry?
   i. All the furniture and materials including the house should be kept neat and clean.
   ii. A 50-60 watt electric bulb should be kept on in the house.
   iii. The eggs should be turned up and down twice time in a day.

Which one is correct?
   a. i and ii  
   b. i and iii  
   c. ii and iii  
   d. i, ii and iii

4. Ceiling is given under the tin roof of layer poultry rearing house because-
   i. it strengthen the house and the roof.
   ii. it protects the poultry layer from excess heat.
   iii. it increases the beauty of the house.

Which one is correct?
   a. i  
   b. ii  
   c. iii  
   d. i and iii

Creative Questions

Nazma established one poultry layer farm taking out a loan from BRAC in order to revive her well-to-do livelihood. She participated at the workshop arranged by BRAC. The main speaker of that workshop put maximum emphasis on the disease prevention issues along with balanced feed supplement for producing quality eggs. Nazma then applied her knowledge gained from the training workshop and became successful in poultry farming.

a. What is a layer?

b. Why oyster grounds are given in the balanced feed of layer poultry after initiating egg layering? Explain.

c. How did Nazma apply her knowledge gained from the training workshop arranged by BRAC? Describe.

d. Why did the main speaker of the workshop give so much importance on the disease prevention factors? Explain with justification.
Chapter Three

The Integrated Farming of Ducks-Fowls-Fish

Simultaneous production of ducks, chicken and fish in pond following scientific methods is called integrated cultivation. The number of ponds in Bangladesh is almost 13 lacs. Most of these ponds are unutilized or unexcavated. Production in all the ponds is less or nil because of shortage of fund for supplying fertilizer and fish food. On the other hand, poultry (chicks and ducks) farming in our country is widely practised. There are about 20.689 crore fowls or chicken and about 3.908 crore ducks in Bangladesh during 2006-2007. But poultry excreta have not been used in productive purposes. By integrated cultivation of ducks-chicks, their excreta are used as sources of producing organic manure and directly as fish food. By integrated farming of ducks-hens-fish, fish production, can be increased without using fertilizer and food in the pond. Besides this houses of ducks-hens constructed on the water of the pond and hence no extra land is required for their farming.

Advantages of Ducks-Fish Integrated Farming

1. The excreta of ducks are good manure. If ducks are reared in the pond, there is no need of supplying fertilizer and supplementary food to fish.
2. Some fish take the excreta of hens and ducks directly as their food.
3. The dropped duck-food in water is used as supplementary food of fish.
4. Ducks take oysters and snails as their food. As a result, the life cycle of such parasites, as can attack fish, is destroyed. Besides these, ducks eat frogs, mosquitoes and other aquatic insects and thus keep the environment.
5. When the duck swims in the pond the oxygen from air mixes with water. This oxygen is necessary for fish.
6. The duck dives into water inquest of food and by way of moving the bottom soil the nutrients of soil mixes with water. As a result, the fertility and productivity of water increases. Also the stored poisonous gas of the soil is released because of this activity.
7. The house of the ducks are constructed on the pond and there is no need of extra land for ducks.
8. There is some positive role of ducks in controlling aquatic plants.
The House of Ducks

A solitary place of the pond has to be selected for construction of house for ducks. The ducks house should be made of a place away from the bank of the pond and where the depth of water is highest. At this, the chance of leaving the ducks house in dry land can be avoided even during dry season. Two types of houses can be made, floating and permanent. The house can be constructed on the bank of the pond also.

Generally for every duck an area of 2700 square centimetres is required. That means for 30 ducks, the house should be constructed on an area of 10 square metres, The height of the house should be 2.25 metres.

The roof of the house may be made of tin, straw or grass. But bamboo laths in such way should make the floor of the house that the excreta can fall into water. The bamboo laths in the floor should be arranged in such a way that the distance between the laths remains 1 cm. Because, if the distance is more than this, the legs of the ducks may be affixed suddenly. If all the excreta do not fall directly in to the water, it should be cleaned by water regularly.

Selection of Breed

Indian runner, Khaki Campbell or Jinding breeds are selected for rearing in integrated farming system: Because the Indian runner lays 200 to 250 eggs and Jinding and Khaki Campbell lays 230 to 250 eggs per year.

Preparation of the Pond

The pond is made suitable for fish farming. For this purpose, fish predators like catfish, Shol, Gajar; Airh should be removed from the pond. Rotenon at the rate of 35 gm per I decimal is used to remove unwanted fish of the pond or those are removed by draining out water.

The aquatic weeds should be uprooted from the pond. The clay, rotten leaves or rubbish should be cleared from the bottom of the pond. The uneven bottom of the pond should be leveled. If the banks of the pond are uneven, those should also be leveled. If there are heavy jungles on the bank some should be cut to allow fight and wind.

After draining out water from the pond lime should be used at the rate of 1 kg, per decimal. If poison is applied in the pond, then lime should be applied after 7 days of application of poison. After 1 week of application of lime young ducks can be brought
to the house constructed on the pond. After 10-12 days of bringing the young ducks fish fries should be released in the pond. After preparing the pond for integrated farming, it is necessary to select the right varieties of fish.

Selection of Species and Varieties of Fish
In this method of farming, enough fish-food is stored in the bottom of the pond, For this, fish like Mrigel, Kalibaush, Common carp should be released because these types of fish eat the food stored at the bottom of the pond. Besides this, grass carp is good to be released.

Measuring the Weight Fishing
The weight of fish should be examined once in every month by pulling net. If the growth of the fish is low, then the fishery experts can be consulted for remedy.

Fishing
Generally fish after 10 to 12 months. At this time after marketing fish, Silver carps of 7-8 cm should be released again.

Control of Fish Diseases
It is difficult to treat fish once if it is diseased. The first condition of control of fish disease is the preparation of the pond in scientific method. Yet if it is diseased, the local fisheries experts can be consulted.

Management of Duck Food
1. Natural Food of Ducks.
Duck eat natural feed from the pond: They fed on weeds of the pond, insects, grasses, leaves, oysters, small fish etc. and thus fulfil 50% of the total requirement of feed. To meet the requirement of feed and to fulfill the rest of the requirement ducks should be supplied with balanced feed.

2. Food Stuff
Crushed wheat, wheat husks, rice dust, til/sesame cake soyabean and fish meal should be mixed together and feed the ducks. The amount of protein for young ducks should be 21 % and that for the laying ducks should be 18%.
The chart of balanced diet for the ducks is given below:

<table>
<thead>
<tr>
<th>Ingredients materials of food</th>
<th>Percentage at young stage</th>
<th>Percentage at adult stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>45.0 Percent</td>
<td>45.0 Percent</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>27.0 Percent</td>
<td>30.0 Percent</td>
</tr>
<tr>
<td>3. Til cake/sesame</td>
<td>14.0 Percent</td>
<td>12.0 Percent</td>
</tr>
<tr>
<td>4. Fishmeal</td>
<td>12.0 Percent</td>
<td>10.0 Percent</td>
</tr>
<tr>
<td>5. Oyster dust</td>
<td>1.5 Percent</td>
<td>2.50 Percent</td>
</tr>
<tr>
<td>6. Salt</td>
<td>0.5 Percent</td>
<td>0.50 Percent</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Percent</strong></td>
<td><strong>100 Percent</strong></td>
</tr>
</tbody>
</table>

1.5 gm/kg vitamin mineral premix should be mixed with water at the time of feeding the duck.

### 3. Fooding Pan

The feeding pan may be made of wood, tin or aluminum. The depth of the pan should be small in case of feeding the young ducks.

### 4. Feed of Duck

The duck likes wet food. The food of ducks should always be mixed with water. They should be fed with enough water. Food and water should be supplied in separate pans.
Generally food should be given to ducks 4-5 times daily at the age of 1-2 months. From age of 8 weeks they should be fed 2-3 times and the growing up ducks should be fed 2 times daily. For the daily Indian Runner types of ducks the daily requirement of food should be 110 gm. The ducks should be fed first at 9 am. Then they should be released to the pond. They should be feed again before sunset. They should be encamped after feeding. They should be given food and water for the night so that they can take food and water during their requirement. In integrated farming of ducks and fish, extra food or fertilizers are not supplied for the fish. Because, the excreta and remains of ducks meal act as supplementary food of the fish.

5. Determination of the Number of Ducks and Fishes

Determination of the Number of Ducks

In case of rearing 2 duck per decimal of pond there is no need of supplying extra food for fish. The ducks should be marketed or sold at their age of 2.5 years and equal number of young ducks should be collected.

Determination of the Number of Fish

In mixed farming system 25 fries per decimal can be released. In ducks rearing pond young fish of 8-10 cm should be released. Fish of this size can protect themselves from the attack of ducks. Ducks can eat up fish of 4 gm or less. Fish need not to be supplied with food except for grass carp. Fish is released in integrated farming system as per following list.

<table>
<thead>
<tr>
<th>Species of fish</th>
<th>Rate of Relative Fish per decimal of pond water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
</tr>
<tr>
<td>Katla</td>
<td>12 Percent</td>
</tr>
<tr>
<td>Silver carp</td>
<td>34 Percent</td>
</tr>
<tr>
<td>Mrigal</td>
<td>30 Percent</td>
</tr>
<tr>
<td>Grass carp</td>
<td>12 Percent</td>
</tr>
<tr>
<td>Mirror carp</td>
<td>12 Percent</td>
</tr>
</tbody>
</table>

Farming of Fish and Fowl

The pond prepared for farming ducks and fish, can also be used for fowl farming with fish. In this case also the excreta and remains of food of fowls are used as food of the fish and help in the production of organic manure. The number of fowls in Bangladesh is almost 20.689 crores during 2006-2007. Their production may be increased by integration of farming.
Advantages of Integrated Farming

1. There is no need of extra land for poultry farming because the house is constructed on the pond.
2. The excreta of fowls drop directly into the water.
3. These excreta supply manure to the pond.

Construction of the House and Preparing the Pond

Construction of Fowl House.

A solitary place of the pond should be selected for construction of fowl house. The place should have light and air. The jungle should be cleaned if required. When constructing fowl house on the pond the floor should be made of bamboo-laths. In distance between 2 laths should be very little, so as to avoid affixing legs of fowl in the hole of the laths. Again apertures should allow the excreta of fowl and remains of feed particles easy dropping into the water. The house should be rectangular in size and the depth of the water of the pond should be at least 1 metre. So that the excreta and remains of food can drop into water even during dry season when water becomes less. The house should be made with to slanting roofs for making. It long lasting. The roof should be made 200-250 cm above the floor. The house should be surrounded by hard bamboo-mat having, 60 cm. height. The 4 cm. space between the bamboo-mat of the fencing and the roof should be fenced with bamboo, sticks having gaps in-between so as to allow light and air to enter into the house properly. The temperature control during winter or summer becomes easier if the house is made of straw.

Selection of Variety/Breed

Star bro type broiler is the best for increased production of meat. Layer chicks like Star cross, Isa Brown and Lohmann can be selected for increased production of eggs.

Preparation of Pond: Similar as that of ducks and fishes.

Food for Fowls and Fish

Fowls: The food of chicks is prepared by mixing wheat, rice bran, til cake, fish meal and salt. Balanced diet should be supplied to the broiler for smooth growth and to the layer to increase the rate, of production of eggs.

Fish: There is no problem of fish food management in integrated farming system. Because the excreta and remains of feed fowls different into the water of the pond.
These excreta and remains of are used as feed for fish. In this case the requirement of food of fish and fertilizer depends entirely on the density or number of fowls.  

**Number of Fowls** : There is no need of supplying food or fertilizer when 2 fowls are reared per decimal of pond. This density of fowls does not pollute the water of pond as well.

### Practical

**Subject:** Visit of an integrated farm of ducks-fowls-fish

**Materials:** A farm established in the school promises or local area and not book.

**Steps of Work**

1. Go to a near by integrated farm of ducks-fowls-fish. The farm may be duck fish or fowl-fish or integrated farm of ducks-fowls-fish.

2. Determine the size of the pond, number of ducks and fish and write down.

3. Write down how profitable it will be by producing eggs and fish in this method.

4. Give logic in favour and against, whether this type of farms should be widely established in Bangladesh.

### Exercise

**Multiple Choice Questions**

Read the paragraph below and give answers to questions 1, 2, and 3.

Solaiman an educated young man aware for self employment completed all the activities to prepare his one acre fallow pond full of weeds for making it suitable for pond duck-fish integrated farming. He applied government approved chemicals to eradicate unwanted fishes and applied lime after a few days.

1. Which of the approved chemical did Solaiman use in his pond to eradicate voracious fishes?
   
   a. Dipterex  
   b. Malathion 
   c. Nogos  
   d. Rotenon
2. How much lime should be applied in that pond?
   a. 200 kg   b. 150 kg
   c. 100 kg   d. 50 kg

3. The most justified schedule of the prioritized probable work for pond duck-fish integrated farming will be -
   a. clearing weeds, eradicating unwanted fishes, constructing the house and bringing ducklings, and releasing fish fries of right species.
   b. eradicating unwanted fishes, clearing weeds, constructing the house and bringing ducklings, and releasing fish fries of right species.
   c. clearing weeds, cutting jungles, eradicating unwanted fishes, releasing fish fries of right species, constructing the house and bringing ducklings.
   d. eradicating unwanted fishes, releasing fish fries of right species, clearing weeds, constructing the house and bringing ducklings.

Creative Questions

a. What is the name of the cultivation method shown in the above picture?

b. Why is separate feed supplement not required in such integrated cultivation methods?

c. Describe sequentially the methods of integrated poultry-fish cultivation methods instead of duck-fish in your own homestead pond.

d. The cultivation method illustrated here can play a very important role in meeting the protein requirement of the highly populous Bangladesh. Explain with reasons.
Chapter Four

Establishment of Poultry Farm

Rearing of poultry birds in scientific management on the commercial basis is called poultry farm. On the basis of production, the farm may be divided into three such as:

1. Broiler farm (meat production farm)
2. Chicks production farm
3. Layers farm (egg production farm)

The main objectives of establishing a farm are production of eggs and meat profitably. Only sound planning can help in achieving this objective.

Farm Planning

The first step in establishing a poultry farm is to have a plan for farm establishment. It is not wise to have an ambitious plan at the first stage. A big capital and a big area will be required for this. The experience of 1-2 years of establishing a poultry farm will help for taking up a big plan in the next stage. One should start a small farm with small capital and with small number of poultry birds.

The available money is the main medium of taking a plan. The available money can be divided into three, such as:

1. Investment of primary capital
2. Annual recurring expenditure and
3. Profit loss

Investment of primary capital include housing in the farm area, purchase of poultry birds, construction of necessary roads, arrangement of water, collection of implements, fencing, purchase of building materials etc. Annual recurring expenditure includes daily expenditure, poultry food, conveyance expenditure, electric expenditure are, labour wages, repairing of the implements etc. Besides this brand number of chicks, cost of vaccine, medicine etc. will come under miscellaneous expenditure.

Farm Management

The key of increased production is the improved management. For better management, therefore, the following things should be considered.
1. **Housing**: Improved and comfortable housing is necessary. The height of the house should be 2 metres. There should be 75 cm brick works under the enclosure and above that there should be wire netting of 120 cm. The floor should be cemented. The roof of the house can be made of grass or bamboo mat. If bamboo-mat is used, polythene sheet should be under it. The house should be comfortable.

2. **The Floor Space**: In litter management, for every layer the requirement of space would be 2300-2800 sq cm. The house should be constructed on this basis.

3. **Management of Litter**: Husks or dry saw-dust should be spread out in the layers house so as make to 15-20 cm. depth. This litter should turned down at least six times a week. Some times the litter should be changed and dried in the sun.

4. **Arrangement for Ventilation and Light**: There must be arrangement for light and for ventilation. So that fresh air can move through all.

5. **Temperature**: Excessive hot or cold, both environments can hinder egg production.

6. **Food for Chicks**: Food for chicks should be stored in the farm at least for 15 days. Chicks should be given balanced diet. The following ingredients must be present in prepare proportion:

7. Feeding Pan: The feeding pan may be of any size depending on the age of the chicks. The pan should be cleaned every day.

8. Pan for water: Pan for water may be made of tin. The pan should be cleaned everyday and the chicks should be supplied with pure water.

9. Pan for Keeping Oyster Dust: The laying hens should be given oyster dust to eat. So there should be arrangement for 2-3 pans for keeping oyster dusts.

10. Feeding System: Hen should be supplied with food 3 times a day. Feed should be given at 7-8 a.m for the first time, at 12 noon to 1 p.m for the second time and at 4-5 p.m for the third time.

11. Laying Box: There should be laying box for the hens. Some straw should be kept in the box. These will hinder chances of breaking of eggs.

12. Arrangement of Light in the Hens House: There, should be in total 16 hours of light including artificial light out of 24 hours in the hens house, at the stage of laying eggs.

13. Debeaking: Fowls can not hit each other with the beaks if they are cut. They can not break the eggs. Debeaking can be done with the help of a machine. Debeaking should be done after each 4-5 months.

14. Culling: Low productive hens dissipate farm food and management. So, they should be culled at the age of 76 weeks.

15. Health Care: The diseased hens should be kept in a separate room and the dead chicks should be buried in soil or burnt to ashes. They should be vaccinated as preventive measures of different diseases in proper time.

Account of Income Expenditure.

An example of the account of income-expenditure for establishing a farm of 100 layers as given below:
Example of Account

**Total expenditure**
1. Land: Farm to be established in own home
2. House: 300 cu.ft for 100 layers (Katcha.house), cemented floor,
   for each cu.ft @ Tk 30 30 x 300 = Tk. 9000
3. Feeding pan -4 noms, each @ Tk 70 4 x 70 = Tk. 280
4. Pan for water-4noms, each @ Tk.50 4 x 50 = Tk. 200
5. Trey for egg- 10noms, each @ Tk.25 10 x 25 = Tk. 250
6. Thermometer-1 nom, each @ Tk.150 1 x 150 = Tk. 150
7. Litter- 15bags, each bag @ Tk.25 15 x 25 = Tk. 375
8. Chicks-100.each chick @ Tk 100 100 x100 =Tk. 10,000
9. Food for chicks 2200kg each k@ Tk 7 2200 x 7 =Tk. 15,400

Total expenditure: Tk. 35,655.00

**Total income**
1. Sales proceed of eggs : No. of hens -70
   if each hen gives 280 eggs, each egg Tk.2,5.0 x 70 x 280 = 49000
2. Sales proceed of excreta/compost = 900
3. sales proceed of hens (at the end of laying eggs)
   30 each @ Tk. 100.00 30 x 100 = 3000

Total income: = 52900

**Account of income - expenditure after one year**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total income</td>
<td>Tk. 52900</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>Tk. 35,655.00</td>
</tr>
<tr>
<td>Net Profit</td>
<td>Tk.17,245.00</td>
</tr>
</tbody>
</table>

Practical

**Subject :** Visit of a poultry farm

**Materials :**
Exercise book, pen etc.

**Steps of Work**
1. Go to selected farm as per direction of the teacher.
2. Observe the farm minutely.
3. Discuss about the variety of hens, variety of ducks, egg production, food, management of the farm.
4. Write down the different information in the practical note book.
Exercise

Multiple Choice Questions

1. After how many weeks should the poultry be culled?
   a. 72 weeks  
   b. 74 weeks  
   c. 76 weeks  
   d. 78 weeks

2. The reason for beak cutting of poultry birds is-
   a. cannot be able to waste feed by beaks.  
   b. cannot attack other birds by the beak.  
   c. can not break eggs.  
   Which one is correct?
   a. i  
   b. i and ii.  
   c. ii. and iii.  
   d. i, ii and iii

3. Mr. Raihan is rearing 100 poultry birds in his poultry farm. The daily requirement for poultry feed is 10 kg. The price of feed per kg is Tk. 10.00 and the daily labour cost is Tk. 50.00. What is the monthly savings if his daily income from the farm is Tk. 250.00?
   a. Tk. 1000.00  
   b. Tk. 2000.00  
   c. Tk. 3000.00  
   d. Tk. 4000.00

Creative Questions

Monu Mandal is an educated young man. He planned to establish a small-scale poultry farm in his own house for the production of eggs. He took loan to meet the capital expenditure from a local NGO. Monu Mandal also calculated that he could easily establish one poultry layer farm having 75 birds in the space available in his house. He started to implement the plan constructing the poultry house with pacca floor and straw made roofs and lastly became successful in poultry farming.
   a. What are the types of poultry farms on the basis of production?  
   b. Why Monu Mandal started one small-scale poultry farm instead of a big farm?  
   c. Prepare a budget for the poultry farm planned by Monu Mandal.  
   d. Only the improved management of the poultry farm brought about the success of this farm. Evaluate the statement.
Chapter Five

Poultry feed

The first condition of getting more meat and eggs from poultry (ducks and hens) is supplying them with balanced food properly. In preparing balanced food the following nutrient elements must be there in proper proportion.

1. Protein  
2. Carbohydrate  
3. Vitamin  
4. Fat  
5. Mineral salts  
6. Water

Sources of Food Nutrients and Function

Carbohydrate:  Carbohydrate is present in food grains like rice, wheat, maize, barly, millet, ground nut, molasses, wheat husks, rice bran, sweet potato.

Function of Carbohydrate: This type of food supplies energy and calories to the bodies of poultry. This type of feeding is helpful in producing yolk of the egg and fat.

Protein:  There are sufficient protein in the boiled entrails of cows and goats, fishmeal, cakes of mustard, til and ground nut, and pulses like khesari, mashkalai etc.

Function of Protein: This type of food is helpful in compensating the loss of the body, increasing meat, producing egg, increasing calorie and producing fat.

Fat:  Sufficient fatty types of food are present in mustard, soyabean, ground nut oil, different types of vegetable oil and seeds.

Functions of Fat: Fat is preserved in the body and supplies calorie and energy when necessary.

Vitamin:  Vitamin is stored in green grass, yellow food grains meat, dried fish, vitamin can be obtained from sun light, cod-liver oil.

Functions of Vitamin: Protein, carbohydrate, fat and minerals are not processed in the body and become inactive due to shortage of vitamins. Vitamins increase the strength of disease resistance and help in producing energy.

Mineral Substances: Calcium and phosphorus are present in oyster dusts, bone meal, lime, egg shells etc.

Function of Mineral Substances: These types of food are helpful in bone development of fowl and production of egg.
**Water:** Poultry birds should be given abundant clean water. Water is also available in green grass and foods.

**Functions of Water:** Water takes out the undesirable thing from the body, of poultry controls the birds temperature of the body and keeps body cell alive.

---

**List of Sources of Different Nutrients**

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Sources of food</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Protein</td>
<td>Dried fish meal, the inner parts of sniles and oysters, boiled entrails of cows and goats, cakes of til and ground nut, boiled soyabean seeds, dried blood.</td>
</tr>
<tr>
<td>2. Carbohydrate</td>
<td>Wheat, maize, wheat husks, rice bran, barley and sorghum.</td>
</tr>
<tr>
<td>3. Fat</td>
<td>Til oil, soyabean, mustard oil cake, boiled. soyabean seeds</td>
</tr>
<tr>
<td>4. Vitamin</td>
<td>Vegetables, liver oil, artificially prepared vitamin premix</td>
</tr>
</tbody>
</table>

**Things to be considered for Poultry Food.**

70-75% of the total capital is spent on poultry food. The following points are to be considered in supplying poultry food -

1. Food should not be costly.
2. There should be necessary nutrients ingredients in proper proportion.
3. The mixture of different food ingredients should be balanced.
4. Food should be easily digestible for poultry birds.

5. Food should not have obnoxious smell.

6. Adulterated food should be avoided.

7. The mixed food should not be kept for more than 5 days so fungus will grow in any circumstances. If kept more than 5 days in the mixed food.

8. If stored food should be sun-dried once in every week.

**The Principles of Food Preparations**

The ingredients and quantity of food are different for different purposes, such as for meat production or egg production. Again there are differences in the quantity of food and the ingredients depending on the age of the bird. So food for the poultry birds should be prepared as per the list.

**The Process of Food Preparation**

First of all maize or wheat should be crushed in the mill. Til and the cake should be mixed well and crushed. The crushed wheat and crushed maize should be poured out in a clean place, bran will have to be poured out on it. Then, fish meal should be poured on bran and til cake on the fish meal.

Lastly soyabean will have to be poured out on the top. After all there are poured out fill the food ingredients will look like a pyramid. This time oyster dust and salt will have to be sprinkled on that pyramid. Taking three to four handfuls of food separately vitamin-mineral premix will have to be mixed thoroughly. Afterwards this mixed materials should be sprinkled throughout the whole food on the pyramid. Now an the food ingredients will have to be mixed by turning upside down and downside up with hand. As a result of mixing thoroughly the food will turn to a mass, of almond colour. The meat of snails or oysters will have to be mixed with the poultry food. After collecting the entrails of fowls from different hotels those are to be washed in hot water and boiled. Those are to be sun-dried cut into pieces and mixed with the poultry ration. In this food mixture, there is no need of mixing dried fish dust. In the same way, the entrail of cows and goat can be mixed instead of dried fish dusts. This boiled soyabean can be used as a substitute of dried fish. The amount of protein is specially considered at the time of preparing of balanced food.
A. Daily Requirement of Poultry Food.

<table>
<thead>
<tr>
<th>Age</th>
<th>Fowl</th>
<th>Duck</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. First week</td>
<td>10 gm.</td>
<td>15 gm.</td>
</tr>
<tr>
<td>2. Second week</td>
<td>20 gm.</td>
<td>25 gm.</td>
</tr>
<tr>
<td>3. Third week</td>
<td>30 gm.</td>
<td>35 gm.</td>
</tr>
<tr>
<td>4. Fourth week</td>
<td>40 gm.</td>
<td>45 gm.</td>
</tr>
<tr>
<td>5. Growing stage</td>
<td>75 gm.</td>
<td>90 gm.</td>
</tr>
<tr>
<td>6. Adult</td>
<td>115 gm.</td>
<td>125 gm.</td>
</tr>
</tbody>
</table>

B. Example of Food Preparation for Poultry Birds up to Eight Week.

<table>
<thead>
<tr>
<th>Feed ingredients</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>4.5 kg.</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>2.5 gk.</td>
</tr>
<tr>
<td>3. Cake (mustard or Til)</td>
<td>1.2 kg.</td>
</tr>
<tr>
<td>4. Soyabean meal</td>
<td>0.6 kg.</td>
</tr>
<tr>
<td>5. Oyster dusts</td>
<td>130 gm.</td>
</tr>
<tr>
<td>7. Mineral mixture with vitamin</td>
<td>20 gm.</td>
</tr>
<tr>
<td>8. Dust of dried fish</td>
<td>1.0 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg.</strong></td>
</tr>
</tbody>
</table>

C. Sample of Food Preparation for the Young Poultry Birds of 9 to 20 Week.

<table>
<thead>
<tr>
<th>Feed ingredients</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>4.5 kg.</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>2.6 gk.</td>
</tr>
<tr>
<td>3. Cake (mustard or Til)</td>
<td>1.8 kg.</td>
</tr>
<tr>
<td>4. Dust of dried fish</td>
<td>0.8 kg.</td>
</tr>
<tr>
<td>5. Oyster dusts</td>
<td>130 gm.</td>
</tr>
<tr>
<td>7. Mineral mixture with vitamin</td>
<td>20 gm.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg.</strong></td>
</tr>
</tbody>
</table>
D. Sample of Food preparation for Adult Plultry Birds

<table>
<thead>
<tr>
<th>Feed ingredients</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>4.5 kg.</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>3.5 kg.</td>
</tr>
<tr>
<td>3. Mustard or Til</td>
<td>900 gms.</td>
</tr>
<tr>
<td>4. Dust of dried fish</td>
<td>800 gms.</td>
</tr>
<tr>
<td>5. Oyster dusts</td>
<td>225 gms.</td>
</tr>
<tr>
<td>7. Mineral mixture with vitamin</td>
<td>20 gms.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg.</strong></td>
</tr>
</tbody>
</table>

E. Sample of Food Preparation for Broiler

<table>
<thead>
<tr>
<th>Feed ingredients</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crushed wheat</td>
<td>4.5 kg.</td>
</tr>
<tr>
<td>2. Rice bran</td>
<td>2.1 kg.</td>
</tr>
<tr>
<td>3. Mustard or Til</td>
<td>1.6 kg.</td>
</tr>
<tr>
<td>4. Dust of dried fish</td>
<td>1.0 gram.</td>
</tr>
<tr>
<td>5. Soyabeen meal</td>
<td>0.6 gms</td>
</tr>
<tr>
<td>6. Oyster dusts</td>
<td>125 gms.</td>
</tr>
<tr>
<td>7. Salt</td>
<td>50 gms.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg.</strong></td>
</tr>
</tbody>
</table>

**Exercise**

**Multiple Choice Questions**

1. What is % of the capital money spent for poultry feed?
   a. 55-60%  
   b. 65-70%  
   c. 70-75%  
   d. 80-85%
Read the chart below and give answers to questions 2 and 3.

The components of the feed of broiler poultry is as below:

<table>
<thead>
<tr>
<th>Feed components</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed wheat</td>
<td>4.5 kg</td>
</tr>
<tr>
<td>Rice bran</td>
<td>2.1 kg</td>
</tr>
<tr>
<td>Oil cake</td>
<td>1.6 kg</td>
</tr>
<tr>
<td>Dry fish grounds</td>
<td>1.0 kg</td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>0.6 kg</td>
</tr>
<tr>
<td>Oyster grounds</td>
<td>125 gram</td>
</tr>
<tr>
<td>Salt</td>
<td>50 gram</td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>25 gram</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg</strong></td>
</tr>
</tbody>
</table>

2. How much money will be required to purchase oil cake for preparing 25 kg of the feed if the price of the oil cake is Tk. 20.00 per kg.
   a. Tk. 70.00  
   b. Tk. 80.00  
   c. Tk. 90.00  
   d. Tk. 100.00

3. Which types of materials can be used for preparing poultry feed in place of using dry fish grounds?
   a. Pre-mix mixture  
   b. Bone meal  
   c. Poultry ration  
   d. Intestine pieces
Creative Questions

The preparation for adult bird feed’s is as follows-

<table>
<thead>
<tr>
<th>Feed components</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed wheat</td>
<td>4.5 kg</td>
</tr>
<tr>
<td>Rice bran</td>
<td>3.5 kg</td>
</tr>
<tr>
<td>Oil cake</td>
<td>900 gram</td>
</tr>
<tr>
<td>Dry fish grounds</td>
<td>800 gram</td>
</tr>
<tr>
<td>Oyster grounds</td>
<td>255 gram</td>
</tr>
<tr>
<td>Salt</td>
<td>50 gram</td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>25 gram</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 kg</strong></td>
</tr>
</tbody>
</table>

a. What are the major preconditions for getting more meat and eggs from poultry birds?

b. What are the sources of protein feed given in the above chart?

c. Prepare a 30 kg feed formulation using the data given in the above chart.

d. The determination of quantitative proportions of feed items is stated to be very important in controlling the quality of poultry feed. Explain with justification in favour of the statement.
Chapter Six

Poultry Diseases and their Treatments

In Bangladesh many poultry-birds die for want of proper treatment every year. As a result, tremendous loss occurs in meeting the demand for meat and eggs, even in the economy of the country.

The poultry-diseases can be divided into five kinds such as –

1. Viral diseases
2. Bacterial diseases
3. Fungal diseases
4. Diseases caused due to parasites
5. Disease due to malnutrition

In case of poultry if treatment is done after they attacked with diseases very insignificant result can be achieved. In case of poultry birds, prevention is better than treatment. Symptoms of some main poultry diseases are described here -

1. Ranikhet Disease

This is a very fatal infectious disease. In rural areas it is also called "Chuna" disease. This disease spreads very rapidly. In our country outbreak of this disease takes place during winter and spring seasons.

Symptoms of the Disease

1. Symptoms of the disease are revealed one week after the germs of the disease enters into the body.
2. The diseased fowl leaves the flock and sits alone in one corner of the house. The layer gives up laying eggs.
3. The diseased fowl stops eating. The head turns downward and begins to drowse.
4. The diseased fowl passes stool like white lime.
5. The diseased fowl blows its nose and salivates from its mouth
6. Respiration becomes rapid and breaths by opening the mouth. Some times makes 'Kok kok' sound during breathing in.
7. The wings swing downwards. The neck of the fowl becomes curved. Sometimes it rotates like a wheel standing on the same place.

8. The fowl becomes weak and sits keeping its beak and chest on the earth. Liquid stool is seen on the rear feathers.

9. The fowl dies within 1-2 days after the disease is revealed.

Prevention of the Disease

The main way of protecting the fowls from this disease is to use preventive vaccine. This vaccine has been distributing throughout whole Bangladesh by livestock offices. There are two types of vaccines such as -

1. BCRDV for Small Chicks: One-day old chicks are to be vaccinated

   System of Use: The original vaccine of the phial should be mixed with 3 cc distilled water and one drop should be applied to every eye with the help of a dropper.

2. RDV for Adult Fowls: This vaccine is to be applied when the fowls are of more than 2 months of age.

   System of Use: The original vaccine of the phial should be mixed with 100 ml of distilled water and 1 ml should be injected into the muscle of the thigh of fowl.

Treatments

1. There is no proper treatment of this disease.

2. The diseased fowl should be kept in isolation and should not be sold anywhere.

3. The dead fowls should not be thrown hither and thither; it should be rather buried into soil.

4. Potash-mixed water can be fed to both diseased and healthy fowls.

5. Sulphadiazine tablet should be divided into four parts and the adult fowl should be fed with one part twice daily.

2. Fowl Pox

Fowl pox is a viral fatal contagious disease. This disease can affect fowls of all ages. But this disease is deadly for the young fowls. Generally fowl pox disease can be found mostly between October to March.
Symptoms of the Disease

1. In the featherless areas of the fowl such as car, comb of the head, surroundings of the eyes etc. small or big blisters appear and sores develop later on. Afterwards black covers develop on it. The bruises remain under this cover.

2. Bruises develop on the lids of the eyes and the lids are swelled up. As a result the eyes are closed partially or wholly.


4. Production capacity is decreased and laying of egg is stopped.

5. Some times the adult fowls can survive but the young ones die.

Prevention of the Diseases

The fowls are to be vaccinated timely.

System of Pushing Vaccine: The vaccine shall have to be prepared by mixing the original vaccine from the phial with distilled water. A two-mouthed needle should be dipped into the prepared vaccine again and again and pushed into the inner featherless area of the wing. Generally, vaccination should be done once in a year.

Treatment

1. It is necessary to wash the bruises with potash water
2. Sulphonelamide powder can be used
3. The disease fowl should be isolated
4. The poultry-shed should be cleaned with iasin solution.

3. Cholera of Poultry Birds (Chicken and Ducks)

This disease is caused by one type of bacteria. This disease can affect ducks and fowls of all ages in any time of the year. Generally this disease is found in case of the chicks when they attain more than 4 months of age. Sometimes some dead fowls can be seen in the flock without showing any symptoms. Again sometimes the symptoms of disease can be noticed.
Symptoms of the Disease
1. Stool of green or yellow colour is passed.
2. The feathers become rough. The bird moves the head hither and thither.
3. Eating is stopped and respiration becomes rapid.
4. Comb of the head, knee and other parts of the mouth are swell.
5. Salivates from nose and mouth and thirstiness is increased.

Prevention of Disease
The healthy fowls should be vaccinated after every 6 months.

System of Using Vaccine
The vaccine is available in 100 c.c. bottle. Each poultry bird should be injected with 1 c.c. of this vaccine into the muscle of the thigh. If the fowl is vaccinated once at the age of 2 and half month, there is no apprehension of attack this disease for 4-5 months.

Treatment
1. The house of the diseased fowl should be kept clean.
2. One to one and a half gm Cosumix powder shall have to be mixed with 1 litre of water and should be fed 3 times in succession.
3. Sulphadiazine or Sulphamezathyne or Renamycin tablet should be fed.

4. Blood Dysentery
This disease is the result of attack of a parasite called Coccidia. This disease can be found generally in the chicks of less than 2 months of age. Sometimes 70-80% of the chicks are attacked with this disease and die.

Symptoms of the Diseases
1. Stops taking food and water. The fowl begins to drowse.
2. The feathers become rough and the fowl keeps its eyes closed.
3. The chicks become weak before death and die within 4-5 hours.
4. The shell of the egg of laying hen becomes thin and egg laying decreased.
5. Passes loose excreta mixed with blood.

Prevention of the Diseases
1. The poultry house should be a condition having plenty of air, light and temperature. The used instruments should be kept clean.
2. The litter should always be dry and clean. In this case rice husks or saw-dust can be used.
Treatment
(a) Medicine like a Sulphamezathene 16%
(b) Sulphademydin ESB 30% and
(c) Emazine 25% should be fed with feed and water as per prescription of the livestock doctor.

5. Gumboro Disease
It is a very contagious disease caused by virus. Generally this type of disease can be mostly found in the chicks of 3-12 weeks age. Once affected the effectiveness of all vaccines are spoiled and the chicks become susceptible to other disease.

Symptoms of Disease
1. Passes loose stool with obnoxious smell. The feathers become rough.
2. Stops eating and thrust for water is increased.
3. Lies down on the ground due to shivering tiredness and at last the bird dies from dehydration.
4. 30-40% ducks die within 3 days of attack by the disease.

Prevention of the Diseases
Following ways can prevent the disease
1. By taking sanitary measures.
2. By vaccinating against Gumboro disease
3. If vaccination becomes impossible, when the bird attains 14 days of age always saline solution should be fed after every 2 days up to 3 months of age.

Treatment
1. 100 gm molasses and 15 ml vinegar should be mixed with 1 litre of water and should be fed in the noon
2. Two packets orsaline and 4 vitamin B-12 tablet should be mixed with 1 litre of water and should be fed at the evening go at night.

6. Plague of Ducks
Virus causes this disease. It is a fatal contagious disease. The expiry rate caused by this disease is high. This disease can affect ducks of any age.

Symptoms:
1. Unwillingness appears in food taking, becomes thirsty and the ducks can be seen to drink water repeatedly.
2. The duck starts passing very loose motion and stool adheres in tail areas.
3. The duck becomes afraid of light, liquid things come through the nose and the mouth.
4. The legs and wings become paralyzed. Trembling appears in head, neck and body
5. The affected duck sits depending on its chest. Laying of eggs by layer-ducks suddenly decrease.

**Prevention of the Disease**
The ducks have to be saved by using duck. One plague vaccine 1 ml vaccine has to be injected into the muscle of thigh of each duck.

**Treatment**
There is no treatment of diseased duck. The diseased duck should immediately be separated. The diseased ducks should be properly buried.

7. **Parasitic Disease**
Parasitic diseases are of two types, such as:
1. Internal parasites: Such as all types of worms.
2. External parasites: Such as lice and mites. These types of parasites attack both ducks and fowls.

**Internal Parasites**
Generally the eggs of worms enter into the body of fowl with food and from wet dirty floor of the house.
The poultry birds are vulnerable to be affected by different types of worms. Out of those the most important ones are round worms, tape worms, thread worms etc. The following symptoms are revealed when the poultry birds are attacked by worms.
1. The comb of the head becomes white or pale.
2. The symptoms of blood anemia appear in faces. The bones of the chest become visible.
3. The bird begins to wither the feathers become rough and growth is retarded.
4. Passes blood-mixed liquid stool. Sometimes worms are seen to come out with stool.
5. The body weight decreases and laying of egg is stopped
6. When the number of worm is enormous the intestinal tube is blocked and the bird

**Prevention of Worms-Disease**
1. Medicine of worms is to be fed at least after every 3 months.
2. The house is to be kept clean always and other sanitation measures are to be followed.


**Treatment**

Pyralgin Should be fed with food as per prescription of the livestock expert.

**Disease Due to Vitamin Deficiency**

If the balanced food is deficient in vitamin different symptoms develop in the body of poultry birds. As a result the productivity is hampered.

**Vitamin A**

Night-blind disease develops due to want of vitamin-A.

**Deficiency Symptoms**

1. The eye lids are swelled and water comes out of the eyes.
2. Odorless pass-like things comes out from nose and mouth
3. The feathers become rough.
4. Body growth is hampered.

**Prevention**

Feeding green vegetables such as leaves of cabbage, kalmi shak, spinach, green grass and cod liver with balanced diet help to prevent to a great extent.

**Vitamin D Deficiency Symptoms**

1. Ricket disease develops due deficiency of vitamin-D
2. The shell of egg becomes soft and thin.

**Prevention**

There should be arrangement for sufficient sunlight in the house of poultry birds, the birds should be fed green vegetables and cod-liver oil.

**Vitamin B-1 or Thiamin Deficiency Symptoms**

1. Drowsiness and loss of appetite.
2. The neck becomes bent, convolution develops and dies of withering

**Prevention**

Deficiency can be overcome by feeding wheat husk, liver, ground nut and rice bran.

**Vitamin B-2 or Riboflavin**

1. Growth is hampered and laying of egg is decreased. 2. The fingers of legs become shriveled.
**Prevention**
Grass and dusts of dried fish should be fed with food.

**Preservation of Vaccines and Use**
The activity of vaccines is lost if those are not preserved properly. Preservation of vaccines is very important. Preservation of vaccines and usage is given below

**Preservation System of Poultry-Vaccines**
Specifications should be known from the manufacturing company of the vaccines and the vaccine is to be preserved accordingly. Some vaccines are to be preserved in freezing condition and some to be preserved in day places. The vaccines are to transported by putting ice in flask.

<table>
<thead>
<tr>
<th>Name of the vaccine</th>
<th>Preservation system</th>
<th>Preservation</th>
</tr>
</thead>
</table>
| Vaccines of fowl Ranikhet, fowl pos and plague of ducks. | 1. Deep freeze  
2. Refrigerator  
3. Thermo flask with ice. (if ice is melt the flask should be filled with ice again)  
4. The vaccine should be used after mixing with water. | 6. Months  
1 month  
1 week  
2 hours |
| Cholera of poultry birds                                | 1. The vaccine should be preserved at 4° c in refrigerator or in thermo flask by putting ice  
2. Can be kept in dry, Cold and dark areas, of the house. | 1 month  
2 days |

**Reasons for Degradation of the Activities of Vaccines.**
1. If the proper use of vaccine is not known.
2. If the vaccine is not used within specified time.
3. If the vaccine is used after expiry date.
4. When the vaccine is, used in proper place and proper method.
5. If two separate vaccines are used at the same time.
6. If the vaccine is not used for definite disease.
7. If the bird is infected by the particular disease before the vaccine is used.
Things to be Followed Before Vaccination

1. Vaccines must be collected from renowned manufacturing companies or from their nominated agents.
2. Hands should be cleaned well by washing.
3. Syringe and needle should be washed well with boiling water to make germ free.
4. If the vaccine is to be mixed with water, the water should be boiled and then to be cooled.

Practical

Subject: Vaccination for Ranikhet disease of fowl.

Materials:
1. Vaccine vial
2. Syringe, needle
3. Distilled water 2.50 c. c
4. Galley pot (pot of mixing vaccine)
5. Cotton and spirit

Steps of Work
1. Take vaccine from the vial in a galley pot.
2. Firstly 2 ml. vaccine with water in the galley-pot.
3. Take the mixed vaccine in a syringe.
4. Now inject 1 vaccine into the flesh of thigh of a full grown fowl.
5. After injecting every fowl wipe the needle with cotton mixed with sprit.

Precaution
1. Preparation of the mixture and vaccination should be done in cool place.
2. The mixed vaccine should be used within 1-2 hours.
3. It is to be noticed during vaccination that the needle does not touch the bone.
4. The vaccine should be mixed with water in cool place.
5. Vaccination should be given during morning or evening in cool condition.
6. Vaccination should be done within prescribed time after preparation of the vaccine. Generally it is safe if vaccination is done within one hour.
Exercise

Multiple Choice Questions

1. Which one of the following is the most serious disease of duck?
   a. Fowl pox  
   b. Ranikhet  
   c. Night-blind  
   d. Duck plague

2. Recently, one poultry disease has become a disastrous factor for poultry industries of this sub-continent: What is the name of this disease?
   a. P P R  
   b. Fowl pox  
   c. Gumboro  
   d. Bird flue

3. What is the name of the disease for which double point vaccination syringe is required?
   a. Cholera  
   b. Dysentery  
   c. Fowl pox  
   d. Ranikhet

4. The symptoms of worm infestation diseases of poultry are-
   i. the comb of the head becomes white/pale in colour  
   ii. the birds excrete white limy materials  
   iii. anemic symptoms are produced in the face.
   Which one is correct?
   a. i and ii  
   b. i and iii.
   c. ii. and iii.  
   d. i, ii and iii

Creative Questions

The poultry birds of Rahima started excreting white-limy stool last year. As the disease infestation increased she rushed to the Livestock Office. The veterinary doctor of the Livestock Office immediately inspected her farm and gave some advice, though he did not recommend any chemical medicine at that time. After that no such disease was found in Rahima’s poultry farm.

a. What are the different types poultry diseases?

b. Why did not the veterinary doctor prescribe any medicine? Explain.

c. What are the disease preventive steps taken by Rahima later on?

d. Explain the dangers of the disease that attacked the birds of Rahimas poultry farm.
Cattle are widely used in Bangladesh for ploughing or pulling carts. There is no permanent productive characteristics for the local breeds. That is why their capability of producing meat and milk is far less. Increased production of meat and milk is possible only by improving its breed. The breed is improved by crossing less productive cattles with highly productive ones. In this case also crossing is done for meat between oxen of improved breed and cows. As a result, the productive capacity of the new born calves is increased to a great extent.

**Introduction of Cattle**

The cow or buffaloes found in Bangladesh can not be called a special breed or improved cattle. Cows have been reared in the houses of this county from ancient times. Although their productive capacity is less but they are sustained well with the weather and environment of this country. For want of balanced diet and proper management they have been attacked by diseases, becoming smaller in size and their productive capacity have been decreasing. An adult cow weighs 150-200kg. Daily milk production is 1-2 litres. The weight of a new born calf is 8-10kg. The weight of an adult ox is 200-255 kg.

**The Main Objectives of Improving the Cattle Breed**

The importance of cattle resources in Bangladesh economy is unlimited. Agriculture development is also dependent on cattle resources development. But we are far behind the other countries in improving this resource. The production of meat and milk from cattle resources is far less in comparison to the demand of the people. This deficit can not be fulfilled by import. We shall have to create opportunities of jobs in order to solve unemployment problem and this can be done with own resources.

1. **Increasing Milk Production** : A local cow gives 1-2 litres of milk daily. Even if she is allowed to improve environment and supply with balanced diet of production of more, than 3 litres can not be expected form her. Because her breed characteristics are
of low standard. But if a calf is produced by crossing local cow with an improved ox, it will give 10-15 litres of milk daily. By this, the demand for milk of the population can be met.

2. **Increasing Meat Production** : The cattle of Bangladesh are small in size, meat production capacity is very less. The average weight of an adult cow is only 150-200kg. But when a calf will be produced by crossing this cow with an improved variety of ox, it will weight 300-400 kg. at adult stage. As a result this size of the cow will be bigger, meat will be abundant and the skin will also be larger, by this the demand for meat can be met easily within short period of time.

3. **Increasing Working Capacity of Cattle** : Bangladesh is an agricultural county. Cattle are the main sources of operating energy now. In order to increase the agricultural production the land must be plough well. Abundant organic manners will have to be applied to the soil. Cow-dung is the main source of organic manure. Hence, the production of crops is basically dependent on cattle resources. One pair of local oxen can plough 3-4 acres of land. 7-8 acres of land can be ploughed yearly by a pair of crossed oxen.

4. **Opportunities for More Employment** : As a result of improvement of breed production of milk, meat and energy will increase. By this, opportunities for employment of unemployed male and female youths will increase. They will be interested in cattle fattening and cow-rearing. As a result they will be able to earn more money through milk: production, ploughing and cattle fattening. If they are employed, unemployment and property would be removed.

5. **Establishment of Big, Farms** : The wealthy persons of the society will come forward with a view to establishing cattle farms of improved breed. As a result milk and meat production farms will be established in different areas of the country. By this many persons will be employed in one hand and, on the other hand after meeting the demand of the country milk and meat can be exported to foreign countries. The country will proceed towards progress by earning foreign exchanges.

**Method of Breed Improvement**

It is possible by crossing to increase in an extensive way the production of local cattle, shortly and inexpensively. In all developed and developing countries the cattle population is improved through crossing. Now a days main objective in our country is to increase production of milk and meat. So, the local cows should be crossed with improved milk producing breed such as Holstein, Friesian, Jersey, Shahiwal and
Sindhi. As a result the calf that will be born, will give much more milk in adult stage in comparison to the local cows: In the manner, if the cow is crossed for meat or energy with specific improved or more improved breed can be produced. This is called hybridization. There are two types of hybridization, such as –

1. **Natural Breeding System.**
2. **Artificial Insemination System.**

1. **Natural Breeding System** : In this process cows are inseminated directly by the local unimproved oxen in the village areas. As a result improved breed of calf cannot be produced and production is not increased. On the other hand, the local cows can be inseminated by improved breed. But it is very much expensive to import so many numbers of oxen from foreign countries. Now a days, arrangement has been made by government in some regions for insemination by improved oxen.

2. **Artificial Insemination System** : This insemination systems is widely in vogue now with a view to improving the cattle population of the country very rapidly. In this process making of improved breed of cattle becomes possible within short period of time in minimum cost and in an extensive way. In this method semen is collected artificially from improved breed of oxen and preserved in scientific method. Afterwards this semen is inseminated through injection in scientific way. As a result, the cow becomes pregnant and gives birth of a calf. This whole system is artificial insemination. The calf produced by this method may possess almost 50% characteristics of the ox of improved breed.

In this way by means of consecutive insemination the breed of local cattle can be greatly improved. It is scientific to inseminate a cow after thorough examination when the cow comes to heat. Generally the local cow-calf becomes suitable for insemination at 2.5 years of age. But insemination should be done after 2-3 months of first heat. By this, more calf and milk can be obtained in the life cycle of the cow.

**Symptoms of a Pregnant Cow and its Nursing**

Pregnancy in cow can be determined by observing the following changes -

1. The cow will not be heated again after 3-4 weeks of artificial insemination.
2. The behavior of the cow will gradually become gentle.
3. The belly will be becoming larger and the abdomen will be tending to extend downwards.
4. Production of milk by the cow will gradually decrease.
5. After almost 5 months the movement of the calf can be felt.
6. At the last stage of pregnancy the size of the udder begins to be larger.

**Nursing and Taking Care of Pregnant and Lactating Cow**

Special type of nursing will be required for livestock husbandry, as is required for crop production after sowing the seeds. In order to get improved type of calf and increased quantity of milk and meat from a cow, the pregnant or lactating cow requires special care. The following points are to be remembered for taking care or nursing of a pregnant cow.

1. From at least one month before the delivery of the pregnant cow should be kept separately in a safe house.
2. Dry straw should be spread nicely on the floor of the house so that the animal can lay down easily.
3. The cow should be bathed regularly.
4. The cow should be protected from mosquitoes, flies and ferocious animals.
5. Care should be taken so that rain water cannot enter into the house of the cow. It should not be taken to slippery areas.
6. The pregnant cow should not be used for laborious work and should not be allowed to graze with other animals. Care should be taken so that the belly of the cow does not get hurt.
7. The house should not be excessive cold or hot.
8. The pregnant cow should be given granular food for its body maintenance firstly 1.5 kg. and from 6 months of pregnancy up to delivery at the rate of 2kg per day. Required quantity of straw and green grass should be fed with it. Enough calcium and phosphorus, mineral materials should be available in the feed.
9. The cow should be allowed everyday to drink abundant pure water with salt.
10. The cow should be guarded at night from 3-4 days before delivery.

**Nursing of Cow During Delivery**

More care needs to be taken during or after delivery in comparison to cares taken during pregnancy period. During this time the following points need to be noticed -
1. It should be kept in clean place during delivery.

2. It should be noticed whether the placenta came out just after delivery. As soon as placenta comes out it should be buried soil. It should be guarded so that the cow can not eat up the placenta.

3. If the placenta does not come out within 24 hours, arrangements should be made to bring out the placenta after consultation with veterinary doctor.

4. After delivery is over the cow should be cleaned by washing with tapped water. It should be given concentrated feed to eat and warm water to drink.

5. The dwelling house of the cow should be dry and clean.

6. The udder and teat of the cow should be washed well with tapped water. Colostrums should be extracted from the teat. The new born calf should be allowed to drink colostrum by bringing in contact with teat.

### The daily balanced diet of a pregnant cow

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Green grass</td>
<td>14-15 kg</td>
</tr>
<tr>
<td>2. Straw (dry/wet)</td>
<td>3-4 kg</td>
</tr>
<tr>
<td>3. Concentrated feed</td>
<td>2-3 kg</td>
</tr>
<tr>
<td>4. Water</td>
<td>enough</td>
</tr>
</tbody>
</table>

### List of granular food mixture

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wheat husks/bran mixed</td>
<td>2 kg</td>
</tr>
<tr>
<td>2. Keshari ground</td>
<td>2 kg</td>
</tr>
<tr>
<td>3. Oil cake (Mustard or til)</td>
<td>500 gm</td>
</tr>
<tr>
<td>4. Rice bran</td>
<td>1 kg</td>
</tr>
<tr>
<td>5. Molasses</td>
<td>300 gm</td>
</tr>
<tr>
<td>6. Mineral mixture with vitamin</td>
<td>100 gm</td>
</tr>
<tr>
<td>7. Salt</td>
<td>100 gm</td>
</tr>
<tr>
<td>Total</td>
<td>6 kg</td>
</tr>
</tbody>
</table>

### Taking Care of the Calf

Soon after delivery the newborn calf should be allowed to take colostrums of the cow. Taking of colostrum will increase disease resistance capacity in its body. Soon after giving birth to the calf the milk that comes in the udder is called colostrums. The first
3- 4 weeks is very for the calf. During this time the calf should be fed with required amount of milk. The milk feeding pan of the calf must be clean and germ free. Because garms of different contagious diseases may spread to the body of the calf through having milk.

The calf is a very important wealth of a dairy farm. In future she will become the cow. She grows up and develops to a milk production animal in the long run. It is very important to be very cow about the cows before its birth to get a healthy and strong calf. Just after the birth the some activities should be performed properly the main activities are -

1. The placenta manual cord should be cut hygienically and tightly bound at the end.
2. The medicine like iodine tincture should be applied at the cut place of the placenta or naval cord.
3. The calf should be kept neat and clean.

The colostrums milk should be given as feed to the born fresh calf. The type of milk is very beneficial for the calf at this stage. The colostrums milk has sufficient diseases resistance elements which save the calf from diverse intention and contiguous disease during the later past of his life. One calf usually take feed in the quantity measuring about 20% of his body weight. That is 1 kg feed materials and required to be given for a calf having its weight about 10 kg. The milk demand for a calf is remain maximum during its first three months after its birth.

**The feed for calf** : The calf may be fed following 3 methods. These are -

**A. Feeding Sufficient Milk from the Mother Cow**
The milk of the mothers cow would be fed during the first these to form weeks after birth. Later on fat free processed milk should be fed. Vitamin should mixed with processed or fat free milks before feed to the calf. Because this remains no vitamins in this type of processed milks.

**B. Feeding other Feed Alternative to Milk**
In the places or situations where the price of milk is very high, alternative feed may be arranged instead or milk of the mother cow, more cheap and available powder milk husk-bran and molasses mixing with hot water may be fed exactly like milk of the mother cow. This is the best alternative method of feeding to calf instead of the milk of the mother cow.
C. Feeding Milk and Balanc Concentrate Mixture

This feed is required for 10-15 days at the birth. This type of feed may be terrier for habitation in case of calf. Initially there may be some repulsion, but gradually the calf be come habituated with is type of feed mixture. The feed mixture composition is give below:

**List of granular feed for calf**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Crushed wheat/ Sorghum</td>
<td>40 Per cent</td>
</tr>
<tr>
<td>2 Maize crushed</td>
<td>40 Per cent</td>
</tr>
<tr>
<td>3 Rice, Wheat husk/bran</td>
<td>18 Per cent</td>
</tr>
<tr>
<td>4 Salt</td>
<td>1 Per cent</td>
</tr>
<tr>
<td>5 Mineral with vitamin mixtm</td>
<td>1 Per cent</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Per cent</strong></td>
</tr>
</tbody>
</table>

Clean drinking water and vitamin mineral mixture should always be kept at the close reach of the calf. After. 15 days age of the calf soft green grass, vines, straw, etc may be given to the calf as feed. At the age of 8 week of the calf, concentrate feed at the rate of 500 grams per day and sufficient quantity of raw green grass should be fed daily. At the age from six months to one year 2 kg concentrate feed should be given per day to the calf along with this type of green grasses. The concentrated protein feed suitable for calf should not contain more than 20 per cent proteins. Its protein content should also be not has than 10 per cent. If it is possible to give sufficient quantities per day, of green grasses or improved quality roughage feed, then the quality of concentrate feed may be slightly reduced. Otherwise the full dose of the concentrate protein should be fed to the calf sufficient quantities of clean drinking water. 7 to 7.5 grams salt and vitamin mineral mixture feed should always be fed to the calf.

**Calf- Castration**

The removal of the two testis of calf in a technical ways of the male calf is known as castration. Usually castration should be done within six months age of the male calf. Points to be considered for getting a healthy calf are mentioned as below:

1. Well accreted with sufficient light clean housing system.
2. Applying germicide medicine after cutting the placenta at the cut place just after the calf is born.
3. Feeding colostrum milk for 3-4 days after the birth of the calf.
4. Using germ free pot for feeding milk to the calf.
5. Frequently not to bring about charge in the feed habit of the calf.
6. Protecting the calf from mites and lice
7. Keeping the ill calf in an isolated place and giving vaccine to the other non infected calves.

Taking Care of Ox having Ability for Insemination
The ox to be used for insemination should be nursed well from its childhood so that during its matured stage high quality semen can be collected from it for long time. The following points will have to be considered for nursing of an ox -

1. Each able ox should be kept separately in clean house.
2. They should be given separate food dwelling arrangement
3. Besides supplying adequate quantity of balanced food vitamin and mineral are also to be supplemented.
4. For every 100 kg of body weight 1.5 to 2 kg. concentrate feed and 3 to 4 kg of green grass should be given daily.
5. It is not proper to collect semen more than once or twice in a week. Otherwise their health will be deteriorate.
6. Measures should be taken so that they are not infected by diseases. If there is any attack of disease, the veterinary doctor should be consulted immediately.

Practical
Subject: 1 Preparation granular food for cow and calf.
Materials:
Wheat husks, crushed wheat, oil seed cake, khesari or mashkalai, rice bran, salt, balance, weights and pan.
Steps of Work
1. Scrutinize the ingredients on the basis of nutrient elements.
2. Determine the quantity of the ingredients separately and show to the teacher.
3. After determination measure the ingredients and mix them.
4. Write down the whole work serially in the practical note book.
Precaution
1. The requirement of salt and mineral materials is very small. So after mixing the ingredients, these two elements should be mixed thoroughly.
2. It is to be carefully noticed that the amount of required ingredients are correct.
3. The concerted food is to be mixed in clean place.

Subject: 2 Preparation of food for calf.

Materials
Oil seed cake, crushed wheat, husks, barley, whey, iried bone meal and salt.

Steps of work are same as preparation of food for cow.

Exercise

Multiple Choice Questions
1. The veterinary doctor should be consulted if after delivery the placenta does not drop with in?
   a. 8 hours.  
b. 16 hours.  
c. 24 hours.  
d. 32 hours.

2. Just after the birth of the calf-
   i. the naval organ should be tightly bound after cutting.
   ii. should be given a bath using cool and clean water.
   iii. tincture iodine should be given at the cut place of the naval organ.
   Which one is correct?
   a. i and ii  
b. i and iii  
c. ii and iii  
d. i, ii and iii.

3. Two kg of granular feed is required daily for each 100 kg reproductive ox. How much money will be spent for a 200 kg reproductive ox for one month when the rate of the feed is Tk. 10/- per kg?
   a. Tk. 1100.00  
b. Tk. 1200.00  
c. Tk. 1300.00  
d. Tk 1400.00
Creative Questions

There were a local heifer and one ox in the house of Rafiq of Santhia Upazila. Taking advice and loan from Milk Vita he then purchased one dairy cow giving 12 litres of milk per day. Rafiq performed artificial insemination of his local heifer when it attained reproductively by an ox of implored breed. He was repaying the Milk Vita loan money from the income from selling the milk. After a few months his local heifer produced a calf like his purchased dairy cow. In this way his farm becomes larger.

a. What is improvement of breed?

b. Explain one necessity of improving cattle breeds.

c. Describe all the processes which Rafiq followed to get a calf like his purchased dairy cow from the local heifer.

d. Explain the rationales of contribution in dairy industrial development through the improvement of cattle breed of the country as initiated here by Rafiq.
Chapter Two

Establishing a Family Milk Farms

Establishing a milk farm in own house under own environment in commercial basis is called family milk farm. Now-a-days small farms have been established centering the families. These types of farms bring about solvency and increase income of the family by eradicating unemployment. The demand for milk of the family is also met up. By widely establishing such types of farms milk-deficit of the country can be fulfilled.

Farm Planning

Attempts to establish family firm with small capital can be taken. In this case, the frame-work of the family farm can be prepared considering the own facilities, man power, capital etc. of the family. The main subjects of the frame-work are -

1. It is necessary to determine the requirement of total capital for the establishment of the farm initially. Out of this fund, the expenditure for site selection, construction of house, purchasing of cows and expenditure for other implements are separately estimated. This expenditure is called capital expenditure.

2. The daily expenditure made for feed for cows, vaccine, medicine is called daily recurring expenditure.

3. It is necessary to note down the daily expected income from the farm.

4. Another important issue of the farm is selection of cows. Improved breed of

Homestead Cattle Farm
cows will have to be selected. In this case, the Halstein (crossed) breeds of cows can be selected. The farm may be started with 2-3 numbers of cows. Afterwards 8-10 cows can be purchased out of the profit of the farm.

According of Income and Expenditure of the Farm

Generally expenditure on account of land of the farm is not counted. Because these types of farms are established in own homestead. The income-expenditure of a small family milk farm is shown as under-

1. Capital Investment Taka
   a) Size of land - 6 decimal, Farmer's own land.
   b) 2 Cows with calf (Crossed breed Halstein-Frisian) Each cow @ Tk.25000/-2 numbers of cows Tk. 50,000/- (Each will give 12 litres of milk daily)
   c) Housing: For each cow and calf @ 6 sq. metre each. Total requireme for 2 cows is 12 sq. metres. Each sq. metre @ Tk. 2000/- total 12 x 2000/- = Tk.24,000/- (single roofed tin-shed)
   d) Expenditure for feeding pan, water pan, implements, milking tub, etc. = Tk. 2000/-Total invested capital = Tk. 76,000/-

2. Recurring Expenditure

Concentrate feed: Concentrate feed for 2 cows at milking stage each 3.5 kg. daily, for 280 days on average total = 1960 kg.

Concentrate feed for each cow @ 1.5 kg. daily, for two cows for 80 days on average total requirement is 240 kg.

Concentrate feed for 2 calves @ 1 kg. daily for 330 days on average = 660 kg.

Total amount requirement of concentrate feed = 1960 + 240 + 660 = 2860 kg.
per kg. @Tk.10/- = Tk. 28600/-

Fibrous food: Straw required for 2 cows each @ 3 kg. daily on average for 365 days = 2190 kg.

Straw required for 2 calves each @ 0.5 kg. daily on average for 300 days =300 kg.

Total straw required for cows and calves together = 2190 + 300 = 2490 kg. Each kg. @Tk. 1.00, So, Total price = Tk. 2490/-
Required for 2 cows each @ 15 kg. daily on average for 365 days = 10950 kg. Green grass for each calf @ 5 kg. daily on average of 300 days total requirement is = 3000 kg.

Total green grass required for cows and calves together = 10,950 + 3000 = 13950 kg.

Each kg. grass @ 0.5 taka 13950 x..50 Total price=Tk. 6,975/-

3. Repairing of cow shed annually Tk.1000/-

4. Miscellaneous annual expenditure including medicine Tk. 2,000/-

5. Labour cost of a cow boy daily @ Tk. 40/- for 365 days Tk = 14,600/-

**Family Milk Farm**

<table>
<thead>
<tr>
<th>Recurring expenditure</th>
<th>Taka</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Concentrated feed</td>
<td>28,600</td>
</tr>
<tr>
<td>b) Fibrous grass ( straw)</td>
<td>2490</td>
</tr>
<tr>
<td>c) Grass (green)</td>
<td>6975</td>
</tr>
<tr>
<td>d) Repairing the cow shed</td>
<td>1000</td>
</tr>
<tr>
<td>e) Expenditure for treatment</td>
<td>2000</td>
</tr>
<tr>
<td>f) Labour cost for the cow-boy (one year)</td>
<td>14600</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>55,665</td>
</tr>
</tbody>
</table>

**Expenditure and income of the farm (from milk and cow-dung)**

From each cow daily 12 litres of milk for 285 days. From two cows : 2 x 285 x 12 = 6840 litres of milk production. Income for the 1st year

Each litre of milk @ Tk. 16.1- price 6840 x 16 = 1,09,440/-
**Farm Management**

The income and the expenditure directly depend on the management of farm. So in order to have good management the following points shall be given importance -

1. In selecting the site for the farm, highland should be taken. The site should have light and air.

2. The cow-shed should be cleaned regularly. The house should be cleaned well by using-germicide twice a week.

3. Regular supply of granular and fibrous food to the farm should be ensured. Food should always be stored in the house at least for 15 days. The homestead can be utilized for, cultivating green grass.

4. Everyday the cow should be given 3 - 4 kg, of granular food and 12 15kg. of green grass. Besides these 3 - 4 kg. straw should be given daily. The cow should be fed balanced food and pure water. It should be bathed regularly.

5. Arrangement should be done for treatment as soon as it becomes ill. It should be vaccinated regularly.

6. Milk should be extracted in hygienic way.

7. The pan for food and water of the cow should be cleaned after every 2 - 3 days.

8. The cow should be inseminated timely at the time of its heat period.

9. Expenditure for food of everyday should be noted down in the note book.

10. Daily sale proceeds of milk should be written down in note book.

If the above mentioned directives are followed the farm production will be increased and the farm will be profitable.

**Practical**

**Subject: Observing a family milk farm.**

**Materials**

Measuring tape, note book, pen etc.

**Steps of work**

1. Go to a near by farm as per instruction of the teacher.
Farm Management

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10. Daily sale proceeds of milk should be written down in note book.

If the above mentioned directives are followed the farm production will be increased and the farm will be profitable.

Practical

Subject: Observing a family milk farm.

Materials

Measuring tape, note book, pen etc.

Steps of work

1. Go to a near by farm as per instruction of the teacher.
2. Observe the farm minutely and closely watch the site, of the farm and the condition of its surroundings.

3. Closely observe the number of breed of the farm, milk production and other activities.

4. Write down different information in the practical note book.

Precaution

5. Do not go to the animal carelessly.

6. Do not disturb any animal after going to the farm.

Exercise

Multiple Choice Questions

Read the paragraph below and give answers to questions-1, 2 and 3.

The household dairy farm can be defined as a form which is established in one’s own house on the commercial basis. Presently, there are many small household farms.

1. With how many hybrid cows can a household dairy farm be started?
   a. 1-2      b. 2-3
   c. 3-5      d. 5-7

2. Establishing household dairy farms extensively by in the rural areas, it is possible-
   a. fulfilling the deficit of meat.
   b. fulfilling the deficit of milk.
   c. fulfilling the shortage of organic manure.
   d. full eradication of unemployment of the country.

3. Household dairy farms-
   i. fully eradicate unemployment.
   ii. fulfill the family’s milk need.
   iii. create self employment.
Which one is correct?

a. i and ii       b. ii and iii

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

4. Abu Mia has 10 cows in his dairy farm. Each dairy cow gives 10 litres of milk every day. His daily operational cost is Tk. 1000.00 How much money can Abu Mia save per month if the price of milk is Tk. 20.00.

a. Tk. 10,000.00  b. Tk. 20,000.00

c. Tk. 30,000.00  d. Tk. 40,000.00

Creative Questions

The fixed cost, operational costs and total income of 3 dairy cattle livestock farms

<table>
<thead>
<tr>
<th>Farm No.</th>
<th>Fixed cost</th>
<th>Operational costs</th>
<th>Total income</th>
<th>Net income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tk. 80,000.00</td>
<td>Tk. 60,000.00</td>
<td>Tk. 1,20,000.00</td>
<td>Tk. 1,20,000.00</td>
</tr>
<tr>
<td>2</td>
<td>Tk. 80,000.00</td>
<td>Tk. 50,000.00</td>
<td>Tk. 1,15,000.00</td>
<td>Tk. 1,15,000.00</td>
</tr>
<tr>
<td>3</td>
<td>Tk. 60,000.00</td>
<td>Tk. 46,000.00</td>
<td>Tk. 1,10,000.00</td>
<td>Tk. 1,10,000.00</td>
</tr>
</tbody>
</table>

Table: Ripon takes the decision regarding his farm management interpreting the information.

a. What is farm management?

b. Describe the expenditure items of the farm.

c. Show which farm is more profitable analyzing the income and expenditure data.

d. Which farm is less profitable and what should be done to make it more profitable? Explain with logic.
Chapter Three
Milking a Cow

In order to measure the amount of milk from a cow the importance of milking system is manyfold. Inspite of the availability of sufficient milk in the udder of the cow it is not possible to collect reasonable quantity milk for not knowing the milking method.

Milking Method
In general there are two methods of milking.

Traditional Method: In this case the extorter extorts milk from the udder with the help of hands.

Modern Method: Milk is extorted from the udder with the help of a machine. As a preparation of milking, the hands of the extorter, the udders of cow, teats, and the milk-pan should be washed with hot water. Otherwise there are apprehensions of spreading numerous germs in the milk. If extortion is not done in hygienic way the detrimental germs may enter into the udder of the cow and thus may cause ramiter disease.

Milking can be done from a milch cow twice a day. Everyday same man will milking at a definite time. Before 6-7 hours of milking the calf should be kept away from the cow.
The jobs to be done during milking are described below-

1. The milch cow should be tied in such way that it cannot move.

2. The calf should be released to the cow so that it can suck milk from the teats of the cow.

3. The calf is to be taken away and tied in a stake. The calf to be kept near the head of the cow.

4. Hands, milk pan and the udder of the cow should be washed well.

5. Milk should be extorted by pressing the teat of the udder with the thumbs and fore finger and pulling downwards.

6. Some oil can be used to help in pulling the teats.

7. Care should be taken so that dogs or other animals can not disturb during milking.

Preservation of Milk

The system of keeping milk undecomposed for a certain period of time is called preservation of milk. The milk preservation arrangement is not easy. Because the changes of chemical composition of milk occurs very easily such as if milk is preserved in freeze the germs can not grow, but the chemical composition is broken. As a result the quality of milk deteriorates. Again if milk is boilid for 20 minutes after every 4 hours it remains germ free. At this also the nutrition value decreases. Some amount of vitamin is spoiled in high temperature system. In big farms germs of all diseases are destroyed by mean of pasteurization. Pasteurized milk can be preserved for longer period than row milk. In foreign countries milk is powdered and preserved for many days. In this case also the quality is somewhat deteriorated. After boiling milk can be kept in good condition up to 7-8 hours.
Practical

Subject: Observation of milking

Materials
Milch cow with calf, tub, water, oil; stake, rope, bucket, paper, pen etc.

Steps of Work
The class teacher will arrange the visit after consultation with an owner of a dairy farm.

1. Go to the concerned farm as per instruction of the teacher.
2. Visit the farm as per arrangement of the owner of the farm and observe milking.
3. Observe critically the milking arrangement of different cows.
4. After observation write down serially in the practical note book how the whole work has been done.

Precaution
The milk cow should not be disturbed during observing the milking of a cow.

Exercise

Multiple Choice Questions
1. What are the diseases which can infect dairy cows if milking is not done in hygienic ways?
   a. Anthrax  
   b. Badla  
   c. Milk fever  
   d. Udder disease

2. The causes of doing pasteurization of milk are-
   i. making it germ free  
   ii. changing the taste of milk  
   iii. preserving milk for a short period.
Which one is correct?

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

3. Which pot is used in milking cows?

a. A mug  
b. A cooking pot  
c. A bowl  
d. A bucket

Creative Questions

Tasnia went to her grand-mothers house to see her ill grandmother. Her ill grandmother could not milk her dairy cow since last two days. Then the grandfather along with Tasnia and milking materials went to the open space to milk the dairy cow. But they failed to milk sufficiently as done in other days.

a. Usually through how many methods can the dairy cows be milked?

b. Describe two major causes why the grandfather of Tasnia failed to milk the cow as expected.

c. What steps may be taken to sufficiently milk from the cow in this situation? Describe.

d. According to Tasnia “Milking is a technical process”- Explain the justification of this statement.
Chapter- Four

Family Goat Farming

The goat is reared in almost every country of the world. The goat meets the demand of protein by producing meat and milk. Skins and hairs of goat are used not only in preparing tannery materials but are used in different handicrafts: Goat dung is used in land as a good organic manure.

The goat population in Bangladesh is almost 2.075 crore during 2006-2007. The skin of Black Bengal' goat of this sub-continent is of superior quality and its demanding the world is tremendous. The Black Bengal she-goat gave of birth of 2-3 kids at a time. So there is opportunity of earning foreign exchanges by exporting skins through increasing the number of goats. Now the number of goats is decreasing alarmingly. In order to increase their number, it is very important to rear goat in family basis. Every body of a family can take part in goat rearing with small capital through sound planning. Goat farming in family basis can be started by purchasing one pair of 4 months she-goats.
1. Housing of Goats

This size of the goat is small. Very limited space is required for their rearing. Generally in our country the farmers of villages make dwelling house of the goats by spreading hessian in their bed room, or corridors. This arrangement is harmful for the dwellers of the house. If money can not be afforded, it will be better to make a separate dwelling house for the goats by making at least a fence in the middle of the bed room.

If the numbers of goats are many, it is necessary to make separate house for them. The house of goats should be constructed on high land. Arrangements should be done to have plenty of air in the house. Care should be taken so that the house does not become damp.

For every adult goat, a house should be built measuring 2 metre in length and 1 metre in breadth, the roof may be made with tin, straw (chhan) or even bamboo. The floor of the house may be cemented and it would be good to have 60 cm brick work in the lower part of fence. The height of the front side of this type of house should be 2 -3 metre and rear side 1 to 1.5 metre. This house should have to be slope in rear portion. A platoon of bamboo or wood can be made at 1 metre height from the floor and the goats can be kept on it. These types of platforms are suitable for comfort of the goats. In this case a ladder can be made to climb up to the platform from the floor. If the platform is made the goat-dung and urine can pass through the gap of the platform. Cleaning of house becomes easier. Light and air can pass well through the house.

If milk, is not produced or if goat is reared only for meat production the kid should be allowed to graze with its mother. The kid should also be nursed with its mother. It is to be ensured that if there, are two kids, both can get the mother's milk, equally.

Nursing

From time immemorial goat has been reared most carefully in the domestic houses of this country. The great advantage of rearing goats on family basis is that the amount of labour after goat is minimum. No extra man is required for this. Early in the morning the goats have to be brought out of their houses and tied in the courtyard. After some time they are to feed with granular food. At about 9-10 a.m. the goats are tied in the field for grazing.

If milk is not produced or if goat is reared only for meat production the kid should be
allowed to graze with its mother. The kid should also be nursed with its mother. It is to be ensured that if there are two kids, both can get the mothers milk equally.

**Treatment**

The goat and its kid should be fed medicine of worms regularly. They should be vaccinated regularly for prevention of disease.

2. **Food for Goats**

Generally the goat grazes in the open field or bushes and eats creepers and leaves. They are fond of green leaves and straws. Generally they do not like to eat dirty or wet food. They eat any plant by lopping off the top which cannot sprout easily. They like the leaves of the trees of jack fruit, jhiga, banyan, mango, mander etc. Besides these, they like to eat green vegetables and granular food such as oat, barley, maize, different types of oil seeds, oil seeds, cakes etc. They prefer to eat crushed granule to uncrushed ones.

Like cows, buffaloes and sheeps the goat is also a ruminant animal. Its stomach is divided into 4 parts. After they take food, those are stored in the stomach without being, chewed. Afterwards they bring the unchewed foods again in the mouth for chewing. For this type of activities they are called ruminant animals.

**Food Taking System**

Putting weight of the body on 2 rear legs, the goat fixes its front two legs to plants or fences and eats the creepers, shrubs or leaves of the plants by tearing them. The special characteristics of the goat is eating by pulling the very small grasses, green leaves, buds of leaves etc. with the help of its hard lips and tongue. The capacity of goat differentiate the tastes of sourness, sweetness, salinity of food is higher in comparison to other animals.

**Food for Kids**

Within one hour of the birth of the kid it should be fed with colostrums. It is necessary to food this colostrums for three days. The food nutrients in colostrums are higher than natural milk and disease resistant capacity of colostrums is also higher. So this milk is very useful for the kids. During the first week of birth the kid should be feed milk 3-4 times a day. A kid weighing 2-3 kg. Should be fed 300-400 gm. milk in the morning and in the evening, besides these each kid requires 100 gm. granular food. In addition, it should be provided with sufficient green grass.
A list granular food of an adult milch goat is shown below

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gram</td>
<td>7 kg.</td>
</tr>
<tr>
<td>2. Maize</td>
<td>18 kg.</td>
</tr>
<tr>
<td>3. Ground nut cake</td>
<td>12.5 kg.</td>
</tr>
<tr>
<td>4. Wheat husks</td>
<td>10 kg.</td>
</tr>
<tr>
<td>5. Mineral mixture with vitamin</td>
<td>1.5 kg.</td>
</tr>
<tr>
<td>6. Salt</td>
<td>1 kg.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50 kg.</strong></td>
</tr>
</tbody>
</table>

Every lay 150 grams granular food should be given to a fully grown goat. Extra 400 grams food should be given daily to a milch goat. This amount should be divided in two meal. In addition to this sufficient grass, leaves eereepers etc. and clean water should be given with it.

**Procreative He-goat**

Procreative he-goats should always be given sufficient grass. During procreation period it should be given 500 gm to 1 kg. granular food daily. In each case clean water should be given to drink with food.

**3. Farm Management**

Before discussing about farm management of goat one should have a clear conception about a goat farm. The place where goat is reared on commercial basis by scientific management is called goat farm. The arrangement taken thorough daily observation for executing the permanent and daily activities of the farm and ascertaining future plan of action are called farm management. Improved management acts as supportive power in achieving aims and objectives of the farm.

**Site of the Farm**

1. The place of the farm should be higher than the-surrounding area so that water cannot stand and dirty water from the surrounding area cannot enter into the farm.
2. The farm should be in an open place. So that sufficient light and air can enter.
3. There should be grazing land in and around the farm. Different trees such as ipil-
ipil, jack fruit, jhiga, mango, black berry tree etc. can be cultivated in the farm and the goat can be fed.

4. The farm should have supply of sufficient quantity of clear water.
5. There should be housing arrangement for the laboures.

**Necessary House in Goat Farm**
1. House for keeping she-goats
2. House for keeping castrated goat.
3. House for kid-rearing
4. House for goat pregnancy and goat just after delivery
5. House for ill goats
6. House for he-goats
7. House for keeping food
8. Store room

**Accompanying Facilities for Establishing a Farm**
1. There should be supply of electricity
2. There should be communication system between the farm and the cities.
3. There should be availability of food at reasonable price.
4. There should be availability of labour as reasonable wage.

**Construction of Houses for Goats**
1. In constructing house for goats building materials like tin, asbestos, chhan, bamboo can best be used. These materials are easily available. If necessary these can be changed after 3-4 years. But brick house can also be constructed.
2. The houses of goat farm need to be in line and south facing. By this, all activities of the house like supply of food, movement and cleaning can be done in short time.
3. Care should be taken so that light and air can enter into the house and the goat can stay comfortably.
The houses of goats can be divided into two –

A. House for joint dwelling
B. Separate stalled house.

A. **House for Joint Dwelling**: When an arrangement is done to keep many goats in one house or room, then it is called the house for joint dwelling. In such types of houses many goats are kept separately on the basis of age and production. In these types of houses many goats can be reared. The area of the house can be increased on the basis of the number of goats. The milch goat can also be kept in joint house. But they should have separate house. Because in order to produce milk they should be given granular and fibrous food separately. The floor of the house should be cemented and high. Or a wooden or bamboo-made platform can be made.

B. **Separate stalled house**: The house each goat is kept in separate individual room, it is called stall house, these types of stall houses are very much suitable for milch, pregnant or goat at delivery stage. In these cases necessary granular food can be given separately. The he-goat stall should be far away from she-goat stall. Every- stall should have facilities for air and light entrance. If there are stall arrangements in both the way sides the for food supply should be in the middle of both the lines. This will also help nursing. The rear portion of the stall should be a bit slopy. This makes drainage arrangement to remove the filth and urine easier. There are arrangements for keeping pans for giving water and grass. These should be cleaned every day so that germ do not grow. In one side of the stall there is arrangement of keeping specially made basket to keep grass type foods.

**Drainage System**

The drainage system of the farm should be as such that the dung and urine of goat can easily move through the drain and store in a hole. This type of hole is called "Serpit". The "Serpit" is thatched to avoid rainwater or sunshine to enter into.

**Daily Routine Work in Farm Management**

1. Everyday the dung and urine of the stall should be cleaned between 7 to 8 a.m. and the goats are to be released in the courtyard.
2. Arrangement for conception of the she-goat is to be done at the time when she is in heat.
3. It is to be marked whether the laboures engaged for farm works have daily joined the work.
Milking

Milking is to be done everyday at a definite time. This can be done once in everyday between 9-10 a. m. The productive capacity of milk of Black Bengal breed of this region is very small and ranges from daily. 400 to 500 ml sometimes this milk is not sufficient for the kids. But in case of highly productive goats milking can be done in the morning and in the evening.

Combing the Body of the Goat

In order to help the body of the goat clean it should be brushed everyday in the evening. The goat is by birth sensitive to water or cold. So it needs to be cleaned by brushing instead of cleaning by bathing. By way of brushing lice or other parasites or dirt will be removed.

Health Care

Every goat should be fed anthematic medicines regularly depending on their ages. The feeding and water pans and other used materials should be cleaned and sundered twice in every week. They should be vaccinated timely and daily health information is to be noted in the register. Numbering in the ear of the goat.

Numbering in the Ear of the Goat

In order to identify the goat at farm level some sort of numbers has to be inserted in its ear. The goat is identified by this number and note is kept in the account book by this number.

Scrutinizing Unproductive Goat

The unproductive goats are to be scrutinizing and sold away. Otherwise the production of the farm will be hampered.

Appointment of Laboures

In order to perform daily activities and nursing it is necessary to recruit laboures. One labour will work 6-8 hours daily. For rearing every 100 goats, 23 labours are required.

Records

1. Lists of assets: This will include implements, number of goats, housing of goats, dwellings and other building materials.

2. Stock register of the goats.

3. Milk and meat production register.
Creative Questions

The Youth Development Department of the Government of Bangladesh gives training and loan for goat rearing. Aklima being at a loss after the untimely death of her husband took training and loan for goat rearing from the Youth Development Department. Aklima constructed suitable goat rearing house within the premise of her own house and purchased 4 she goats. One she goat became pregnant after 6 months and gave 2-3 kids in each time twice a year. The number of goats became 25 within 3 years. Meanwhile, she repaid the goat loan and improved her livelihood.

a. What is masticating animal?

b. How should be the goat housing system? – Explain

c. ‘The 4 goats of Aklima multiplied and increased to 25 within 3 years’. Describe the thing considering their pregnancy period and kid birth.

d. Evaluate the household level goat rearing concept of Aklima in the context of poverty eradication.
Chapter - Five

Diseases of Cattle

It is necessary to prevent or control disease of cattle for successful cattle farming.

Every body wants a healthy animal. So it is necessary to identify a healthy and a sick animal. It can be detected by seeing the external symptoms. The external symptoms of a healthy animal are as following.

1. Remains vigilant towards surrounding situation and movement will be normal.

2. Nose, mouth and eyes would be clear and they will be droplets of sweats on the forefront of the nose.

3. The hairs of the body will be smooth and will drive away flies and mosquitoes by moving ears and tail.

4. There will be taste for eating and will chew the cud after eating.

5. The nature of stool and urine will be normal. If there is any deviation of the symptoms as described above of a healthy animal, then it can be ascertained that the animal is sick.
Kinds of Cattle Diseases
The cattle diseases can be divided into 4 parts, such as –

1. Contagious disease
2. Parasitic disease
3. Disease due to malnutrition
4. Disease due to poisonous action.

Diseases and Preventive Measures
The measures taken as precautions for not to be attacked by diseases are called preventive measures against diseases. In order to prevent cattle diseases the following few measures can be adopted.

1. Recently vaccines and injections for different diseases have been invented. The animal can be protected from many contagious diseases by regular vaccination or injection.
2. Different disease are cause due to malnutrition. The degree of disease due to malnutrition is decreased by feeding the cattle with balanced diet.
3. Cleanliness is the way of preventing many diseases. By bathing regularly and feeding them fresh food and clean water. The animals can be kept disease free.
4. If the dwelling places of cattle can be washed with germicide everyday environment can be kept congenial.
5. The diseased animals should be separated immediately so that the disease can not spread out to healthy animals.
6. If many animals die suddenly somewhere at the same time immediate preventive measures should be taken.

1. Contagious Diseases
In Bangladesh cattle suffers very much by contagious diseases. These diseases can be divided into two parts, such as-

a. Virus infected diseases.

b. Bacteria infected diseases.

The important virus infected diseases are foot and mouth diseases, rabies and cow-
Important diseases infected by bacteria are anthrax, black quarter, hemorrhage septicemia, remitter, pneumonia and titenus.

Symptoms and treatment of these diseases, are described here under –

**A. Viral Disease :** Foot and mouth disease (PMD)

The foot and mouth disease is caused by viral germs. Cows, buffalos, goats and sheep are mainly attacked. This disease is contagious. Mouth and foot are the main infected place of this virus.

When come in contact with infected animal, this disease can be spread through water, food and grazing land. Virus enters rapidly into the mouth, tongue and foot.

**Symptoms of the Disease**

The main symptom of this disease is the development of sores in the mouth and the foot. It takes, two to five days time to reveal this disease after the entrance of virus into the body. Slivering occurs from the mouth. The body temperature rises up to 40.5' C to 41.2' C. The infected animal can not eat anything. Sores develop in the tongue and mouth. Milk of a milch cow decreases. The animal becomes weak physically. It can not walk due to development of sores on the foot. The rate of death of infected calves is high.

**Treatment**

1. The foot and the mouth should be washed repeatedly in potassium permanganate mixed water.
2. Boric acid and potash alum should be mixed with water and mouth should be washed repeatedly.
3. Teramycin injection is to be pushed once in a day for three days.

**Preventive Measures of the Disease**

1. The animal infected by foot and mouth disease should be separated.
2. The farm or the cow-shed should be washed well with germicide such as dettol or phenyle.
3. Soon after the outbreak of the disease all neighbouring healthy animals are to be vaccinated.

**Rabies Disease**

Rabies is a deadly viral disease. Generally dogs, cats and other wild animals carry the germs of this virus. The cattle is infected when a dog infected by this virus bites it. Virus remains in the saliva of the animal infected by rabies disease. This virus spreads in healthy animal as a result of biting by infected animal. This disease can be infected when saliva comes in contact with wounds of healthy animals.

**Symptoms of the disease**

The symptoms of the disease may be revealed after 14 days, 3 months, or sometimes 6 months of biting by an animal infected by rabies disease. The infected animal shows the symptoms of madness. Even comes definitely by to attack, saliva will be coming out from the mouth and later on paralysis will be revealed slowly. The animal will be inactive. It does not like to eat. The lower jow of the animal hangs. The tongue tends to come out; the animal can not stand. At one time lies down on the ground and dies.

**Preventive Measures of the Disease**

No result of treatment can be had after the symptoms of the disease are revealed. Because at that time the germs of disease had attacked the nervous system of the head. When a diseased cattle bites another's animal the biting place needs to be washed immediately with soap or citric acid. The pet dog is to be vaccinated timely. In order to prevent the disease the unclaimed dogs are to be killed.

**Treatment**

The cattle is to be vaccinated once at the ower portion of the belly. This vaccine measuring 30 ml. is to be pushed noce in everyday for 14 days in total.

**Cow-pox Disease**

This is a contagious disease caused by viral germs. This disease affects the skin of the teats and udder of milch cow, the skin of the schrotum of ox and the skin of the mouth of the calf, this disease spread by the hands of milkman, teatcup of the milking machine, and by the bites of mosquitoes and flies.

**Symptoms of Disease**

The temperature of the diseased animal increases. Red spots boils like mustard grains develop. Those small boils joins together to make a blister. Sores develop on the
mouth and food canal. Loose motion and bad smell in the mouth develop.

The animal suffers from respiratory problems. The diseased animal dies within few days.

**Treatment**

1. Germicide paste or lotion can be used in the sores.

2. The animal can be cured by pushing antibiotic or sulphonilamide injection.

**Preventive Measures of the Disease**

The infected animal should be isolated and kept in separate house. As a preventive measure the healthy animals are to be vaccinated regularly.

**B. Bacterial diseases Anthrax Anthrax**

Anthrax is a deadly bacterial disease. Cows, buffaloes, goats and sheep are infected by this disease.

**Symptoms of Disease**

The infected lives for a short time. The temperature of the animal rises up to 41.7°C. Stools may be loose or mixed with blood. Blood can be present in urine also. Coal-tar like blood - mixed foam comes out of the nose, mouth and rectum. The animal suddenly droops down and dies from convulsion.

**Treatment**

In many cases good results can not be obtained by treatment. But it can be cured if antibiotic injection is pushed at the primary stage of the disease. Good results can be obtained if 10-40 Lac unit of antibiotic injection can be pushed into the muscles of upper thigh for consecutive 3-4 days.

**Preventive Measures of the Disease**

Outbreak of this disease mostly occurs during rainy season specially in wet and cold weather. So the animal is to be vaccinated before rainy season.

**Black Quarter**

This is also a deadly disease caused by bacteria. Cows, buffaloes and sheep are mostly attacked by this contagious disease. Generally, the cow calves and ox calves of 6 months to 2 years of age are mostly infected. The germs enter into the body through cut-sores.
Symptoms of Disease

1. The infected animal becomes strayed from the heard and begins to drowse. Later on the animal is seen to kuno.
2. The disease spreads rapidly. Generally the infected animal dies within 48 hours.
3. The body temperature of the animal increases.
4. Different parts of the body swell crackling sound can be heard when swelling places are touched.
5. The swelling places slowly turns into blackish colour and begin to rottening.
6. The infected animal becomes very weak and dies.

Treatment

Soon after the symptoms of disease is revealed antibiotic medicines can be fed, same treatment can be followed as described in the case of anthrax disease.

Preventive Measures of Disease

In order to control the disease the healthy animal is to be vaccinated after every 6 months from its age of 6 months.

Hemorrhagic Septicemia

This disease is caused by bacteria, cows, buffaloes, goats and sheep may be infected by this disease. Animals of all ages are attacked. Infections by this disease becomes severe when the animals are grazed in wet land after rains. This disease can spread through the saliva, stools and urine of the infected animal, polluted food and water.

Symptoms of the Disease

1. The head, neck and dewlap swell of infected animal.
2. Body temperature increases and stool becomes loose.
3. Chewing the cuds and milking are stopped.
4. Water comes from the eyes.
5. The infected animal suffers from respiratory problem. Tries to breath through the mouth by extending the neck.
6. The infected animal dies within 24-36 hours.
Treatment
Good results can be obtained if treated with antibiotic injection or sulphonelamide type of medicines.

Preventive Measures of the Disease
1. The infected animal should be isolated from the healthy ones.
2. All healthy animals of the village should be vaccinated,
3. Regular vaccination is the main way of prevention of this disease.

Remitter (Sore teat)
This disease is caused by one kind of bacteria. This disease spreads through cut wounds. Generally the milch cow and goats are mostly infected by this disease.

Symptoms of the Disease
1. The udder swells
2. Body temperatures increases
3. After milking, reddish yellow coloured precipitation forms at the bottom of the milk.
4. Push cells forms inside the infected udder. Amount of milk is decreased due to the infection of this disease. The udder and teats gradually become stiff and milk is stopped. If not treated timely, the udder becomes completely inactive. The cow may die also due to severe infection by this disease.

Treatment
1. Regularly milking is to be done so that no milk remains in the udder.
2. Higher antibiotic injection is to be pushed to the infected cow.

Prevention Measures
The cow is to be kept in clean place so that the udder may not come in contract with any dirty materials. Milking should never be done with uncleanness hand, Care should be taken so that the cow is not hurt. The veterinarian is to be consulted as soon as the symptoms of the disease are revealed.

Pneumonia
This is also a bacterial disease. This disease is mainly caused in cold environment.
Symptoms of the Disease
1. The infected animal catches cough and cold come, out through the nose and mouth.
2. The animal breaths rapidly and sounds when breaths. Eating decreases.
3. The body temperature increases due to intensity of, the disease.

Treatment
1. The infected animal is to be kept in dry-clean place.
2. The bed of the animal is to be made with straw so as to avoid cold.
3. Medicines to be gain as per the prescription of the veterinarian.

Preventive Measures of the Disease
Always care is to be taken towards the environments of the dwelling place of the animal. The infected animal should be kept in isolated from the healthy ones.

Calf Scour Disease
Generally this disease affects calves of tender age. At the primary stage the calf get fever and temperature is increased
1. With in short time the temperature decreases and comes below the normal one.
2. The calf gradually becomes inactive and weak gives up eating and ultimately dies.

Preventive Measures of the Disease
1. The calf is to be kept in dry clean place
2. After birth the calf should be fed colostrum.
3. The veterinarian is to be consulted for treatment of the infected calf.

Diphtheria Disease
This is a deadly bacterial disease of the calf. Calves up to six month of age are found to be attacked by this disease. The disease spreads through dirty feeding pan. Many calves may be affected with diphtheria at the same time.

Symptoms of the Disease
1. The body temperature increases from the very beginning, the animal salivates and do not wants to eat.

**Treatment**

Treatment to be administered as per prescription of veterinarians. Good results can be obtained when treatment and cares are taken timely. The feeding pan should always be kept clean.

**Parasitic Diseases**

Some times two creatures live together in assistance with each other. At this case if one creature depends for its livelihood on the other, then the benefited creature is called parasite. The on which parasites live is called host. In Bangladesh, 80-85% of cattle population are attacked by parasites.

**On the basic of association, the parasites are two types -**

1. **Internal parasites** : They live inside the body of the host. Such as all types of worms.

2. **External parasites** : They stay at the outside of the body of the host, such as lice, tick, flies and mosquitoes.

**1. Internal Parasites**

Three types of internal parasites are harmful for cattle, such as –

1. Roundworms
2. Leaf worms
3. Tape worms
2. **External Parasites**

External parasites cause tremendous loss to the cattle in our country. They damage the skin of the cattle by biting and sucking blood. Among the harmful parasites of the body of the cattle, the important ones are flies, mosquitoes, lice, tick and mites. These external parasites live on the skin of the body of the cattle and suck blood. As a result of infestation the affected animal rubs its body with hard rough materials and cause damage to the skin.

Besides these, the parasites make small holes in the skin thus decreasing its value. Most of the time they lay eggs by piercing the skin and cause sores in the hole. At the attack of excessive external parasites the body activities become hindered the animal eats less and as a result milk production decreases. Working capacity also decreases.

**Treatment**

The veterinary doctors need to be consulted in controlling external parasites. Medicine is to be used on its body as per the instruction of the veterinary doctors.

**Tetter and Itching**

This disease is contagious and caused by fungus. Cattle are mostly hump sores. It is mostly found in the surroundings of the mouth and eyes. They are to be treated as per prescription of the veterinary doctors.

**Yoke Sores**: Generally sores are developed on the skin by continuous rubbing by the yoke. The attacked place swells. Its boundary is increased when germs of diseases and flies inject the sores. If not treated timely the activities of the animal may be stopped. For controlling the disease, the animal has to be allowed rest and medicine should be applied on the sores.

**Hump Sores**: Flies mostly spread this disease. If sores are developed on the hump by germs flies increase the area by sitting on those sores. Flies lay eggs there. As a result the sores increase and in many cases rotting starts. The animal decreases eating and loses working capacity. Treatment is to be done as per prescription of the veterinarian.

**Preventive Measures for Controlling Parasites**

1. Cow Sheds surrounding places and grazing land should always be kept clean.
2. It would be better if sodium borate be spread in the cow-shed.
3. Cattle should not be grazed in water logged fields.
4. Vermicides are to be fed regularly.
5. The bodies of the cattle are to be cleaned by brush.
6. The cattle are to be bathed regularly by clean water.
7. Ticks and mites are to be killed manually with hands.
8. The rubbished are to be dried and the cow sheds are to be smoked at night regularly by burning the dried rubbishes.

Diseases due to Malnutrition
These disease are developed due to shortage of balanced diet. Care should be taken so that cattle can be fed with balanced diet as per their requirements. Despite supplying them with proteins, carbohydrates, fatty foods they should also be supplied calcium, phosphorous, magnesium, cobalt, zinc and vitamins. Bone diseases milk fever and sterility are among the diseases caused due to malnutrition.

Control of Mild Fever of the Cow
This disease may develop just after giving birth to the calf. This disease is due to malnutrition. This milk fever is the result of coming out of excessive calcium with milk of the cow. The cow attacked by this disease lays down on the ground and by turning the neck adjoins the head with the back. The cow may die if not treated timely. At this time the cow should be given enough green grass and food enriched with calcium and mineral materials. Immediately the veterinary doctors should be consulted.

Preservation and Usage of Vaccines
A. Preservation of Vaccines : If vaccines are not preserved in right methods their activities are lost. Directions for storing are written on the vial. It written on separate paper also. The vaccines those are kept in vial or spool in freeze in dry condition should be kept under zero degree temperature. That is why these vaccines are to be kept in the deep freeze of the refrigerator, The liquid vaccines of anthrax, black quarters, mouth and foot disease and hemorrhagic septicemia are to be put into vials and kept at a temperature of 40° C. The vaccine should not be used after the expiry of the mentioned date.

B. Transportation of Vaccines : In order to send the vaccines to different places, these are to be transported in proper way. If there is any mishandling in transportation the quality of vaccines may deteriorate. After the vaccines are supplied to the district head quarters in cool van those are to be kept in cool room or can be taken in small flasks with ice for use. The coolness is to be maintained till the expiry date for use. Otherwise the quality of the vaccines will be lost.
C. Usage of Vaccine: Usage of vaccines is to be known from the vaccine production centers at the time of collection of vaccines. Besides these, usage procedure is written on the body of the vial. The introductory information on the procedure of use of the medicine is also may be available on the printed literature of the package. Introduction to different types of vaccines are briefly given below.

Introduction to Vaccines
There are several types of contagious disease in Bangladesh. Adequate quantities of vaccines of all diseases have not yet been made.

The vaccines of contagious diseases used for cattle are-
1. Rinder pest
2. Mouth and foot disease
3. Rabies
4. Anthrax
5. Black quater
6. Hemorrhagic septicemia
7. Cattle pox vaccines etc.
8. PPR

The Vaccine for Foot and Mouth Disease (FMD): This vaccine is to be injected under the skin or below the dewlap. For every cow or buffalos injections are to be pushed. Again this injection is to be pushed after 4 months and then it is to be pushed once in a year.

Rabies: This vaccine is to be pushed in the belly of cow and buffalo once daily. Daily 30m1 are to be pushed for 14 days. Dogs of 3 months of age are to be injected in muscles. This vaccine is to be used after an interval of one year. The vial of the vaccines is to be kept in freeze. These vaccines are to be pushed with pure water.

Method of Determining Body Temperature of Cattle
Femenhite thermometer is used in determining body temperature of cattle. During use shaking well lowers the mercury of the thermometer. Thermometer is placed in the rectum of the animal in such away so that it touches the mucus membrane and kept for 2-3 minutes. Then it is brought out to take reading for determining actual temperature.

In the first step of diagnosing a disease the temperature, pulse rate and breathing rate are examined.
### Body Temperature of Domestic Animal

<table>
<thead>
<tr>
<th>Animal</th>
<th>Temperature</th>
<th>Average Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf</td>
<td>38.5°- 40.0°c</td>
<td>39.5° c</td>
</tr>
<tr>
<td>Cow</td>
<td>37.5°- 39.0°c</td>
<td>38.50°c</td>
</tr>
<tr>
<td>Ox</td>
<td>38.35°- 39.5°c</td>
<td>38.90°c</td>
</tr>
<tr>
<td>Bull</td>
<td>37.5°- 39.5°c</td>
<td>38.5° c</td>
</tr>
<tr>
<td>Buffalo</td>
<td>37.5°- 39.5°c</td>
<td>38.5° c</td>
</tr>
<tr>
<td>Goat</td>
<td>38.35°- 40.60°c</td>
<td>39.5° c</td>
</tr>
<tr>
<td>Sheep</td>
<td>38.5°- 40°c</td>
<td>39.5° c</td>
</tr>
</tbody>
</table>

### Method of Determining Pulse Rate of Cattle

Determination of pulse rate of cattle is very simple. The pulse rate can be known by pressing the fingers lightly on the artery of the jaw or on the artery of the lower side of the base of the tail. Pulse rate may change with the increase of age. Generally pulse rate is higher at the tender age. It decreases as the age increases. Normal pulse rates of cattle are given below.

### Pulse rates of cattle (per minute)

<table>
<thead>
<tr>
<th>Animal species</th>
<th>Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf</td>
<td>90-100 bids</td>
</tr>
<tr>
<td>Cow</td>
<td>60-90 bids</td>
</tr>
<tr>
<td>Ox</td>
<td>40-60 bids</td>
</tr>
<tr>
<td>Bull</td>
<td>35-55 bids</td>
</tr>
<tr>
<td>Buffalo</td>
<td>65-90 bids</td>
</tr>
<tr>
<td>Goat</td>
<td>65-90 bids</td>
</tr>
<tr>
<td>Sheep</td>
<td>65-90 bids</td>
</tr>
</tbody>
</table>

### Determination of Breathing Rate of Cattle

It is necessary to know the per minute breathing rate of cattle. Changes in breathing determine its illness. Hence arrangement should be done for its rapid treatment. But sometimes breathing can be high or low due to some normal reasons. Such as, when the stomach is excessively full, when excess fat accumulates in the body, when the animal becomes excited during pregnancy for doing hard labour in higher temperature of the working area etc. Breathing rate can easily be determined by counting how many times the chest and belly rises and falls per minutes during motionless position of the animal. Besides this per minute breathing rate can be counted by keeping hand in front of their noses.
### Rate of breathing of animals (per minute)

<table>
<thead>
<tr>
<th>Animal species</th>
<th>Frequency of Breathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf</td>
<td>30-40 Times</td>
</tr>
<tr>
<td>Cow</td>
<td>24-30 Times</td>
</tr>
<tr>
<td>Ox</td>
<td>10-30 Times</td>
</tr>
<tr>
<td>Goat</td>
<td>12-20 Times</td>
</tr>
<tr>
<td>Sheep</td>
<td>12-20 Times</td>
</tr>
</tbody>
</table>

### Methods of Feeding Medicines and Use of Injection:

1. Direct feeding of medicine
2. Pasting medicine on the external part of the body.
3. Pushing injection directly into the body.
4. Before feeding medicine, it should be thought what type of medicine is to be fed. (liquid medicine, power medicine, pills, tablets, bolles, capsules etc.) are some of the types of medicine.
5. Piercing needy into the muscle—Generally injection is pushed into the muscle of the back part of the animal. In this method, the needy is forcibly pierced through the skin into the muscle. Afterwards, the medicine of the syringe is pushed.
6. Piercing needle into the vein—Injection is pushed into the thick veins of the two sides of the neck of the cattle.
7. Piercing needle into the membrane of the belly—In this case, injection is pushed into the skin of the belly.
8. Pushing the needle in the gap of the bone of the waist. Injection is to be pushed in the injection of the last bone of the waist and the first bone of the tail.

### Practical

**Subject:** Determination of pulse rate and breathing rate of a cow.

**Materials:** One cow, Note book.

**Steps of Work**

1. Determine the pulse rate of the cow by touching the lower artery of the jaw and by touching the lower artery of the base of the tail.
2. Write down the steps of work and pulse rate in the practical note book and show it to the class teacher.
Precaution
1. Proceed by fondling the cow
2. Never excite the cow.
3. This work should be done after fully controlling the cow
4. It will be better to have a gentle cow for doing this task.

Subject: 2. Practical lesson of using the vaccine of cow pox.

Materials
A cow, vaccine of cow pox, injection syringe, needle, hot water, spirit, pure water, vaccine mixing box, dettole, cotton.

Steps of Work
1. Go to a cattle farm or a farmer's house with a friendly approach.
2. Tie a cow with a hard stick.
3. Wash well the syringe of injection and needle with hot water.
4. Cautiously break the tip of the vial of vaccine.
5. Join the syringe and the needle.
6. Thrush 2 to 3 cc pure water into the vial with the help of its syringe.
7. Shake the vial having water and vaccine and then pour into a mixing pan
8. Mix well the vaccine and water in the mixing pan and with the help of a syringe.
9. Take 1 ml of the mixed vaccine into the syringe and inject into the skin of the neck of the cow.
10. Write down the description of the cow, name of the vaccine, date etc in the practical note book.

Precautions
1. The animal should be controlled in a right way.
2. The vaccine vial should be opened with extreme care.
3. Write down the description of the cow, name of the vaccine, date etc. in the practical note book.

Exercise

Multiple Choice Questions
Read the paragraph below and give answers to questions 1, 2 and 3.

Mr. Yunus, the veterinary doctor while came to his village house noticed that there are some flies on the shoulder of the cow tied in the homestead. He advised the owner of the cow tied to solve the problem. The problem was solved within a few months.
1. What was the disease of the cow?
   a. Scab  
   b. Jowal kanda  
   c. Hop canker  
   d. Allergy

2. What was the type of the disease?
   a. Infectious  
   b. Caused by parasites  
   c. Caused by poisons  
   d. Skin disease

3. The treatment of the disease is-
   i. Allowing leisure for the animal  
   ii. Giving vaccination  
   iii. Applying medicines on the disease affected spot

   **Which one is correct?**
   a. i  
   b. ii  
   c. i and ii  
   d. i and iii.

**Creative Questions**

Observe the figures very keenly and answer the following questions.

![Fig-1](image1.jpg)  ![Fig-2](image2.jpg)

a. What is a parasite  
b. What are the different types of parasites according to their habitat place? Describe one of the important loss which is done by the infestation of parasites.  
c. What are the steps which should be taken to protect the animal from the attack of the parasites given in the Fig-1 and Fig-2?  
d. Prepare a comparative analytical statement of the dangers of loss due to the animal parasites given in Fig-1 and Fig-2 in the context of Livestock sector.