



SEE THE
FUTURE
CHANGE



**Training manual
on
HOUSEHOLD BASED POND AQUACULTURE,
HOMESTEAD GARDENING AND NUTRITION AWARENESS**



SEPTEMBER 2011

CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA IN BANGLADESH (CSISA-BANGLADESH)
WORLD FISH CENTER



IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE



HOUSEHOLD BASED POND AQUACULTURE, HOMESTEAD GARDENING AND NUTRITION AWARENESS

CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA IN BANGALDESH
(CSISA-BANGLADESH) Project
WORLD FISH CENTER, House # 22B, Road # 7, Block F, Banani, Dhaka – 1213

Editorial Panel

W J Collis
Md. Mokarram Hossain
Mahabubul Alam Miah
Asoke Kumar Sarkar
Md. Mazharul Islam (Jahangir)
Shattanarayan Rai
Gopal Chandra Saha
Israt Zahura

Overall cooperation from

Dr Binay Kumar Barman, Dr Manjurul Karim, Dr Benjamin Belton, Dr Khondokar Morshed – e –Jahan
Khonodkar Ishrat Mahmud, Bijoy Bhushan Debnath, Khondokar Hasib Mahbub, Bilash Mitra
Afrina Chowdhury, Billal Hossain, Md. Humayuun Kabir

Publication directed by

World Fish center Bangladesh
September 2011

Written by

Md. Mazharul Islam (Jahangir), Md Habibur Rahman, Mashiur Rahman, Kajol Kumar Basak

Photographs
World Fish Center, Ambassador Finn Thilstead

Illustrations and Graphics
Sparrow Communications (01711-142520)

**Manual on Household Based Pond Aquaculture, Homestead Gardening and
Nutrition Awareness**

A Course Manual on Household Based activities for Women



Preface

Currently many farming households face health and economic risks because of problems in malnutrition as a result of lack of knowledge and training, improved technologies and processes in farming. From the beginning of the CSISA-BD project, the World Fish Center has initiated introduction improved practices and technologies in rural farming to address malnutrition in farming households.

In order to address the problem discussed, as a part of this project it has been felt there is a lack of skilled trainers and training materials. Based on field experience and existing training manuals, the WFC has developed training material and manuals on 'Household Based Pond Aquaculture, Homestead Gardening and Nutrition Awareness with respect to the environment and socio-economic risks faced by fish farmers.

These manuals have been developed for government and non-government training staff and fish farmers. During the project period the training staff and fish farmers, it is expected that the manuals will be beneficial. Based on the experience in the field, the manuals will be further developed and enriched in future. It can be expected that various government and non-government training staff and persons will utilize this manual to assist in the development of human resources as well as fish production and thus contribute to the country's overall economic development.

We acknowledge the contribution of all who have directly or indirectly contributed to the development of the manual

TABLE OF CONTENTS

Session	Topic	Page
	Introduction to training manual	i-ii
Session	Registration, introductions and course inauguration	4
Session	Overall knowledge of rural household- centered agricultural practices	8
Session	Understanding Homestead pond culture	12
Session	Appropriate Household Based Pond Aquaculture and Management	15
Session	Discussion of previous day's session	44
Session	Homestead gardening of nutritious vegetables	45
Session	Potential production of homestead pond –fish culture and vegetable gardening, const-benefit analysis and data preservation	57
Session	Awareness on family nutrition	64
Session	Discussion of total course sessions and closing	76
	Necessary information on measurements on fish farming	78

HOUSEHOLD BASED POND AQUACULTURE, HOMESTEAD GARDENING AND NUTRITION AWARENESS

Training Manual

Introduction to the manual:

Currently the rise of life-debilitating diseases, especially night blindness is on the increase in Bangladesh, particularly in the rural parts. These diseases are mainly as a result of lack of awareness about malnutrition. Various types of necessary vitamins and minerals can be easily obtained from vegetables and fish cultivated in rural household ponds, ditches, pond banks and gardens. Women can play a major role in cultivating and gathering this necessary nutrition for the family. All over the country, the cultivation of fish, poultry, and various vegetables around homesteads has become popular, however because of the lack of proper knowledge about cultivation technologies and practices, farmers are not getting optimum production and are thus being deprived from full economic benefit as well. In order to address this issue, the CSISA-BD project has developed this training manual for 'Household based pond aquaculture, homestead gardening and nutrition awareness'.

In addition to meeting nutritional needs for the rural family, an extra income-generating source is also made possible for rural and poor women through the information in this training manual which the extension workers will be disseminated to women's groups.

Training period:

This manual is designed to help conduct a 2-day basic training course, however depending on the needs of the trainees; the course time may be adapted within the 2-day period. Usually the training will be from 10 am to 2 pm. The training venue is preferred to be within range of the women trainee's homesteads so that their participation can be ensured.

Training Process:

Most of the teaching material in this manual is introduced in a practical and participatory manner. The training method takes into consideration the existing practical knowledge of the women farmers and ensures everyone's easy participation. In all the sessions, following methods are included:

1) Brain-storming, 2) group discussion, 3) open discussion, 4) analysis of field experiences, 5) practical demonstration using existing materials, 6) speech with discussion and 7) question and answer sessions.

Number of trainee participants: Each training session employs methods that can ensure proper participation and instruction for 25 trainees. If the number of trainees is more than this, it will create problems in conducting the sessions effectively.

Role of trainer in training:

The main role of the trainer is to create a learning environment whereby the trainees will feel easy and actively participate in the training. The trainer is at the same time a facilitator and a trainee. In the process of enriching the knowledge and practical experience of the trainees, the trainer will at the same time learn from their experiences. In this manner, both trainer and trainees will achieve the objective of learning from each other.

Training topics and Supporting manual/Trainers Guide:

The training topics have been developed according to the practical needs of the women farmers which at the same time have been scrutinized by experts and adapted with their advice. For each of the sessions described in the training manual, handouts have been also developed. These handouts will assist the trainer to better prepare him/herself. The sessions are arranged sequentially and before the trainer delivers the training session, the trainer should read the manual fully to prepare well in order to deliver the training properly and effectively.

Use of the training manual:

In order to obtain successful results from the training process so that the trainees have efficient and confident skills by the end of the training, it is necessary that the trainer studies the manual properly and delivers the training in the recommended participatory process and not the traditional method of teacher –student delivery. The latter method will not be beneficial and will instead reap negative results. For the trainer and trainee to use this manual efficiently the following tips are given:

1. Before starting the training session, the session plan needs to read well, which will assist the trainer to conduct the session properly. We need to remember that good preparation and planning contributes to at least half the success of a training session.
2. Handouts given for each session should be read thoroughly. The trainer can then use the materials for the training session in a sequential manner and conduct the discussion similarly.
3. This manual is only a guideline for the trainer to conduct the sessions such that the both the trainer and trainees discuss the topics based on practical experience.
4. The process and approach for each session is given in such a manner to ensure the full participation of the trainees. If the given process and approaches are used, the participation of trainees can be ensured wholly and expected results for each session largely achieved.
5. The sessions are arranged sequentially. Each session will be discussed within a given period. If required the trainer based on his/her experience may change or adapt the session times. However, it is advisable for both trainer and trainee to start and end the sessions timely.
6. It is important to evaluate the success of the training session and therefore while conducting the session, the lessons learnt by the trainees from the session need to be evaluated.
7. This assisting document is a very important material which needs to be kept carefully and may be used later as reference.

Learning environment:

One of the primary objectives of the training is to create a conducive learning environment which is especially important for the trainer. In a lively learning environment, every participant will feel comfortable to discuss and share their opinions freely. To enable such an environment the trainer should be interested and take the initiative to know every trainee's expectations, attitude and experience. The trainer has to motivate the trainees to participate in the training practically and give due respect to their experiences and opinions. This will help the trainees work together during the training sessions. Other guidelines are given below to enable a good learning environment and lively training session:

Training guidelines:

1. To be respectful towards everyone
2. To be objective and have polite behavior
3. Respecting others opinions so that there is an open and free exchange which will help to make good decisions
4. Everyone must participate especially the more quiet trainees
5. Must take the effort to listen more than speak
6. Take notice trainees do not talk among themselves while discussions are going on
7. Everyone should have the opportunity to speak up one by one; if everyone talks at the same time, no one will be heard
8. Patience and sensitiveness is required
9. Sensitive issues need to be taken into consideration
10. Need to have respect and trust about the trainee's experience and knowledge
11. Do not hesitate to interact with the trainees as a co-worker/colleague
12. Admit if you have no knowledge about any issue

HOUSEHOLD BASED POND AQUACULTURE, HOMESTEAD GARDENING AND NUTRITION AWARENESS Training Course

Training Schedule

Period: Two Days

Day	Time	Discussion topic
1	10.00 – 10.30	Registration, introduction and course inauguration
	10.30 -11.00	Overall knowledge of rural household- centered agricultural practices
	11.00 -11.30	Understanding of Household based pond culture
	11.30 – 12.00	Appropriate Household Based Pond Aquaculture And Management
	12.00 – 12.30	Tea break
2	12.30 - 14.00	Appropriate Household Based Pond Aquaculture And Management (cont)
	10.00 - 10.30	Discussion of previous day's session
	10.30 -11.30	Homestead gardening of nutritious vegetables
	11.30 – 12.00	Potential production of homestead pond –fish culture and vegetable gardening, const-benefit analysis and data preservation
	12.00 – 12.30	Tea break
	12.30 -13.30	Awareness on family nutrition
	13.30 – 14.00	Discussion of total course sessions, evaluation of course and closing

If required the trainer in discussion with trainees may change training times

GROUP SESSION PLANNING

Day 01

Time – 10.00

Duration: 30 minutes

- Target group : Women famers of Household based pond aquaculture and homestead gardening
- Title of session : Registration, introduction and course inauguration
- Aim : To inaugurate training session on' Household Based Pond Aquaculture, Homestead Gardening and Nutrition Awareness' so that trainer and trainees are introduced with each other and get a basic understand of the training
- Objective : At the end of this session, the participants -
- The trainer and trainees will be introduced with each other
 - Will have a basic understanding about the training course
 - will register their names in a given form
 - Will be able to articulate the objectives and aim of the course
 - Will be able to state the course timings and express their expectations
 - Will be able to state the guidelines to follow during sessions and understand why

Discussion topic	Training approach	Duration
Introduction		2 minutes
Welcoming the course participants and seating arrangements	speech	
Topic		
Registration and distribution of training material Notebooks, pen etc will be distributed among the trainees and their names registered in a given form		
Introduction Trainer through discussion and interaction will complete introductions with the trainees	Speech, Discussion, Individual work. VIP card	25 minutes
Inauguration of training course One of the trainees will start with recitation from the Quran, there will also be recitation from the Geeta and Bible		
Establishing Training objectives Trainer will listen and list farmer participants objectives/ expectations		
Course contents and period The trainer will distribute the course schedule/ contents and will explain any questions the trainees have about the course timing or contents		
Guidelines for the training sessions The trainer will explain the importance of the guidelines and how to write them and then will take the guidelines written on VIP cards from the trainees and will compile for hanging on the board		
Main aim and objectives of the training course With reference to the handout of the session, the trainer will explain to the trainees the overall aim and objectives of the training course		
Summary		3 minutes
Thanks from the trainees to the trainer	Q&A	

Discussion and link up to the next session

Supporting Training Material ▶ Banner, registration form and handout

CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA IN BANGALDESH (CSISA-BANGLADESH)
WORLDFISH CENTER

Training course on household based pond aquaculture, homestead gardening and nutrition awareness
HUB

Name of group.....Address of group.....

Place.....

Timedate: fromto.....201.....

	Name	Father/husband's name	signature	
			1 st day	2 nd day
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11		<u>Flip chart design</u>		
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Signature:

Signature:

Name:

Name:

Field staff

ADO

Signature:

Name:

HUB Manager

HOUSEHOLD BASED POND AQUACULTURE, HOMESTEAD GARDENING AND NUTRITION AWARENESS TRAINING COURSE

Course AIM and Objectives

Aim of the training course:

This training course aims to enhance knowledge and skills in household based pond aquaculture, homestead gardening and nutrition awareness in order to improve household nutrition and also earn an additional income.

Overall objectives:

The participants of this course will:

- Be able to describe agricultural practices of rural homesteads
- Be able to discuss the benefits of women's' participation in family/homestead centered agricultural interventions
- Be able to state the importance of household based pond aquaculture and homestead gardening
- Will be skilled in household based pond aquaculture
- Will be able to carry out vegetable cultivation in and around homestead
- Will be able to elucidate about household nutrition

GROUP SESSION PLANNING

Day -01

Time- 10.30 am

Duration – 30 minutes

- Target group : Women famers of Household based pond aquaculture and homestead gardening
- Title of session : Overall knowledge of rural household- centered agricultural practices
- Aim : To give an overall understanding about rural household- centered agricultural practices to the women farmers so that they can perceive the importance and benefits of these activities.
- Objective : At the end of this session, the participants -
- Will be able to describe rural household-centered resources and how these can be used viably
 - Will know the importance of using household-centered resources in a viable manner
 - Will be able to plan on how to productively utilize household-centered resources
 - Will know about the role of women and their empowerment by participating in household-centered agricultural activities

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and asking about participants welfare 2. Discussion about previous session 3. Linking previous session’s topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		20 minutes
<ul style="list-style-type: none"> • Current status of activities of rural households and potential benefits that may be obtained • Potential utilization and benefits of household-centered resources in rural environment • Importance of utilizing household resources in a viable manner • The potential of women’s role in household based agricultural activities and their empowerment through these 	Lectures, Q&A Discussion Flipcharts	
Summary		5 minutes
<ol style="list-style-type: none"> 1. Summary discussion of main topic 2. Assessment of session objectives 3. Distribution of handouts 	Q&A	

Discussion and link up to the next session

Supporting Training Material ➤ flipchart, handout, white board and marker and handout

Flip chart design

Overall understanding about rural household- centered agricultural practices

Current status of activities of rural households and potential benefits that may be obtained

Benefits of household pond fish culture and vegetable cultivation

Role of household pond fish culture and vegetable cultivation in the diet, family nutrition and livelihood security a rural household

List of resources in rural household, and the potential use and benefits of the resources

List of potential agricultural activities in rural households and viable application

Importance of potential agricultural activities in rural households

The potential of women's role in household based agricultural activities and their empowerment through these activities

CURRENT STATUS OF ACTIVITIES OF RURAL HOUSEHOLDS

The handout given below is only to give a basic understanding which the trainer needs to read thoroughly. If required, trainer to prepare better and get more information may take advice from experts. The training session includes information as required for the farmer participants which are illustrated in the flipcharts and you can use in your presentation.

Most of Bangladesh's rural households, especially those that are poor and marginalized are directly or indirectly involved in various agricultural activities. Notable agricultural work includes cultivation of paddy, jute, sugar cane etc; rearing of livestock and fish cultivation. The mentioned agricultural activities are usually controlled by well-off farming households where the poorer farmers work as laborers. What is of particular interest is that, the poorer farmers who cannot take on large scale farming interventions because of scarcity of own land usually have some area around their homes which may include ponds and ditches. The poor farmers use their limited household land and water bodies to cultivate vegetables and fruit trees and fish for household consumption as well as extra income. In order that these households can optimally utilize the household land and other resources such as water bodies to increase the food consumption, improve nutrition and increase income, these farmers need assistance mainly in modern technologies and use of good quality materials more than capital. Most of the material they require is already present in their homestead area which only needs to be properly identified and used.

In rural areas, almost all homes have one or more ponds. Also in the area around the homesteads, there are various ditches, canals, borrow pits and seasonal water bodies. These water bodies are essential not only for fish cultivation but also for other household activities. Traditionally, most Bangladeshi rural homes rear domestic animals, and nowadays, at larger farm-scale rear various poultry and livestock. Apart from cow manure, the excreta and by-products of other domestic animals are not used. Animal excreta and leftover food materials of domestic animals may be used in fish cultivation. It has been observed that in scientific and modern fish culture techniques, up to 60-65% is spent by farmers to satisfy pond needs for natural and supplementary food. Waste, unused by-products from other household activities can be used to reduce the investment cost in fish cultivation.

Benefits of pond cultivation and vegetable cultivation on pond bank in rural households

Proper use of resources: In rural households, fish cultivation in the ponds and vegetable cultivation on pond banks can reap multiple products at the same time, and so in a small area at a low cost, optimum production can be obtained. Also there are a lot of unused products and materials around the rural household that can be used viably and for every unit increased production can be achieved. In some cases one crop can be helpful for other crops to grow well.

Reduction in expenditure: The cost of fertilizer and supplementary feed is usually about 60-65% of the total expenditure. However in integrated culture management, a very minimum expense is required for the different inputs in aquaculture is needed since waste products and other unutilized by-products from the household area is used thus bringing down costs in fish cultivation.

Additional nutritious food production: By practicing integrated agriculture in homesteads, nutritious fish can be produced as well as vegetables on the pond embankment as well as breeding poultry and rearing livestock. Within the same area thus a variety of nutritious food can be produced i.e. fish, meat, eggs, milk, vegetables and fruits.

Maintaining balance in the environment: In modern agricultural methods there is use of inputs such as chemical fertilizers and these are harmful for the environment. Also many industries, factories and butcheries produce waste that pollute water bodies. Some of these waste especially of the latter can be used as supplementary feed or fertilizer in fish cultivation. If these water bodies could be used for purposes of integrated agriculture then it would be beneficial for the environment.

Sustainable development: Integrated agricultural methods practiced in homestead areas can be managed almost single-handedly, contributing to increasing production, building household resources and thus bringing about sustainable development.

Year round income from various sources: It takes time to get some benefit from fish cultivation however by practicing integrated agriculture in the homesteads, there are alternative sources of crops that reap faster incomes and therefore this contributes to lessening risk in management costs.

Risk reduction: There is less risk in household-based integrated agriculture. If one productive activity is affected by some disaster, there is the safeguard that the loss may be covered by the other productive activities.

Role of household-based fish and vegetable cultivation in the family diet, nutrition and livelihood security:

The role of household-based fish and vegetable cultivation is to contribute to the family diet, nutrition and livelihood security by:

- Increasing and stabilizing family income, improving family nutrition and addressing basic needs of poor rural households
- Being aware about what constitutes a healthy environment and improving the environment of the rural households
- Improving food production, and also to contribute to improving mother and child health
- Reducing malnutrition of mother and child

To ensure that household-based resources are viably used, it is first important to identify the various resources around the household area and to plan their utilization. An example is given below of what kind of resources we look for in a rural household:

Poultry: Fresh excreta which can be used in agricultural production either directly or in making compost

Livestock : Cow dung which can be used as organic fertilizer in crop production or in making compost

Pond or ditch: Bottom layer of mud in these water bodies which have waste matter can be used in crop production and water can be used for irrigation of vegetables cultivated

Kitchen: Fresh ashes from earthen stoves and other waste which can be used in making compost to use in other agricultural activities

Trees, vines: Can be used as food for both people and for fish

Additional resources can be practically used so that with very little capital fish culture can be carried out in nearby ponds and ditches and vegetables and fruits can be grown on the banks.

Next it is important that the household is involved in the integrated agriculture activities, since the male members are usually engaged in work outside the home, the female members can undertake these activities, however in some of the work, the women will require the men's assistance. This will contribute to not only increasing household-based production but also empower women as major contributors to the family income and livelihood security.

GROUP SESSION PLANNING

Day 01

Time – 11.00

Duration: 30 minutes

Target group : Women famers of Household based pond aquaculture and homestead gardening

Title of session : Understanding of Household based fish culture

Aim : To give the training participants a basic understanding on ‘Household Based Pond Aquaculture’

Objective : At the end of this session, the participants -

- Will be able to describe household-based pond fish cultivation
- Will know how to use household-based resources for pond fish cultivation
- Will know about the role of women in pond fish culture and how they can be empowered

Discussion topic	Training approach	Duration
Introduction		5 minutes
5. Welcome/reception: welcoming the participants and asking about participants welfare 6. Discussion about previous session 7. Linking previous session’s topic to current session 8. Explanation of aim and objectives of current session	Q&A and discussion	
Topic		20 minutes
<ul style="list-style-type: none"> • Importance of fish culture in ponds based near household area • Use household-based resources for pond fish cultivation in aviable manner • The role of women, their involvement and empowerment through household based pond culture 	Lectures, Q&A Flipcharts	
Summary		5 minutes
4. Summary discussion of main topic 5. Assessment of session objectives 6. Distribution of handouts	Q&A	

Discussion and link up to the next session

Supporting Training Material flipchart, handout, white board, marker and handout

Flip chart design

For discussion follow the handout

Understanding of Household based fish culture	Use household-centered resources for pond fish cultivation in a viable manner (use open discussion)
<ul style="list-style-type: none">• Importance of fish culture in ponds based near household area• Indigenous small fish that can be found in ponds e.g. mola , darkina , puti etc• These fish are rich in vitamin, iron and zinc as well as other minerals• All the small fish (except chanda) that are found in ponds where large fish are cultured are an additional benefit• In addition to getting an additional source of income, the small fish is an important contribution to meeting the nutrition needs of the family members especially the women and children• Women members for the household can be directly involved in fish culture	The role of women, their involvement and empowerment through household based pond culture (use open discussion)

OVERVIEW OF FISH CULTURE IN HOUSEHOLD PONDS

The handout given below is only to give a basic understanding which the trainer needs to read thoroughly. If required, trainer to prepare better and get more information may take advice from experts. The training session includes information as required for the farmer participants which are illustrated in the flipcharts and you can use in your presentation.

Importance of fish culture in household ponds

In rural areas, almost all homes have one or more ponds. Also in the area around the homesteads, there are various ditches, canals, borrow pits and seasonal water bodies. These ponds are usually ignored for fish culture because they are either considered seasonal or too small. However these ponds actually have potential to rear small indigenous fish such as mola, darkina, puti etc. It also ensures appropriate utilization of household based resources and contributes to increasing the household income. At least for a few months of the year, the family nutrition requirements can be satisfied if the pond resources are properly utilized. Following are a list of benefits of fish culture in household ponds:

- Mixed fish cultivation consisting of fast growing carp and small indigenous fish cultivated together can reap quick profits as they are fast growing, tasty and have good market demand
- The small indigenous fish such as mola, darkina, and puti have vitamins, minerals such as zinc and iron and therefore very nutritious and can contribute to meeting the family's nutritional needs.
- The small indigenous fish mentioned feed on plankton, insects as well as other dry food and therefore alongside large fish culture, these fish are very important in utilizing pond water and also as additional produce
- To maintain the productivity of the ponds, various fertilizers are used and through periodical harvesting of small fish to control their population in the pond, breeding the small fish alongside larger fish has no adverse effects
- Since most rural households rear livestock and poultry, the excreta of these animals can be used to increase productivity of the pond, without any negative effects and thus reduce the expenses in fish cultivation
- All family members especially women and children can be involved in fish cultivation and so management and maintenance is not a problem

Therefore small fish can easily be bred alongside large fish such as carps easily and these small fish can contribute to not only increasing household income but also meeting nutritional needs of the family. It needs to be noted that the head and eyes of mola fish have the most vitamins and should not be cut off before cooking.

Use household-based resources for pond fish cultivation in a viable manner (use open discussion)

The role of women, their involvement and empowerment through household based pond culture
(use open discussion)

Types of fish that can be easily cultured in water bodies adjacent to rural households
(use open discussion)

GROUP SESSION PLANNING

Day 01

Time – 11.30

Duration: 30 minutes

Target group : Women famers of Household based pond aquaculture and homestead gardening

Title of session : Fish culture and management in household based ponds

Aim : To give the training participants a basic understanding on ‘Fish culture and management in household based ponds’

Objective : At the end of this session, the participants -

- Will be able to classify the different types of water bodies around rural households.
- Will be able to prepare ponds and other water bodies for fish culture
- Will know how to select the correct fish composition and stocking density according to the type of pond or water body
- Will know how to correctly transport and release fish seed/fingerlings
- Will be able to manage post stocking management of fish
- Will be able to timely harvest and distribute the fish
- They will have knowledge about the various types of fish that can be cultured in household ponds and water bodies

Discussion topic	Training approach	Duration
Introduction		5 minutes
9. Welcome/reception: welcoming the participants and asking about participants welfare 1. Discussion about previous session 2. Linking previous session’s topic to current session 3. Explanation of aim and objectives of current session	Q&A and discussion	
Topic		110 minutes
<ul style="list-style-type: none"> • Classification of water bodies • Pond preparation • Selection of the correct fish composition and stocking density according to the type of pond or water body • Fish seed transport and release • Post-Stocking management • Harvesting and distribution/marketing of fish • The various types of fish that can be cultured in household ponds and water bodies 	Lectures, Q&A Flipcharts	
Summary		5 minutes
7. Summary discussion of main topic 8. Assessment of session objectives 9. Distribution of handouts	Q&A	

Discussion and link up to the next session

Supporting Training Material flipchart, handout, white board, marker and handout

Flip chart design

For discussion follow the handout

Fish culture and management in household based ponds/water bodies

Classification of water bodies

Selection of the correct fish composition and concentration according to the type of pond or water body

Stages of Pond preparation

Selection of fish species and their preservation

Criteria for selection of fish species for culture

Determination of stocking density

Fish seed transport and stocking

Post-stocking management

Harvesting and distribution/marketing of fish

Common problems in fish culture and the solutions

The various types of fish that can be cultured in household ponds and water bodies

FISH CULTURE AND MANAGEMENT IN HOUSEHOLD BASED PONDS

The handout given below is only to give a basic understanding which the trainer needs to read thoroughly. If required, trainer to prepare better and get more information may take advice from experts. The training session includes information as required for the farmer participants which are illustrated in the flipcharts and you can use in your presentation.

Almost all rural households have water bodies of various types: ponds, ditches, pit borrows which are deep or shallow, with or without bank. Based on the length of time these water bodies have water, they are of two types:

1. Seasonal ponds/ water bodies: The water bodies around rural households that have water (about 3 foot deep) for less than 5 months a year are considered seasonal. From experience it has been found that it is possible to culture fish for about 5-6 months a year. Within 6 months, up to 10-15 kg of fish can be cultured
2. Annual ponds: These ponds have water year round, even in the dry season there is around 3 feet of water.

Most of the poor and marginalized farmers have seasonal ponds around their homes and in some rural areas, 20-50% of the total ponds are seasonal. If these ponds are properly utilized then a considerable contribution to family income and diet can be obtained. Since the seasonal ponds are shallow, the sunlight reaches bottom of the ponds as a result of which the bottom mud is extremely fertile and there is plenty of natural feed for fish culture. In these ponds, most of the small indigenous fish of Bangladesh as well as carp, Chinese carp, nilotica, shorputi, freshwater prawn, fish seed can be cultured. For at least 6 months of the year, these ponds can meet family requirements for protein.

Pre-Stocking Management

For all types of small and large water bodies, the primary work to be carried out are:

1. Repair of bank and bottom of water bodies, removal of weeds
2. Removal of predatory and unwanted competitive fish species
3. Application of lime
4. Application of fertilizer
5. Assessment of natural feed in the water body
6. Testing the water for toxicity

Repair of embankments and bottom of water bodies, removal of weeds

Importance of repair of embankments/pond banks:

If the pond banks are broken or damaged, the problems would be:

- In excessive rain or floods, fish would leave the water body
- Predatory fish from other ponds can enter and eat up the fish of the water body
- Polluted water from outside can contaminate pond water
- Rat holes in the pond banks cause even further damage to pond banks
- Crabs, frog, snakes etc can hide in rat holes and then eat up the fish

Problems of having vegetation on pond banks: Excessive vegetation on pond banks will not allow sunlight on the water body water preventing photosynthesis. Also the vegetation provides cover for the predatory animals such as rats, snakes, frogs, mongoose etc as well as making it difficult to walk around the pond.

Time to repair pond banks: It is preferable to repair ponds and their banks towards the end of the dry season ie around March (Chaitra in Bengali year) since at this time water in the water bodies are low and makes it easier to manage and repair. Earth cutting, building banks to be higher is more easily done at this time.

Process/method of repairing pond banks and excess vegetation: Using physical labor, vegetation should be cut using hand tools such as sickles and hoes. Damaged or broken banks can be repaired using the mud from bottom of the pond or from earth outside the bank. The rat holes should be blocked with earth.

Repair of pond bottom: In case of old ponds, the mud at the bottom of the pond is usually black. The black mud should be removed at least six inches deep and the bottom evened after dewatering the ponds. This can also be done by blocking the water to one side and the rest of the pond bottom evened using a hoe.

Removal of weeds and other vegetation from pond environment:

Aquatic weeds: Aquatic flora that adversely affect the culture are referred to as aquatic weeds. However there is some aquatic vegetation which in appropriate amount is beneficial for fish culture. Following are four classes of aquatic weeds:

1. Floating: kachuri pana water hyacinth, khuti pana - duckweed (*Wolffia* sp), topa pana (*Lemna* sp)
2. Creepers: malancha helencha (*Enhydra* sp), water spinach *Ipomea aquatica*(nutritious leafy vegetation)
3. Submerged: *Najas* sp, jhaji(*Utricularia* sp)
4. Emergent: shushni shak (*Marsilea* sp), arail, shapla- water lily (*Nymphaea* sp)

Harm caused by aquatic weeds and how to control growth of these plants:

Aquatic weeds and excess vegetation affect fish culture adversely and need to be removed and maintained. The harm caused by excess aquatic vegetation include following:

1. Aquatic vegetation takes up the nutrients in the pond water and thus reduces growth of fish
2. Prevents sunlight from penetrating water impeding photosynthesis process which prevents the production of natural feed
3. Without sunlight, the water temperature falls
4. Excess vegetation makes it easy for predatory animals to hide
5. Fish movement is hampered
6. Waste of the aquatic weeds pollutes the water and gives rise to various diseases

Process of removal of aquatic weeds and vegetation:

1. Physical labor: All vegetation around pond needs to be removed physically either by cutting them down. Pulling out the plants with roots if possible is advised. Floating vegetation can be drawn by tying them with rope and dumping them outside the pond.
2. Natural/biological control: Fish such as grass carp and shorputi eat vegetation and these can be cultured so as to also control growth of vegetation.

Name of beneficial plants and there benefits

Not all aquatic vegetation are harmful, some in small and controlled quantities are beneficial for the fish culture, such as duckweed which is a favored vegetation for grass carp and shorputi (*Puntius gonionotus*) to feed on. There is also water spinach and other small grass-like plants which small fish feed on. Care should however be taken to keep the density of these plants in check so that they do not hamper the growth and movement of culture fish.

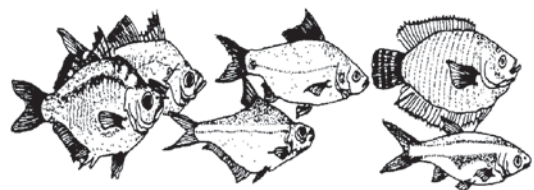
Removal of predatory and other unnecessary competitive fish

Predatory fish: The fish that eat other fish are known as predatory . these include – shoal , taki , gojar , boal , kakila , bele , foli , chital etc. These fish will eat up the fish seed and fingerlings being cultured in the water body.



Competitive fish:

There are some fish species that might not eat the cultured fish however they create competition for food, habitat, oxygen etc with the fish being cultured hampering their growth and production. These fish are considered unnecessary and competitive. However depending on the fish composition for fish culture, a fish species considered unnecessary and competitive in one pond may not be so in another pond.



In culture of small indigenous fish species especially in polyculture with carps, chanda fish is an unnecessary fish

Necessity of removal of predatory and competitive fish

- Predatory fish eat fish being cultured
- Both predatory and unnecessary competitive fish compete with culture fish for food, space, oxygen etc, as a result of which the culture fish do not grow well and production is thus hampered.

Removal process of predatory and competitive fish

The three methods that can be used to remove predatory and competitive fish:

1. **Drying the pond:** This is the most preferable method of removing unwanted fish. By de-watering the pond, fish can be caught easily. At the same time, insects and mollusks can be removed. Toxic gasses at the bottom are also released, the bottom can be repaired. However if the pond is large and deep, this will be a costly method.
2. **Netting fish using fine-mesh net:** If the pond cannot be dewatered or poisoned using rotenone then it is preferable to use a fine mesh net to catch and remove all fish. Many fish hide in the mud, in old crab holes or among roots of old trees and may not be caught in the net. However if the pond is fairly new and the bottom is even then the predatory fish can be caught and removed.
3. **Use of rotenone:** When fish cannot be removed by de-watering or netting, then application of rotenone is a preferred method to remove predatory and unwanted fish. Rotenone is root extract of a plant known as Deri. It is available in powder form. Its effectiveness only lasts 7 days in the water. Fish killed using rotenone can be eaten after removing the gills.

Determination of rotenone concentration:

Strength	Rate of Application gm/ft depth
9.1%	18-24 gm
7%	24-30 gm

Rotenone of 9.1% strength is mostly available and application of this strength is preferred.

Determination of amount of rotenone to be applied:

$$\frac{(\text{Width} \times \text{length} \times \text{depth}) \text{ ft} \times \text{treatment determination (gm)}}{435.6} = \text{rotenone amount (gm)}$$

For example: if a pond is 150 feet long, 90 feet wide and 4 feet deep and rotenone of 24gms per 100 feet is used and total rotenone amount is

$$\frac{150 \times 90 \times 4 \times 24}{435.6} = 2,975 \text{ gm}$$

Mixing and application method: after the total rotenone amount is calculated then the required amount of rotenone powder is taken, dissolved with a little water to make in dough like consistency and split into 3 balls of rotenone. One ball is made is smaller balls a scattered all over the surface of the water body. The other two balls are mixed in water to make a watery solution and sprinkled all over the pond 15-20 minutes after the first part has been applied. Fish that die and float should be netted and removed as quickly.

Time of application: 10-11 am on a sunny day

Precautions in rotenone application:

- When mixing rotenone and applying in pond water, hands should be covered in polythene as well cover mouth and nose using a towel or cloth
- Rotenone treatment should be done on a sunny day otherwise it will not be effective

- It should scattered or sprinkled with the wind current
- After applying rotenone , wash your hands and all the dishes used properly
- Keep rotenone out of children’s reach

Application of lime

Lime is a calcium-based compound that lessens acidity and is also assists structural formation of animals

Why apply lime: The two reasons for application lime are 1) firstly pH of water has to be appropriate for fish culture and not acidic. The acidity of the water should be more than 20milligrams/liter; 2) secondly by applying quick lime, parasites and other germs can be killed as well increase the rate of waste of dead organisms at bottom of the pond.

What is pH?

The pH scale measures how acidic or basic a substance is. The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic. A pH greater than 7 is basic. The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic. A pH greater than 7 is basic. For fish culture pH should be in the range of 6.5 to 9.0. pH above 11 and below 4 may kill the fish.

Application of fertilizers in pond or water body mainly means to supply nitrogen and phosphorus so that plankton can grow. If pH is too high or too low then plankton cannot utilize the nitrogen and phosphorus.

Lime application in pond preparation is extremely important because:

- Lime helps kill germs in the water and pond mud
- Lime helps to clarify the water
- Parasites, bacteria and other similar germs are killed
- Lime increases effectiveness of fertilizers that are applied
- Increase supply of CO₂ which is necessary for photosynthesis
- Mitigates ulcerative syndrome in fish

Types of lime and determination of application:

Name of Lime	determination of application (perdecima)	Chemical composition
<i>Pathure</i> Lime / Calcium carbonate	3-4 kg	CaCO ₃
<i>Kali</i> Lime / slaked lime	2-3 kg	Ca(OH) ₂
<i>Pora</i> lime/ quicklime / burnt lime	1-2 kg	CaO
Dolomite	3-4 kg	CaMg(CO ₃) ₂
Gypsum	1.5-2 kg	CaSO ₄ ·2H ₂ O

It is advised to measure the pH of water and pond earth before applying lime. Usually in case of new ponds, for every decimal 1 kg and in case of old ponds 2kg per decimal is enough. Lime is a commonly used in fish culture and every 3 months or according to need; quick lime (Calcium oxide) 250-300gms/decimal may be applied to get good results.

Use of different types of Lime:

Name	Use and effectiveness
quicklime	This is extremely alkaline. With the application of this lime, pH increases rapidly. Removes germs and safe to use in dry ponds
Calcium carbonate / Dolomite	When water is acidic i.e. pH is less than 7. Dolomite can also be effectively used in ponds that are rich in organic matter
Gypsum	Helps to clear water turbidity caused by mud that is washed into the pond by rains; also helps to balance the pH level (if bicarbonate /carbonate/hydroxyl ion and other ions such of aluminum are present.)

How to identify good quality lime:

Take some water in an aluminum container or a glass and drop in a piece of lime. If it is of good quality, it will dissolve giving off bubbles and heat. In the market place this can be tested in a tea cup with water.

Application of Lime:

Dry pond: Take the required amount of lime and grind into powder and then sprinkle it evenly over the bottom and on the slope of the pond bank up to the upper level of the water.

Water-filled pond: Take a steel bucket or clay pot and take water at least three times the required amount of lime and mix with the lime. Dissolve it fully. If required add more water. After the solution cools down, stir with a stick and use a bowl to sprinkle it evenly over the pond water. After application of the lime, pull a net to stir the bottom of the pond or walk through to mix the lime with the pond mud – the application of lime will thus be more effective.

Application time of Lime:

1. Seven days after rotenone application
2. Seven days before applying fertilizer
3. Lime works best when applied on a very sunny day

Precautions of applying lime:

- Do not dissolve lime in plastic bucket
- When dissolving and sprinkling lime, cover nose and mouth with cloth or towel
- Sprinkle the lime along with the wind current
- Do not apply lime when still hot to pond filled with water
- First take water in the bowl or bucket and then apply lime
- Do not apply lime on a cloudy or rainy day
- If lime gets into the eyes, wash it repeatedly with clean water
- Keep children away during lime preparation and application

Fertilizer application in pond preparation

Importance of fertilizer application: Fish might not consume fertilizer directly but it is required to help in the production of plankton, small insects, worms etc which are natural food for the fish. If sufficient sunlight falls on the pond and fertilizer is applied in the appropriate manner, then there is little need for supplementary feed for the fish.

Fertilizer type: There are two types

Organic fertilizer: Cow manure and compost

Chemical/inorganic fertilizer: Urea, TSP, MP

Amount of fertilizer to be applied: Depending on the type of water body, amount of fertilizer applied also varies. Using the color of the pond water, it is determined whether fertilizer application is necessary. In comparison to old ponds, newer ponds require more organic fertilizer.

Following fertilizers may be applied in pond preparation:

Name of fertilizer		Amount for application (per decimal)
Organic fertilizer	Manure/compost	Manure : 5-7kg/ Compost: 8-10 kg
Inorganic fertilizer	Urea	100-150 gm
	TSP	50-75 gm
	MP	25 gm

Method of fertilizer application:

- Fertilizer is applied at least seven days after lime application (if phosphate fertilizers are given immediately after lime application then it will not be effective) and seven days before releasing fish seed
- TSP needs to be soaked for 24 hours before being used. Before application of fertilizer, the organic and inorganic fertilizers can be mixed together in water in one container or separately in different bowls and evenly sprinkled over the pond
- In a dry pond, the necessary amount of organic fertilizer can be applied to all parts evenly

Fresh manure should not be applied. Manure should be kept in a hole for at least 7 days for decomposition before use

Points to take into consideration when applying fertilizer

- Fertilizer should not be applied when weather is cloudy
- If water color is very green, fertilizer application should be stopped
- Amount of fertilizer applied is less in winter – half of what is given in summer.

The different types of plants and animals present in water

- The top level of water may have floating flora (water hyacinth, duckweed etc)
- Both in the top level and below it, there are various aquatic fauna of different sizes, usually insects and their larvae

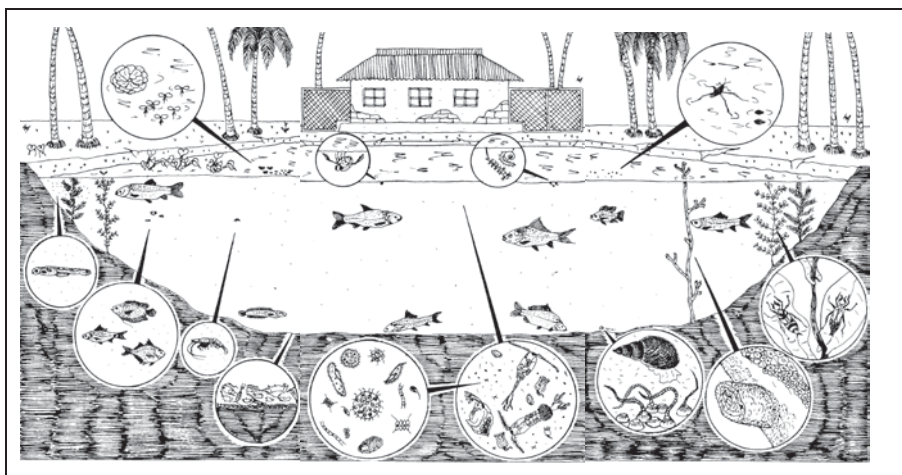
Phytoplankton: in the middle layer of the pond or water bodies, there are a variety of fish, crustaceans as well as plants. The smallest is bacteria and extremely small plants which remain in this layer and cannot be seen with the naked eyes or with spectacles. However when their concentration is high, the water color turns green. These are classified as phytoplankton.

Zooplankton: Small fauna such as insects and bugs are present in pond water which can be gathered using fine mesh net or gamcha (Bangladeshi style towel). These are known as zooplankton and can be seen with the naked eyes.

Periphyton: In the water, many flora and fauna are borne on stones, other solid materials such as roots and these are known as periphyton

Benthos: The flora that grows at the bottom of the pond in the mud and above it along with fauna such as small insects, insect larvae, mollusks are known as benthos

Detritus: Dead flora and fauna as well as fish excreta which accumulate at the bottom of the pond, these decomposed material at the bottom are known as detritus



চিত্র: পানিতে অবস্থিত বিভিন্ন প্রাণী ও উদ্ভিদ

Assessment of natural food

Natural food: The natural productivity of a pond or water as a result of fertilizer application give rise to feed such as small insects, plants and zooplankton. These are so small, they cannot be seen with the naked eyes, they can be

perceived however by the color of the water. The color can be light green, brownish green or light brown. The natural food are of two types:

Flora : Very small algae type plants (phytoplankton)

Fauna: Very small insects and bugs (zooplankton)

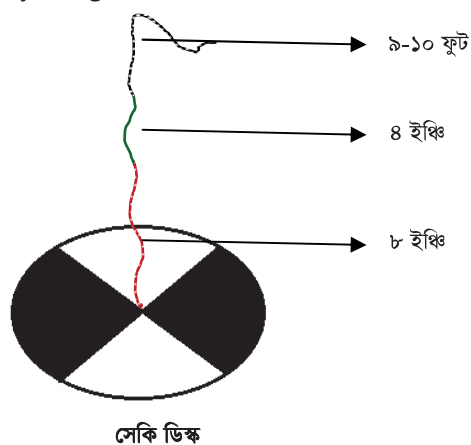
Assessment of natural food: 3-4 days after fertilizer application and before stocking fish seed, the water needs to be assessed for natural feed using color of the pond water as indicator: light green, brownish green or light brown.

How to assess natural food: this can be done by first seeing the color with naked eyes and then the using the following methods to more specifically define the natural feed present in the pond water:

1. Secchi disc test
2. Glass test
3. Hand test
4. Plankton net

1. Secchi disc test: The Secchi disc is a disc which is painted black and white alternately in four parts. It is made or cast iron or any other metal from the centre of which rises a lead. The lead is tri-colored according to depth. From the centre of the disc the lead is colored red and is 8 inches, after which 4 inches are colored green and last 9-10 feet are colored white.

In line with sunlight rays the Secchi disc is lowered into the water and you have to determine at what depth the white color of the Secchi disc can be seen. It needs to be ascertained at which level you can just see the white before it cannot be seen at all. If the red part of the lead is above water then this indicates that there is excess feed in the pond and to give additional fertilizer and feed is not advisable. If the white of the disc can be seen at depth of white of the lead then this indicates additional feed or fertilizer is required for the pond. If the green part of the lead is above the water then this indicates that the amount of feed in the pond is just right and the fish seed can be released.



Time to use the disc: After sun rises

Precaution: Should not be used in murky waters or cloudy weather.

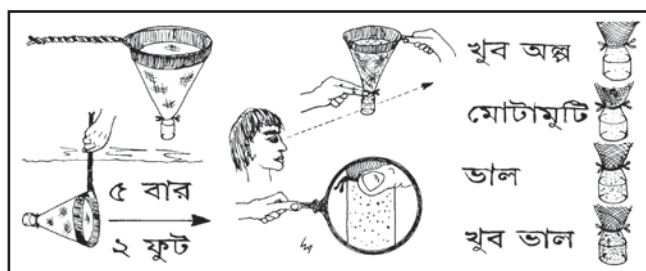
2. Glass test: 5-7 days after application of fertilizer, water collected using a clean cloth and put into a clean glass and held up in sunlight will show color of the water. It should ideally contain green phytoplankton and 5-10 zooplankton. A clean and clear glass should be used, not one that is decorated colored or dirty.

3. Hand test: Dip hand in the water with the palm facing upward. If the palm of the hand cannot be seen even before being dipped elbow-depth then it indicates that there is feed in the water. And if the palms can be seen after being dipped elbow deep then this indicates there is not enough feed. This cannot be done in turbid waters.

Time of test: After sun rises

Precaution: These tests do not apply on days that are cloudy or in water that is murky

4. Plankton net: The plankton net consists of a steel ring with a steel handle or wooden handle and the ring has a funnel-shaped net made of very fine mesh cloth (micron). At the end of the funnel is a small glass bottle. Hold the net by the handle and draw it through the water at 0.5 ft to 2ft depth five times in the same direction and collect plankton in the glass bottle. By assessing the density of plankton in the glass bottle – the amount of natural feed in the pond can be inferred.



প্ল্যাকটন নেটের সাহায্যে সারের কার্যকারিতা পরীক্ষা

Testing water toxicity

Before releasing fish seed/fingerlings, the water needs to be tested for toxicity.

First method: Set a hapa in the pond where the fish seed are to be released and release a few fish seed for 12 hours. At the end of 12 hours if the fish seed are healthy and fine then this means the water is not toxic.

Second method: take water from the pond where the fish are to be cultured – 10-12 liters of water. In another bucket take regular tube well water in the same amount. In both buckets release same number of fish seed and check for 3-4 hours. If the behavior and survival of the fish seed is the same in both buckets then it can be assumed that the pond water is safe and not toxic.

Advice: if fish seed die during the toxicity tests, then this means you will have to wait a few more days before testing again for toxicity before releasing fish seed.

Species of fish seed/ density and composition

By polyculture we mean culture of two or more species of fish in a pond. The main objective of polyculture is to ensure that all layers of the pond or water body are fully utilized and optimum production of fish obtained. To ensure this, species of fish to be released needs to be determined. Selecting only one species of fish is not profitable and we also need to take into consideration competition for food and space.

Fish species	Water layer where the species inhabit	Main food
Silver/bighead	Top layer	Phytoplankton/zooplankton
Catla	Top and middle layers	Zooplankton and Phytoplankton
Ruhi	Middle layer	Zooplankton, small insects and algae
Mrigel/kalbaus	Bottom layer	Zooplankton, plant matter and benthos
Common/mirror carp	Bottom layer	Zooplankton, waster organic matter and and benthos
Grass carp	Top, middle and bottom layers	Aquatic plants, grass, weeds, other leafy vegetation
Thai sharputi	Top and middle layers	phytoplankton and zooplankton, wolfia sp- duckweed
Tilapia	Top and middle layers	Phytoplankton and zooplankton
Mola	Top and middle layers	Phytoplankton and zooplankton

Criteria for species selection:

- Fast growing
- Market demand and high price
- Ability to counter diseases
- No competition for food
- Not predatory in nature
- Fish seed easily available

Determination of stocking density

Stocking density of fish depends on type of water body, earth type, depth, culture method and management. Other criteria to take into consideration include:

- Stocking density also depends on what size of fish you wish to harvest. If of same size then if stocking density is low then the fish will grow faster than when stocked at high density
- If it is a new pond, then fish inhabiting top layer should be more and in case of older ponds, fish that feed in the bottom layer of the water body should be more
- In shallow ponds where water is present for only 5-6 months, it should be stocked with fast growing fish such as tilapia, *P. goniontus*, silver carp, *Cyprinus carpio* fish
- Tilapia breed frequently releasing eggs 3-4 times a year and the fish seed can easily be harvested in seasonal ponds.
- In sandy soil pond, Thai shorputi (*P. goniontus*) and silver carp grow well
- Within the same stocking density if different sizes of fish seed are released then at time of harvest different sizes of fish will be harvested

Recommended species and stocking density per decimal

For household based fish polyculture, any of the following models can be used. For best production carp type fish fingerlings should be 4-6 inches.

Species	Model -1	Model -2	Model -3
Silver carp	10-15	10-15	10-15
<i>Catla catla</i>	6-8	6-8	6-8
<i>Labeo rohita</i>	10-15	10-15	15-20
<i>P. goniontus</i>	-	15-20	-
Tilapia	20-25	-	-
Grass carp	1-2	1-2	1-2
Common carp	4-6	4-6	4-6
Total carp Indigenous/tilapia seed	51-71	46-66	36-51
<i>Mola/darkina</i>	100-150 (gm) /35-50	100-150 (gm) /35-50	100-150 (gm) /35-50

** if mola is cultured together with tilapia and shorputi then mola fish seed is eaten by tilapia and shorputi, also competition for food and space is created*

** instead stocking small fish from outside, the small fish present in the pond can be used or channel to catch the small fish from paddy fields can be made and cultured in the ponds (especially for mola and darkina)*

** If pond management is good especially with regards to water and oxygen supply, stocking density may be increased in future*

Sources and availability of fish fingerling

Before stocking fish seed/fingerlings, we have to determine the source, availability and transport arrangements so that they can be stocked quickly after pond preparation

Stocking good quality fish seed

- If good quality/ fish seed/fingerling are stocked, then survival will be good
- Diseases will not easily attack these fish seed and fingerlings
- Production of fish will be good and high
- Better profit will be obtained

Stocking brood of mola: If sufficient brood fish of mola is stocked in the pond during April-May, then when the rains come large amounts of mola fish seed are produced

Identification of good and bad quality fish seed/fingerlings

Good quality	Poor quality
~ Body color bright and glossy	~ Dull body color
~ Slippery scales	~ Scales are rough
~ No marks on body and gills	~ Red marks on the body and gills
~ If tail is held in a pinched manner then head moves quickly	~ If tail is held pinched then moves head very slowly
~ Very agile in movement	~ Does not move and moves with current if water is stirred in container
~ Normal body structure	~ Body structure is not normal

Transport, cleaning, acclimatization and stocking of fish seed

Density of fish seed during transport: Whatever the method of transport, modern or traditional, this depends on the size of fish seed, i.e. whether it is PL, juvenile or fingerling size, their weight and distance of transport. Usually 36x20 inch sized polythene bags are used to transport PL/fish seed. Following tables give details on transport of fish seed and prawns using modern and traditional method:

Stocking density during transport of carp fish seed

Transport method	Size (inches)	Density (piece per liter) of water	Distance of transport (hours)
Oxygen bag	1-1.25	33-35	10-12
	1.25-1.5	20	10-12
	1.5 -2.5	13	10-12
	2.5-3.0	5	10-12
	3.0-3.5	4	10-12
Pot	1-2	15	3-4
	2.5-4	5-6	3-4

Note: Pangas fingerling

Stocking density during transport of Prawn seed

Transport method	Size	Density (piece per liter) of water	Distance of transport (hours)
Oxygen bag	PL	125-150	12-16
	PL	300-350	6
	Juvenile	100	6
Pot	PL	250-500	1-1.5
	Juvenile	15-20	4-6

Transport method of fish seed

1. Traditional method using drum or aluminum pot

- 10-12 hours before transport, feeding has to be stopped
- Two parts tube well water and one part pond water should be mixed in the transport container
- The container with fish seed should be covered with fine mesh net
- During transport, every 2-3 hours, 2-3 parts of the water needs to be changed
- During transport the water should be aerated by stirring the water using hands, so that sufficient oxygen is made available for the fish seed.

2. Modern method using polythene bag:

The modern method of packing and transporting fish and shrimp/prawn seed is about the same, however in case of shrimp/prawn seed some additional arrangements are needed. Following are points on stocking and transport that need to be taken into consideration for shrimps/prawns:

- At least two hours before transport, feeding should be stopped however if the shrimp/prawn are being carried long distance, PL can be fed Artemia nauplii or for every 500 PL one-eighth of a boiled egg yolk
- Polythene bag should be checked carefully for holes. One bag should be placed in another and the corners tightly bound so that fish/shrimp/prawn seed do not get stuck anywhere. One-third of the bag should be filled with water
- Only in case of transporting shrimp PL and juveniles, some weeds should be added to the water for shelter
- Apart from PL and water, two-thirds of the bag should have oxygen and the bag should then be tightly bound.
- If transporting many bags at the same time, it is safe to use a container where the temperature can be maintained

Precautions in transport

- The pot being used to transport fish/shrimp seed should be covered with wet cloth or jute sack
- Need to be careful that polythene bags have no pressure on them from the outside
- Polythene bags should not be subject to be hit by hard objects
- The pots and bags should be in shade during transport
- Aeration of water in pots need to be ensured
- Sufficient oxygen should be available in case polythene bags
- Keep extra batteries for the aerator
- To keep the water cool, every hour, 10 gm of ice per liter of water should be added.

Cleaning the fish seed:

Before stocking the fish seed in the pond, it is important to release them germ-free and therefore they need to be sanitized. For sanitization, take 10 liters of water in a bucket and add to this one spoon of potassium permanganate (doctor's potash) or 200 gm of salt. Take a just enough fish seed in a fine mesh net and dip in bucket to wash them for 1-1.5 minutes and then release into pond. For every wash 300-350 fish seed can be washed and the same water can be used 4-5 times.

Time of release of fish seed:

- Early morning or in the evening
- Should not release in very sunny or rainy weather

Acclimatization and stocking

Fish seed or PL may die because of high temperature or insufficient oxygen. Before releasing into pond if the fish seed and PL can be acclimatized with the new environment, then the mortality rate after release can be reduced.

For this the temperature of transport container and that of pond should be as much as possible the same, then it will be easier for the fish seed/PL to adjust to the new environment. The steps to be followed in the release of fish seed/ PL, juveniles and fingerlings are:

- Float the transport container in pond water for about 15-20 minutes
- After opening the container, by exchanging water gently from the pond to the container, the temperature should be the same
- Use hand to test the difference in temperature of water in transport container and that of pond water
- Need to ensure that the difference in temperature of the two environments is not more than 1-2 0C
- After it is ensured that the temperature of the two waters are similar, the transport container can slowly be tipped and the fish/prawn seed will swim out against the water current that is created gently by hand.

Assessment of fish seed mortality

During transport, fish seed face stress which the smaller ones cannot tolerate most of the time and also if the acclimatization with pond environment is not done properly, the fish seed usually die. So after release of fish seed, in comparison to the fertilizer and feed costs for the specific amount of fish seed becomes high when actually the number of fish seed that have survived are less. If the survival rate of the fish seed is not assessed then expected fish production is low while production costs are high. Calculating the survival rate gives an indication of how much more feed/fertilizer needs to be applied

6-8 hours after release of fish seed, the pond boundaries should be surveyed for fish seed movement and in the place where the hapa is fitted should be checked for any dead fish seed/fingerlings at the bottom. Dead fish seed should be removed quickly from the pond and depending on the number of fish seed found dead, release for a similar number of fish seed carried out.

Post-stocking Management

The following tasks need to be carried out after release of fish seed

1. Application of supplementary feed
2. Post-stocking fertilizer application
3. Netting to remove excess plankton/aquatic vegetation
4. Treating fish's growth and health
5. Partial harvesting and marketing
6. Management of common problems in fish culture

Application of supplementary feed

Supplementary feed: In addition to the natural feed of the pond, it is necessary to give supplementary feed to ensure good production of fish. These are of two types:

- Pellet/granular feed – prepared by various companies and available in packets
- Granular/ball: such as oilcake, bran, dried fish powder, fishmeal etc

Importance of giving supplementary feed

- Fish can be cultured more intensively with higher stocking density
- Fish grow faster
- Within a short period, fish are of marketable size
- Fish mortality
- Fish are less affected by diseases
- Maximum production can be achieved from a small water body

Criteria for selection of supplementary feed

- Easily available feed
- Cost and nutritional benefits
- High feed conversion ratio
- Financial ability of the farmer

Nutritional requirements of the fish: For the fish to grow well and be able to prevent being afflicted by disease, it requires a complete nutrition in the feed they get. Fish nutritional requirement is simply understood as protein requirement. Nutritional requirement of fish depends on their age and species. Fish get 5-15% of their protein requirements from natural feed and therefore it is sufficient if the supplemental feed contains 25-30% protein.

Nutritional details of various feed: Below are given nutritional details of various feeds based on research

Name of feed material	Nutritional value (%)		
	Protein	Carbohydrate	Fat
Rice bran	11.88	44.42	10.45
Wheat bran	14.57	66.36	4.43
Mustard oilcake	30.33	34.38	13.44
Sesame oilcake	27.20	34.97	13.18
Fish meal (A- grade)	56.61	3.74	11.22
Blood meal	63.15	15.59	0.56
Meat and bone meal	50-55	-	12.36
Wheat flour	17.78	75.60	3.90
Molasses	4.45	83.62	-
Corn	7.7	82.7	2.80
Soya bean oilcake	52.5	32.1	3.2

Formula to prepare supplemental feed at lost cost

Feed material	Amount of feed (%)	Protein (%)		Necessary amount of feed material per kg of complete feed (gm)	Price per kg (tk)	Price of necessary feed material per kg of (tk)
		In the feed material	In the feed (%)			
Fish meal A grade	10	56.61	5.66	100	40	4.00
Mustard oilcake	25	30.33	7.58	250	25	6.25
Soya bean oilcake	10	52.5	5.25	100	26	2.60
Rice bran	50	11.88	5.94	500	18	9.00
Wheat	5	17.78	0.88	50	20	1.00
total	100		25.31	1000		22.85

* the price may vary according market price

For carp polyculture in seasonal ponds, supplementary feed may be given as balls made from equal amounts of rice bran, wheat bran and oilcake. 24-48 hours before making the final feed, the oilcake should be soaked and with this the rice bran and wheat bran should be made mixed and made into balls.

Amount of feed material for carp fish supplementary feed.

Feed material	Example 1		Example 2	
	Utilization rate (%)	Gm/kg food	Utilization rate (%)	Gm/kg food
Wheat bran	-	-	25	250
Rice bran	45	450	30	300
Mustard oilcake	45	450	25	250
Fish meal	-	-	10	100
Wheat/molasses	10	100	10	100
total	100	1000	100	1000

Apart from feeding on supplemental feed, fish such as grass carp and shorputi (*P. goniontus*) feed regularly on duckweed, algae, soft grass, banana leaves, potato leaves, drumstick leaves, papaya leaves, napier grass and various winter vegetables. On a daily basis, grass carp can eat up to 40-45% of its body weight.

As fish grow larger, the rate of feeding slows down but overall total feeding increases. Below is given daily feed application in fish culture management.

Total weight (gm)	Daily feed amount (%)
1-5	10
5-10	5
10-50	4
50-500	3

Preparation of daily feed

Fish feed can be prepared quite easily which the farmer can make by herself. If possible a food processor may be used. Below are steps in preparation of fish feed.

- Required amount of oilcake should soaked at least 20-24 hours and the oil layer the water on top should be thrown away
- Rice husk, wheat bran and fishmeal should be sieved well
- If rice bran is used then it should be boiled
- All the different materials should be taken in own bowl
- Wheat should be boiled in enough water to produce a gluey substance
- The gluey wheat should be used to mix the other materials into a dough and then made into small balls

Distribution of supplemental feed

Fish feed during the day and therefore on a daily basis the necessary daily feed should divided into two equal portions. The first portion should be given around 10-11 in the morning and 2nd portion 3-4 in the evening. To prevent wastage of feed, it is best to give the feed in a feed tray. Using a feed tray is effective to measure how much feed has been given or eaten as well as prevent wastage.



চিত্র: সম্পূরক খাদ্য

Making a feed tray: The feed tray is 9 square feet (3ft x 3ft) bamboo frame to which a mosquito net is attached and hung like a dharma/lift net four inches high. In a 30 decimal pond, two trays should be made, in 60 decimal pond 4 trays and 100 decimal 6 trays. If feed tray is used it should be cleaned regularly. If a feed tray cannot be used, then a place along the pond bank should be selected where the feed can be given.

Providing green food: feed for grass carp or shorputi should be given in bamboo frame which might be round or square (feeding ring) and the green vegetation that they feed on should be given in this ring. The frame should be placed 1-2 feet from the ponds edge. The frame is usually 1m² or 10 square feet in a 30 decimal pond. If banana leaves are given, these should cut into small pieces. When the green feed finishes, it should be given again.

The success of fish culture depends largely on selection of feed. It has been seen previously that farmers give feed according the type of mouth the fish have and this has been good in preventing wastage and getting a good production

Precautions in giving fish feed

- Feed should be given in the same place every day
- The amount of feed being consumed should be monitored by lifting the feed tray to assess how much feed should be given later
- If the water is excessively green, supplemental feed should be lessened or temporarily stopped

For mola fish fine rice bran (auto rice polish) should be scattered dry over the pond surface. Excluding the weight of silver and grass carp, the feed amount given should be 2-5% of the remaining total fish weight. Grass carp should be regularly fed with green feed. Organic and inorganic fertilizer should be applied according to fish culture management process to keep the water green. It has been observed that if additional feed is stopped for one day, the next day the fish feed even more. This does not affect fish production, it actually reduces cost.

Determination of the amount of feed:

From the day after stocking fish seed in the pond, commercial feed or feed prepared on the farm should be given 2-5% of the total weight, twice a day in the morning and evening. When determining the amount of feed, weight of silver and grass carp should be excluded. Duckweed should be made available for shorputi and grass carp.

Daily and monthly growth rate of different fish species:

Name of fish	Daily growth rate (gm)	Monthly growth rate (gm)
Silver carp	2-5	60-150
Catla	1-3	30-90
30-60 Ruhi	1-2	30-60
Mrigal	1-2	30-60
Common carp	2-4	60-120
Grass carp	2-5	60-150
Shorputi	0.5-1.5	15-45

This growth rate may vary according to age of fish seed, management method, length of day, and temperature.

Post-stocking fertilizer application

To get good production results, fertilizer should be given according to fish management process. Every 15 days or depending on the status of the pond's existing natural feed, fertilizer needs to be applied to the pond.

Below is given weekly/or as required rate of fertilizer application:

Name of fertilizer		Application rate per decimal
Organic fertilizer	Manure/compost	Manure: 1-2 kg/ compost 2-2 kg
Chemical/inorganic fertilizer	Urea	40-60 gm
	TSP	20-30 gm

Method of fertilizer application

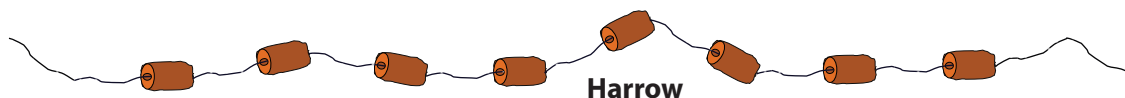
Cow manure (after gaseous decomposition) and TSP should be taken in a bucket with three times the amount of water and soaked for 12-14 hours. The TSP should be dissolved properly in the water. To this mixture urea should be added before applying to water body. Time of application is 10-11 in the morning on a sunny day.

Precautions of fertilizer application:

- If the color of water is excessively green, then fertilizer application should be stopped
- Should not be applied on cloudy day or if weather is overcast
- If urea is kept open then its effectiveness is spoiled
- The effectiveness of fertilizer is reduced if it applied in turbid or acidic water
- When using mixed fertilizer, it has to be well mixed and dissolved in water

Harrowing

The pond should be harrowed to turn the mud over. This harrowing can be done by tying bricks to a rope or instead of bricks, clay balls with holes can be used which are available in the market. The rope runs through these balls which are knotted into the rope and the rope has to be long enough to cover the width of the water body as well as touch the bottom so that two people can hold it on two ends and drag down the length of the water body at least twice. The harrowing helps to release any toxic gases at the bottom to surface of water. This has to be done at least every two weeks or 15 days. If needed this dredging can be done more frequently



Sampling of fish:

Sampling is the method used to assess the growth, weight and health of fish being cultured by netting fish from the pond time to time.

Necessity of sampling:

- To know about the fish's growth
- To determine population of stocked fish
- To review and determine the amount of supplementary feed to be given
- Whether harvested fish are appropriate for sale
- Checking fish health, determination of any disease and to thus take necessary steps to solve this

Sampling method:

To get proper results from sampling, 5-10% of the fish have to be caught or at least 10-20 pieces of every species of fish and prawn. The sampled fish that are netted are checked for overall growth, the fins, gills, scales, body slime. The fish body is also checked for any unusual marks or whether there are any parasites. According to species, every fish is then weighed and based on the average weight and stocked population of each of the fish species, following which these are added up to determine the total weight of fish in the pond is calculated.

Points to take into consideration during sampling

- Sampling should include all small and big fish in a pond
- Large net for sampling is recommended, where this is not available as well as in case of small ponds, jhaki/cast net can be used. When jhaki net is used in large ponds, fish have to be sampled for different parts of the pond.
- When a seine net (ber jal) is used, it has to be used in such a manner that fish to be sampled can be collected at one attempt and at least 90 % of the fish stocked are collected in the net. This cannot be done twice because netting causes stress from which fish take 1-2 days to recover.
- The fish that are selected for sampling are collected from the net and placed in a hapa and the rest of the fish quickly released back into the water.
- Sampling process needs to be completed as quickly as possible and the fish released gently back into the pond
- Sampling should be first done 1-2 months after stocking and then every month.

Harvesting and Marketing

Harvesting is catching fish either for marketing or for eating. In order to be profitable in fish culture, fish should be harvested at correct time and using appropriate method. Harvesting can be done in two ways: 1) partial harvest and 2) complete harvest.

Each water body has its own holding capacity and when this fulfilled, the fish production slows down or stops even though fertilizer and feed continue to be supplied. This is not profitable for the farmer.

If some large fish can be harvested before the pond's holding capacity is fulfilled then other fish can continue to grow. This is partial harvesting and is recommended. Also partial harvest reduces the risk of loss from theft and disasters and if these are sold timely, good market price can be availed. Whether fish are partially or completely harvested, following points are taken into consideration:

- a. Fish size and weight
- b. Total fish population
- c. Market price
- d. Risks
- e. Availability of larger-sized fish fingerling for re-stocking

a) Fish size and weight: To get a better profit, it is advisable to harvest large fish or what is known as table fish and let the smaller fish grow. Following are appropriate harvest weight of different fish species:

- Catla : 500 gm or more
- Silver carp/grass carp : 750 gm or more
- Ruhi : 400-500 gm or more
- Shorputi/tilapia : 150-250 gm
- Mola : 25-30 gm

After stocking of mola/darkina, notice needs to be taken to see whether their seed are being released. When mola/darkina start to release seed, the mola/darking have to be harvested. Every month or 15 days mola/darkina can be partially harvested

b) Total biomass of fish: This is the total weight of all fish stocked

In the various methods of polyculture, per decimal of pond should have following total weights:

- Extensive method : 8-10 kg
- Improved extensive method : 12-15 kg
- Semi-intensive method : 20-25 kg
- Intensive method : 45-50 kg or more

c) Market price: Since fish culture is carried out also for economic benefit for the farmer household and therefore the market price is very relevant for the fish being harvested. This varies from place to place and also season to season. Fish should be harvested keeping in mind maximum profit

d) Risks: There are many types of risk in fish culture such as theft, floods, drought etc. These need to be taken into consideration when harvesting fish. Also when netting large fish in winter, the smaller fish which are injured at that time might catch infection and die. Fish should be harvested with consideration to the risks present.

e) Availability of larger-sized fish fingerling for re-stocking: To get high productivity from water bodies, then the cycle of fish culture management should be continued throughout the year. To continue the production cycle, every time fish are harvested, for each species the same amount plus 10-15% of this amount should be the number of fingerlings for re-stocking. If large fingerlings are stocked then 10% might die which is why the additional number of fish seed are considered during re-stocking. For example if a 100 fish are harvested, then 110-115 fingerling fish seed should be released. To ensure restocking, availability of fingerling fish seed should be ensured before harvesting.

Method of fish harvest: This depends on the size of the pond and number of fish to be harvested. There are various methods of harvesting fish:

Seine net method: When the pond is large and number of fish to be caught is high then ber jal is used. The net spacing should be according to smaller than size of fish to be caught. The net should be long as twice as deep as the pond and 1.5 times wider than the pond. In one pond, the netting should not be done more than twice so as to minimize the stress on the smaller fish. After drawing the net, large fish should be collected and smaller fish quickly released back into the water.

Cast net method: This method is used to catch smaller numbers of fish

De-watering: This best to collect catfish e.g. singh

Time of harvest: Fish should be caught in cool and clear weather especially in the early morning as well as taking into consideration of local market time

1. Partial harvest: If large fish are left in the pond then this is not profitable and so if there are marketable fish these should be caught to allow smaller fish to grow and reduce the completion for food and space. Partial harvest of fish is more logical to obtain economic benefit.

Things to be considered for partial harvest:

- Marketable fish should be caught
- Large fingerlings should be restocked after harvest
- Number of fingerlings for restocking should 10 to 20 pieces more

In annual ponds, after partial harvest, the number of fingerling for restocking should be according to the number of fish harvested

2. Complete harvest: This is to catch all marketable fish and this can also be done by dewatering the pond to catch all fish.

- Keep the fish in shade
- Care should be taken to avoid injury to the fish
- Fish should be caught at the time it is to be marketed
- Fish should be first kept in hapa and jeol (live) fish can be kept separately in a drum to keep them alive until market time
- To keep arrangements for ice
- The fish should be caught so as to be able to sell the fish as soon as the market opens

Production: if the water body is seasonal, then within 6-7 months, it is possible to get a production of 10-15 kg per decimal or mola, darkina and carps.

Advice:

- Large sized fingerlings should be used in restocking
- Water should be kept green with the continuous application of organic and inorganic fertilizer
- Regular supplementary should be given for stocked fish
- Pond embankment should be kept high so that fish cannot get out
- Fish should sampled by netting to monitor fish health
- Water quality should be monitored at all times

Marketing fish:

The first consideration in marketing fish is that the fish quality should be maintained and for this to be ensured, all steps should be taken such as ice for the fish, storing in clean container, proper transport etc.

Main objective of fish culture in household-based ponds is to meet nutritional requirements of the household. Therefore the farmers should keep the mola/darkina fish for their own consumption.

Common problems in fish culture and the solutions

Seasonal risks in fish culture:

There are seasonal risks in fish culture and if these are not managed properly and timely then extensive damage might be caused in fish culture, such that there might be total loss and fish culture might have to be stopped:

- 1. Risks in the rainy season:** During rainy season, the main risk is of flooding and damage to pond banks as a result of heavy rains. Fish as a result escape from the pond. At this time it is advisable to harvest and market fish as much as possible to minimize loss.
- 2. Risks in the dry season:** In the dry season the water level falls, causing the water to heat up quickly and also cause a shortage of oxygen as a result of which fish might die. Before this situation is created, marketable fish should be harvested and sold.
- 3. Risks in the dry season:** Since the 80's there is an outbreak of the Epizootic ulcerative syndrome of fish in Bangladesh mainly during November –December. If the fish population in the pond is high then the probability of this disease is also high and so during this time marketable fish should be harvested as much as possible to reduce loss and prevent spread of disease.
- 4. Theft:** This is a common social problem especially when there are large fish in the pond. This risk can be reduced by harvesting the fish as soon as they are big enough to be marketed or eaten.

Oxygen depletion and fish gulping for air

Symptoms:

- Fish float near surface of water in early morning and gulp for air
- Fish float lethargically at water surface
- If the shortage of oxygen is extreme, then fish start to die and dead fish have their mouths open
- Mollusks and crustaceans gather at the pond edges

Remedy:

- Create current in the water so as to aerate it
- Set a water pump by the pond and pump water into the pond
- Oxygen creating chemicals are easily available in the market which in prescribed amount should dissolved in water and scattered over the pond.

Thick green layer on pond surface

Symptoms:

- Water surface has a thick layer of green algae
- Fish come to the surface and gulp for air

Remedy:

- Application of supplementary feed and fertilizer should be stopped
- If necessary, water should be changed
- One kg of lime per decimal should applied
- Can biologically control the green algae by releasing silver carp

Thick red layer on pond surface

Excessive amounts of iron or euglena type of algae makes the water layer red

Remedy:

- Draw a bundle of paddy straw or banana leaves across the water surface and use these to remove the red algae from the top
- 100-125 gm of urea to be scattered per decimal of water.
- Potash alum at the rate of 100 gm per decimal can be applied to the water to reduce the red bloom

Water sedimentation

Water sedimentation is a major problem for fish culture. Water is made murky or cloudy because of floating debris or fine soil particles. Also rain water makes pond water misty as a result, sun rays cannot penetrate the pond water impeding photosynthesis and the production of natural food. Murky waters cause damage to fish gills.

Remedy:

- Application of 1-2 kg burnt lime or 1.5-2 kg gypsum per decimal
- Application of potash alum 250 gm/decimal can be applied to clarify the water
- By immersing a one-kg straw bundle per decimal, water sedimentation may be lessened.
- Pond banks should be repaired properly, so that when it rains the banks do not disintegrate and the soil does not get washed into the pond.
- Daily application of 4-5 kg of ashes helps clear the water in a few days

Fish floating on pond surface:

Sometimes after rains, fish float on pond surface gulping for air. This is as a result of fall in the pH and production of hydrogen sulphide which is detrimental i.e. making the waters acidic and toxic

Remedy:

- After rains water pH should be measured
- After rains, 75-80 gm of burnt lime/dolomite per decimal should be applied.

DISEASES AND HEALTH MANAGEMENT OF FISH

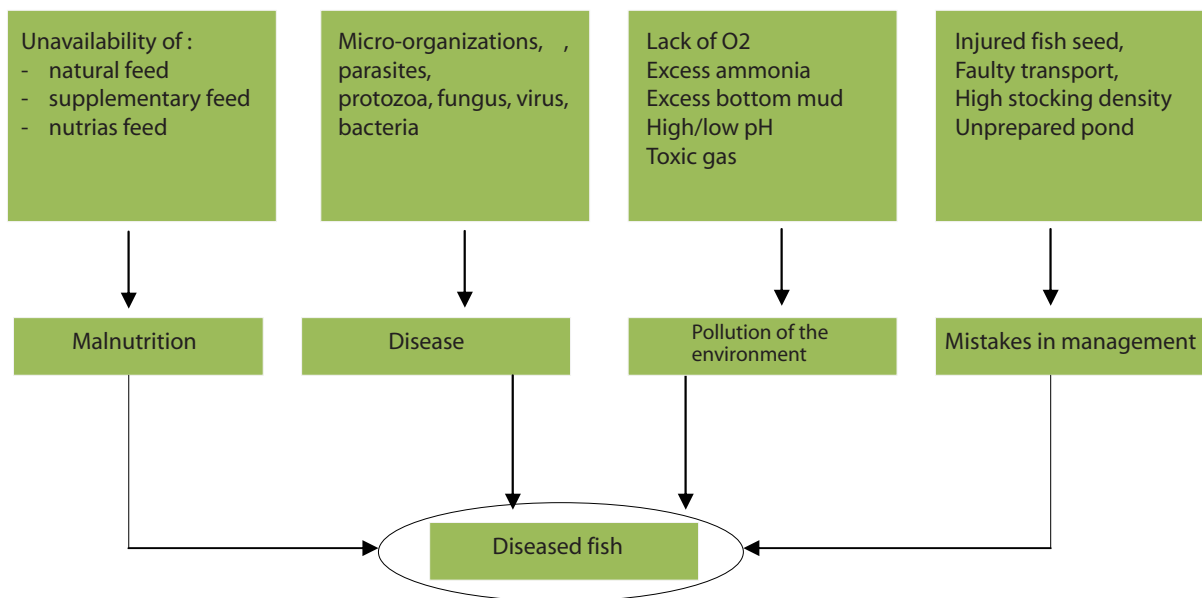
Disease is a manifestation of ill health or condition of a body. Fish may be attacked or infested by other animals resulting in diseased state. Every year, many fish farmers incur huge losses in fish culture due to ignorance or lack of knowledge about diseases and their management and the country is deprived of millions of taka in production.

Causes of diseases:

As a result of stress on water environment and presence of germs which affect the fish's immune system, diseases are triggered. There are various factors that contribute to fish diseases. The main reasons contributing to fish diseases that have been identified so far include:

- Degradation of water's physical and chemical composition: temperature, waste matter, pH, dissolved oxygen, ammonia, hydrogen sulphide etc
- Application of excessive feed and fertilizer
- Pollution by gases and water from outside the pond
- High stocking density
- Insufficient nutrition
- Faulty handling and transport
- Infestation by parasites and germs

The flow chart below shows how fish become diseased:



There is a close relation between the causes of fish diseases and fish kill. It has been observed that when water is polluted, the rate at which fish die is comparatively less when compared causes such as germs, and insufficient nutrition.

Common indicators of diseases in fish:

Depending on the type of disease, and disease-causing agent or parasitic infection, fish manifest various types of symptoms. The most common indications of a diseased fish are:

- Loses balance and swims in the water in a haphazard manner
- Body loses its glossy shine
- Feeding is reduced or even stopped

- Float in water and gulp for air
- Gills normal color changes
- There are red/black/white marks on body of fish
- Body is not slippery, instead becomes rough
- Fish rubs its body against object at the bottom of pond
- Eyes become swollen, even distended from the socket

Common Diseases of Fish:

The treatment of fish diseases is a complex and costly matter because identification of disease and treating each fish separately is not possible. Nevertheless if the fish become ill, it becomes imperative to treat them. Following are some common diseases and their remedial management:

1. Epizootic ulcerative syndrome

Symptoms:

- Initially small red marks are seen on fish body
- The red marks gradually become large deep sores
- The tail, fins and operculum of the fish show signs of decomposition
- Fish stop eating and subsequently start to die

Remedy:

- Disinfect the pond before stocking
- In a diseased pond, apply 1 kg of lime per decimal and an equal amount of salt
- With every kg of food, mix 1-2 gm of oxytetracycline and feed this for 5-7 days

2. ail and fin/gill rot disease: this disease is usually caused by Aeromonas sp and Mixo sp bacteria

Symptoms

- Body color of fish becomes indistinct
- Body becomes rough
- Initially red marks are seen on the body
- The fin joints become torn and start to decay before falling off

Remedy

- Start with cutting off the rotting pieces of fin and washing the fish in 2.5% salt solution
- One minute bath in 2-4 ppm potassium permanganate solution
- 1 kg lime + 1 kg salt per decimal should be applied

Prevention

Application of 1 kg lime per decimal in the pond

3. Dropsy

This disease is as a result of bacterial infection in the fish. This is seen mostly in carps and catfishes and mostly occurs during summer

Symptoms:

- Water accumulates in the stomach and under the scales
- Fish stomach becomes swollen and looks like a balloon

- Ulcers on the body, and bowels becomes swollen, also scales become loose

Remedy

In every kilogram of feed mix 250 mg of oxytetracycline and feed for 4-7 days
For every 400 gm of fish weight, give 3 mg oxytetracycline injection

Prevention

Reduce amount of organic fertilizer and apply 1 kg lime per decimal

4. Argulosis

This disease is caused by infestation of fish by fish lice – Argulus sp. This louse attacks the fins and scales. This is prevalent during summer and rainy season

Symptoms:

- Fish run around in a wild manner
- Parasites can be seen with naked eyes, and the fish rubs its body against hard objects
- Various parts of the body has red lesions

Remedy:

- Make a solution of 200 gm salt in 10 liters of water and bathe the fish in this solution
- Apply 6-12 gm/decimal/ft to the pond for four weeks
- Apply 2-3 ml/decimal/ft Sumithin to the pond for 3 weeks

Prevention:

- Application of one kg lime per decimal
- Not to use net used in a diseased pond in other ponds

5. Disease due to malnutrition

When there is lack of mineral salts and vitamin, fish exhibit various kinds of symptoms

Symptoms:

- Body become bent and so does the tail

Remedy:

- There is no remedy for bent body and tail

Prevention:

- Proper application of supplementary feed, mineral salts and vitamin-enriched feed

Prevention of fish diseases

Taking into consideration the socio economic status of poor and marginalized farmers in Bangladesh, it is difficult for them to take remedial measures when fish become diseased since these are quite expensive and therefore they need to take preventive measures seriously. Disease prevention should be a part of the fish culture management from the beginning. If the steps given below are taken, then treatment of diseases may not be required:

- Ensure sufficient sunlight in the pond environment
- Dewater the pond and apply lime periodically
- Do not over-stock pond
- Be careful to prevent entry of unwanted fauna and flora from outside
- Not have excessive mud at bottom of pond
- Apply fertilizer and feed in prescribed amounts
- Not to frequently net fish from the pond and to prevent sedimentation

Appropriate fish for culture in rural household based ponds

Like polyculture of carps, household-based ponds can also be used to carry out monoculture of fish which can both meet family nutritional needs as well as increase income. The pre-stocking preparation of ponds is the same and monoculture can be carried out in case of other fish species. In monoculture, the stocking density may be higher. Description of monoculture of different fish species is given below:

1. Tilapia culture: After pond preparation, tilapia fish seed should be stocked after the water takes on a greenish or brownish color. 80- 100 pieces of 2-3 inch gift tilapia fingerlings of both sexes should be stocked per decimal – this will give good result .

Application of supplementary feed: From the day after stocking, based on total fish weight 4-6 percent rice bran should be given. After the fish grow a little big, all types of food can be given such as kitchen waste (vegetable parts not consumed) cut into small pieces.

Harvest of fish seed: Gift tilapia breed quickly in closed water bodies and can reproduce within three months. The fish seed quantity becomes so much that pond fills up and therefore these fish seed need to be netted and either sold or thrown away.

Harvest of fish: Within 5-6 months fish become 150-250 gm which are caught using seine net

2. Raj puti/ Thai shorputi: This fish has high productivity and is very tasty. Within 5-6 months, these fish can grow to 150-250 gm weight and can be cultured in any type of water body. Pond preparation: is similar to preparation for seasonal ponds.

Stocking: Fish seed should be stocked after the water takes on a greenish or brownish color. 70-80 pieces of 1.5-2 inch fingerlings should be stocked per decimal.

Supplementary feed: From the day after stocking, based on total fish biomass 4-6 percent rice bran should be given. Duckweed and soft grass are favorite food of these fish and so along with rice bran, supplying the pond with duckweed will give good results also every 16 days, 2kg cow manure per decimal should be scattered over the pond. The manure has to be decomposed properly for 5-6 days before application.

Harvest: If the described process is followed, the fish will have grown to 150-200 gm size in 5-6 months and should be netted.

3. Bangladeshi catfish (Clarias batrachus and Heteropneustes fossilis) Culture:

Commercial culture of indigenous catfish is yet to start in Bangladesh on a large scale. Some research has been done. For the farmers who are interested in culturing catfish, the process is described here. Magur and singh can be cultured in all types of water bodies small and large. Since these fish can also breathe in air, there are fewer problems to be faced in their culture. Currently a small amount of catfish seed are being produced by hatcheries and it can be expected that in the future their availability will increase.

Pond preparation: The pond should be dewatered and all fish harvested or if dewatering is not possible, all fish and other animals should be killed using rotenone (25-30 gm/decimal/foot depth). If there are any predatory fishes, they will eat up the fish seed of catfish that are released into the pond.

Lime application: Apply 1-1.5 kg of lime after the pond has been dewatered.

Fertilizer application: 7-10 days after applying lime, for every decimal apply 5-7 kg of cow manure, 100-150 urea, 50-75 gm PSP, 20-25 gm of MP.

Stocking: Release fish fingerling of 1.5-2.5 inches length. For every decimal stock 100-150 pieces which is 1000-1500 per acre.

Application of supplementary feed: Supplementary feed for catfish (*C. batracus* and *H. fossilis*) fish fingerlings consists of 40% rice bran, 30% oilcake and 30% dried fish which are all mixed in bowl and made into balls before giving to the fish. If these are fed as pellets after being made in a pellet making machine, the fish will feed and grow better. Also mollusks can also be given as feed

Rate of application of supplementary feed: Feed should be given 5-10% of the fish biomass that has been stocked

Harvesting and marketing: Both *C. batracus* and *H. fossilis* can be harvested when they are about 100 gm and these fish should be sold live otherwise they will not fetch a good price.

GROUP SESSION PLANNING

Day -02

Time- 10.00 am

Duration – 30 minutes

- Target group : Women famers of Household based pond aquaculture and homestead gardening
- Title of session : Revision of previous day's session
- Aim : Participants will narrate and discuss previous day's sessions, express their opinions so that previous day's discussion are recalled and an gaps in understanding resolved.
- Objective : At the end of this session, the participants -
- Will be able to come to a common understanding on previous day's sessions through discussion

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and asking about participants welfare 2. Discussion about previous session 3. Linking previous session's topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		22 minutes
<ul style="list-style-type: none"> • One participant will review previous day's session through discussion • Everyone's opinion taken on previous day's session 	Q&A , Lecture and Flipcharts	
Summary		3 minutes
<ol style="list-style-type: none"> 1. Summary discussion of main topic 2. Assessment of session objectives 	Q&A	

Discussion and link up to the next session

Supporting Training Material  flipchart, white board and marker

GROUP SESSION PLANNING

Day -02

Time- 10.30 am

Duration – 30 minutes

Target group : Women famers of Household based pond aquaculture and homestead gardening

Title of session : Overall knowledge of rural household-centered vegetable gardening

Aim : To give an overall understanding about rural household- centered vegetable gardening to the women farmers so that they can perceive the importance and benefits of these activities in meeting requirements of family nutrition and also economic benefit.

Objective : At the end of this session, the participants -

- Will be able to narrate the importance of cultivating vegetables around household area
- Will be able to describe the advantages and obstacles in cultivation of household-based vegetable gardening
- Will know management practices of vegetable gardening in household area and the use of household resources
- Will be able identify the role of women in household-based vegetable gardening
- Selection of vegetables based on specific criteria for cultivation and main issues in vegetables gardening around the household area
- Will have the capacity to carry out vegetable gardening in their household area
- Will be able to distribute and market vegetables

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and asking about participants welfare 2. Discussion about previous session 3. Linking previous session's topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		50 minutes
<ul style="list-style-type: none"> • The importance of cultivating vegetables around household area • The use of household resources in the management practices of vegetable gardening in household area • Selection of vegetables based on specific criteria for cultivation and main issues in vegetables gardening around the household area • The management practices in household-based vegetable gardening • Harvest and distribution of the vegetables 	Q&A , Lecture and Flipcharts	
Summary		5 minutes
<ol style="list-style-type: none"> 1. Summary discussion of main topic 2. Assessment of session objectives 3. Distribution of handouts 	Q&A	

Discussion and link up to the next session

Supporting Training Material flipchart, white board and marker

Flip chart design

Overall knowledge of rural household-centered vegetable gardening

The importance of cultivating vegetables around household area in order to contribute to meeting nutritional needs of the family as well as family income

The use of household resources and the role of women in the management practices of vegetable gardening in household area

Selection of vegetables based on specific criteria for cultivation and main issues in vegetables gardening around the household area

The management practices in household-based vegetable gardening

Harvest and distribution of the vegetables

Cultivating Vegetables around Household Area to Contribute to Meeting Nutritional Needs of the Family and Family Income

1.5 million metric tons of vegetables are produced annually in Bangladesh. The requirement of Bangladesh's population for vegetable is 3.5 million metric tons and so there is a huge gap in the country's needs. According to nutritionists, an adult on average requires 200-250 gm but based on the amount of vegetables produced in Bangladesh, on average an adult person gets only 80-100 gm of vegetables in his daily diet. As a result of not eating enough vegetables, many people suffer from malnutrition. Because of lack of many nutrients in the daily diet, diseases such as night blindness, anemia, sores in the mouth, scurvy, beriberi, thyroiditis etc. To solve this, vegetable production needs



চিত্র: বাড়ির আঙ্গিনায় সবজি চাষ

to increase and change people's behavior to want to consume more vegetables. Bangladesh has 17,500,000 rural households and most of these households are unplanned and not productively used, but if these households were to use their resources appropriately, every household would be able to meet their nutritional requirements by growing vegetables as well as contribute to household income.

Vegetable garden in households

Vegetables grown in a planned way utilizing rural homestead area and resources can reap a variety of crops throughout the year

Advantages of vegetable cultivation in homesteads

- The minimum area required to grow vegetables is found in most homesteads
- Even if the area available for growing vegetables is not enough, by vertical expansion, vegetables can still be grown
- Homestead area is usually high and therefore during the rainy season there is no water logging enabling vegetable cultivation
- All family members can work within homestead area
- After meeting family's requirements for vegetables, some can also be sold thus contributing to increasing family income
- 3-4 crops can be grown since most vegetables are short-duration crops
- Daily family requirements for vegetables can be addressed and help reduce malnutrition

Obstacles/challenges in vegetable gardening in homesteads

- Waterlogged homesteads (usually for two months in the south)
- Salinity – especially in the south from July to November and even more during March-April
- Drought - especially in the north
- Limited availability of quality seeds
- Limited availability of quality vegetable varieties – i.e. those that stand drought or salinity
- Lack of skills
- Lack of awareness
- Dependence on season
- Low market price

Criteria for election of high-value vegetables crops for cultivation on homesteads

Agricultural productivity in Bangladesh varies from area to area depending on the quality of soil and water. In the south, crops grow poorly because of the salinity in the soil and water. In the north drought affects growth of crops. Also according to seasonal availability, some crops fetch high prices while

others do not. For example during August-September, market price for chili is very high. Therefore factors such as water-related risks, drought, demand according to location, economic benefit and nutritional requirement determine which high-value vegetable crop is appropriate for cultivation according to region or district, ensures the participation of women in this activity, contributes to household income and helps meet nutritional requirements.

Production according to season: In selection of crops, criteria such as nutritional benefits and economic value should be considered together to determine which crop is appropriate to cultivate in a given season for example chili demand and price is very high during August-September and is a crop that can be cultivated on the homestead. Summarily the criteria for selection are:

- Season of production:
- Nutritional value
- Market price
- Market demand

The taste of fresh vegetables is extremely good. Fresh vegetables have high nutritional value and get high price. To eat insecticide/pesticide free vegetables, grow these on pond banks.

And also

- Soil structure
- Resistance to drought
- Economic profit
- Salinity of soil
- Process of cultivation (to decrease the effect of salinity, pumpkin-type vegetables are grown in pits)

Criteria for selection of vegetables to cultivate on pond banks

- Type of bank
- Sunlight
- Soil quality
- Market price
- Farmer's economic ability
- cultivation of vegetables from the same flora family

Preparation of land for vegetable cultivation on homestead

Type of vegetable cultivation in homesteads

1. Bed-type garden of a given size
2. Pit-type randomly placed all over the homestead

Selection for location for vegetable cultivation

- Depending of the availability of land, it may be in front, behind or side of the house
- Open space where there is sunlight
- Near water source
- Should not get water logged during rainy weather
- Should not be damp and shady
- Preferable if soil is loamy or loamy sandy

Bed preparation in appropriate locations around the rural household

Appropriate space	Rabi (winter) October - March	Kharif 1 (summer) mid April - June	Kharif 2 (summer) July -September
Pond embankment and bank	Tomato, bottle gourd, broad beans, oranges, sweet potato, pumpkin, German turnip	Bitter gourd, wax gourd, cucumber, pumpkin, water spinach, papaya	Cucumber, bitter gourd, wax gourd, water spinach
Roof of house and fruitless plants	broad beans, pumpkin	Wax gourd, pumpkin	Wax gourd, pumpkin
Scattered plots on the homestead that can be used for cultivation	Carrots, orange sweet potato, tomato, broad beans, bottle gourd, winter spinach, red spinach, pumpkin, chili	Water spinach, chili, red spinach, lady's fingers, pumpkin, wax gourd, bottle gourd, papaya	Malabar spinach, water spinach, red spinach, wax gourd, bottle gourd

Vegetables that grow on beds: Tomato, oranges, sweet potato, German turnip, water spinach, carrots, red spinach, English spinach, chili, lady's fingers, Malabar spinach etc

Bed size and preparation: Size should be 4 ft x 10 ft depending on shape of homestead area. The space between two beds should be 0.75 – 1 ft so that there is space to walk between the beds. The beds should be prepared so that they get equal amount of sunlight. 6 inches of topsoil should be hoed and sorted of weeds, roots of other plants, stones and larger blocks of earth. Finally the top soil should be evened. For every bed measuring 4ft x 10 ft, 40 kg organic fertilizer (manure) and 500 to 700 gm of urea, TSP and MP fertilizer should be applied evenly and mixed well with the soil.



১ ফুট ৪ ফুট ১ ফুট

Application of fertilizer to the bed

Rate of application of manure/compost, urea, TSP and MP are:

- Organic fertilizer: 15-20 kg/decimal
 - TSP: 500-800 gm per decimal
 - MP: 500-800 gm per decimal (in two parts)
 - Urea: 1 kg/decimal (in three parts)
- The amount of manure and TSP required for a crop should be applied before planting seeds/seedlings. Half of the MP fertilizer required should be given at time of bed preparation and other half 15-20 after planting seed/seedlings
 - One third of the urea fertilizer required is applied with other fertilizers at time of bed preparation. The other two –thirds are given additionally in two parts later.

Preparing pit:

Where there limitations in household area, crops that grow on pit can be constructed in small spaces where there is sunlight. These plants include Broad beans, bitter gourd, ash gourd, and bottle gourd. These plants can grow on a pit or just simply on a bamboo stick erected next to the plant.

Size of pit:

Bottle gourd, sweet pumpkin: 1 hand x 1 hand x 1 hand
Ridged gourd, snake gourd, cucumber, bottler gourd – 15 inches x 15 inches x 15 inches
Broad beans: 1.5 ft x 1.5 ft x 1.5 ft



চিত্র: মাদায় চারা রোপণ

Distance between two pits:

Bottle gourd, sweet pumpkin: 4.5 hands

Ridged gourd, snake gourd, cucumber, bottle gourd – 3.5 hands

Broad beans: 5 ft

Application of fertilizer for crops growing on pit

Fertilizer	Fertilizer per pit				
	7-10 days after planting seedling	10-15 days after planting seedling	30-35 days after planting seedling	50-55 days after planting seedling	70-75 days after planting seedling
Organic manure	10 kg	-			
TSP	100 gm	-	-	-	-
Urea	-	25 gm	25 gm	25 gm	25 gm
MOP	40 gm	20 gm	-	-	-
Gypsum	15 gm	-	-	-	-
Zinc	10 gm	-	-	-	-
Borax	10 gm	-	-	-	-

Management practices of vegetable cultivation in rural households

The modern management practice in vegetable cultivation around rural households starts from planting the seeds/seedlings to harvest of the crops.

The steps in crop management are:

1. Mulching
2. Arranging shade
3. Irrigation
4. Weeding
5. Loosening the soil
6. Thinning the number of seedlings
7. Application of additional fertilizers
8. Filling up the empty spaces
9. Placing earth around base of plant
10. Placing sticks for support
11. Building pit
12. Trimming and thinning number of fruits
13. Fertilization
14. Pest management
15. Disease management

The steps above are discussed in short below:

Mulching:

Covering the crop bed or base of a plant with rotting hyacinth, dry grass and other vegetation is known as mulching. Amount of mulch is about 1-2 inches. Mulching helps the soil to improve its water-retention, can absorb water better and enable aeration of the soil, reduces soil erosion, produces organic fertilizer, increases budding of the plant and its ability to absorb nutrients from the soil also improves. Sometime ants and termites make nests in mulch so this needs to be turned over time to time.

Shade for plants:

Just after planting seedling, sunlight or rain might kill the seedling and therefore it needs some protection in form of shade which can be made from banana leaf twisted into a cone.

Irrigation:

Water is extremely important for vegetable cultivation and so just after planting seedling or seeds, water has to be given daily. The soil needs to be kept moist, not water logged and so the water can be given using a small bucket. After giving additional fertilizer, watering is a must. In most cases plants are irrigated 5-7 times.

Weed control:

Weeds are plants' biggest enemies. To get good production from vegetable cultivation, the crop beds should always be weed free. From time of planting for about 40-50 days, the crop beds should be weeded regularly. Good time to weed is in the early morning and then the weeds dry up.

Loosening the soil:

The earth around vegetable crops should be kept loose and soft. After rains or watering, the soil usually clumps and becomes hard, this should be loosened using tools such as hoes, sickle etc.

Thinning seedlings:

It is not always possible to maintain prescribed spacing between plants especially when they grow from seeds. 8-10 after seeds have been planted, the seedlings that grown need to be sorted to keep the healthy ones and throw away the weak ones and also ensure there is enough spacing between the plants.

Application of additional fertilizer:

The recommended application of fertilizer during vegetable cultivation should be given and after application of fertilizer, the soil should be irrigated.

Pit/frame/pole for support:

For vine-like plants, support is required for the plants to grow quickly and various types of frames or sticks can be fixed beside the plant. These can be made from bamboo slats, jute straw, etc.

**Pruning:**

Fruiting plants sometimes do not give enough fruit. To ensure that sufficient fruit is produced, excessive branches should be pruned. Also branches and parts of plant that have been attacked by pests or disease should be cut to



avoid spread. If the upper parts of ridge gourd and dundul are pruned then more branching and more fruit can be produced. Excessive branches of tomatoes should be pruned so that the tomatoes produced are big. Old plants of lady's fingers and eggplant should be pruned so that another crop can be grown again.

Cross-fertilization:

It has been observed that on pumpkin plants, shortly after the female flower blooms it dies. When there are no bees or other insects to help with the fertilization, the female flower withers away. The cross fertilization therefore has to be carried out artificially. In the evening or morning, a freshly

bloomed male flower should be taken and petals removed keeping the stamens intact which should then be touched with the female flower 2-3 times to ensure that fertilization will be successful. One male flower can be used to fertilize 8-10 female flowers.

**Pest and disease management:**

Diseases and pest are serious enemies of plants. If plants are not kept diseases and pest free then productivity will be poor. To manage this, instead of using chemical pesticides it is better to prevent using physical control e.g. proper cultivation methods used, keeping the land clean, mechanical control e.g. pruning off parts of plant that are diseased, biological control e.g. using beneficial insects to control pests.

Various methods of vegetable cultivation in rural households

Name of vegetable	variety	Planting time for seed and seedling	Seed/seedling gaps (ft/inch)	Seed rate per decimal	Crop growth duration/period (days)	Produce kg/decimal
1. Red spinach	High quality variety	Any time of the year	Row to row: 5to 6 inches Plant to plant: 5-6 inches	4-5 gm	20	80- 100
2. Winter spinach	High quality variety	September - January	Row to row: 5to 6 inches Plant to plant: 5 to 6 inches	120-150 gm	30-35	110-120
3. Water spinach	Gima kalmi	Any time of the year but best from March to April	Row to row: 10to 11 inches Plant to plant: 5 to 6 inches	50 gm	90-100	150-180
4. Orange sweet potato	BARI SP- 4, BARI SP-7, BARI SP-8	1-15 November	Row to row: 2ft Plant to plant: one ft	220-230 vines	120-135	120-140
5. Malabar spinach	BARI Malabar spinach – 1(chitra) BARI Malabar spinach –2 , High quality variety	Any time of the year but best from February to August	Row to row: 1 ft 6 inches Plant to plant: 1 ft after thinning	15-20 gm In every hole 3-4 seeds	60-120	180-225
6. Bottle gourd	BARI 1 – winter BARI – 2 – winter and summer High quality variety	August – October and March - April	Row to row: 10 ft Plant to plant: 1 ft Pit to pit 10 ft Pit size: 21x21x18 inches	20-25 gm	140-185	140
7. Wax gourd	BARI wax gourd -1, High quality variety	February - May	Row to row: 8 foot Pit to pit 8 ft	15-20 gm	120-130	80-100
8. Cucumber	High quality variety	March to April	Row to row: 2m Plant to plant: 1.5 m Pit size: 60x60x50	2-3 gm 4-5 seeds per pit	after sowing seeds 70-80 days	40-60
9. Pumpkin	High quality variety	December-February; all-year round in all seasons	Row to row: 1.5m Plant to plant: 1.5 m Pit size: 50x50x50	3-4 gm 4-5 seeds per pit	100-120	80-100
10. German turnip	High quality variety	Planting seeds – August Planting seedlings:	Row to row: 25-30 Plant to plant: 15-20	3-4 gm 230-260 seedlings	After planting seedlings 45-60 days	70-100
11. Bitter gourd	Local and High quality variety	February – May	Row to row: 1m Plant to plant: 1 m Pit size: 45x45x30	25 gm 4-5 seeds / pit	After sowing seeds 50-60 days	20-25
12. Tomato	Local and High quality variety	September - October	Row to row: 60-80 Plant to plant: 45-50	1.5 gm/90-100 seedlings	After planting seedlings 70-90 days, After sowing seeds 100-120 days	70-100
13. Broad beans	BARI broad beans – 1, BARI broad beans -2, 12 monthly IPSA-1 Purple IPSA -2, High quality variety	Middle of January	Row to row: 6.5ft Plant to plant: 6.5 ft	40-50 gm	Advance: 130-150 days and nabi- 150-200 days	85
14. Chili	High quality variety	September – October/ February - March	Row to row: 15 inches Plant to plant: 15 inches	12 gm	120-130	80
15. Lady's fingers	BARI -1 and High quality variety	All year round but best during February -May	Row to row: 2ft Plant to plant: 1.6 ft	25-30 gm	80-100	80-120
16. Carrots	High quality variety	October - December	Row to row: 1.5ft Plant to plant: 1 ft	15 gm	After planting seedlings 70-120 days	60-100

17. Papaya	High quality variety	All year round but best when seedlings are planted march to April	Row to row: 6.5ft Plant to plant: 6.5 ft Pit: 2ftx 2ft	15 trees	9-10 months for fruit	450-600
------------	----------------------	---	--	----------	-----------------------	---------

Hanging cultivation method of plants:

In households where there is limited space or the soil is damp, saline and clogged, the hanging method of cultivation can be used to cultivate vegetables. Holed bamboo pole pieces are erected vertically or horizontally to create two or more layers above the earth and filled with loamy sandy soil, organic matter and these are then planted with plants that have roots such as chili, Malabar spinach, broad beans, water spinach

Main diseases and pests of vegetable crops and their management

Name of pest	Name of vegetable	Type of injury	Control management
<i>Jab poka</i>	Broad beans, bottle gourd, cabbage, pumpkin, cucumber	Feeds on flower and fruit juice. Fruit and flower fall to the ground	Organic pesticides such as neem oil and tobacco. - Make a paste of 20 ml neem oil + 60 gm soap powder and dissolve this with 10 liters of water. This mixture should be sprayed using a spray machine. - Tobacco powder should be soaked in water overnight and then sieved- the water should be used to spray the affected plants - Dissolve 10 ml of Malathion-57 EC or Admire-200 in every 10 liters of water and spray
Fruit-boring insect	Broad beans, tomato	Nisfa/krira fruit sre bored and centre eaten causing the fruit to fall of tree	By pruning affected fruits and burying them in soil helps control the disease somewhat. And when the attack is severe, 10 ml of lebacid-50 EC or sevin-85 should dissolved in 10 liters of water and sprayed
Fruit fly	Bottle gourd, pumpkin, wax gourd, and other gourds	Fruit rot while still in green/unripe and fall off tree	Poison trap: 100 gm of pumpkin diced or mashed and mixed with 0.25 gm mypsin or sevin 85 + 100 ml water should all be mixed together and placed in a clay pot. The clay pot should be placed 1.5 feet above the ground near the affected plants and renewed 3-4 days later. Sex pheromone: either poison traps or sex pheromones should be placed among crops with 13 yard gap to help in pest control.
Red pumpkin beetle	Bottle gourd. Pumpkin, cucumber, bitter gourd, ridge gourd, teasle gourd	Bores thru matured or old roots from beneath the ground through to the stem. Plant thus bends over, dries up and dies	Up until the seedings are 20-25 days old, they should be protected by mosquito netting. The rate of attack is high then after planting the seedlings, the earth around the pit should be mixed with 2-5 gm of carbofuran and watered to ensure the chemical is well-mixed
White fly	Lady's fingers, tomato, brinjal	Spread viral diseases	Dissolve 10 ml of Malathion-57 EC or Admire-200 in every 10 liters of water and spray on the underside of leaves

Main diseases and pests of vegetable crops and their management

Virus	Broad beans, tomato, papaya	Papaya leaves take on a green-yellow mosaic look. Broad beans and tomato leaves stop growing and curl up	White fly is a virus carrier and so that his fly does not come near crops every 7-10 days from the time seedlings are planted use organic pesticides. Remove infested plant far from the crops. Also every 15 days 1 ml of dimecron mixed per liter water should be sprayed. Neem oil can also be used.
Root and stem rot	Lady's fingers, pumpkin, ridge gourd	Lower stem of seedling rots and seedling dies	Irrigation should be reduced. 10 gm of Diethon M-50/Rovral-50 WP/ Entral-70 WP should be dissolved with 10 liters of waters and sprayed every 7-10 days 2-3 times around the lower part of the stem.
Anthrnose	Chili, broad beans	Whichever part of the plant is attacks, the part bursts and fruits fall off	Diseased and dead plants should cleared from the crop cultivation area. 20 gm of Diethon M-45/redomil gold/ mencozeb group of fungicide Entral-70 WP should be dissolved with 10 liters of waters and sprayed every 7-10 days 2-3 times on the diseased plants
Leaf spot disease	Broad beans, string beans and Malabar spinach	Leaves have round and watery-looking marks, which come together and make big round marks	20 gm of Diethon M-45/redomil gold/ mencozeb group of fungicide Entral-70 WP should be dissolved with 10 liters of waters and sprayed every 7-10 days 2-3 times on the diseased plants

Nutrition and production plan of orange sweet potato

Oranges sweet potato is a carotene-rich and tasty tuber vegetable. By cultivating orange sweet potato around the homestead, this vegetable can contribute to reducing Vitamin A deficiency among household members. The young buds and leaves of this plant are also very nutritious and tasty which can help to meet nutritional requirements of the family. This is a drought tolerant crop that the women of the household can easily cultivate on the homestead.

Production plan:

Soil and water:

The soil should be of sandy- loamy quality and well-drained in a sunny part of the homestead for cultivation of the orange sweet potato.

Cultivation process:

The soil (wet) should be hoed diagonally in 5-6 lines to prepare the crop bed. After which prescribed fertilizer should be applied and within 1-15 November sweet potato vine cuttings should be planted in 1st, 2nd and 3rd rows, two thirds of the vine cuttings should be below soil and one third above the soil – planting in this manner gives good production. Each cutting should be 10-12 inches long and planted one ft apart along a row while each row is 2 ft apart. In this way per decimal land requires 220-240 cuttings of sweet potato.



চিত্র: ফল সহ কমলা মিষ্টি আলু

Amount and process of application of fertilizer per decimal:

Before the final plough in land preparation, 40 kg organic manure, 550-650 gm, 300-375 gm MP. 14-15 days after planting the vine cuttings, a further 280-325 gm urea and again the same amount 30-35 days from planting.

Management during culture period:

Depending on soil moisture, the bed needs to be irrigated 2-3 times. 1st time 30-35 days after planting and 2nd time at 60-65 days after planting on even land, the earth needs to be raised 6 inches like dykes at 14-15 days and 30-40 days after planting. Excess water needs to be drained.

Disease/pest control management:

Usually there is little attack of disease on this plant in Bangladesh. However to control the pest - sweet potato weevil, one ml dimecron/benicron insecticide should be dissolved per liter of water in which the cutting should be dipped for 20 minutes. If weevil attack is observed after planting then 8 gm diazone-14G, carbofuran-5G should be sprinkled lightly and crop bed irrigated. Other sweet potato diseases include blackish disease and soft rot are the most common. If attacked by -blackish disease then 1 ml diethane or rodomil MZ in one liter water should be sprayed. If soft-rot is observed then the potatoes should be harvested and good pieces sorted from the rotting ones and cured.

Crop harvest and production: On average per decimal 120-140 kg

GROUP SESSION PLANNING

Day -02 **Time- 11.30 am** **Duration – 30 minutes**

- Target group** : Women famers of Household based pond aquaculture and homestead gardening
- Title of session** : Cultivation of vegetables on pond banks and embankments in rural households, the potential production of the vegetable, cost-benefit analysis and preservation of information
- Aim** : Participants will know about the potential production of vegetables on pond banks and embankment, the cost benefit analysis and how to maintain this information and thus be motivated to undertake this activity.
- Objective** : At the end of this session, the participants -
- Will be able to dispel any gaps in understanding an come to a common understanding on previous day's sessions through discussion
 - Will be able to do cost –benefit analysis of fish and vegetable production
 - Will be able to collect and preserve data

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and asking about participants welfare 2. Discussion about previous session 3. Linking previous session's topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		25 minutes
<ul style="list-style-type: none"> • Cost benefit analysis of polyculture (tilapia and mixed carps) in seasonal ponds(per decimal) • Cost benefit analysis of vegetable cultivation (per decimal) • Process of preserving data 	Q&A , Lecture and Flipcharts	
Summary		3 minutes
<ol style="list-style-type: none"> 1. Summary discussion of main topic 2. Assessment of session objectives 3. Distribution of hand-outs 	Q&A	

Discussion and link up to the next session

Supporting Training Material flipchart, white board and marker , handout

POTENTIAL PRODUCTION AND COST BENEFIT ANALYSIS OF FISH CULTURE IN RURAL HOUSEHOLD BASED PONDS

Fish culture is a very profitable venture. In comparison to other agricultural activities, it can generate income in a short period and over longer period can bring high profit with little investment. Also risks in fish culture is comparatively less, even then the loss and profits depend on a number of factors:

- Experience of the farmer
- Management plan
- Price of input material
- Harvest process and time
- Type of culture
- Availability if input
- Culture period
- Marketing opportunities, weather and environmental situation

To proceed with fish culture activities the main input materials required are: lime, poison, fertilizer, fish seed/fingerling, man labor, pond repair etc. the price of these input vary according to place, season and person.. Below is given an estimate of costs required per decimal for culture of tilapia, carp, carp-catfish fish:

1. Potential production and cost benefit analysis of mixed culture of carp fish with tilapia (model 1)

	Cost item	Amount	Price Taka/kg/piece	Total cost
1	Pond preparation			
	a) repair of embankment and banks and weeding	-		Own labor
	b) rotenone (2 ft water)	50 gm	350.00	17.50
	c) lime	1 kg	15.00	15.00
	d) manure	5 kg	2.00	10.00
	e) urea	150 gm	20.00	3.00
	f) TSP	75 gm	25.00	2.00 (approx)
	g) MP	25 gm	20.00	0.50
2	Fish seed/seedling			
	Tilapia	20 pieces	1.00	20.00
	Carp-type fish	40 pieces	2.00-3.00	120.00 (3 taka per piece)
	Mola/darkina	150 gm (50 pieces)	400.00	60.00
3	Fertilizer			
	Manure (2 kg x 2 x 10 months)	40 kg	1.00	40.00
	Urea (75 gm x2 x 10 months)	1.5 kg	20.00	30.00
	TSP (100gm x2 x 10 months)	2.0 kg	25.00	50.00
4	Re-stocking			
	Silver carp	10 pieces	2.00	20.00
5	Supplementary feed (mustard oilcake, auto bran)	20-25 kg	20.00	400-500.00
6	Lime	1 kg	15.00	15.00
7	Harvesting	-		20.00
8	others	-		25.00
	Total			848.00-948.00

INCOME PER DECIMAL:

Production of tilapia per decimal	: 3kg (80% survival rate and av. Weight 150-200 gm)
Production of carps per decimal	: 12-14kg (80% survival rate and av. Weight 300-350 gm)
Production of mola per decimal	: 1.5kg (approximate)
Price of fish	
Tilapia and carp fish	: 90 taka/kg x 15-17 kg = 1350-1550 taka
Mola fish	: 200 x 1.5 kg = 300 taka
Total sale price of fish	: 1650-1850 taka
Pond management cost	: 848 – 948 (almost)
Expected profit	: 802-882 taka

2. Potential production and cost benefit analysis of mixed culture of of carp fish with shorputi (model 2)

	Cost item	Amount	Price Taka/kg/piece	Total cost
1	Pond preparation			
	a) repair of embankment and banks and weeding	-		Own labor
	b) rotenone (2 ft water)	50 gm	350.00	17.50
	c) lime	1 kg	15.00	15.00
	d) manure	5 kg	2.00	10.00
	e) urea	150 gm	20.00	3.00
	f) TSP	75 gm	25.00	2.00 (approx)
	g) MP	25 gm	20.00	0.50
2	Fish seed/seedling			
	Shorputi	20 pieces	1.00	20.00
	Silver carp, catla, Ruhi, grass carp, common carp	45 pieces	2.00-3.00	135.00 (3 taka per piece)
	<i>Mola</i>	150 gm (50 pieces)	400.00	60.00
3	Fertilizer			
	Manure (2 kg x 2 x 10 months)	40 kg	2.00	80.00
	Urea (75 gm x2 x 10 months)	1.5 kg	20.00	30.00
	TSP (100gm x2 x 10 months)	2.0 kg	25.00	50.00
4	Re-stocking			
	Silver carp	10 pieces	2.00	20.00
5	Supplementary feed (mustard oilcake, auto bran)	20-25 kg	20.00	400-500.00
6	Lime	1 kg	15.00	15.00
7	Harvesting	-		20.00
8	others	-		25.00
	Total			903.00-1003.00

INCOME PER DECIMAL:

Production of shorputi per decimal : 3kg (80% survival rate and av. Weight 150-200 gm)
 Production of carps per decimal : 12-14kg (80% survival rate and av. Weight 300-350 gm)
 Production of mola per decimal : 1.5kg (approximate)

Price of fish

Tilapia and carp fish : 90 taka/kg x 15-17 kg = 1350-1550 taka

Mola fish : 200 x 1.5 kg = 300 taka

Total sale price of fish : 1650-1850 taka

Pond management cost : 900-1000 (almost)

Expected profit : 750-830 taka

3. Potential production and cost benefit analysis of mixed culture of of carp fish without tilapia and shorputi (model 3)

	Cost item	Amount	Price Taka/kg/piece	Total cost
1	Pond preparation			
	a) repair of embankment and banks and weeding	-		Own labor
	b) rotenone (2 ft water)	50 gm	350.00	17.50
	c) lime	1 kg	15.00	15.00
	d) manure	5 kg	2.00	10.00
	e) urea	150 gm	20.00	3.00
	f) TSP	75 gm	25.00	2.00 (approx)
	g) MP	25 gm	20.00	0.50
2	Fish seed/seedling			
	Silver carp, catla, Ruhi, grass carp, common carp	50 pieces	2.00-3.00	150.00 (3 taka per piece)
	<i>Mola/darkina</i>	150 gm (50 pieces)	400.00	60.00
3	Fertilizer			
	Manure (2 kg x 2 x 10 months)	40 kg	0.50	40.00
	Urea (75 gm x2 x 10 months)	1.5 kg	20.00	30.00
	TSP (100gm x2 x 10 months)	2.0 kg	25.00	50.00
4	Re-stocking			
	Silver carp	10 pieces	2.00	20.00
5	Supplementary feed (mustard oilcake, auto bran)	20 kg	20.00	400.00
6	Lime	1 kg	15.00	15.00
7	Harvesting	-		20.00
8	others	-		25.00
	Total			838.00

INCOME PER DECIMAL:

Production of carps per decimal : 12-15kg
 Price of fish : 90 taka/kg
 Total sale price of carp fish : 1080-1350 taka
 Production of mola per decimal : 1.5kg
 Price of fish : 200 taka/kg
 Total sale price of mola fish : 300 taka

Total sale price of fish : 1380-1650 taka
Pond management cost : 840 (almost)
Expected profit : 540-810 taka

Note: Investment capital has no interest and own labor cost has not been included

The cost benefit analysis might vary because of fluctuating prices of input and market price of the fish

INFORMATION PRESERVATION AND COST BENEFIT ANALYSIS OF FISH AND VEGETABLE CULTIVATION IN HOUSEHOLD BASED PONDS

Cost-benefit analysis of vegetable cultivation:

As previously discussed selection of crop for cultivation on pond banks depends on the type of pond bank. The cost-benefit analysis varies from crop to crop. Some crops have low production e.g. red spinach and water spinach while other crops are cost-intensive e.g. bitter gourd and tomato. Also the income from selling vegetables varies according to the type of crop. Below is given the cost-benefit analysis of some vegetables that can be planted on the pond banks.

1. Cost-benefit analysis of cultivation of bottle gourd/sweet pumpkin/wax gourd/bitter gourd/ cucumber (per decimal)

SI	Cost item	Amount	Taka	comments
1	Plastic/polythene thread (for pit) and bamboo	1 kg and 1 bamboo	250	
2	Land preparation	0.5 people	100	0,5 persons labor, family and also give their own labor
3	Seedling/sapling	5-20 gm	60-130	
4	Fertilizer	Urea 2 kg Tsp 1.8 kg MOP 1 kg Borax 50 gm	100	
5	Disease control and other management		100	Poison trap/ sex pheromone, other pest control
6	Irrigation	3 times	60	
	Total cost		670-740	
	Income			
1	Production	100-170kg	2000-2550	
2	Leaves and Stem	30 kg	300	
			2000-2850	
	Total profit		1330-2110	

**cost of land, organic fertilizer, and family labor have not been considered.*

2. Cost-benefit analysis of cultivation of broad beans (per decimal)

SI	Cost item	Amount	Taka	comments
1	Bamboo for vine	2 pieces	200	
2	Land preparation	0.5 persons	50	
3	Seedling/sapling	50 gm	100	
4	Fertilizer	350 gm urea 300 gm MOP 100 gm TSP 40 gm borax	30	
5	Disease control and other management		50	If required
6	Irrigation		60	
7	Others		10	
	Total cost		500	
	Income			
1	Production	90 kg	1530-1800	17-20 taka/kg
	Total profit		1030-1300	

**cost of land, organic fertilizer, and family labor have not been considered.*

3. Cost-benefit analysis of cultivation of German turnip (per decimal)

Sl	Cost item	Amount	Taka	comments
1	Land preparation	0.5 persons		
2	Seedling/sapling	250 pieces		1000 taka/kg
3	Fertilizer	0.8 – 1 kg urea 400 gm MOP 400 gm TSP 0.75 gm gypsum 20 gm zinc		
4	Disease control and other management		35	according to need
5	Irrigation	3 times	60	
6	Total cost		400	
Income				
1	Production	150 kg	1500-1800	10-12 taka/kg
	Total profit		1100-1400	

**cost of land, organic fertilizer, and family labor have not been considered.*

4. Cost-benefit analysis of cultivation of lady's fingers (per decimal)

Sl	Cost item	Amount	Taka	comments
1	Land preparation	0.5 persons	100	
2	Seeds	25 gm	40	
3	Fertilizer	600 gm urea 600 gm MOP 400 gm TSP 280 gm gypsum 80 gm boron 20 gm zinc	60	
4	Disease control and other management		40	According to need
5	Irrigation	3 times	60	
	Total cost		300	
Income				
1	Production	55 kg	825-1100	15-20 taka/kg
	Total profit		525-800	

**cost of land, organic fertilizer, and family labor have not been considered.*

5. Cost-benefit analysis of cultivation of tomato (per decimal)

Sl	Cost item	Amount	Taka	comments
1	Land preparation	0.5 persons	100	
2	Seeds	150	200	
	Plant support	3 bamboos	300	
3	Fertilizer	800 gm urea 1 kg MOP 1.8 kg TSP 50 gm borax	80	
4	Disease control and other management		100	If required
5	Irrigation		60	
	Total cost		840	
Income				
1	Production	210 kg	1680-2100	8-10 taka/kg
	Total profit	7228	840-1260	

**cost of land, organic fertilizer, and family labor have not been considered.*

6. Cost-benefit analysis of cultivation of leafy vegetables- spinach , water spinach, Malabar spinach, red spinach (per decimal)

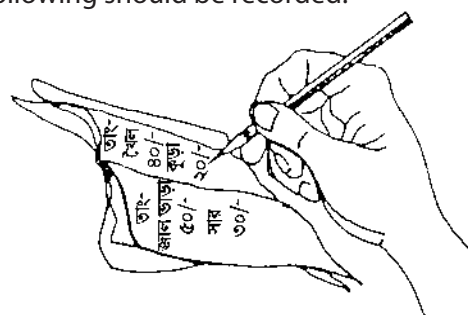
SI	Cost item	Amount	Taka	comments
1	Land preparation and planting of seedling	0.5 persons	100	
2	Fence preparation		100	
3	Seeds/seedlings	50-100 gm	20-25	
4	Fertilizer	600 gm urea 100gm MOP 300 gm TSP 50 gm borax	25	
5	Disease control and other management		-	Not easily attacked by pests or diseases
			245-250	
	Income			
	Production	80-100 kg	900-1000	10-15 taka/kg
	Total profit		655-750	

*cost of land, organic fertilizer, and family labour have not been considered.

Data Preservation

For any productive activity, it is important to maintain record in order to assess the success or failure of the activity. By maintaining records of the fish and vegetable cultivation process, cost and income, helps to determine future decision-making in culture management and planning. Therefore from start to finish of productive activity, the following should be recorded:

- Physical characteristics of the pond
- Depth of water
- Description and cost of pond preparation
- Fish seed collection/ transport/ stocking cost
- Stocking density
- Fertilizer application data – type/weight/cost
- Feed application data - type/weight/cost
- Sampling data
- Amount of fish/prawns harvested/ income etc



চিত্র- আয়-ব্যয়ের হিসাব সংরক্ষণ

There is no particular form for data collection. It is more important to be careful in correctly recording the data whatever the format may be. The farmer can record data according to her own convenient format. CSISA-BD uses a specific format for record-keeping which may be adopted or recording the items listed above can also be used by the fish farmer to keep an easy record of income and costs.

GROUP SESSION PLANNING

Day -02 **Time- 12.30 pm** **Duration – 60 minutes**

- Target group** : Women famers of Household based pond aquaculture and homestead gardening
- Title of session** : Awareness on Nutritional Requirement of families
- Aim** : To increase awareness of participants about the vitamins and nutrients available in different types of food so that they increase their consumption of these food and be able to lead a healthy life.
- Objective** : At the end of this session, the participants -
- Will be able to dispel any gaps in understanding an come to a common understanding on previous day's sessions through discussion

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and asking about participants welfare 2. Discussion about previous session 3. Linking previous session's topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		45 minutes
<ul style="list-style-type: none"> • Importance of nutritional food for the human body and reasons for malnutrition • Source and effectiveness of food and nutrients • Role of vegetables in a healthy diet and recipes • Importance of consuming nutrient-rich food, the intake amount, problems for not consuming nutritious food and solutions • Determining the amount of food to be consumed by family members according to their body requirement 	Q&A , Lecture and Flipcharts	
Summary		10 minutes
<ul style="list-style-type: none"> - Summary discussion of main topic - Assessment of session objectives - Distribution of hand-outs 	Q&A	

Discussion and link up to the next session

Supporting Training Material flipchart, white board and marker , handout

Awareness about family nutrition

Introduction

As Bangladesh's population is growing, so is the demand for food and on the other hand malnutrition is also increasing. Currently the country is taking steps to reduce the shortage in food requirements for its population and the country will become self-sufficient in production of grains such rice and wheat. However this will not solve the problem of malnutrition because the food we eat might be small in portion but also not complete in nutrition. For this reason, the people of Bangladesh suffer more from malnutrition than from shortage of food supplies.

Problems due to lack of nutrition

Every year, Bangladesh's population is growing by 4 million every year and likewise demand for food is increasing likewise and at the same time a shortage of nutritious food. People are now easily affected by disease because of malnutrition. Most scarce nutrients are vitamin A, vitamin C, iron, calcium and protein.

- Due to lack of vitamins, minerals, protein etc, people suffer from a lack of development in the ability to work and intelligence.
- Due to lack of vitamin A, every year thirty-forty thousand children are becoming blind every year
- Other diseases due to malnutrition include anemia, mouth sores, scurvy/bleeding gums, beriberi, thyroiditis etc and people being affected by these diseases are increasing everyday

The status of diseases as a result of malnutrition in Bangladesh

Substance	Current status in Bangladesh
1. Protein /Carbohydrate (national)	In comparison to age height is 50% less In comparison to age height is 57% less 30-50% babies have low birth weight at birth (Ref: HKI, NSP Annual report 2001)
2. Vitamin A	Current rate of night blindness 0.21% Mother's night blindness 0.4% (Ref: HKI, NSP Annual report 2001)
3. Iron	47% children who are under 5-years suffer from anemia 33% elderly women suffer from anemia (Ref: HKI, NSP Annual report 2001) 45% pregnant women suffer from anemia 49% breast-feeding women suffer from anemia (Ref: HKI –iron deficiency report 1999)
4. Iodine	43.1% of the total population suffer from iodine deficiency (IDD, national survey 1999) 49% suffer from thyroiditis (National survey 1993)
5. Zinc	Malnourished babies suffer from zinc deficiency
6. Breast milk	33% new born are fed colostrum (within one hour of birth) 36% babies are fed only breast milk (Breast Feeding Surveillance)

Overall causes for Malnutrition

Immediate causes

- Lack of awareness
- Insufficient food intake
- Diseases

At family level

- Insufficient food available
- Inequality in distribution of food among women, men, elders and children
- Intake of polluted water
- Lack of proper sanitation
- Unavailability/limited access to medical treatment
- Lack of care for mother and child

Social reasons

- Poverty and inequality of men and women
- Ignorance and lack of knowledge
- Population growth
- Low quality seeds and poor method of cultivation
- Technical problems in production, harvesting, processing and preservation
- Political and environmental problems

Food and Nutrition

Food is essential for survival. The substances that we get from both flora and fauna have most of the nutrients we require – protein, carbohydrate, fat, mineral salts, water, which if eaten one or more of the following actions are completed is known as food.

- Repair and development of body
- Heat and energy production
- Strengthening of the immune system and proper functioning of internal organs

For example:

Milk is an ideal food. Milk helps to complete above mentioned actions. Lemons too are food with the nutrient Vitamin C which helps to counter diseases, improve immunity and enable internal processes of the body to keep the body healthy and fit.

Food substances:

Food has many different types of chemicals which help the internal systems to function properly. Keeping in mind the various nutrient in food, these are broadly:

1. Carbohydrate
2. Protein
3. Fat
4. Vitamin
5. Mineral salts
6. Water

A food substance may have one or more nutrients. Depending on the presence of the majority nutrient, the food is labeled as that particular nutrient:

- Protein rich foods: fish, meat, milk, lentils, soya bean, nuts etc
- Carbohydrate rich foods: sugar, molasses, juice, puffed rice, flattened rice, rice, bread, wheat, flour etc
- Fat-rich foods: oil, ghee, butter, animal fat
- Vitamin and mineral rich food: green leafy and non-leafy vegetables, various types of fruits

Source of different foods and the main function of these foods

Substance	Source	Function
1. Carbohydrate	a) grains: rice, wheat, maize etc b) root/stem: potato, taro, turnip etc c) sugar, molasses, honey	a) source of energy, in every gm about 4kcal energy b) helps mobilization of fat in the body
2. Protein	a) Animal: fish, meat, eggs, milk and milk products b) Plant: lentils, soya bean, beans, peas, etc	a) Helps in body growth, repair and development of muscles b) Building immune system by producing antibodies and hormones c) Produces energy d) Important for oxygen transport to all cells and building hemoglobin
3. Fat	a) Animal: fish, meat, egg yolk, milk and milk products b) Plant: vegetable oil	a) Stored as energy source in the cells Every gm produces 9 kcal b) Carrier fat-soluble vitamins A,D, E,K
4. Vitamin A	a) Artificial medicine b) Animal: liver, egg yolk, fish oil and butter c) All types of colored fruits and vegetables	a) Become blind at night or in the dark – night blindness b) Helps growth and adhesion among epithelial cell layers c) Helps fight diseases d) Helps bone and teeth development
5. Mineral salts - Iron	a) Artificial medicine b) Animal: liver, egg yolk, fish oil and butter c) All types of colored fruits and vegetables and also molasses	Helps in hemoglobin production
6. Zinc	a) Animal: small fish, egg yolk, milk and milk products b) Plant: vegetables, fruits, spices	Helps in cell function
7. Iodine	a) Iodized salt b) Sea fish c) Coastal vegetables	Manufacturing thyroid hormone

Assessment of nutritional status of children:

Children's nutritional status can be assessed by age and weight and the formula for this is:

$$\frac{\text{Current weight of child} \times 100}{\text{Deal weight of child at corresponding age}}$$

Deal weight of child at corresponding age

The result (Gomez classification) gives indication of various types of malnutrition. For example:

- 90-100 – within this range, nutritional status is normal
- 75-89 – within this range, malnutrition is mild
- 60-74 – within this range, malnutrition is medium
- Below 60 – malnutrition is very high

Assessment of nutritional status of adults:

This is done by calculating body mass index (BMI). Normal BMI is between 19-25 and below 18 is indicative of malnutrition.

Role of vegetables in preventing malnutrition:

A very easy way to avoid malnutrition is to consume large quantities of vegetables. Vegetables can help prevent all types of malnutrition. Vegetables have sufficient amount of vitamin A, vitamin C, iron and calcium. Bean type vegetables have high level protein.

Use of vegetables and fish healthily

- Vegetables should be cooked fresh and then the taste and nutrition remain unspoiled
- Before cooking, the vegetables should be cut in large pieces to minimize loss of nutrition and taste
- Vegetables should be cooked in small amount of water for short time (not more than 15 minutes of heat) – this will preserve maximum nutrition of vegetable
- The vegetables that can be eaten raw, such as tomato, cucumber, carrots, lettuce, peas etc should be prepared as salad
- Some vegetables such as lady's fingers, if slightly boiled tastes better and easily digested so it is a good habit to boil lady's finger with a little bit of salt
- Some vegetables can be preserved before they go out of season – tomato chutney or sauce.
- Carrots can be sundried in chip-form and kept for a long time
- Small fish such as mola have should be cooked without cutting of the heads.
- Should not wash fish with salt since this reduces the nutritional value

Various types of malnutrition problem and the solutions

1. Malnutrition due to lack of calories

Diseases are caused as a result of lack of calories and protein, In Bangladesh, children under five and women suffer mostly from PEM. In this country almost 50 % mothers suffer from malnutrition. A significant number of children die from malnutrition, i.e. 7.7 per 100 children. According to UNICEF report mortality for children under five directly or indirectly due to malnutrition is up to 55%. Diseases that children suffer from as a result of lack of protein and calories are mainly marasmus and kwashiorkor. Also children's weight and height according to their age is becoming less. Marasmus is more commonly seen in one year old children and kwashiorkor is seen in children aged one to three.

Reasons for PEM

1. Not being properly breast fed.
2. Not giving additional food at the right age.
3. Illiteracy, lack awareness about nutrition and social superstitions.
4. Diarrhea, measles and various worm infections.
5. Polluted water and poor sanitation.
6. Lack of proper care and nursing.

Kwashiorkor

Lack of specific essential proteins causes kwashiorkor and this is more prevalent among children aged one to three or who had just been weaned.

Causes of Kwashiorkor

When weaning children or when children are only breast fed for a very long time without additional food, then they are affected by kwashiorkor.

Symptoms:

1. Normal weight in children is impeded
2. There is water retention in feet and hands.

3. Children become restless and temperamental .Children’s natural playfulness and interest is lost and they become listless and sad.
4. Dystrophy of muscles but cannot be detected because of fat deposition under the skin. Fat deposition is most around the cheeks making the face round and moon-like.
5. Hair becomes pale in color
6. Skin sores

Prevention:

Lack of milk intake causes protein deficiency leading to kwashiorkor and so children need to be fed milk to prevent this. In a developing country like Bangladesh the availability of cow’s milk is limited and therefore children should be breastfed for as long as possible and this should be supplemented with additional protein-rich food. Cooked mixture of rice and lentils known commonly as khichuri is cheap to make and strategies protein-calorie requirements. Children should also be fed eggs, liver, fish etc type of protein rich food. If the child has kwashiorkor , he should be fed high-quality protein which can be gotten form fat-free cow’s milk. When a child has this disease, he is subject to being attacked by infectious diseases and might have to be given a course of antibiotics. At the same food intake should include a lot of vitamins and mineral salts.

2. Marasmus

When there is calorie deficiency along with low protein intake, the weight of child falls and body becomes small and thin and a 2-3 year old child looks like a 5-6 month baby. This illness is known as marasmus.

Cause of marasmus:

Main cause of marasmus: lack of sufficient food is the main cause of this disease. When mother’s milk becomes less, if the child is not fed with additional food then the problem of insufficient calorie and protein intake occurs.

Symptoms:

- Hair fall and body....
- Depletion of fatty layer under the skin,, loosening of skin causing it to hang in folds
- Ribs protrude and can be seen clearly
- Hair of head becomes thin and of a light color
- Head size becomes small

Prevention:

Like kwashiorkor marasmus treatment also requires intake of high-quality protein food – fat free milk. In order that that food is digested well, medication may be required otherwise intake of nutritious food will not give any results. There is not separate food for marasmus. High calorie and protein-rich food is given according to the child’s requirement. Since these children cannot eat a lot at a time, they should be fed small portions frequently.

Signs of marasmus and kwashiorkor in children

	Marasmus	Kwashiorkor
1. Facial features	Looks like old people, somewhat similar to monkey face	Face becomes round, and mouth becomes swollen
2. Body structure	Thin, dry and loose skin; the waist and abdomen and upper back and other visible bones have folds of skin. Skin is dry	Water retention in hands, feet and
3. Hunger	Extremely hungry	Feels hunger
4. Mental state	Temperamental and bad tempered	Idiotic
5. hair	-	Hair becomes thin and brownish in color

Solution :

children that have either of the diseases discussed, they have to be immediately treated by the local health worker/doctor and admitted to health centers

3. Problems of Vitamin-A deficiencies

Like other developing countries, Vitamin A deficiency is a major health problem in Bangladesh. Vitamin A is a micro-nutrient very important for the human body

Depending on the solubility there are two types of vitamins:

1. Oil-soluble: A, D, E and K
2. Water soluble: B and C

Therefore vegetables should be cooked in oil as well as washed before cutting to conserve the nutrition of vegetables as much as possible

Problems of the Vit-A deficiency:

1. Eyesight: Most biggest problems of Vit A deficiency is night blindness which might turn towards blindness
2. Body growth: Growth of children slows down and so in comparison to age of child, height and weight is low. Skin and hair health also becomes poor.
3. Immunity: Vit A deficiency leads to poor immunity against diseases
4. Reproductive organs: helps to keep reproductive organs healthy and normal

Reasons for Vit-A deficiency:

- Discontinuing breastfeeding
- Child might have suffered from a bout of diarrhea or mumps
- Normal growth has been hampered
- Child is frequently subject to infections
- Child does not eat nutritious food such as liver, eggs, small fish especially mola, darkina, yellow/orange vegetables and fruits, dark green leafy vegetables

Solution:

The first manifestation of Vitamin A deficiency in a child is night blindness. When this happens, he should be taken immediately to a health worker, doctor or health center. The child should be regularly fed vit-A rich vegetables and other food.

Vitamin A rich food

Animal substance	Fruits	Vegetables	Vegetables	Vegetables
All types of liver	Ripe jackfruit	Malabar spinach	Coriander leaves	Sweet potato
Egg yolk	Ripe mangoes	Water spinach	<i>Helancho</i> spinach	carrots
Small fish – <i>mola</i> , <i>darkina</i>	Ripe papaya	Mint	Bottle gourd leaves	
Fish oil		Sweet potato spinach	Radish leaves	
Butter		Red spinach	Winter spinach	
cheese		Jute leaves	<i>Notey</i> spinach	
		Drum stick leaves	pumpkin	

Daily requirement of vit-A

sl	Age groups	Intake Amount (microgram retinol/day)
1	Below one year	400
2	Children above one year	400-600
3	Pregnant women	600-750
4	Breast feeding women	850

4. Anemia

More than half the population in Bangladesh suffer from shortage of hemoglobin, most of all mothers and children. About 10-15% deaths can be attributed to anemia, if hemoglobin level is low (depending on age and gender).

Reasons for Anemia:

There are mainly two reasons for anemia: 1) malnutrition and 2) due to various diseases

Anemia due to malnutrition:

Anemia due to malnutrition is mainly due to deficiencies of vitamin B12, folic acid and vitamin A. These micronutrients have iron and thus if these are insufficient, hemoglobin levels fall. Another reason is worm infections. Almost 80% children in rural Bangladesh have worm infections. When there is iron deficiency, it is usually because of not eating iron-rich food which is because of lack of awareness about nutrition.

Symptoms:

For whatever the reason of anemia, the following symptoms can be seen:

- Always feeling of weakness, and lack of concentration
- Burning sensation of hands and feet
- Head pulsates when sitting down or standing up, eyesight is hazy and heart palpitation is high
- Fair people become even more pale
- The inside of eyelid and under the tongue becomes whitish
- Sores at corner of lips
- Lack of appetite and feeling of lethargy

The effect of anemia on the body

During delivery: Excessive loss of blood might cause death of mother. Delivery may be delayed and dead baby might be borne, also baby might be born might be low weight.

Children: Who have anemia development will have problems in development of intelligence and mental abilities

Elderly: are not able to undertake physical activities and have poor immunity

Prevention:

- Intake of iron-rich food: All types of meat and liver, eggs, all types of dark green leafy vegetables (e.g.) taro, Malabar spinach, winter spinach, pumpkin leaves, bottle gourd leaves, water spinach, spinach, radish leaves, jute leaf, cauliflower leaves, coriander and vegetables that remain green even after being cut up and cooked such as broad beans and string beans.
- Food should have plenty of vitamin A and C
- From the day pregnancy is confirmed up until the baby is 6 months old, the mother should have iron tablet every day then she will not have anemia during and after pregnancy.

5. Iodine deficiency:

Iodine is a necessary mineral.

Natural source:

Sea fish, vegetables from the coastal areas

Artificial source:

Iodine-rich salt

Problems of Iodine deficiency

- Affects physical growth
- Hair becomes dry
- Becomes, crippled/disabled
- Hypothyroidism, dark, dim-witted, and even cross-eyed
- Irregularity in monthly periods
- Affects pregnancy
- Creates risks in pregnancies
- Fetal death

Treatment of iodine deficiency diseases

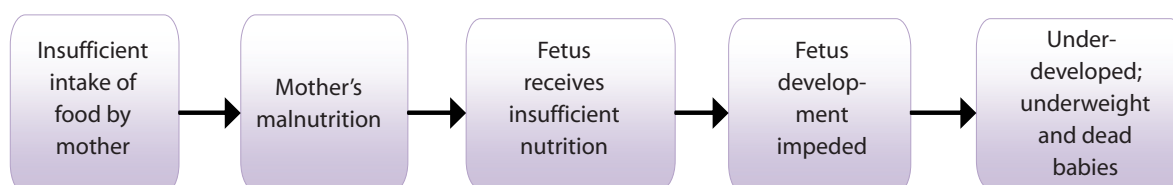
To prevent or treat iodine-deficiency diseases, we need to consume iodine-rich food. Iodine-rich salt is easily available in Bangladesh and if this is used in everyday cooking and meals then the iodine requirement can easily be fulfilled. When buying salt, care has to be taken to ensure the salt has iodine. Even if extra iodine is consumed daily, the excess is excreted with urine and so this is not harmful.

Identifying iodine-rich salt and its preservation

- Take one level teaspoon of salt and keep this in a clean plate, after this take five grains of rice. Be careful not to take more than 5 grains and mix this well with the salt. Spread the mixture on the plate evenly. Put two drops of lemon juice on the salted rice grains and observe for change in color. If the color changes to purple then there is iodine in the salt – this is the way to test salt for iodine.
- Keep iodine-rich salt in plastic, glass or clay containers or bottles with covers. If kept in sunny or humid places, the quantity of iodine reduces. Iodine-enriched salt should be used within six months.

Nutrition and care for pregnant women

Research has shown that the health of a baby depends on the nutrition and care of the mother. During the pregnancy period, insufficient food can have severe consequences for the child. Mothers with malnutrition who give birth, have babies with low birth weight, are retarded, and unhealthy. Also if the mother's health is good, but she does not eat enough, the baby is unable to develop normally. In this case, the harm caused to mother's body leads to bad health of the mother. For improved and high quality production, you need productive soil, and similarly the mother's health is tantamount to reproducing a healthy baby. Most girls in Bangladesh get pregnant at an early age and are subject to problems in malnutrition. Therefore they deliver retarded or even dead babies. How malnutrition affects fetus is shown below



Below is given the daily food requirement and advice for pregnant women

Food substance	Amount (gm)
Rice/wheat	350-400
Lentils (all types)	40-50
Potato	40
Sugar/molasses	30-40
Oil/butter	30-40
Fish/meat/liver	30-40
Eggs (at least four every week)	1 piece
All types of green and coloured vegetables	150
All vegetables	150
Seasonal fruits	1 piece
Milk and milk products	200-250

Reference: Food and nutrition science: Shaheen Ahmed

Recommendations for pregnant mother's nutrition and care is listed below:

- In pregnant state, during every meal, the mother should eat one fistful more of nutritious food
- To prevent anemia, vitamin and iodine deficiencies :
- Once pregnant, mother should have one iron tablet every day during pregnancy and six months after birth.
- Iron-rich food should be consumed (eg animal source – eggs, liver, meat, fish and plant source
- Malabar spinach, winter spinach, pumpkin leaves, bottle gourd leaves, water spinach, spinach, radish leaves, jute leaf, cauliflower leaves,, coriander)
- Vitamin A – rich food (all type of livers, egg yolk, milk, cheese, butter, fish oil, small fishes like mola, darkina, yellow colored fruits and berries like ripe mangoes, papaya, jackfruit; various dark green vegetables
- Iodine rich food (sea fish, coastal vegetables) and iodized salt
- Prevention of diseases and treatment
- Complete five doses of Tetanus vaccination (2nd vaccination 28 days after the first, 3rd 6 months later, 4th after one year, and after another year the 5th vaccination)
- Use medicated mosquito nets to prevent Malaria and filaria.
- Do medical check-up at least four times during pregnancy (mother's weight, blood test, blood pressure, fetal development)
- Keep pregnant mother physically and mentally healthy, so that fetal development is normal
- Avoid heavy work
- Take sufficient rest – at least 2 hours during day and 8 hours at night)
- Wear loose and comfortable clothes and stay clean
- All family members should be helpful towards the pregnant mother

Care and nutrition for breast feeding mothers

Taking care of post-partum mothers is an essential part of her care. During the post partum period, mothers require special care because when the mother breast feeds her child, body is subject to depletion of nutrition. For child development, all nutrients should be present in the breast milk which they receive from their mothers and so the mothers have to be fed nutritious food and given additional care.

Below is given daily food requirement of post partum mothers

Food substance	Amount (gm)
Rice/wheat	550-600
Lentils (all types)	50-55
Potato	40-50
Sugar/molasses	55-60
Oil/butter	50-60
Fish/meat/liver	50-70
Eggs (at least four every week)	30 (1 piece daily)
All types of green and colored vegetables	150
All vegetables	100-200
Seasonal fruits	1 piece
Milk and milk products	250-300
peanuts	25-30

Reference: Food and nutrition science: Shaheen Ahmed

Breast-feeding mothers should eat two fistfuls more of food during meals.

Below are issues that have to be considered for breast feeding mothers:

- Breast feeding mothers should eat nutritious food e.g. eggs, liver, meat, fish ;yellow colored fruits and berries like ripe mangoes, papaya, jackfruit; various dark green vegetables. The additional food helps in milk production for these mothers as well as replenish the depletion in the mother's body
- Breast feeding mothers should have at least 2 extra glasses of water
- With 14 days of delivery , one capsule of vitamin A should be taken
- Up to six months after birth, every day the mother should take one iron capsule
- After birth at least four times medical check-up
- Take sufficient rest – at least 2 hours during day and 8 hours at night)
- Wear loose and comfortable clothes and stay clean
- All family members should be helpful towards the breast feeding mother

Nutrition and care for adolescent girls

When a girl reaches the age of 13-14, she becomes an adolescent. At this time, there is mental and physical changes and development in the girl very quickly. At this time, the girls become very hungry since the body requires more food for energy. If this food requirement is not met then development is hampered and the adolescent girl shows manifestations of various diseases due to malnutrition. Along with the physical development of these girls, their monthly periods also start and if food needs at this time are not fulfilled, she will be subject to anemia.

Below are issues that have to be considered for adolescent girls:

- According to requirement, nutritious food should be given to adolescent girls
- To prevent iron- deficiency, the following food should be eaten e.g. eggs, liver, meat, fish ;yellow colored fruits and berries like ripe mangoes, papaya, jackfruit; various dark green vegetables. The additional food helps in milk production for these mothers as well as replenish the depletion in the mother's body
- Similarly to avoid vitamin A deficiency to , the above foods already mentioned should be consumed
- To avoid iodine deficiency, should consume, sea fish and coastal vegetables and iodized salt
- Complete five doses of Tetanus vaccination (2nd vaccination 28 days after the first, 3rd 6 months later, 4th after one year, and after another year the 5th vaccination)

- STDs, HIV and AIDS prevention and education should be given to these adolescents
- Motivate parents to treat son and daughters equally and thus not marry their daughter at an early age

Below is given daily food requirement of adolescent girls

Food substance	Amount (gm)
Rice/wheat	300-400
Lentils (all types)	40-50
All types of green and colored vegetables	100
All vegetables	100
Seasonal fruits	80-100 (1 piece)
Milk and milk products	200
Fish/meat/liver (at least 4 times a week)	110-120
Eggs (at least four every week)	1 piece
Sugar/molasses	40-50
Oil/butter	30-40
Nuts/seeds	50-100

Reference: Food and nutrition science: Shaheen Ahmed

In this way, food should be given for all members of the family which will contribute to a healthy and productive life and this in turn will contribute to the country's development positively.

GROUP SESSION PLANNING

Day -02


Time- 13.30 pm

Duration – 60 minutes

- Target group : Women famers of Household based pond aquaculture and homestead gardening
- Title of session : Course evaluation and conclusion
- Aim : To conduct a course evaluation by participants on household based fish and vegetable culture and through which future decisions can be determined.
- Objective : At the end of this session, the participants -
- Will be conduct the course, evaluate the course and conclude the training session successfully

Discussion topic	Training approach	Duration
Introduction		5 minutes
<ol style="list-style-type: none"> 1. Welcome/reception: welcoming the participants and askin about participants welfare 2. Discussion about previous session 3. Linking previous session's topic to current session 4. Explanation of aim and objectives of current session 	Q&A and discussion	
Topic		20 minutes
<ul style="list-style-type: none"> • Course evaluation • Conclusion (Evaluation forms will be distributed among participants and they will evaluate using the mood meter. After wards 2-3 participants will discuss overall topics and give concluding remarks on the training session. The trainer will also give tanks to all the participants and will invite any special guests to conclude the training event)	Q&A , Lecture and Flipcharts	
Summary		10 minutes
Advice for next training session	Q&A	

Discussion and link up to the next session

Supporting Training Material  mood meter (evaluation format), white board and marker, handout

Fish culture training course

Course evaluation format (mood meter)

Training

location.....date:.....
.....

Objective is to take opinion from participants about everyday's sessions

Guidelines:

1. Reviewing drawbacks and advantages of the training sessions critically
2. Get an overall feeling about the sessions by getting the participants to mark the symbols on the mood meter
3. Before taking opinion using the mood meter, care should be taken to elucidate what needs to be considered in evaluating the training sessions e.g. Approach, delivery, and use of training material. This does not include residential arrangements, food and personal feelings
4. Participants should listen carefully to trainer's explanation before evaluating

Tick in the correct box

Mood meter	comments
	
	
	

Some commonly used measurements in fish culture

12 inches	One foot
435.6 square feet	One decimal
10.76 square feet	1 square meter
40.46 square meters	One decimal
1 meter	3.281 ft
100 decimals	1 acre
247 decimals	1 hectare
10,000 square meters	1 hectare
1 inch	2.54 cm
35.31 ft ³	1 meter ³
1 ft ³	28.317 litres
1 meter ³	1000 litre
1 kg	2.205 pounds = 1.07 sher
1 metric ton	26.7924 maund
1 gm	1000 milligm
1 liter	1000 ml
1 ppm	1 milligm/liter = 1 gm ³
ft ₃ 35.31 x ppm	Gm/ milliliter

References:

1. Department of Fisheries (Upazila Fisheries Office – Gouripur and Mukthagachha): CIG skill development course
2. Department of Fisheries (CBACC-CF project 2010): improved fish culture training manual
3. Bangladesh Fisheries Research Institute (2008): Strategic planning for commercial fish culture
4. MAEP (1996): poly culture of carp fishes
5. MAEP (2002): booklet on fish culture- pond fish culture
6. WorldFish Center (Cyclone affected aquaculture rehabilitation project 2008): management of carp fish culture
7. River erosion project, Practical Action Bangladesh