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Participant Handbook

Sector
Agriculture and Allied

Sub-Sector
Fisheries

Occupation
Aquaculture



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**Freshwater Aquaculture
Farmer**

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Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



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AGRICULTURE SKILL COUNCIL OF INDIA

for

SKILLING CONTENT: PARTICIPANT HANDBOOK

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It is expected that this publication would meet the complete requirements of QP/NOS based training delivery, we welcome the suggestions from users, Industry experts and other stakeholders for any improvement in future.

About this book

The Participant Handbook for the job role of Freshwater Aquaculture Farmer has highlighted knowledge and skills to assist the trainee to develop desired competencies for undertaking responsibilities of the job role as per NOSs specified by the ASCI. The book has **Modules** corresponding to major tasks and **Units** as competencies. Key learning outcomes are given of each module and under the module, units have specified objectives to be achieved. This workbook contains topics to highlight underpinning knowledge regarding various tasks expected to be undertaken by the trainee. Each unit has objectives with a view to develop skills for the concerning tasks. Contents in each unit give a brief introduction of the topic followed by details in order to obtain practical knowledge and activities for developing skills through training and re-training. Illustrations have also been given for understanding the theory part in a better way. At the end of each unit exercise has been given to assess and evaluate the trainee. Exercise contains questions, assignments, visits, topics for Focus group discussions (FGDs), etc. depending upon the contents and objectives of the units. Tips have been given in the book to highlight some important concern.

A brief of the modules and units is given below as the summary of contents covered in the hand book:

Module 1 Introduction—This part of the book attempts to give an overview of the aquaculture sector of India in general and with special reference to Scope of Freshwater Aquaculture (Unit 1.1), Skill development needs for freshwater aquaculture (Unit 1.2) and Enterprises in Freshwater Aquaculture sector (Unit 1.3). The contents in the module include:

- Importance and status of Indian fisheries and aquaculture at a glance
- Fish and its importance
- Criteria for selection of suitable site for fish farm
- Common fishing nets used in composite fish culture
- List of tasks and corresponding skills for freshwater aquaculture
- National Skill standards for the job role of FWAF
- Enterprises in aquaculture in culture systems and as supply chains including consultancy services
- Exemplar project for setting up enterprise for freshwater aquaculture

Module 2 Perform pre - culture activities – This modules aims at introducing the composite fish culture principle and practices with focus on pre-stocking preparations to be undertaken. Skills to be developed with respect to perform these activities include planning for composite fish culture (Unit 2.1), maintaining water quality of the pond (2.2) and pond preparations to be undertaken before stocking fish seeds in the pond (2.3). Accordingly, the contents covered in this module include the following:

- Principles and planning of Composite fish culture
- Feeding habits and feeding zones of fishes cultured under composite fish culture
- Species Combination in Composite Fish Culture
- Types of Ponds in Composite Fish Culture
- Freshwater Fish-pond Designing
- Water Management for pre-culture preparations
- Principles of Pond Preparation
- Steps for Pond preparation for stocking fish seed
- Removal of Aquatic weeds, insects and predatory Fishes
- Applying lime and manures in the Ponds

Module 3 Perform Post stocking culture activities – Under this module theoretical knowledge and skill based practical activities have been highlighted to manage fish seeds stocked in the pond. Broadly three major aspects have been dealt in this module viz. selection and procurement of quality seeds and stocking (Unit 3.1), supplementary feeding, manuring, growth monitoring and thinning (Unit 3.2) and water management and maintenance of aeration system in hatchery and ponds (Unit 3.4). The topics covered under the units are given below:

- Importance and quality issues of fish seed
- Stocking and ratio of different fishes recommended for mono, three and 6 spp combination of fishes in composite fish culture
- Maintaining Water Quality and range of physico-chemical parameters of fish pond water
- Supplementary feed and feeding
- Manuring and Production of Live food organisms - Zooplankton
- Monitoring of Health status and common observable abnormal behaviour in fishes
- Growth Monitoring and Thinning

Module 4 Perform harvesting & marketing activities for freshwater Organism--- In this module contents cover the entire process and planning of harvesting of table size fish. Situations and decision as to when harvesting should be done, has been discussed besides the method of harvesting Type of net to be used with desirable mesh size is very important in the harvesting operation of fish (unit 4.1). Handling of fish during netting and on-boat is also very sensitive part in view of maintaining market value of the catch. In this module marketing strategy and linkages have also been discussed in order to fetch better price of the fish catch (unit 4.2). The final outcome of the composite fish culture is the calculation of production and input cost. So to do this, details of items to be recorded for input cost have been highlighted in tabular form. A broad view has been given with respect to maintenance of records and accounts for inputs, fish production and sale. In this module the topics covered include:

- Harvesting of spawn, fry and table size fish
- Partial and total harvesting of fish crop
- Precautions in large scale hauling of net and storage of fishes on the boat during de-netting by proper handling
- Processing, grading and segregation of fish catch for fetching good price in the market
- Agencies, linkages and strategies for marketing of fish
- Maintenance of Records and Accounts for inputs and production of fish

Module 5 Ensure Safety, Hygiene, and Sanitation Practices for Culture Operations --- This module is about hygiene and safety measures to be undertaken for safety of fish farm and human resource working at the farm. Also, with a view to have concern of the environment and the fish farm, desirable sanitation practices have been suggested in the module for maintaining sanitation at the farm. The contents in this module covers three aspects such as safety,

hygiene and sanitation at the farm under principles of safety measures during fish farm operation (unit 5.1), maintaining hygiene at the fish farm (unit 5.2) and Clean water and clean ponds for good fish health and growth (unit 5.3). The contents in the module include the following:

- Policy and norms for the occupational safety and health issues of workers involved in aquaculture practices
- Safety of the farm
- Safety against natural calamities & environmental conditions of pond
- Safety threat caused by humans
- Self protection and observe hygiene measures at the workplace
- Maintaining water quality and clean water supply in hatchery and pond in terms of pollution free water and desirable DO, pH and salinity

About the Exercise

Each unit has exercise in which the activities given will help you to develop necessary knowledge, skills, and attitude that you need for becoming competent in performing the tasks at workplace. The activities should be done under the supervision of your trainer who will guide you in completing the tasks and also provide feedback to you for improving your performance. To achieve this, trainee must prepare a timetable in consultation with the trainer and strictly adhere to the stipulated norms or standards.

Symbols Used



Key Learning
Outcomes



Steps



Time



Tips



Notes



Unit
Objectives



Exercise

Table of Contents

| S.No | Modules and Units | Page No. |
|-----------|---|-----------|
| 1. | Introduction | 1 |
| | Unit 1.1 - Scope of freshwater aquaculture | 3 |
| | Unit 1.2 - Skill development needs for freshwater aquaculture | 17 |
| | Unit 1.3 - Enterprises in freshwater aquaculture sector | 20 |
| 2. | Perform Pre- Culture Activities (AGR/N4921) | 28 |
| | Unit 2.1 - Principles and planning of composite fish culture and planning | 30 |
| | Unit 2.2 - Maintaining water quality | 38 |
| | Unit 2.3 - Pond preparation for stocking fish seeds | 41 |
| 3. | Perform -Post Stocking Culture Activities(AGR/N4922) | 49 |
| | Unit 3.1 - Quality fish seed, stocking and water quality | 51 |
| | Unit 3.2 - Supplementary feeding, manuring and culture of live food organisms - zooplankton | 56 |
| | Unit 3.3 - Health and growth monitoring and thinning | 61 |
| 4. | Perform Harvesting and Marketing Activities for Freshwater Organisms (AGR/N4923) | 65 |
| | Unit 4.1 - Harvesting of fish crop | 67 |
| | Unit 4.2 - Handling, marketing of fish catch and record keeping | 70 |
| 5. | Ensure Safety, Hygiene and Sanitation Practices for Culture Operations (AGR/N4918) | 85 |
| | Unit 5.1 - Principles of safety measures during fish farm operation | 87 |
| | Unit 5.2 - Maintaining hygiene at the fish farm | 92 |
| | Unit 5.3 - Clean water and clean ponds for good fish health and growth | 94 |
| 6. | Employability & Entrepreneurship Skills | 98 |
| | Unit 6.1 - Personal strengths & value systems | 102 |
| | Unit 6.2 - Digital literacy: a recap | 121 |
| | Unit 6.3 - Money matters | 127 |
| | Unit 6.4 - Preparing for employment & self employment | 138 |
| | Unit 6.5 - Understanding entrepreneurship | 147 |
| | Unit 6.6 - Preparing to be an entrepreneur | 169 |







1. Introduction

Unit 1.1 - Scope of freshwater aquaculture

Unit 1.2 - Skill development needs for freshwater aquaculture.

Unit 1.3 - Enterprises in freshwater aquaculture sector.



Key Learning Outcomes

At the end of this module, you will be able to:

1. Understand the economic importance and scope of aquaculture in India.
2. Know the difference between capture and culture fisheries
3. Know various aquatic ecosystems with special focus on aquaculture.
4. Know various skills required to undertake aquaculture as an entrepreneur
5. Know existing and upcoming enterprises in aquaculture sector.
6. Know various parameters and criteria to select suitable site for freshwater aquaculture farm.

UNIT 1.1: Scope of Freshwater Aquaculture

Unit Objectives

At the end of this unit, you will be able to:

1. Explain meaning of aquaculture and types of aquaculture system i.e. freshwater, brackish water and marine/ sea water.
2. Enlist fresh water bodies in India.
3. Describe prospects of aquaculture in India with special reference is freshwater aquaculture.
4. Enlist common aquatic organisms cultured under aquaculture system i.e. fin fish, shell fish, sea weeds and algae.
5. Write names and identify different types of nets used in fish culture, their repair and maintenance needs.

1.1.1 Importance of Aquaculture

India has magnificent wealth of diverse aquatic resources. The wide range of aquatic ecosystem in different geographical zones is spreading from hills to plain and up to seas. This distribution of aquatic resources of the country has paved way of using rich fish biodiversity for aquaculture prospects. In the total fish fauna scenario across the globe, India owes more than 10 percent of the fish fauna. But over the time fishery wealth i.e. fish production through capture fisheries in natural waters, mostly seas and rivers have reached to its maximum capacity long back. Now India has to rely for fish production on its rich and diverse aquatic resources offering enormous potential for aquaculture in cold water, fresh water, brackish water and marine waters of India. Thus, fisheries sector in India has advanced towards the culture practices due to reduction in fish production from capture fisheries.

India occupies 2nd position in fish production and in aquaculture as well in the world. The total fish production of the country in 2015-16 was 10.8 million tones contributing 6.4% to the world's total fish production. India is the largest country in the world for shrimp production and its export. Our country has set the target reaching 15 million tones by the year 2020. The term fisheries covers all fish production i.e. obtaining fish by capturing or fishing from seas, rivers, reservoirs etc. and by culturing through aquaculture systems in different water bodies or ecosystems. Culture of aquatic organisms under aquaculture includes finfish (true fish), shell fish (prawns /shrimps/mollusc) and sea weed culture. Critical input for successful aquaculture is using pure and healthy seeds of fish and prawn. The important strategy to increase production of aquaculture is establishment of thousands of hatcheries which are in use for breeding and seed production purposes in the country. Based on the fish culture being under taken in marine ecosystem (sea water), brackishwater (backwaters/ sea water mixed with

freshwater) or freshwater, the aquaculture practices are given names as mariculture or marine fish culture, fish or shrimp culture in brackish water is called brackish water fish culture and fish culture in fresh water is called fresh water fish culture. The fisheries sector employs about 14.5 million people in various culture and allied activities including hatcheries offer an attractive and promising sector for self-employment, livelihood, and food security. Fish products from India are well received by about 122 countries across the world, creating export-driven employment opportunities in India and greater food security for the world. The Indian Fishing Industry has done manifold developments and has infused most modern technology in its fishing crafts and tackle besides using highly sensitive navigational devices, radars, ultra-sonic aids etc.

With reference to fresh water aquaculture including cold water ecosystems, country has about 195 km spread of 14 major rivers, 44 medium rivers, numerous river trajectories and streams besides 2.36 million ha area is of ponds and tanks. All these water bodies offer variety of aquaculture production and allied enterprising opportunities. Data show that ponds and tanks alone accounts for 55% aquaculture production of the total fish production in India.

The fresh water aquaculture potential lies in the natural resources which are comprised of rivers, reservoirs, wetlands, lakes and ponds, responsible for continuous growth of this sector. It is expected that by the year 2020, it may yield up to 15 million tons of fish productions against 9.6 millions tones in 2013-14. The aquaculture production target of this magnitude thus place demand for more skilled human resource to handle modern technology for enhancing production.

Aquaculture is also important to meet protein requirement and as a solution to food scarcity and malnutrition problem in the country. The text given under unit has covered the meaning of aquaculture and aquatic organisms including fishes which are produced in different culture systems i.e. freshwater, brackish water and marine waters.

What is Fish and its Importance

Fish is a natural resource of animal protein for our food obtained from aquatic ecosystems viz. freshwater, brackish water and seas. Fish as a commodity is available in the market ranging from Rs. 10 to Rs 600 per kg. The term 'Fishery' in general is used for all the organisms and sea weeds obtained by culture or capture from natural water resources. Freshwater fish and prawns for food are cultured or fished from rivers, lakes, reservoirs, canals, estuaries and seas. Fishes are source of our entertainment as well. Ornamental fishes are kept in aquaria in our homes for stress relieving and decoration. Fishes in natural bodies offer great recreational facility through game fishing. Also fishing is done to obtain fishes for food from local water bodies. Fishery sector offers huge opportunities of wage and self employment in both capture and aquaculture.

Fisheries of India

Fisheries include all aspects related to obtaining fish both finfish and shell fish for commercial and domestic uses. Broadly, fishing or capturing fishes from seas, rivers, reservoirs, culture of fish or aquaculture, processing, value addition and export etc. are included in 'Fisheries'.

The fishery wealth of India is comprised of 8,118 kilometers of marine coastline, 3,827 fishing villages, and 1,914 traditional fish landing centers. India's fresh water resources consist of 195,210 kilometers of rivers and canals, 2.9 million hectares of minor and major reservoirs, 2.4 million hectares of ponds and lakes, and about 0.8 million hectares of flood plain wetlands and water bodies. Fish fauna is available in all the aquatic ecosystems viz. seawater, brackish or fresh water in rivers, ponds, cages, etc. Fish can thus be obtained both by capture from seas or rivers and culture in marine, brackish water and freshwater ecosystems. Accordingly there are 3 types of fisheries viz. marine, brackish water and inland fisheries. There are two ways of obtaining fish. One is catching fish (fishing) from natural resources, which is called capture fisheries. The other way is by fish culture/ farming, which is called culture fishery. Mostly fish production from these resources is obtained through aquaculture/ fish culture. The term, aquaculture refers to 'aqua' means water i.e. culture of organisms in water is called aquaculture including fish culture. Hence, culture of algae, prawn, mollusc and fish in marine, brackish and fresh water is covered under aquaculture. Commonly, the terms like fin fish and shellfish culture is used in reference to culture of fin fish and shelled animals like prawns and molluscs respectively.

Tips

Finfish – These are real fishes in true sense having slender body divided into three distinct regions i.e. head, trunk and tail. To support in swimming and direction these are fins- pectoral fins, pelvic fins and tail fins. Fishes having skeleton system made of cartilage are cartilaginous fishes and made of bones are called bony fish. Examples; Catla, Rohu, Mrigal, Eel, Hilsa, Milk Fish etc.

Shell Fish – These are aquatic organisms having shells, legs or appendages in arthropodes, tentacles in squids and molluscs. Example; Prawn, Shrimps and Crab in arthropods and Squids, Mussel, Octopus in molluscs.

What is Aquaculture

Cultivation or farming of aquatic organisms and plants refers to as Aquaculture. With reference to fisheries sector, culture of 'fin fish' and 'shell fish' (fig.1) is known as Aquaculture. Fin fish is a real fish having gills and fins and shell fish includes crustaceans (shrimps, prawn and crabs) and molluscs having shells on their body. Aquatic plants generally cultured are algae, seaweeds etc. In the context of shrimp and prawn farming, it may be noted that shrimps (*Penaeus monodon*) are marine crustaceans

and can be cultured in brackishwater whereas prawns (*Macrobrachium rosenbergii*) are fresh water organisms. The basic difference between the two is of size, shrimps are smaller than prawns and have shorter legs whereas prawns are larger in size and have long legs



Fig 1.1.1 crab



Fig 1.1.2 Shrimp



Fig 1.1.3 Seaweed



Catla catla (Hamilton-buchanan)

Fig 1.1.4 Showing fin fish (Catla), shell fish (crab and shrimp) and sea weed,

Aquaculture could be freshwater, brackish water and marine water or sea water depending upon the type of aquatic ecosystem used for aquaculture. Commercial production of fishes, crustaceans, mollusc, aquatic plants, algae, etc. under different aquatic ecosystems is termed as aquaculture. Aquaculture may also be referred to as farming of fish. It involves breeding, rearing and harvesting of aquatic animals under controlled conditions of water, space, breeding and feeding using hatcheries.

The freshwater aquatic resources, include fresh water natural bodies i.e. rivers, tanks, ponds etc. The brackish water is a mix of fresh water and sea water. These water bodies are mostly estuaries. This water has more salinity because of salt water which is also known as briny water. In short brackish water is the water, which is more salty as compared to fresh water but less salty than sea water. In India famous Chilka Lake of Odisha and Sambhar Salt Lake are brackish water lakes.

Freshwater fishes cannot live in brackish water and sea water due to high salinity of water or salty water. On the other hand fishes of seas and brackish water bodies cannot live in freshwater. Hence, aquaculture is named after type of water body of which fishes are being cultivated viz. freshwater aquaculture, brackish water aquaculture and mariculture term is used for culture of marine water or sea water fishes. In the context of shrimp and prawn farming, the shrimps (*Peneus monodon*) are marine crustaceans, cultured in brackish water whereas, prawns (*Macrobrachium rosenbergii*) are freshwater aquatic organisms.

Shrimps have shorter legs and have claws on two pairs of their legs. Their front pincers are typically the largest.

Prawns are larger in size having large legs, have claws on three pairs of legs and second pincers are larger than the front ones.

Fresh Water Aquaculture

India is at the second position in the world in total fish and aquaculture production after china. The freshwater aquaculture production is obtained from ponds and tanks nearly 2.36 million ha area. Fresh water aquaculture contributes 55% to the total fish production of the country. Freshwater aquaculture is also done in freshwater lakes, irrigation canals, reservoirs, paddy fields, beels, jheels, derelict waters. In Eastern India, freshwater aquaculture is undertaken mostly in ponds & tanks. Common Fish farming undertaken in freshwater is the commercial production or farming of Indian carps such as catla, rohu and mrigal along with exotic sps. of carps i.e. silver carp, grass carp and common carp. This culture system is known as composite fish culture or poly culture.

The most active freshwater aquaculture states of the country are located in eastern parts viz. West Bengal, A.P., Orissa. The up coming states in the freshwater aquaculture are Assam, Haryana, Punjab, U.P., and Tripura.

- **Cold Water**

India's geographical diversity is a boon for fish production in having temperate to tropical regions with rich aquatic resources in all the climates. The Himalayan region and Western ghats of the country have upland rivers/streams, manmade reservoirs and high and low attitude natural lakes. These cold water bodies have cultivable varieties of food fishes both exotic and indigenous such as trouts and mahaseers respectively. These fishes are cultured in hatchery based system with high survival rates. The cold water fishes can withstand water temperature between sub-zero to 20 C abounding in coldwater lakes of Kashmir and Kumaon and reservoirs of Himachal Pradesh and J&K. the cold water fishes which are important from aquaculture point of view include exotic salmonids, brown trout (*Salmo trutta forio*) and rainbow trout (*Onchorhynchus mykiss*) besides Indian fishes mahseer (*Tor* sps.) and snow trout (*Schizothorax* sps.). Trouts are liked as food fishes by fish eaters hence their farming holds great potential in Indian market .



Fig 1.1.5 Rainbow Trout



Fig 1.1.6 Snow Trout

Brackish Water Aquaculture

Brackish water culture is popular for the production of mullets, sea bass, milk fish, tiger shrimp, mud crab etc. in coastal states like Andhra Pradesh, West Bengal, Goa & Kerala. This is also known as coastal aquaculture. Shrimp farming is the major brackish water aquaculture commercial activity.



Fig 1.1.7 Brackish water aquaculture

Brackish water aquaculture is carried out in swamps, creeks, bays and low-lying fields situated on the coastline which gets filled with saline water during high tides and gradually desalinated during rainfall. India has a wide spectrum of aquatic organisms which can be cultured in brackish waters such as prawn, fin fish, mollusk, etc. Prawns are major aquaculture organisms in brackish water due to high productivity, ready marketability and export value. The common prawn species cultured are *Penaeus monodon* also known as tiger prawn, the other species is *P. indicus* the white prawn. The common fin fish species cultured in brackish water impoundments, paddy fields and lagoons include mullets (*Mugil cephalus*), milk fish (*Chanos chanos*) and sea bass (*Lates calcarifer*).



Fig 1.1.8 *Chanos chanos*



Fig 1.1.9 *Mugil cephalus*



Fig 1.1.10 *Lates calcarifer*

Mari Culture

Marine organism culture system also significantly contributes to aquaculture sector. The cultivation of mariculture organisms is known as marine culture which is an allied branch of aquaculture. Marine culture is undertaken in open ocean, enclosures of ocean, lanes and by lanes or race ways around oceans filled with sea water, cage culture etc.

The common aquaculture practices undertaken in sea water include fin fish culture (Sea bass is very popular) and shell fish culture, including mussel culture, edible oyster culture, sea weed, sea cucumber. Fin fishes viz. milk fish, mullets, perches, eels etc. are suitable for culture in saline lagoon and ponds. Sea weed culture is very important for the production of agar. The sea weeds are generally harvested from Indian coasts include red algae *Gracilera edulis* and sps. of *Sargassum*. The Seaweeds can also be cultured in calm coastal water using specially made coir mat or a frame of coir ropes tied to wooden poles.



Fig 1.1.11 Sea weed - *Gracilera*



Fig 1.1.12 Sea weed - *Sargassum*



Fig 1.1.13 Cage culture



Fig 1.1.14 Oyster

Criteria for Selection of Suitable Site for Fresh Water Fish Farm

Selection of suitable site is extremely important step for successful fish culture or aquaculture enterprise. The basic considerations in view to have a economically viable of the project are in relation to land, connectivity, topography of the site, water resource and soil quality.

Land

The land may be searched which is not usable or fit for agriculture purposes. The reason for this is that the wasteland could be utilised and it will be cheaper. Record of the land may be checked for maximum water level during the rainy season to avoid flooding of ponds or the farm as a whole. In view of this the land elevation must be considered as important factor in determining the suitability of the area for the construction of a fish farm or hatchery as the fish seeds for rearing at different stages require different types of ponds. It is suggested that local people may also be contacted to get the information regarding the flood conditions, pollution problems and about the locality and people in general. The shape and size of available land, may preferably be of rectangular shape with possibility of future expansion of the fish farm.

Another important thing is to know about the development plans of the government in that area. The plans could be launch of some industrial project or any other activity which may cause air and water pollution. Also, a site adjacent to a populated area, may have the risk of pollution and theft.

In view of looking for low construction cost the land must not have heavy vegetation, as removal of root systems to clear the site may incur heavy expenses and consume time. However, the vegetation is also an indicator of soil types and of the elevation of the water table. The abandoned agriculture fields, grassland, open woodland or land covered with low shrubs and bushes may involve low construction cost than the land with very thick jungle or swampy areas with high trees.

Connectivity

A fish farm connected to roadways is always successful in many ways such as transportation of raw material, fish seeds, brooders and table fish for sale, easy access of customers and more visibility of the farm. Hence, land should be selected near road side.

Topography

The topography of the farm is important in relation to the following aspects:

- Topography having high elevation of the site helps in proper drainage of the ponds for the purpose of cleaning or liming.
- Based on the topography of the land such as valley, sloping land, swampy and marshy areas or barrage the farms are prepared by different methods.
- If land is in a location of valley then the high lands with three sides surround the basin and a narrow outlet is made in the front.
- The sloping land location facilitates self drainage of ponds can be constructed on
- Bunds are constructed in preparing ponds in swampy and marshy areas by depositing soil.
- Farms are made by constructing series of dams at barrage sites and narrow flowing stream.

Soil factor

The best soil considered for a fish farm ponds is sandy clay to clayey loam. Loamy soil helps growing natural foods at the pond bottom This soil type can be tested visually i.e. darkness and smooth texture can be felt by touching or feeling by hands or making their balls showing good binding capacity. This type of soil has good water retention capacity with no seepage. It may also be noted that soils with rocks or stones may not be desirable for ponds except raceways or lined ponds. Desirable soil quality of the pond include clayey loam soil which is ideal for low permeability and high fertility. The soil composition could be sand, 20-45%, silt, 15-23% and clay, 28-40%.

Water Factor

Water factor in terms of quantity and quality play key role in aquaculture. Hence, it is advisable to select an aquaculture site near a natural water resource such as an irrigation canal, river, creek, reservoir, lake, spring, rainfall runoff and dug or deep wells. To ensure water supply to ponds or hatchery a water storage tank or pipeline by gravity or by pumping to the ponds is installed. The most economical method is by gravity. The quality of water depends upon desirable physic - chemical conditions of pond water. These include pH range from 7.5-8.5, dissolved oxygen (DO) more than 5ppm, salinity less than 2 ppt. Ideal depth of the pond should be between 1.5 to 2 m should be maintained throughout the year. Water quality must be checked for any contamination or pollution.

There is need to carefully examine the land location for the drainage possibility of the ponds carefully during the site selection so that ponds are drained off themselves because of gravity without using extra arrangements like water pumps to take out the water. For draining a pond by gravity, its bottom should be at a level higher than that which the maximum water table reaches during the harvesting periods in a normal year.

Also, the soil base of the pond must be checked for the water retention capacity so that desired water level may be maintained throughout the year and quality of water is ensured.

Supply of water

A fish farm must be feed by regular good quality water throughout the year. Site for farm may be situated near a natural water body to ensure water supply. These could be reservoirs, streams, canals, surface run offs, wells, tube well etc. Also, rain water, water from springs and wells can be assured of good quality. Also to enrich the pond water by oxygen, aerators are installed in ponds. These are agitated to dissolve the oxygen in pond water.

Requirement of a normal fish farm site under Indian conditions

| Particulars | Requirements of a normal fish farm site |
|--------------------------------------|--|
| Nature of terrain | Non rocky with at least 2m deep soil |
| Slope of the terrain | Land should be gently sloping or level |
| Physical quality of soil | Soil fraction should be above 90% of the whole soil, stone and gravel not exceeding 10% |
| Chemical quality of soil | Neutral pH, total nitrogen >0.1%, total phosphorous >0.1%, Organic carbon >1.0%, Free CaCO ₃ >5%. |
| Rate of fall in water level in ponds | Should be less than 1 m per anum |
| Water table | Should not be far below the pond bottom when the soil is not water retentive |
| Water supply | There should be a source of perennial water - supply nearby, sufficient to meet the requirement of the farm |
| Biological productivity | Average plankton production per m ³ should range between 10 ml and 20 ml. |

Source: Ext. Folder No 69, 2014, ICAR, Goa Research stn. North Goa.

Common Fishing Nets (gears) Used At Composite Fish Culture Farm

Commonly fishing nets (also called gears) are generally made of cotton twine, cotton dori, silk twine, sisal, hemp, jute, and coir. Common fishing nets are given below:

1. Gill Net (Fasla Jal) :- Measuring generally 25 to 100 mts. length and 1 to 3 mts. depth. Hanging is 40 to 50%. This net is used in reservoir, tank and pond for catching all types of fishes.



Fig 1.1.15 Gill net

2. Cast Net (Ghumauwa Jal):- Mesh size 30 to 75 at the top and 800 to 1200 mesh at the bottom with sinking force of 3 to 8 times of total weight of the webbing and head rope. Very suitable gear in all types of water bodies for catching small to medium fishes. Live brood fishes can also be caught by this net.



Fig 1.1.16 Cast net

3. Drag Net (Maha Jal): -Measures 30 to 300 mts length, depth range from 4 to 8 mts, upper head rope is of ½ inch, mesh size 2 to 3 inches , sinking force three times of the wt. of the weaving and head rope. Drag net is used for all types of fishes and water bodies not having rocks or trees.



Fig 1.1.17 Drag net

4. Siene Net (Chipni Jal):- This net measures 50 to 150 mts in length, 4 to 6 mts in depth, upper part is mounted with manila head of ½ inch diameter with hanging quotient of 40% to the main webbing. Seine net of different types are used for catching fishes from banks/ shores or deep water bodies. Net is spread from bank to middle of the water body and then forming a circle to drag it for collecting fishes.



Fig 1.1.18 Siene net

5. Plankton Net:- The plankton net is conical in shape having dimension of 250 mm and 880 mm long bag. It consists of net, mouth ring, cold- and assembly and three – point bridle. This is used to estimate population of zoo plankton in the nursery ponds. viz. rotifers, daphnia, zoea etc



Fig 1.1.19 Plankton net

Repair and Maintenance of Nets

The continuous use of net require repair as it gets torned due to its entangling in the pond plants or weeds or due to some other obstacles. The nets are industry made by machines but fishermen are skilled enough to repair the nets after fishing operations and therefore the common knot is known as the fisherman knot. This knot is used for repair of small portions of nets torned off during fishing operations. Also ropes and twines are joined by this knot by fishermen at the farm. Besides repair, nets after each operation need upkeep in desired manner to maintain the nets for their use for longer duration. Common methods of maintenance of nets are given below:

- Due to prolonged and continuous use of fishing nets twine, loose its strength. To regain its efficiency washing, cleaning, coloring and minor repairs are undertaken.
- Rotten part of nets should be washed with detergents and some preservative should be used for their preservation. Sometimes the damaged part is removed and new part is fabricated or damaged part is repaired
- The nets are thoroughly dried to avoid rotting by attack of micro-organisms due to moisture and less sunlight when stored inside the work shed. However, synthetic nets should not be dried under sunlight as they become stiff and de-threaded.
- Preservation of nets done by applying coal tar or neem oil or by chemicals such as Cuprinol, copper sulphate, etc. Also, generally all types of nets are preserved by using tanning liquid @ 100 kg tannin in 800lit of water.

Common Fresh Water Cultivable Fishes and Prawns

Fin Fishes

Indian sps. of carps i.e. Indian major carps

| S.No. | Fish Sps | | |
|-------|-------------|------------------------------------|--------|
| a | Catla | <i>Catla catla</i> | Indian |
| b | Rohu | <i>Labeo rohita</i> | Indian |
| C | Mrigal | <i>Cirrihinus mrigala</i> | Indian |
| d | Carp | <i>Hypophthalmichthys molitrix</i> | Exotic |
| e | Grass carp | <i>Ctenopharyngodon idella</i> | Exotic |
| f | Common carp | Cyprinus , carpio | Exotic |

Shell Fishes

1. Prawn and Shrimps - *Macrobrachium rosenbergii, Peneus monodon*
2. Crab - *Scylla*
3. Mollusc - Unio and Pyla

Exercise

1. What you know about Indian aquaculture write in 500 words.

Ans: _____

2. Write difference between the following:

- Fresh water and brackish water aquaculture.
- Capture and culture fisheries.
- Fin fish and shell fish.

Ans: _____

3. Enlist 2 species each of fishes commonly cultured in different aquaculture systems.

Ans: _____

4. Multiple choice questions. Tick the correct answer.

i. Fin fish and shell fish are cultured in:

- a) Freshwater b) Brackish water
- c) Sea water d) All

ii. Shrimps and prawns are cultured in:

- a) Brackishwater and freshwater respectively b) Both in sea water
- c) Freshwater and brackishwater respectively d) None of these

iii. Trouts are cultured in:

- a) All types of freshwater ponds b) only in hilly region Coldwater
- c) Brackishwater d) None of these

5. State True or False

- i. An ideal fish farm land should not be on the sloppy terrain
- ii. Gill net measures generally 25 to 100 mts in length
- iii. Seine net measures 50 to 150 mts
- iv. Plankton net is used for both zoo and phytoplanktons
- v. Daphnia and zoea are zooplanktons

Notes 

UNIT 1.2: Skill Development Needs for Freshwater Aquaculture

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the acquaint with different types of skills required for freshwater aquaculture
2. Understand the acquaint with tasks required in composite fish culture
3. Learn about practicing on different tasks to develop desired skills

1.2.1 Skill Development Needs for Freshwater Aquaculture

National Standards and Skills

India stand out in the world in the aquaculture production with second position after china. This progress has been achieved because of infusion of modern technology and scientific management. To sustain and exploit full potential of aquaculture sector, the role of skilled manpower has increased manifold. To ensure the quality of aquaculture production throughout the country, the Govt. of India has developed National Occupation Standards (NOS) for different tasks to be undertaken in different vocations including aquaculture sector with respect to freshwater and brackish water aquaculture systems. The skills have to be developed as per the prescribed National Occupational Standards for particular job role. These NOSs have been developed by the national agency the concerned sector skill council such as Agriculture Skill Council of India(ASCI) for the Aquaculture Farmer as mentioned below:

1. Perform pre-culture activities
2. Perform pre-stocking culture activities
3. Perform harvesting and marketing activities for freshwater organisms
4. Ensure safety, hygiene and sanitation practices for culture operations

In view of the above, the skills required to perform the tasks of job role of Freshwater Aquaculture

Farmer are highlighted below in tabular form

| No. | Tasks | Skills |
|-----|---|--------|
| 1. | Seeking guidance - Visit to concern institutions/contacting experts and obtaining information. | |
| 2. | Selection of site - Selection of proper site with respect to topography Water source, soil & water quality. | |
| 3. | Preparation of the project - Preparation of project on fish culture for financial support. | |
| 4. | Arranging the institutional finance - Visit to some of the agencies viz. NABARD, (required) filling of application for loan, subsidies and insurance. | |

5. Creating infrastructural facilities - Establishment of 1 or 2 ha fish farm for composite fish culture
6. Fish health and management - water quality control to avoid common fish diseases.
7. Stocking, harvesting and marketing - Harvesting of seeds from nurseries, segregation, conditioning and packing, price formulation, demand and supply analysis for marketing.
8. Observations on
 - a. Soil - Texture and permeability testing
 - b. Benthos - Handling and operating benthos samplers and sieves
 - c. Water - Collection of water samples and analysis of pH, Do, CO₂, total alkalinity, etc.
 - d. Plankton - Collection and preservation of plankton Quantitative estimation of plankton Identification of common planktons.
9. Identification of common nets Identification of plankton nets, nursery nets, hand their Uses and maintenance nets, cast nets, seine nets, gill nets, etc. Acquaintance with mesh size regulation with respect to size of fishes to be netted.
10. Eradication of weeds and - Identification of weeds, methods of removal; deweeding, handling of deweeding equipment, preparation of chemicals. For spraying Identification of aquatic insects, eradication of insects, by netting and oil emulsion method.
11. Application of lime, manure - Identification of lime, manure and and fertilizers fertilizers. Estimation of their doses , phased manuring, preparation and application.
12. Selection of brooders - Identification of male and female fishes.
13. Identification of: - Identification of fry and fingerling of carps
 - a) Carp Seeds
 - b) Eggs - Fertilised and unfertilised
14. Storage and application of - Identification of feed ingredients, supplementary feed mixtures. preparation of feed mixture, storage and application of feeds.
15. Seed packing and transport - Conditioning of seeds, packing of seeds with Oxygen, transport of seed in different containers.
16. Recording and maintenance of field - Recording of data for fish seed stocking and Data and records. fish feed,
17. Fish handling and storage - Packaging and preservation of harvested fish.

Exercise

1. What is the importance of skill development? write in 500 words.

Ans: _____

2. What are NOSs and why are they required?

Ans: _____

3. Enlist five major skills according to you required for fresh water aquaculture/ fish culture and why?

Ans: _____

4. Undertake survey and enlist lower and middle level work force engaged at the fish farm and tasks assigned to them.

Ans: _____

5. Based on the survey, prepare a table showing existing and required skills (as per your suggestion) of the human resource engaged at the farm.

Ans: _____

Notes

UNIT 1.3: Enterprises in Freshwater Aquaculture Sector

Unit Objectives

At the end of this unit, you will be able to:

1. Acquaint the trainees with the scenario of existing and emerging enterprises in aquaculture
2. Prepare a project to run an enterprise in any of the aquatic systems
3. Enlist different culture systems to make a choice for future enterprise
4. To enlist enterprises in aquaculture in ancillary areas such as consultancy, providing services and supply chain of materials required in aquaculture industry

1.3.1 Enterprises in Freshwater Aquaculture Sector

Aquaculture has given worldwide recognition to India with second position in the world. Fisheries sector as a whole has transformed into an industry with numerous ancillary occupation. In view of this, development of skilled lower and middle level manpower of a significantly high magnitude is long overdue. This is also required to set up and sustain enterprises in aquaculture with infusion of technological innovations. The economic activities or enterprises in aquaculture sector are of two types. The first one is culture system including integrated aquaculture enterprises and the second one is supply chain of various equipment, tools, raw materials, infrastructural facilities, manufacturing, services and marketing, etc.

Integrated Aquaculture Enterprises

The skilled and experienced enterprises look for multi pronged approach to maximise production through same area say one ha, by using many other related business activities. This enterprising approach enhances income per hectare. The examples of per such activities could be multiple stocking and harvesting, use of intensive aquaculture approach, such as supplementary feeding, heavy stocking of fingerling stages for more survival rate and better yield. The enterprises could be integrated fish farming along with duck, poultry, livestock and horticultural production at bundhs. All these strategies may increase the production from 1 ha to only 4000 kg of fish to about 10 tonnes of production of fish, dairy, poultry, vegetables/fruit production. Other integrated system could be used are rice cum fish culture, makhana cum fish farming, supply fish seeds, supply of brooders, supply of fingerlings etc. Game fishing and tourism fisheries ventures offer a very attractive enterprise. An established farm with camping facilities or resort, boats, supply of game fishing accessories, and tourist travel and hospitality management can become a part of state tourism as tourism fisheries.

A. Enterprises in Culture System

As discussed in previous unit that there are various aquatic ecosystem viz. freshwater, brackish water and marine water. Corresponding to there are culture systems to culture economically important fin fish and shell fish in these waters. Fins fishes are true fishes having fins where as shell fishes include

aquatic organism having shells which include prawns & shrimps, mussels', molluscs. The enterprises in culture include running farm and hatcheries. Examples of fin fish and shell fish culture systems in various aquatic ecosystems are given below:

Freshwater

- Culture of Indian major carps and Exotic carps (Polyculture)
- Culture of trouts in cold waters.
- Culture of freshwater prawns i.e. *macrobrachium rosenbergii*.
- Culture of live fishes i.e. singhi, magur, channa sps. etc.
- Culture of aquarium fishes or ornamental fishes.

i) Brackish Water

- Culture of mullets
- Culture of shrimps, *Peneaus monodon*, *P. indicus*.
- Culture of crabs sps.
- Culture of fin fish sps. *Liza*, *Chanos*, *Etroplus* etc.

ii) Marine Water

- Culture of Mussels
- Culture of edible oyster.
- Seaweed Culture.
- Pearl Culture.
- Fin fish Culture.

B. Enterprises in Providing Services and Chains for Supplying Materials

Consultancy Services

- Setting up of Aquaculture farm
- Setting up of hatchery
- Selection of culture and viable project proposal development
- Developing project for game and tourism fisheries

Supply Chains

- Supply of fish seeds induced breeding agents, growth promoting hormones, raw material, feed, fishing nets, equipment, fertilizers ,etc.
- Supply of brooders
- Infrastructural Development for fish/ aquafarm and hatchery
- Marketing of fish seed and table fish.
- Supply of boats, game fishing accessories, camping facilities etc.

Enterprises in Freshwater Fishculture

- Production and marketing of table fishes.
- Production of brooders for composite fish culture
- Production of seeds of cultivable fishes in indoor/ circular hatching.
- Fish meal production as supplementary feed.
- Fishing net making unit.
- Supply of fish fillet to fish corners at eating joints.
- Production of Air breathing fishes.
- Production of Ornamental fishes.
- Game fishing
- Tourism fisheries

Exemplar Project For Setting Up Enterprise

Production and Marketing of Table Fish

1. Objectives

- i. To produce table size fish on commercial basis.
- ii. To market and meet the demand of local consumers for table size fish.

2. Locality and Area of Operation

- The locality should be chosen on the basis of availability of water for the cultivation of fish and quality of soil.
- The area of operation could be rural and semi-urban area.

3. Marketing Plan

- Existing market - Contacting local fisherman/retailer for supply of fish for the local market.
- Future demand - Contacting retailers/ wholesalers for assessing demand on the basis of consumption per month.
- Marketing strategies - Liasoning with local retailers/ wholesalers.
- Tie up - Fish farmers development agency and fisheries cooperatives.

Tips

Role of Fish Farmers Development Agency

- To provide training and popularize fishery related vocations to the rural people by self and wage employment
- To make efforts in strengthening and empowering fishers community
- Arranging training and guiding fishermen cooperative societies to get the benefits of government schemes and obtaining subsidy for making their fishery project viable

Source: www.fisheries.tn.gov.in

Role of Fisheries Cooperative Society

- Helping in marketing of fish
- Arranging storage facility
- Market information
- Price formulation
- Weighing facility
- Cold storage facility
- Processing and transportation
- Financial assistance to fishermen

Source: shodhganga.inflibnet.ac.in

4. Project Components

- One hectare water area
- Tube well
- Feed
- Nets
- Equipment

5. Assumptions

- Own water area (1 ha) is available for the cultivation of fish.
- Fish production
 - (a) Production level per hectare : 4000kg
 - (b) Cost of table size per kg : Rs. 40
- Bank loan will be 80% of the actual project cost or the amount required for launching the project, whichever is applicable.
- Repayment of the bank loan will be done in 60 monthly installments. The loan can negotiate on the period of moratorium needed for setting up the infrastructure.

6. Financial Details of the Project

A. Project Cost

(a) Capital Cost

| | | |
|-------|---|----------------------|
| (i) | Layout and construction charges For 1 hectare water area | Rs. 55,000 |
| (ii) | Shallow tube well/ pump set/ Guard shed | Rs. 55,000 |
| (iii) | Nets and accessories | Rs. 10,000 |
| | Total | Rs. 1, 20,000 |

(b) Variable Expenses

| | | |
|------|---|----------------------|
| (i) | Fish seed (10,000 per hectare) @Rs. 0.50 | Rs. 5,000 |
| | Feed | Rs. 25000 |
| (ii) | Manuring, limiting and fertilizing, Water quality monitoring, etc. | Rs. 12,000 |
| i. | Salary of fisherman @ Rs. 1000 Per person per month for one year | Rs. 12,000 |
| ii. | Miscellaneous (wages for netting etc.) | Rs. 2,000 |
| | Total | Rs. 62,000 |
| | Total project cost (a+b) (1, 20,000+62,000) | Rs. 1, 82, 00 |

B. Financial Pattern

| | | |
|-----|--------------|-----------------------|
| (a) | Bank loan | Rs. 1,45,600 |
| (b) | Margin Money | Rs. 28,900 |
| © | Subsidy | Rs. 7,500 |
| | Total | Rs. 1, 82, 000 |

C. Expenditure

| | | |
|-------|--|--------------------|
| (a) | Fixed Expenses | |
| (i) | Interest on bank loan @ 11% annum | Rs. 16,016 |
| (ii) | Depreciation for pump And equipment @ 10% | Rs. 6,500 |
| (iii) | Miscellaneous (insurance, etc.) | Rs. 1,200 |
| | Total | Rs. 23, 716 |
| | Say | Rs. 24,000 |

| | | |
|-----|---|-------------------|
| (b) | Variable Expenses | Rs. 62,000 |
| | Total expenditure (a+b) (24,000+62,000) | Rs. 86,000 |

D. Total Receipts

| Product | Rate | Quantity | Value |
|-----------------|-----------|----------|---------------|
| Table Size fish | Rs. 40/kg | 4000 kg | Rs. 1, 60,000 |

E. Profit Per Annum (D-C)

(1, 60,000 – 86,000)

Rs. 74,000

F. Installments (60)

(1, 45,600/60)

Rs. 2,426

G. Net Profit per Month

Rs. 6,166

Note: The figures given are exemplar to develop an understanding of calculations. Bank loan percentage is also not the current one.

6. Project at a Glance

Selection of the project should be done on the basis of the demand of table size fish in local market. After deciding to set up the project, following steps may be followed:

- (i) Contact Bank, District Industry Centre (DIC) and other concerned Government agencies to finalize the project.
- (ii) Ensure that the application is forwarded to the bank or any other financial institution advancing loan.
- (iii) Finalise the loan scheme with the Bank.
- (iv) Prepare pond
- (v) Procure equipment.
- (vi) Procure raw material for preparation of feed.
- (vii) Procure various cultivable fish seedlings.
- (viii) Maintain water level and ensure timely feeding.
- (ix) Perform trial netting and monitor continuously.
- (x) Harvest and market table fish.

Exercise

1. Visit a fish farm and collect information about quantity and prices to take up fish culture in paddy fields. Make a table to show recurring expenses per year for producing 10,000kg of fish in paddy fields.

Ans: _____

2. Procure information from the bank for taking loan for fish production and ponds on lease. Submit a report.

Ans: _____

3. Procure recent information on the role of FFDA in the marketing of the fish

Ans: _____

4. Prepare a plan to establish a unit ornamental fish production.

Ans: _____

5. Compile information on prospects of game fishing and tourism fisheries in your district by undertaking a survey. Submit a report.

Ans: _____

Notes 

