



# CLIMATE PROOFING FISH FARMING

A SLEM BEST PRACTICE

GIZ and Ministry of Environment, Forest and Climate Change developed a SLEM best practice on Climate-proofing Fish Farming which ensures livelihood security through fish farming in the changing climate.

The fact that fish constitutes the most important part of 60% of India's population highlights the possibilities that this sector holds. India's climate is conducive to fish cultivation thereby reducing the inherent risks in fish cultivation. The demand and the market price always stay at a high given fish being a high source of protein. Fish farming can also form an important component of integrated farming in the rural areas that can enable holistic and judicious utilization of natural resources in the area. Projected climate change and extreme climatic events are leading to change in rainfall pattern and shift in monsoon. Poor and marginal farmers are more likely to be adversely affected due to climatic changes.

Rate of growth and production of fish are likely to be adversely affected by increase in water temperature. Higher water temperatures also result in less quantity of dissolved oxygen available for fish. Delayed monsoon may cause delay in introduction of fish seeds resulting in low harvest from ponds. Size of the pond and its structure/construction should be adequate enough to hold water till next monsoon season. Alternate water sources may be required in the event of delayed or inadequate rainfall.



In the state of Chhattisgarh and Madhya Pradesh, small farmers traditionally depend on rainfed agriculture for their livelihood. Excessive extraction of ground water for irrigation is causing severe depletion of water sources as recharge rates are very low.

Climate-smart approaches in fisheries aims to overcome the vulnerability of poor farmers overarching by providing income generation opportunities, achieving sustainable food systems, reduce the vulnerability of the sector to the impacts of climate change and to enable fish farming practice, where possible, to contribute to the mitigation of greenhouse gas emissions during the harvest and production stages. Climate fish farming besides providing the income generation activities, will also lead to conservation of water resources and generation of sustainable livelihoods.

## Prerequisites for fish farming

The ponds for fish farming may be seasonal or perennial. It is absolutely essential to check for any leakage and to take corrective action promptly. Fish seed should be introduced only after 3 to 4 days after filling the pond with water. High productive and fast-growing species must be selected for fish farming. Arrangement of feed for the fish which can in turn be of two types- 'internal feed' which includes insects, protozoans, algae etc. found in the pond and 'external feed' which includes flour, rice and the readymade food available in the market, and tending which includes protection against diseases, periodic fertilization of the ponds and the measurement of pH of pond which should be maintained at 7-8 for optimum growth.

## Nursery pond management

Small water bodies of 0.02-0.10 ha with depth of 1.0-1.5 m are preferred for nurseries though areas up to 0.5 ha can be used for commercial production. Drainable or non-drainable earthen ponds and cement cisterns are the different systems used for nursery rearing of fry.

The different steps involved in nursery raising of fry are as under:

### Pre-stocking pond preparation

- ▶▶ **Clearance of aquatic vegetation:** Aquatic weed clearance is the first operation in pond preparation. Generally, manual methods are only used in nursery and rearing ponds, as they are shallow and small in size. In bigger ponds mechanical, chemical and biological methods can be used for eradication of aquatic weeds.
- ▶▶ **Eradication of predatory and weed fish:** Various predatory/ weed fish besides predatory animals like snakes, tortoises, frogs, birds, otters, etc present in ponds pose problems for survival of young fish besides competing with the for space and oxygen. Dewatering and drying the ponds or application of suitable piscicides are the methods adopted for eradication of predatory and weed fish. Application of mahua oil cake @ 2,500 kg/ha-m three weeks before stocking of fish seed is suggested.
- ▶▶ **Pond fertilization:** Planktons are the preferred natural fish food organisms that are produced by fertilizing the culture ponds. The ponds used for seed production are first limed and then treated either with organic manures such as cowdung, poultry dropping or inorganic fertilizers or both, one following the other. Mixture of groundnut oil cake 750 kg, cowdung 200 kg, and single super phosphate 50 kg/ha is found to be very effective in production of desired plankton. Half of the above amounts, after being mixed thoroughly by adding water to make a thick paste is spread throughout the nursery 2-3 days prior to stocking. The rest amount is applied in 2-3 split doses depending on the plankton level of the pond.

- ▶▶ **Control of aquatic insects:** Aquatic insects and their larvae compete for food with the young growing fish and also cause large-scale destruction of hatchlings in nurseries. Application of soap-oil emulsion (cheap vegetable oil @ 56 kg/ha with 1/3 its weight of any cheap soap) is a simple and effective method to kill the aquatic air-breathing insects. Kerosene @100-200 litre or diesel @75 litre and liquid soap @ 560 ml or detergent powder @ 2-3 kg/ha water area can be used as substitute to make the emulsion.
- ▶▶ **Stocking:** After three days of hatching, the spawn are transferred to the nurseries. The stocking is done preferably during morning hours by acclimatizing them to the new environment. The normal density of spawn recommended for earthen nursery is 3-5 million/ha. However, higher densities of 10-20 million/ha can be followed in cement cisterns.



## Post-stocking pond management

The phase fertilization is done in 2-3 split doses during the culture period of 15 days. Finely powdered mixture of groundnut oil cake and rice bran at 1:1 ratio by weight are provided as supplementary feed @ 6 kg/million for the first 5 days and 12 kg/million spawn per day for the subsequent days in two equal instalments. With adoption of scientific methods of rearing, the fry attain the desired size of 20-25 mm with survival of 40-60% in 15 days rearing period. Since nursery-rearing period is limited to 15 days, the same nursery can be utilized for multiple cropping, at least for raising 2-3 crops in case of earthen ponds and 4-5 crops in case of cement cisterns.

**Technical design of the pond:** The aim of recommending technical design of the pond is to ensure that there is sufficient water that allows fisheries to be conducted for at least 10 months in the year. This implies that the water should be at least 6 ft deep even during the summer months. This depth will have the advantage of providing the fish farmer sufficient quantities of water to prepare the pond for the next season. The ponds should be rectangular for better management.

- ▶▶ **Depth:** The fish require water of 6-8 ft of depth. Greater depth is being proposed for water retention for longer duration
- ▶▶ **Length and breadth:** Design of less than 0.5 ha be allowed for fisheries
- ▶▶ **Site location:** Alternative source of water be available
- ▶▶ **Water retention:** Minimum 6 months, however the greater retention, the better it is for fish cultivation
- ▶▶ **Control of weeds**
  - Mechanical: Safe but costly
  - Biological: Through Grass carp 150-200 kg/ha (300-500 no.), safest and most beneficial
  - Chemical:
    - For floating: 2-4-D; 5-10 kg/ha
    - Submerged: Ammonia 10-15 ppm
    - Algae: Diuron/ Simazine 0.1-0.3 ppm
- ▶▶ **Use of manure and lime**

**Lime:** 250 -500 kg/ha/year to be sprayed as solution based on the pH of the pond.

**Manure:**

  - Organic
    - Cowdung: 10-15 tonnes/ha/year
    - Poultry droppings: 6 tonne/ha/year
  - Inorganic
    - Urea: 100-150 kg/ha/year
    - Single Superphosphate: 150-200 kg/ha/year

Any manure as above can be used for manuring the pond. One third portion of the above mixture of lime and manure should be administered as solution one week before the procurement of the seed.



## Selection of species for Fish farming

The recommendation for fish species is based on the preference of the consumer and the need to conduct fisheries for the major part of the year. The recommendations are based on:

- ▶▶ Fast growing
- ▶▶ Sustained demand in the region
- ▶▶ Multiple species can be cultivated at the same time for better utilization of resources- for instance surface fish, fish living at medium depths and bottom dwelling fish, the best example of which can be Rohu, Mrigal and Catla.
- ▶▶ **Species:** Rohu/ Katla/ Common Carp
- ▶▶ **Distribution of Fish Species:** 30:30:40
- ▶▶ **Density of fingerlings:** 15,000



Species of Fish  
can be cultivated ▶



Common Carp  
(Most Preferred)



Rohu



Grass Carp



Silver Carp



Catla



Mrigal

**Marketing :** Three types of markets are identified for fish. These are local haats, major markets and permanent shops. The small fish farmers are most likely to operate at the haat level and hence the haat market should be focussed.

## Problems in fish farming

- ▶▶ **Diseases:** Diseases form one of the biggest challenges in fish farming. About 28 different types of diseases have been observed which are classified according to their causative agents. Infectious which include diseases caused by Bacteria, Fungus, Parasites, Protozoa, Virus and other miscellaneous reasons, and Non-infectious diseases
- ▶▶ Predators including birds, predator fish and mammals
- ▶▶ Pollution
- ▶▶ Poor infrastructure forces the fishermen to harvest fish in small quantities and forces them to sell at distress prices as well
- ▶▶ Fish farmers and fishermen do not have access to banks and financial institutions to enable them to make investments in fishing and market infrastructure.

## Prevention of fish disease

It is difficult to identify the appearance of disease in its initial stage on account of the gregarious nature of fish in water and therefore, effective preventive measures must be taken since this is a key link in fish disease control.



## General preventive measures

- » Increasing the internal resistance of fish is important in the prevention of diseases.
- » Selection of healthy fish seed
- » Proper density and rational culture
- » Careful management
- » Qualitatively uniform ratio and fresh food
- » Good water quality
- » Prevention of fish body from injury
- » Abolishing pathogens and controlling its spreading
- » Existence of pathogen is one among three factors (Host, Causative Agent and Environment) in outbreak of fish disease



## Controlling Measures for Pathogen

- » **Thorough Pond Cleaning and Disinfection:** Bleaching powder (chlorinated lime) should be applied at the rate of 50 ppm in the pond. It readily kills all the wild fish species, molluscs, tadpoles, crabs and disinfects pond soil and water. In nursery and rearing ponds, it is desirable to use malathion at the rate of 0.25 ppm 4-5 days prior to stocking of fish seeds.
- » **Disinfection of Appliances:** Nets, gears, plastic wares etc. should be sun-dried or immersed in a disinfectant solution.
- » **Disinfection of Fingerlings and Feeding Platform:** Disinfection with mild concentration of potassium permanganate solution is helpful during the transfer of the fingerling to stocking tanks. The feeding platform can be disinfected by hanging bleaching powder cloth bags with mixture of copper sulphate and ferrous sulphate (in 5:2) near the feeding place.
- » **Proper Feeding:** Fixed quality, quantity, time and place have to be followed for proper feeding. Any reduction in quality and quantity and variations in feed application and place may cause not only deficiency disease, but also will increase the susceptibility to many infectious diseases.
- » Segregation of brood and older fish from young fish, as the older fish may serve as carriers of disease-causing organisms.
- » **Spot removal of dead fish from the pond:** Dead and sick fish should be removed as soon as it is located.
- » **Chemoprophylaxis:** Occasional pond treatment with potassium permanganate at the rate of 2-3 ppm and dip treatments with potassium permanganate at the rate of 500 - 1000 ppm for 1-2 minutes or short bath in 2-3% common salt solution is safe.
- » **Immunoprophylaxis:** Immunisation programme is gradually emerging as one of the most important measures for preventing infectious disease.

Vaccine against *Aeromonas hydrophila*, *Flexibacter columnaris*, *Edwardsiella ictaluri*, *E. ictaluri*, *Aeromonas salmonicida*, *Yersinia ruckeri*, *Vibrio anguillarum* and several viral pathogens such as IPNV (Infectious Pancreatic Necrosis Virus), CCVD (Channel Catfish Virus Disease), VHSV (Viral Haemorrhagic Septicaemia Virus), IHNV (Infectious Haemopoietic Necrosis Virus), etc. are being tried on large scale.

## Other key information

- ▶▶ One year old seed gives higher production
- ▶▶ Water quality should be focussed upon. If the colour of the pond water turns green and fish come to surface for breathing, then spray lime solution at 100 kg/ha and postpone manure and feed.
- ▶▶ Reduce feed and manure on cloudy days, as this reduces dissolved oxygen
- ▶▶ Replace at least half of pond water with fresh water, if dissolved oxygen reduces.

Indian Council of Forestry Research and Education (ICFRE), Dehradun as Ecosystem Services Improvement Project Implementing Unit (ESIP-PIU) is building the capacity of the local communities of ESIP project areas of Chhattisgarh and Madhya Pradesh for upscaling of climate proofing fish farming with the technical assistance of the institutions dealing the fisheries.



## Brief About ESIP

The World Bank funded Ecosystem Services Improvement Project (ESIP) supports the goals of the Green India Mission by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits. ESIP will introduce new tools and technologies for better management of natural resources, including biodiversity and carbon stocks. Main components of the project are: strengthening capacity of government institutions in forestry and land management programs, improving forest quality, and scaling up of sustainable land and ecosystem management (SLEM) best practices. ESIP is being implemented in the states of Madhya Pradesh and Chhattisgarh by Indian Council of Forestry Research and Education, Chhattisgarh State Forest Department and Madhya Pradesh State Forest Department under the overall direction of Ministry of Environment, Forest and Climate Change, Government of India.

## Brief About ICFRE

Indian Council of Forestry Research and Education (ICFRE) is an autonomous body of the Ministry of Environment, Forest and Climate Change, Government of India. It is an apex body in the national forestry research system that promotes and undertakes need based research, education and extension in the forestry sector. It has a pan India presence with its 9 research institutes (Arid Forest Research Institute, Jodhpur; Forest Research Institute, Dehradun; Himalayan Forest Research Institute, Shimla; Institute of Forest Biodiversity, Hyderabad; Institute of Forest Productivity, Ranchi; Institute of Forest Genetics and Tree Breeding, Coimbatore; Institute of Wood Science and Technology, Bengaluru; Rain Forest Research Institute, Jorhat and Tropical Forest Research Institute, Jabalpur) and 5 centers located at Agartala, Aizawl, Prayagraj, Chhindwara and Visakhapatnam. Each institute are directs and manages research, extension and education in forestry sector in the states under their jurisdiction.

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