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FISH REARING AND MANAGEMENT

TRAINING MANUAL

COMPOSITE FISH CULTURE

1. INTRODUCTION

Meghalaya with its vast inland fishery resources in the form of rivers, reservoirs, lakes and ponds and an average rainfall of 1200 mm offers tremendous scope for developing the fisheries sector. With so much potential, however, only small part is utilized for fish culture. Though the State is predominantly a fish consuming State, the supply of fish is inadequate to meet its growing demand, making the State import fish from Andhra Pradesh. Though farmers are practicing fish culture, but still the technology of scientific fish culture has not been well established among them for which the farmers are not able to harvest desired yield. But through scientific culture practices like composite fish farming, production can be enhanced.

The technology developed for fish culture in which compatible and non-competing fishes are cultured simultaneously through the utilization of different feeding zones (all the natural niches) from a pond so as to increase the total production from unit area of water is known as Composite Fish Culture and it is the most popular culture technique in the country. Among many fish farming practices, the composite fish culture is one, which a common fish farmer can easily adopt with comparatively less investment to have more production and income than the traditional farming practice. In principle, the methodology of composite fish culture remains the same all over with minor modifications to suit the local needs.

2. POND MANAGEMENT

Pond Management plays a very important role in fish farming before and after the stocking of fish seed. There are three management practices generally adopted in composite fish culture. These are-

A. Pre-stocking management
B. Stocking management and
C. Post stocking management

A) Pre-stocking management

For new ponds, pre stocking operations starts with liming and filling of the pond with water. For existing pond, the first step is to remove the unwanted weeds and undesirable fishes from the pond.

i) **Removal of weeds-** there are different methods but the safest way is to remove manually.

ii) **Removal of unwanted and predatory fishes-** it is also done manually by repeated netting or by complete dewatering and sun drying the pond bed.

iii) **Liming:**

The soils/ tanks which are acidic in nature are less productive than alkaline ponds. Lime is used to bring the pH to the desired level. Lime is an essential component in fish farming practice. When applied in proper dose, it help in releasing primary nutrients and trace elements from the soil to maximize productivity. For effective utilization of lime, ponds are required to be dewatered which help in drying the pond bottom, killing of disease causing parasitic organisms. Basal dose of lime is applied to correct soil acidity. Powdered lime or Agricultural lime (CaCO3) is the safest and best liming material. The basal, monthly and annual requirement of lime is indicated below:

Basal Dosage of lime (kg/ha)	Month Dosage (kg/ha)	Annual lime requirement (kg/ha)
200	65	800

iv) Application of Manure :

Manure is also essential in fish farming practices to increase pond productivity. Cow dung, the commonly available organic manure in raw form is applied @ 15 tons/ha/yr to enhance natural food productivity. 25% is applied as basal dose atleast 10-15 days prior to stocking of fish. Daily application of manure throughout the pond or atleast in the four corners is advocated as per following rate:

Basal Dosage of cow dung (kg/ha)	Month Dosage (kg/ha)	Annual cow dung requirement (kg/ha)
3750	45	15,000

B. Stocking management

The pond will be ready for stocking after 10 - 15 days of application of organic manure.

Stocking density- 10,000 – 12,000 nos. 3-10 cm fingerlings per hectare or 1000-1200 nos. per 0.1 ha (1000 m^2)

Fish species involved in composite fish culture

Depending on the compatibility and type of feeding habits of the fishes, Indian as well as Exotic varieties have been identified and recommended for culture in the composite fish culture technology.

Species, feeding habits and feeding zone

	Sl. No.	Scientific name	Common name	Local name	Feeding habit and feeding zone
INDIAN MAJOR CARPS	1.	*Catla catla*	Catla	Kha baw	Zoo plankton feeder Surface feeder
	2.	*Labeo rohita*	Rohu	Kha bah	Omnivorous Column feeder
	3.	*Cirrhinus mrigala*	Mrigal	Kha mirka	Detritivorous Bottom feeder
EXOTIC CARPS	4.	*Hypopthalmichthys molitrix*	Silver carp	Kha silver	Phytoplankton feeder Surface feeder
	5.	*Ctenopharyngodon idella*	Grass carp	Kha bam phlang	Herbivorous Surface, column and marginal areas
	6.	*Cyprinus carpio*	Common carp	Kha dkhar	Detritivorous/ Omnivorous Bottom feeder

Species combination

Generally, the species ratio is 30-40 % surface feeder; 15-20% column feeder, 40-50% bottom feeder and 5-15% macro vegetation feeder depending upon the depth and productivity status of the pond. Species combination and proportion in North Eastern Region depends on the altitudinal variations and agro-climatic conditions of the region. Moreover, due attention should be given to the biological production in the pond and the availability of aquatic/terrestrial weed for grass carps. In composite fish culture pond, fingerlings should be stocked in the following ratio according to the altitudinal variation-

Species	**In lower altitudes (upto 2500 feet msl) with warm temperature**		**In medium altitude (upto 3500 feet msl):**		**In higher altitudes (above 3500 feet and below 4500 feet msl)**	
	% ratio	**No./ha**	**% ratio**	**No./ha**	**% ratio**	**No./ha**
Catla	20	2000	20	2000	-	-
Rohu	20	2000	10	1000	-	-
Mrigal	15	1500	10	1000	-	-
Silver carp	20	2000	30	3000	40	4000
Grass carp	10	1000	10	1000	25	2500
Common carp	15	1500	20	2000	35	3500
Total no. of fish/ha		**10,000**		**10,000**		**10,000**

(Source: ICAR, Umiam)

Other species like *Labeo gonius (Kha ski), labeo bata,* etc can also be stocked together in the same pond.

C. Post stocking management:

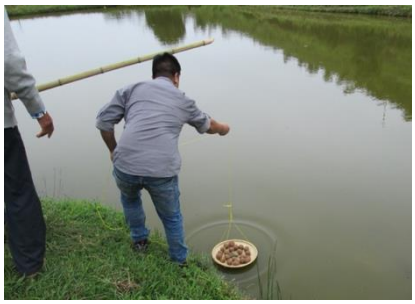
i) Supplementary Feeding:

Supplementary feeding is a very essential input in culture fisheries because natural food available in a pond is insufficient for rapid growth and higher production of fish. The supplementary feed comprising of rice bran/wheat bran and mustard oil cake /ground nut oil cake in the ratio of 1 : 1 are mixed together with some water and broadcast in the four corners of the pond.

Tray or basket Feeding: To form dough, small quantity of flour (as binder) is added to the mixture, which is then made in to small balls and kept in bamboo trays. The trays are then placed at a particular depth of the pond, tied to a pole, fixed on the embankment, to avoid displacement of the trays. In this way feed wastage is minimized. For a hectare pond, 10 to 15 trays placed at different locations are sufficient. The feed is provided two times in equal amount-in the morning and in the afternoon@ 2-3% of their body weight.

Bag Feeding: The feed mixture can also be kept in feeding bag (with perforation at the sides) that is tied with a rope and suspended at specific depth (1-5 – 2.5 ft) in the pond.

Chopped green vegetation (banana leaf, any soft grass, etc) is provided for grass carp in 2-3 fixed places.

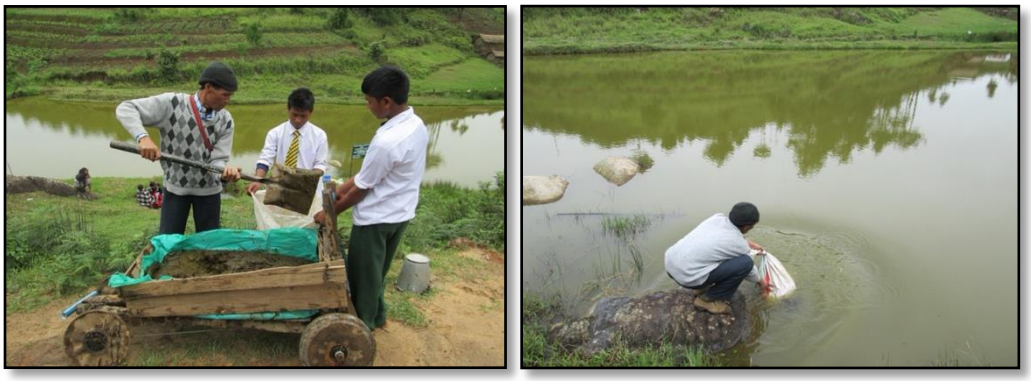



ii) Liming:
Liming is also done once a month @ 65 kg/ha or 6.5 kg/1000 m^2

Fig: Liming (Agricultural lime) in fish pond

iii) Manuring

Cow dung is applied once a month @ 1000 kg/ha or 100 kg/1000 m^2



3. HARVESTING

Harvesting is generally done at the end of first year. With Proper management, a production of 2.5 to 3 tons/ha can be obtained in a year (this can vary according to the management practices and also the climate). Harvesting is done by partial dewatering and repeated netting. In some cases complete dewatering of ponds is resorted to. Some farmers resort to partial harvesting also depending on the season and demand for fish.

4. CONCLUSION

Farmers/unemployed youths can easily take up fish culture in village ponds, tanks or any new water body and can improve their financial position substantially. It also creates gainful employment for skilled and unskilled youths. Any perennial fresh water pond/tank retaining water depth of 2 metres can be used for fish culture purpose. However, the minimum level should not fall below one metre. Even seasonal ponds can also be utilised for short duration fish culture. It is establish that fish culture is a highly profitable venture if properly managed. The unemployed youth of our state may go for fish culture practices to earn their livelihood by adopting improved method of fish farming.

Annual Work Calendar:
The Annual Work Calendar for proper management under semi-intensive composite fish culture activity is outlined below:

Year round activity Schedule

MONTH	ACTIVITIES	REMARKS
	PRE-STOCKING MANAGEMENT	
FEB to MAR	Weed clearance, Dewatering and removal of unwanted fish.	
MAR to APR	Dyke repairing side slope maintenance, embankment repair, bottom soil correction by application of lime and application of basal dosage of organic manure after 7-10 days of application of lime.	1/4th or 25% of the quantity of lime and cow dung in pond bed as basal dosage. Maintain side slope as per the soil texture.
APR to MAY	Stocking of Seed (fingerlings): Supplementary feeding Liming. Manuring and fertilization. Keep embankment clean. Test netting Fish Helth monitoring	Daily supplementary feeding with Rice polish and Mustard Oil cake. Feed chopped grasses to Grass carp.
	POST STOCKING MANAGEMENT	
MAY to JUN	Liming, Supplementary feeding Manuring and fertilization. Keep embankment clean. Test netting. Fish Health monitoring.	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp.
JUN to JULY	Liming Supplementary feeding Manuring and fertilization. Keep embankment clean. Test netting. Fish Health monitoring.	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass crap.
AUG to SEP	Liming Supplementary feeding Manuring and fertilization. Keep embankment clean. Control algal bloom. Test netting. Partial Harvesting Fish Health monitoring.	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass crap. Partial Harvesting 40% out of the total fingerling stocked only in case of MSMH
SEP to OCT	Liming Supplementary feeding Manuring and fertilization. Control algal bloom. Test netting. Fish Health monitoring.	Supple,entary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp.
OCT to NOV	Liming Supplementary feeding. Manuring and fertilization. Control algal bloom. Test netting Fish Health monitoring. Partial Harvesting	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp. Partial Harvesting 40% of the total fingerlings stocked in case of SSMH and 25% of the total fingerlings stocked in case of MSMH

NOV to DEC	Liming Supplementary feeding Control algal bloom. Manuring and fertilization. Test netting. Fish Health monitoring	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp.
DEC to JAN	Liming Supplementary feeding Control algal bloom. Manuring and fertilization. Test netting. Fish Health monitoring.	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp.
JAN to FEB	Liming Supplementary feeding Manuring and fertilization. Control algal bloom. Test netting. Fish Health monitoring	Supplementary feeding with Rice polish and Mustard Oil cake on daily basis. Chopped grasses to Grass carp.
FEB to MAR	Supplementary feeding Control algal bloom. Fish Health monitoring Final Harvesting.	Harvesting remaining fingerlings stocked in case of MSMH &

INTEGRATED FISH FARMING

The principle of integrated fish farming involves farming of fish along with livestock or/and agricultural crops. This type of farming offers great efficiency in resource utilization, as waste or by-product from one system is effectively recycled. It also enables effective utilization of available farming space for maximizing production.

Fish culture in combination with agriculture or livestock is a unique and lucrative venture and provides a higher farm income, makes available a cheap source of protein for the rural population, increases productivity on small land-holdings and increases the supply of feeds for the farm livestock. The scope of integrated farming is considerably wide. The system provides better production, provides more employment, and improves socio-economic status of farmers and betterment of rural economy.

Integrated fish farming can be broadly classified into two, namely: Agriculture-fish and Livestock-fish systems. Agri-based systems include rice-fish integration, horticulture-fish system, etc. Livestock-fish system includes pig-fish system, poultry-fish system, duck-fish system, cattle-fish system, goat-fish system, etc.

FISH CUM AGRICULTURE

A. Rice-fish Integrated Farming System

Rice is one of the major crops and staple food of Meghalaya which is grown in a wide range of climatic conditions. Water logged rice field forms natural habitat to many aquatic organisms and offers a good environment for fish which can be integrated and enhanced to improve the livelihood of the farmers. This kind of integration is very well suitable for fish as well as paddy and they function together. Rice-fish culture system is relatively easy, low cost and low risk.

Recently, many farmers have converted their rice fields to fish ponds although productive since most of them have no choice as they are small land holders. Expecting the benefits in terms of enhanced productivity, optimum and double utilization of paddy field, integrated rice-fish farming is one of the most ideal methods for farmers and this will discourage them from converting their rice fields to fish ponds.

Advantages

- Plenty of natural fish food.
- Biological control of pest as fish eats a number of harmful insects.
- Rooting activity of fish helps control weeds.
- Increase in organic fertilization by fish excreta and remains of artificial feed.
- Better tillering of the paddy seedlings due to the activity of the fish.
- Fish stir up soil nutrients making them more available for rice.

Lay-out of the field

- Modifications in the paddy field involved digging canals or trenches in various forms and the dykes have to be elevated with gentle slope which can retain or withstand if water level rises. Trenches should be about 0.5 m deep and at least 1 m wide and they serve as refuge for fishes. Inlet and outlet with fine screening are also important.

- Sufficient water should be available for maintaining a depth of 10-15 cm in areas planted with paddy after introduction of fingerlings.

- Another modification in certain cases is the keeping of tree branches on top of the trenches which prevents fish from poachers.

Transplanting of paddy

Sowing/transplantation of paddy (local rice variety) are done when the field is ready. However, it is advisable to grow transplanted paddy as it gives better paddy yield and also fish can move freely in search of food. A spacing of 25-30 cm between the rows of the plant is recommended.

Stocking of fish

Stocking of fish is done after 15-20 days of transplanting when the root system is established properly and when the paddy field is flooded. Common carp which has the ability to survive in extreme habitat and climatic conditions along with silver carp, bata, gonius, etc are stocked @ 4000 no. or 6000-7500 no. of advanced fingerlings per hectare of paddy area. Species like grass carp (small fingerlings) which is suitable in the hills can also be stocked when the paddy has grown to some extent.

Supplementary Feeding

Fish are fed with rice bran and mustard oil cake in the ratio of 1:1 on a daily basis @ 2-3 % of their body weight.

Limimg and manuring:

Limimg and manuring are done as per the following rate :

Item	Rate	Time of application
Lime	10 mg/lit of water initially and 5mg/lit of water monthly	When water level raises
Cowdung	50-60 kg/bigha/month	7 days after liming

Harvesting

Paddy and fish can be harvested at the same time and in 4 months culture period, an average fish production of 350 kg/ha was achieved and this can vary depending on the agro climatic conditions. Rice production from this system was 40qt/ha.

However, depending on the availability of water, fish can be further reared after the harvest of paddy where the field can be filled with water which allows the fish to move around and graze in the harvest field.

LIVESTOCK - FISH INTEGRATED FARMING SYSTEM

Evolved on the principles of productive recycling of farm wastes, fish- livestock farming systems are recognized as highly assured technologies for fish cultivation. In these technologies, predetermined quantum of livestock waste obtained by rearing the livestock in the pond area is applied in pond to raise the fish crop without any other additional supply of nutrients.

The top, inner and outer dykes of ponds as well as adjoining areas can be best utilized for horticulture crops. Pond water is used for irrigation and silt, which is a high-quality manure is used for crops, vegetables and fruit bearing plants. The success of the system depends on the selection of plants. They should be of dwarf type, less shady, evergreen, seasonal and highly remunerative. Ideal management involves utilization of middle portion of the dyke. Residues of vegetables cultivated could be recycled into fishponds, particularly when stocked with fishes like grass carp.

Types of Livestock - Fish Integrated Farming System:

A. Pig - fish Integrated Farming System
B. Duck- fish Integrated Farming System
C. Poultry - Fish Integrated Farming System

(Note-pig, duck, poultry, etc should not be introduced in the same pond. It should be done separately)

Fish culture practices

Fish culture practice followed in livestock-fish integration is the “Composite fish culture system”. In this kind of integration, only minimal feeding is required to the cultured fish or not at all. This is because the livestock excreta (of pigs, ducks, poultry, etc) helps in fertilizing the pond water and produce the fish food organism like- phytoplankton and zooplankton. But supply of feed to the herbivorous fishes like- grass carp is required. They

need to be fed with grass like napier, maize leaves, banana leaves, chopped green cattle fodder, etc.

In large ponds (=0.5 ha), livestock excreta should not be allowed to fall on a single spot. The collected dung should be divided into 5- 6 parts and applied in pre-specified sites.
If extensive algal bloom appears on water surface, livestock excreta (cow dung, pig dung, poultry droppings, duck droppings, etc) instead of introducing into the pond, it should be kept collected in cemented pit.

A. Integrated pig-fish farming.

Integrated pig- fish farming is a highly profitable fish culture system, where pigs are reared adjacent to the fish ponds, preferably on the pond embankment from where pig urine, excreta and spilled pig feeds are introduced into the pond water. In one harvest cycle of fish (one year), 2 batches of pigs are grown, 6 months each. This is direct integration system, which is a more efficient method than the indirect integration model, wherein pigs are raised elsewhere and the pig waste is manually applied to the pond daily at a pre-determined dose.

Benefits of pig- fish farming (Direct integration)

- Fish utilizes the feed spilled by pigs and their excreta, which is very rich in nutrients for fish.
- Pig dung act as a suitable substitute to pond fertilizer and supplementary feed for some of the fishes, therefore the cost of fish production is reduced by about 60%.
- No additional land is required for piggery operations.
- Cattle fodders required for pigs and grass carps are grown on the terraced pond embankments.
- Mortality of pig is greatly reduced, as pond provides much needed water for washing the pig- sties and pigs.
- The pond mucks which get accumulated at the pond bottom due to constant application of pig dung, can be used as an excellent fertilizer for growing vegetables, other crops and cattle fodder.
- Efficient labour utilization.

Pig husbandry practices

Growth of pigs depends upon many factors including breed and strain, but good management contributes to the achievement of optimum production.

I. Construction of pig house

- The pig house can be constructed by using locally available materials such as bamboo and thatch, but the floor must be roughly cemented (so as to be non slippery).
- An enclosed run is provided to the pen so that the pigs get enough air, sunlight and space for dunging.
- The wall should be 1.0 m in height and preferably made of bricks. The upper part of the wall should be provided with wire netting. The height of the pig sty is 1.5 m.
- The floor of the house is slightly slanted towards a drainage canal. The canal is connected to the pond. The drainage canal is provided with a diversion canal leading to a cemented pit, where the wastes are stored in the days when the pond has algal bloom. A built- in shutter is provided in the drainage canal to regulate the flow of wastes.
- Space requirement per pig is 1.5 m^2. The roof of the house may be made using thatch or asbestos or tin. Feeding and drinking troughs are constructed alternatively inside the pen, attached to one wall. A bath tub may also be constructed attaching to one wall of the open run.

II. Selection of pigs :

Pigs with 75% or 50% pure Hampshire blood has been found to be the best for such system. Landrace, large-black, etc. can also be used. 2- 3 months old weaned piglets are brought to the pig sty for six month rearing.

III. Number of pigs :

40 to 45 piglets/ ha water spread area for 6 months.

IV. Pig feed:

Twice or thrice feeding with balanced concentrate feed (readymade feed) @ 1 - 1.5 kg/ pig/ day. (Composition: Maize, Wheat bran, Rice polish, Soybean meal, GNC, Mineral mixture, Salt)

Green fodder, sweet potato, banana stem, tapioca and other tuber crops may be provided (15- 30%). kitchen waste and crop by-products are also used.

V. Health care :

Pig sties need be washed regularly two times a day in the summer months and once in winter season. Pigs should also be given bath twice a day in summer and once in winter.
Disinfection of pig sties should be done twice in a week, with quick lime, and potash (KmNO4) respectively. The washed water leads to a fish pond serving double purpose. Piglets must be vaccinated against swine fever. They are to be dewormed at the age of 3- 4 months.

VI. Disposal :

After rearing for about 6 months, pigs attain slaughter maturity size. These are to be sold out and the new piglets are to be introduced into the pigsty.

Production :

Production from direct integration per ha water area :-

Fish : 2500- 3000 kg/ ha.

Pig : 4000- 5000 kg (live weight)/ 80 pigs/ ha. (40 pigs/ha for 2 batch)

B. Poultry - fish integrated farming system

In this system, the fish crop is integrated using only poultry droppings or dip litter by rearing the poultry either directly over the pond or on the pond embankment. By adopting this technology, production of 3500 to 4000 kg fish, more than 20000 eggs and about 1250 kg (live weight) chicken meat can be obtained from a hectare of pond area in one year.

Poultry Husbandry Practices

I. Housing of birds :

In integrated poultry fish farming, the birds are confined to the house entirely, with no access to the land outside. This intensive system is of two types, viz. Battery system (Cage system) and dip litter system. The dip litter system is preferred over the cage system due to higher manurial value of the built up dip litter.

In this system, the poultry birds are kept in pens up to 250 birds per pen on floor covered with litter. For starting the dip litter system, the floor of the pen is covered with dry organic material. The chopped straw, dry leaves, hay, saw dust etc. to a depth of about 6 inches. 0.3 to 0.4 m floor space is required per bird. The dropping of the birds which fall on the litter gradually combine with the litter material due to bacterial action. When the depth of litter becomes less, more organic matter is added to maintain sufficient depth. In case the litter becomes damp (slightly wet) superphosphate or lime is added to keep it dry. The litter is regularly stirred for aeration. In about 10-12 months, it becomes fully built up litter, having very high manurial value.

The fully built up dip litter removed from poultry pens is stored in suitable place and supplied to the pond @50 kg/ha/day every morning after sunrise. The application of this is deferred on the days when algal bloom appears in the pond. However, if algal bloom appears in the pond, application of litter is reduced or stopped.

II. Selection of birds :

The fowls of Rhode island, kuroiler or other improved birds (eg. Vanaraja, gramapriya) are suitable for the purpose. About 500 to 600 birds (lay eggs) are required for one hectare water spread area. About eight week old chicks, after vaccination against viral diseases and providing other necessary prophylactic measures as a safeguard against epidemics are kept in poultry house near the pond.

III. Feeding :

Grower mash is provided to the farmed birds during the age of 9-20 weeks @50-70 gm/bird/ day, whereas a layer mash is provided to the birds above 20 weeks @ 80-120 gm/bird/day. The feed is provided to the birds in feed hoppers to avoid wastage. An ample supply of water is made available to all the birds at all the time.

IV. Egg laying :

Each pen of laying birds is provided with one nest for 5-6 birds. Egg production commences at the age of 22 weeks and then gradually decline. The birds lay from 240-250 eggs per year. After the age of 18 month birds are disposed.

V. Health care :

The poultry house and equipment must be disinfected atleast 30 days prior to bringing in the new flock. The birds are to be vaccinated against diseases at the appropriate age. In severe cases, veterinary expert should be consulted.

Production :

Fresh fish : 2300 to 2800 kg/ha/yr
Egg : 70000 nos./pen
Poultry meat : 1250 kg (live weight) per year.

C. Fish - Duck Integrated Farming System

Integrated fish farming has received attention in recent years in the North East India.

Advantages of Fish Duck Integration

- Water surface of ponds can be put into full utilization by duck raising
- Duck dropping act as feed and fertilizer for cultured fish in the pond.
- Duck collect 50% of their food naturally from the pond.
- Ducks keep the water body clean and increase dissolved oxygen by doubling action.
- Duck house can be constructed at the embankment or over the water surface, hence no need of extra place for it.
- Left over feed of duck used as supplementary feed for fish.
- Manuring is conducted by ducks and homogeneously distributed without any heaping of duck droppings.

- By virtue of the digging action of ducks in search of benthos, the nutritional elements of soil get diffused in water and promote plankton production.
- Ducks serve as bio aerators as they swim, play and chase in the pond. This disturbance to the surface of the pond facilitates aeration.
- Ducks keep aquatic plants in check.
- Production of duck eggs, meat, fish and horticulture from the same unit area.
- It ensures high profit through less investment.

Selection of fish species

Such integration is suitable only for rearing and stocking ponds where fishes are above 12 gm.

Duck husbandry Practices

I. Selection of duck and their maintenance

- Some important varieties of ducks are Nageswari, Sylhet Meat, Indian Runner, Serachameli and Khaki Campbell. Out of these varieties, Khaki Campbell is the best.
- It should be collected from the Government Farm and then consult with the veterinary Doctor for treatment and preventive measure of some epidemic disease like Duck Plague, Cholera etc.
- Ducks are stocked @200-300 ducklings/ha of fish pond. From duck excreta annual manure production is 45-55 kg/duck/yr, which besides fertilizing the fishponds and can be directly utilized as fish food. Apart from this, 10-20% feed/day/duck is wasted which is utilized in ponds. Duck dropping contains 81% moisture and 0.91% N and 0.38% P2O5.

II. Duck-house

Duck house should be made on the pond dyke or over the pond surface with the help of locally available material such as bamboo cane, thatches etc. In case of duck house over the pond surface, a small bamboo bridge is constructed from the duck house for feeding the ducks as well as for collecting eggs and duck from the house. Another bridge is constructed from the duck house to the pond surface for helping the ducks ascend or descend to pond water. The floor of the duck house is also perforated.

Again duck house should be well ventilated for air circulation and exposed to direct sunlight. Periphery of the pond should be fenced for protection of ducks. Ducks are kept in duck house providing about 0.3-0.5 m2/bird. Again one male duck should be kept in every 5-6 female ducks. Ducklet especially up to 3-4 weeks old are very susceptible to disease, hence, care should be taken within this period. 2 – 4 months ducks are preferred for stocking after taken prophylactic measures.

Use of duck dropping as manure:

The ducks are given a free range over the pond surface from 9 to 5 PM, when they distribute their droppings in the whole pond, automatically manuring the pond. The droppings voided at night are collected from the duck house and applied to the pond every morning. Each duck voids between 125 - 150 gm of dropping per day. The stocking density of 200-300 ducks/ha gives 10,000 - 15,000 kg of droppings and are recycled in one hectare ponds every year.

III. Duck Feed

- Ducks in the open water are able to find natural food from the pond but that is not sufficient for their proper growth.
- Mostly fine rice bran and poultry feed (layers mash etc.) are used as duck feed at the rate of 100 gm feed/day/duck.
- Duck also consume tadpoles, juvenile of frogs and dragon fly larvae. Further protein content in natural food organisms of the ponds consumed by duck is high. Therefore, the duck reared in fishponds save the cost on protein substantially in duck feeds and gives more eggs in comparison to duck which are not allowed in fishponds. The left over feed given to the ducks and duck dropping fulfill more than 59% of food requirements of farm fishes.
- The feed is given twice in a day, first in the morning and second in the evening.
- The feed is given either on the pond embankment or in the duck house and the spilled feed is then drained into the pond.
- Water must be provided in the containers deep enough for the ducks to submerge their bills, along with feed Since ducks are not able to eat without water.
- Sometime algal bloom may increase, then duck dropping should be stopped periodically by using plastic at the bottom of the duck house and removed.

IV. Egg laying

The ducks start laying the eggs after attaining the age of 24 weeks and continue to lay eggs for two years. The ducks lay eggs only at night. It is always better to keep some straw or hay in the corners of the duck house for egg laying. The eggs are collected every morning after the ducks are let out of the duck house.

Production

By this integration a production range of 2000 - 3000 Kg of fish, 18000-18500 eggs and 500-600 kg duck meat from 1 ha of pond area in 1 year without any supplementary feed and fertilizers can be obtained.

Conclusion

Integrated rice-fish farming is most suitable for farmers having very less land holding. It is an efficient way of using the same land resource to produce both fish and rice. In integrated livestock-fish farming, the animal manure if properly applied could lead to a considerable increase in fish production. The significant additional profit in livestock-fish

farming is due to the reduced feed costs to the fish as well as extra revenue from the sale of birds/animals, etc.

Although integrated fish farming system has long been practiced, yet the concept has not explored fully in our state. The various types of integrated fish farming systems can contribute to income and employment generation, food security and nutrition, decreased risk of production, sustainable resource management and increased farm sustainability.

KABA PYNKHA IA KI KHA DKHAR HA KI HAPA
(BREEDING OF COMMON CARP IN HAPA)

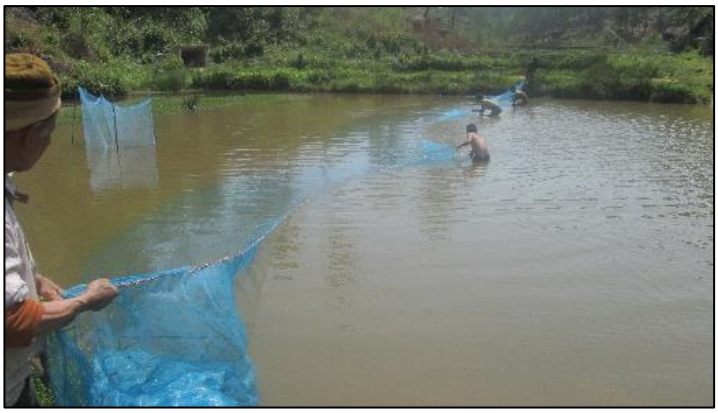
1. Ka lamphrang

Ka kha dkhar (common carp; *Cyprinus carpio*) ka long ka dohkha kaba kongsan bha ha ka thain lam mihngi ha kaba la ri lang bad ki wei pat ki dohkha ha kajuh ka pung (composite fish culture). Wat lada ka jingsan jong kane ka dohkha ka kham biang ha ka um ba kham syiad (23-30 ^{0}C), hynrei ka lah ruh ban shah ia ka jingkhriat ha ka por tlang. Kane ka pynlong ia ka kha dkhar kum ka wei na ki dohkha kaba iahap bha bad ka mariang jong ka thain Ri lum jong ngi. Ka kha dkhar ka im ha trai jong ka pung, ka bam naphang (omnivorous), ka heh kloi, ka lah ban shah ia ka jingkylla jong ka um bad mariang bad ka long ruh ka dohkha kaba bang ban bam.

La ka rit ne heh, ka kha dkhar ka pun pylleng naduh ka por ba ka dap hynriew bnai. Ka kha pylleng bun sien ha ka shi snem bad ka aiom kha ba kham biang ka long ha u bnai February-March bad ruh ka ki bnai July-August.

2. Kaba ri kyrpang ia ki dohkha ban pynkha (broodstock)

Ia ki dohkha bala biang bha ka ryta ban pynkha, la tong noh na ka pung bad buh la ka jong ia ki kha shynrang bad kha kynthei la kumno kumno shi bnai shuwa ka aiom kha. Ka jingpyniakhlad ka iada ia ki dohkha ba kin kha hi ha pung namar ka jingshah pynjot ka jur bha. Ia kine ki dohkha ba lah dep jied, la ri la ka jong ha ki ar tylli ki pung bad ka jingthep ia ki dohkha ka long 1,500-2,000 kg ha ka shi hectar bad bsa da u kheri bad skop khaw da kaba khleh lang mar katjuh bad ai kumba 3 % naka jingkhia ki dohkha.



Dur 1: Kaba tong ia ki dohkha

3. Kaba jied ia ki dohkha kynthei bad shynrang

Kaba jied ban ithuh ia ki dohkha kynthei bad shynrang ka long kaba suk bha. Ha kaba iadei bad ki dohkha shynrang, ki shnet kiba don ha trai jong ka khlieh (pectoral fin) ki long kher kher bad ha ki dohkha kynthei, ki pectoral fin ki jlieh bha. Ka kpoh jong ki dohkha shynrang kam da at than bad ha ka aiom kha, lada khniot suki, ka mih dud (symbai) katba ka kpoh jong ki dohkha kynthei ka at bha, ka jem bad lada khniot suki, ka mih pylleng.

Dur 2: Ki dohkha kynthei bad shynrang

4. Kaba pynkha ha ki hapa

Ki hapa ki long ki kynja jar ba long kum ki musari pyrjong bad kiba don jingtap ne jingker ha baroh sawdong. Ka jingheh jong ki happa ka long 2m x 1m x 1m. Ia ki hapa la la buh hapoh ka pung da kaba teh ha ki saw tylli ki siej ha kaba 3 bynta ka ngam shapoh um bad shi bynta hajrong jong ka um. Na ka bynta kawei ka dohkha kynthei ba la biang bha ka yrta bad khia kumba 1 kg duna lane 1 kg lane 1 kg shiteng la buh hapoh jong ka hapa ryngkat bad ar tylli ki dohkha shynrang. Ki dohkha shynrang ki dei ban mih ka dud (symbai) tang shu ktah na kpoh.

Ki pylleng jong ka kha dkhar ki long kiba bitnah (sticky) bad dei ban buh lang bad ki kynbat ba mih ha um kum ki water hyacinth (*Eichhornia crassipes*), u ‘bat jakoid (ba mih bha ha pynthor kba) khnang ba ki pylleng kin snoh ha kine ki kynbat. Ka jingkhia jong kine ki kynbat ka dei ban long ar shah ia ka jingkhia jong ka wei ka kha kynthei. Shuwa ban buh hapoh ka hapa, dei ban sait bha ia ki kynbat bad weng ia ki jakhlia bad ktieh bad hadien kata pat sa wieh ia ki ha ka um potash. Ha ka jaka jong ki kynbat, lah ruh ban buh da ki kynja tyllai plastic/nylon bala thir ksai bha bad teh shi rynjup.

Dur 3: Kabab uh ia ki dohkha hapoh hapa

Dur 4: U bat iakoid

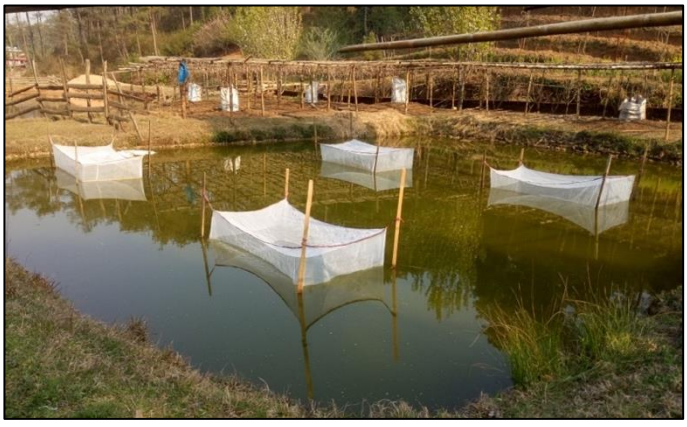
Dur 5: Ki hapa

Ia ki dohkha la buh hapoh hapa haka por janmiet bad ka jingkha pylleng kan long hapoh 6-10 kynta. Haka por mynstep lada peit hapoh hapa, kin sa don ki pylleng kiba rit bha bad phyrnai kiba snoh ha ki kynbat. Ki pylleng kiba long khun lane kiba bha ki long rong stem blad malu mala, ki sngur bad iohi lyngba hynrei ki pylleng ki bym long khun lane kiba sinew ki long rong lieh, kim sngur bad ym lah ban iohi lyngba. Ka dohkha ba khia 1 kg ka kha kumba shi lak tylli ki pylleng. Ia ki dohkha ki bym kha pylleng hapoh 36 kynta bala buh hapoh hapa, dei ban weng noh bad buh da kiwei.

Dur 6: Ka rukom teh ia ki hapa ha pung

5. Kaba sumar ia ki kha symbai hapoh hapa

Ia ki dohkha la tong noh hadien ba ki lah dep ban kha pylleng bad shuwa ban pyllait, dei ban wieh shuwa ha ka um potash. Ia ki kynbat ba snoh pylleng, la shim noh bad pynbynta ha kiwei pat ki happa kumba 3-4 tylli. Lada ka mariang ka khriat, ki pylleng ki shim por ban kylla khun, hynrei ki kloi lada ka mariang ka syiad. Tang shu kylla khun, lah ban iohi ia ki dohkha ba dang rit ki jngi sha ki sait (side) bad shatrai jong ka hapa. Kine ki kha rit (hatchlings) ki kit lang ia ka pylleng ba dang sah ha ka met kaba ai bor ia ki katba ki nang heh bad jah noh hadien 3-4 sngi.



Dur 7: Ki pylleng dohkha ba snoh ha ki kynbat

6. Kaba sumar ia ki kha symbai ha ki pung nursery

Hadien ba ka pylleng ka jah noh naka met ki dohkha ba dang rit, rah noh ia ki sha ka pung nursery ban ri kham kyrpang. Hadien 15-20 sngi, kine ki dohkha ki heh kumba 2-3 cm katkum ka jinglong ka mariang.

Dur 8: Ki kha symbai ba dang rit (spawn) jong ki Kha Dkhar

7. Ka jingpynkut

Ka rukom pynkha ia ki kha dkhar ka long kaba suk bha bad ka iarap ban pynkiew ia ka jingpynmih kha symbai bad khamtam kum ka lad ban kamai bad kyntiew ia ka ioh ka kot.