POTENTIAL AND CONSTRAINTS OF SMALL-SCALE FRESHWATER FISH CULTURE ENTERPRISES IN INDIA

by

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Abstract

Small-scale freshwater fish culture enterprises presently constitute the main aquaculture base in India. Excellent opportunity exists for stepping up of rural economy through development of small-scale fish culture enterprises, for the obvious reason that most of the small ponds lie centred and scattered in the hinterland of the country. Aquaculture research and development in India have already paved the way for transfer of technology from the precinct of the laboratory to the fish farmers' ponds. Thus with the different technologies available, small-scale fish culture entrepreneurs can increase their earnings substantially. The paper also discussed certain constraints in the development of such enterprises and indicates that the freshwater aquaculturist has to evolve and perfect still better and easier technology for rural ponds and particularly for those which are non-drainable, deeper and perennial.

CONTENTS

1. INTRODUCTION

India is endowed with innumerable small freshwater ponds, widely scattered all over the country. These small water bodies, usually less than one hectare in size are utilized for multipurpose uses like irrigation to the agricultural fields, washing the cattle, domestic purposes and above all for fish culture too. It is estimated that about 500 000 households are engaged in traditional fish culture operations, in such water bodies. At present there is no clear-cut group of fish farmers in the country distinct from fishermen engaged in capture fisheries in the inland rivers, estuaries and seas, who belong to the lowest economic and social strata of the country.

Fish farms as distinct from fishponds consisting of a battery of nurseries, rearing and stocking ponds are as yet a new concept in the private sector. Fish culture is practised presently in individual ponds or in groups of ponds scattered widely. These ponds are generally seasonal, retaining water for about 9 to 10 months a year.

For the purpose of this paper, fish culture operations (including the production of fish seed) carried out in bodies of water of less than 1 hectare in total area will be described as small scale operations. We will not discuss the factors in creating a small scale operation, such as area, income or socio-economic status of the fishermen. It is important to consider how best the knowledge of modern scientific culture could be transferred to increase the fish production levels of such small ponds. The development in this direction will help the country in two ways. First, it increases the purchasing capacity of the rural poor, and secondly, it increases the production basket in the fish culture sector, ensuring more availability of fish supplies to the farmer and to the consuming public.

2. DEVELOPMENTAL POTENTIAL OF SMALL SCALE FISH CULTURE OPERATIONS

Modern aquacultural research in India has greatly improved development of small scale fish culture enterprises in rural village ponds of the country through many alternate fish culture systems. The fish farmers now have the option of intelligently choosing the most profitable and convenient fish culture venture best suited to their ponds. Freshwater fishes have a marketable size of about 500-750 g and it is not difficult to grow them to this size in about 8-10 months time in seasonal ponds. Production of hatchlings or rearing fry/fingerlings is a short-term economic activity confined to a period of 3 to 4 months. The anticipated economics of fingerlings are presented in relevant sections. Thus fish farmers can go for culture of food fishes or for rearing of fry and fingerlings or for production of hatchlings through hypophysation or "bundh" breeding, according to the availability of facilities to them.

Food fish culture

The general practice in traditional fish culture operations is to stock fish seed of Indian major carps mainly catla, Catla catla (Hamilton),

rohu, Labeo rohita (Hamilton), and mrigal, Cirrhinus mrigala (Hamilton), collected from rivers without recourse to any supplementary feeding or fertilization programmes. Compared to modern methods of aquaculture, the traditional fish culture is extensive in its approach with an average level of fish production at 600 kg/ha/a. The aquaculture research in India has shown the feasibility of producing about 10 000 kg/ha/a in experimental ponds (Sinha, 1978) and a large number of progressive fish farmers obtained about 7 000-8 000 kg/ha/a in field conditions. The wide gap between the average level of fish culture production in the country and the results of research and achievements of fish culture demonstration programmes in farmers ponds, have given encouragement of substantially raising the productivity levels of small scale fish culture operations.

A profitability of about I.Rs. 16 000 at a farm gate price of I.Rs. 6 to 7 per kg and an average production level of 4 000 kg/ha/a have been well demonstrated by West Bengal fish farmers consecutively for two years during 1975-76 and 1976-77, through a set of improved fish cultural practices popularly known as "Composite Fish Culture" i.e., mixed culture of three Indian major carps with grass carp, Ctenopharyngodon idella Valenciennes, silver carp, Hypophthalmichthys militrix Valenciennes, and common carp, Cyprinus carpio L. in India. The average pond size of such demonstration centers was 0.4 ha. Even on moderate levels, a minimum profitability of about I.Rs. 9 000/ha/a is ensured to small scale fish culture entrepreneurs. The economics is presented here.

Operational expenses for culture of food fish per ha/a
(Sinha, 1976)

Item	Intensive culture I.Rs.	Traditional culture I.Rs.
Rental	500	500
Developmental cost	400	400
Mahua oil cake	450	-
Stocking material	500	500
Fertilizers	1 000	-
Feed	4 500	-
Labour (skilled labour + fishermen + watchmen)	4 080	1 445
Total costs	11 430	2 845
Production	3 000 kg	600 kg
Income at a farm gate price of I.Rs. 7/kg	21 000	4 200
Profitability	9 570	1 355
Return on cash variable expenses	83.7%	47.6%

Induced breeding

The Asiatic carps such as catla, rohu, mrigal, silver carp and grass carp do not breed in confined waters. However, it has now become possible to induce them to breed by injecting the pituitary extract in ripe fishes. In many parts of the country, induced breeding of Indian major carps such as catla, rohu and mrigal has become so popular that private operators are available in the countryside who have mastered the necessary skill of induced breeding and many took it up as part-time job.

The anticipated economics of induced breeding operations and of "bundH" breeding that are presented in this paper are based on the experience of the authors and published work of the Central Inland Fisheries Research Institute in order to have an approximate idea about the cost of operations and the returns that are likely to accrue. However, the farm operational economics are likely to vary because of changing price levels in different parts of the country.

The anticipated operational economics for induced breeding of Indian major carps is given for a production target of 10 million hatchlings in a month during the season. This production target could be expected from about 52 sets of successful breeders for which a total of about 80 sets is required. Selected female and male breeders can be brought from the stock ponds either of the farmers or of others.

	Total cost I.Rs.	Annual cost I.Rs.
A. Materials and equipment		
Brood fishes at I.Rs. 20/kg	12 000.00	12 000.00
Hapas and nets	3 705.00	1 667.50
Pituitary material	350.00	350.00
Others	510.50	363.50
Sub-total	16 565.50	14 381.00
B. Wages and fees		
Casual labour for 1 month 5 labourers at I.Rs. 8/day		1 200.00
Technical consultancy fee for induced breeding operator		750.00
Sub-total		1 950.00
C. Rental and cultural cost		
Rental of the pond		250.00
Clearing of the pond		50.00

	Total cost I.Rs.		Annual cost I.Rs.
Manuring with cow-dung including transport at 10 t/ha			250.00
Supplementary feeding at 1% body weight with oil cake and rice bran at a ratio of 1:1 for 3 months			1 000.00
Sub-total			1 550.00
Total			17 881.00
D. Income			
Anticipated minimum income from sale of hatchlings at a farm gate price of I.Rs. 300 per 100 000		I.Rs.	30 000.00
Sale of left over fishes at I.Rs. 7/kg		I.Rs.	4 200.00
Total			34 200.00
Net farm business income from induced breeding operations of Indian major carps in a month's time		I.Rs.	16 319.00

An additional income of I.Rs. 16 319 for a small and marginal farmer undertaking induced breeding of Indian major carps is thus a promising occupation supplementing his agricultural or labour earnings in other months of the year.

"Bundh" breeding

The bundhs are of two types, viz perennial bundhs commonly known as "wet bundhs" and seasonal ones, known as "dry bundhs" A typical wet bundh is located in the slope of vast catchment area of undulating terrain with embankments. The bundh has a large shallow area adjoining a deeper pond area which retains water throughout the year and where an adequate stock of breeders is maintained. A "dry bundh" is a shallow depression enclosed by an earthern wall on three sides which impounds fresh rain water from the catchment area during the monsoon season. Soon after sufficient rain water is accumulated in the bundh breeders from nearby ponds are introduced unlike the wet bundh where the fishes are already there. Breeding generally commences in the early hours of the morning. Nowadays, in West Bengal about 10% of the breeders are also injected with fish pituitary extract

and are kept with others which are not injected in the bundh. This gives better results of dry bundh breeding. In recent times, the research workers of the Central Inland Fisheries Research Institute have made path-breaking advances in breeding silver carp and grass carp in bundhs of Bankura District of West Bengal (Sinha, et al, 1975) and have thus shown the commercial feasibility of producing their hatchlings like those of catla, rohu and mrigal. This method of breeding is highly possible in other parts of the country where suitable areas for bundh construction is available.

The operational costs for breeding major carps weighing 400 kg in a dry bundh in West Bengal are presented below.

	I.Rs.
A. Operational costs	
Cost of 400 kg of breeders at I.Rs. 20/kg including transport	8 200.00
Wages for 2 watchmen for about 50 days at I.Rs. 8/day for looking after the fish after release in bundh and labour charges for egg collection	1 740.00
Fee for professional fish injector	300.00
Cost of small drag net, mosquito net, petromax, torch and miscellaneous items	900.00
Rental of bundh at 10% of sale proceeds of the hatchlings	1 728.00
Total	12 868.00
B. Income	
Hatchling production in one crop from 50 kg females, 150 000 eggs/kg body weight of fish, 80% breeding, 80% fertilization, 60% recovery of fertilized eggs and 50% hatching and survival up to hatchling stage	14 400.00
Anticipated hatchlings production in a season if four such breeding programmes can be operated	57 600.00
Income in a season at a farm gate price of at I.Rs. 300/100 000	17 280.00
Sale of breeders at I.Rs. 7/kg	2 800.00
Total income	20 080.00
Net farm business income	7 212.00

The expected net farm business income will thus amount to I.Rs. 7 212 in a season from "bundH" breeding operation.

Fry rearing

Hatchlings rearing to fry stage is a well established practice in certain pockets of West Bengal and proved to be very lucrative (Ranadhir and Gopalakrishnan,1974). Small shallow freshwater ponds are ideally suited for the rearing of fry.

It is attempted here to project the economics of fry rearing in a nursery pond of 0.04 ha, stocked at the rate of 10 million/ha.

	Annual costs I.Rs.
A. Capital expenditure	
Annual capital expenditure of fishpond, value of 0.04 ha fishpond is estimated at I.Rs. 1 000/20 year pay-out	50.00
B. Recurring expenditure	
Weed clearance	30.00
Fish eradication with mahua oil cake	70.00
Cost of organic manure and its application	25.00
Netting for removal of insects	20.00
Soap oil emulsion treatment	30.00
Cost of 400 000 fish hatchlings (including transport)	1 300.00
Cost of feed: 14 kg of ground nut oil cake at I.Rs. 1.30 kg and 14 kg of rice polish at I.Rs. 0.50 per kg	25.20
Harvesting	20.00
Depreciation of nets	100.00
Pond preparation and maintenance	150.00
Sub-total	1 820.20
Expected fry production at an average rate of survival of 60%	240 000
Income from sale of 240 000 fry at I.Rs. 20 per 1 000	4 800.00
Net farm business income	2 979.80

It is also possible to have a second crop in the same season from the same pond. But even with one crop, for a water area of 0.04 ha, the

net profit of about I.Rs. 3 000 per 3 to 4 months is extremely lucrative.

Fingerling rearing

Another possibility in small scale sector is culture of fingerlings of Indian major carps. The pond size suitable for this type of activity is about 0.1 ha area.

	Costs/season I.Rs.	
A. Capital expenditure		
Cost of 0.1 ha pond is I.Rs. 2 500. Pay-out period, 20 years	125.00	
B. Recurring expenditure		
Weed clearance	30.00	
Fish eradication	120.00	
Labour	20.00	
Cost of organic manure	40.00	
Cost of inorganic manure	60.00	
Cost of fry	320.00	
Cost of feed	90.00	
Harvesting	40.00	
Net depreciation	100.00	
Pond preparation	300.00	
Total	1 245.00	
Fingerling production at an average survival rate of 80%		12 800
Income from sale of 12 800 fingerlings at I.Rs. 150 per 1 000	1 920.00	
Net profit from a water spread of 0.10 ha	675.00	
Net profit per ha during the season (4 months)	6 750.00	

3. CONSTRAINTS

Though there are certain handicaps standing in the way of development of small scale fisheries, the vast manpower available in the countryside, their hardworking nature coupled with urgent need of enhancing their nutritional standards, have put small scale fish culture operations in a good stead poised for faster development in times to come. The constraints are grouped into six major sub-sections viz (a) basic input, (b) social

constraints, (c) legal constraints, (d) financial constraints, (e) extension gap and (f) lack of infrastructural facilities (Sinha, 1979).

Basic input

Fish fingerlings at a size of 10 to 15 cm should constitute the bulk of stocking material in modern freshwater aquaculture production in the country. This basic input which any aquaculture operation should start with, is mainly dependent to a great extent on the collections of wild seed mainly from rivers, even though the method of artificial propagation has been developed and standardized as long back as 1957 by the Central Inland Fisheries Research Institute.

George and Sinha (1975) estimated the total requirement of 2 000 million carp fingerling by 1984 to develop intensive fish culture in those ponds where the traditional fish culture is undertaken presently. Compared to this, the fry and fingerlings production in 1973 was 434 million only, which indicates the gravity of the situation in regard to availability of basic input.

Indian Railways provide special vans for transport of fish seed to distant places, yet the majority of seed is transported by traditional methods in earthern pots which contributes to a heavy mortality of hatchlings. Transport of fish seed with oxygen packing has greatly increased the chances of survival. It is estimated that under conventional methods of transport the mortality of hatchlings is about 40-50% compared to 0-5% mortality in transit under oxygen packing (Ghosh, 1976), so some mandatory railway rules asking for oxygen packing for transport of seed might avoid wastage of this precious commodity.

Social constraints

Social taboos among fishermen communities have so deeply penetrated that it is not an easy task for developmental planners to change them over to modern scientific methods early. Probably the best way to convince them is by showing them the actual practices in their ponds successfully. Poaching and organized dacoties have become a serious problem for fish culture throughout India, especially in the eastern part of the country where fish is in great demand. Besides employing watchmen, perhaps it may be helpful if bushy plant materials are put inside ponds to prevent easy netting. Hooks attached to the bottom of boat, rowed in water might locate gill nets, hook and lines if any put by poachers. Trained watchdogs may prove more effective and economical in controlling poaching.

Legal constraints

Conflicting interests in regard to water use between agriculture and aquaculture have been brought to focus by many Indian aquaculturists, important among them being lowering of the ground water table as a result of digging of many tube wells, and withdrawal of water from ponds for the

purpose of raising high yielding agricultural crops. These situations call for urgent rectification through laying down specific rules and regulations for water use, and safeguarding the interests of aquaculture. Conflicting claims also arise on the use of reclaimed land such as swamps, land bordering natural lakes, disconnected river courses, etc. Such reclaimed areas are more suitable for fish culture. It needs urgent consideration to enact suitable laws to demarcate such areas for fish culture purposes.

The industries by and large release their untreated effluents to nearby flowing or still water bodies, thereby making the surrounding ponds ineffective for fish culture. Pre-treatment of effluents to safe limits should be laid down by law. Water quality standards should be laid down for preventing pollution from the aquaculture point of view.

It is also essential to deal with the threat posed to fishponds by the increasing use of insecticides in agricultural fields.

State ownership of ponds is vested with either Revenue or Public Works or Irrigation Department, which lease out these to either Fishermen's Cooperative Societies or Gram Panchayats or individual lessees for specific duration. Generally the duration of lease is so short that the lessee has no incentive to carry out any development work. However, the Government of India, in recent years has established Fish Farmers Development Agencies in selected districts to facilitate long-term leases of 7 to 10 years. The long-term lease facility needs to be extended to other areas so as to provide incentives to the fish farmers to make long-term investments in fish culture sector.

Sometimes ponds remained fallow in the countryside because of migration of the land-owning class to the cities or because of multi-ownership and unwillingness to let others or co-owners to utilize their ponds for fish culture purposes. The luxury of fattening fishes for four to five years to a big size by the well-to-do farmers for special occasions like marriages and festivals hampers fish productivity levels from such ponds.

Financing institutions are also aware of legal problems concerning loans for fish culture purposes in cases of multi-ownership ponds. Banks have been insisting on a no-objection certificate from the co-owners, in the event that anyone is interested in obtaining financial help from them. It is necessary to enact suitable aquacultural legislations or bring appropriate modifications in the country's existing laws so that such water bodies are easily available for fish culture. Fixing up of fish productivity levels or state takeover with adequate compensation in the event of lack of interest among co-owners are some of the possible solutions to effectively counter the problem of multi-ownership of water bodies.

Further, the small fish farmers are often landless daily labourers who have nothing to offer as security for loans from the banks, and the insistence of banks for collateral security puts them in a difficult position to secure loans for cultural and developmental costs. The financial

institutions should give a serious thought to the problem of financing small fish farmers even on the basis of standing crops of fish production.

Financial constraints

Small fish farmers and landless labourers have no financial capabilities of undertaking scientific fish culture on their own. The participation of institutional finance for development of fish culture in the country is keenly felt. Institutional finance for fisheries development is available through Reserve Bank of India, Agricultural Refinance and Development Corporation (ARDC), Cooperative Banks, Commercial Banks and Land Development Banks. However, the participation of financial agencies is very scanty in fish culture development programmes due to inflexible banking policies towards lending.

State Fisheries, Community Development and Cooperation Departments extend financial assistance by way of subsidies and grants to fishermen's cooperatives/individuals. The assistance by the community development department is mostly for the cost of seed, whereas the State Fisheries Departments give subsidies and grants towards desilting of ponds and also to cultural costs. The Fisheries Departments share the working capital of fishermen's cooperatives. District cooperative banks in few states also make funds available for working capital requirements of Fishermen Cooperative Societies, which in turn provides funds for the benefit of their members. However, the objective of such credit assistance at times are frustrated, since beneficiaries could not take advantage of such schemes because of non-availability at the right time. It is obvious that even though subsidies and loans are available, still, due to some unfavourable factors like lack of knowledge among the farmers and lack of appreciation of the fish culture problems on the part of bankers, finance still remained a major obstacle standing in the path of aquaculture development. The banks require project preparation by the fish farmers, who are by and large uneducated and ill-informed. Thus it is necessary that the Banks should waive cumbersome procedures in obtaining a loan.

Extension gap

The central and state agencies carry out numerous fish culture training and demonstration programmes to impart training to progressive fish farmers in modern methods of fish culture. But lack of suitable demonstration fish farms in adequate number in different parts of the country, like agriculture, is one of the serious handicaps in rapid extension of scientific aquaculture to different parts of the country. There is also an important need to train fish farmers to identify common fish diseases and hazards so as to apply remedial measures in time to save their crop.

Lack of infrastructural facilities

Freshwater fisheries sectors totally lack the necessary infrastructural facilities like cold storages, good approach roads from landing sites

to marketing centers, and quick transport. The fish markets are controlled by powerful groups of middlemen who buy from the producers at prices which generally average about 300% less than the price paid by the consumer (Ranadhir, 1979). Organized arrangements for storage and marketing of fish are necessary, and would be helpful in stabilizing price structure to benefit both the producer and the consumer. Efficient cooperative marketing organizations may minimize and ultimately do away the vicious circle of the middlemen. It is equally important to lay stress in extending minimum support prices to fisheries sector so that the fish farmer may take up the operation without any uncertainty associated with prices.

4. GENERAL DISCUSSION

As it is obvious from above, the potential of small scale freshwater fish culture enterprises is vast and the constraints many, which have fortunately been realized now by planners and administrators; thus India is trying to circumvent many socio-economic constraints for the development of small scale enterprises. However, of all the constraints the most serious is the inadequate amount of fish seed.

The existing network of fisheries extension mechanism presently available with the Central and State Government Departments are unable to make much headway in popularizing the technology of induced breeding. Added to this, is perhaps the easy availability of fish fry/fingerlings from government agencies at a subsidized rate which has lessened the incentive of fish farmers in entering in production of fish seed. Instead of supplying fry/fingerlings from government agencies, if brood fish in good condition are given to interested farmers with proper extension backing, to undertake induced breeding by themselves, it might bring a desired effect in bridging the wide gap between demand and supply. Initially it may be difficult for them to succeed but once they do, they become a great asset rather than remaining a permanent liability for fish seed supply. The easiest of all the carps to breed with or without injection is common carp. It may possibly be better to make available the brood stock of common carp in healthy condition to selected farmers who, after trying common carp will then try induced breeding in mrigal, rohu, catla and eventually the most difficult to breed, silver carp and grass carp. The experience of rearing common carp hatchlings will enable them to handle other carp hatchlings also. Moreover, the popularity of common carp raising may solve to a certain extent the shortage of pituitary material for induced breeding.

Further, undertaking fry/fingerlings raising by the small pond owner will facilitate the availability of large fingerlings which are necessary for stocking large ponds. Large ponds invariably have predatory fish population, the control of which is not feasible through dewatering or using fish toxicant since these ponds are mainly meant for multi-purpose use. Yet, they are stocked with fry, the chance of survival of which is very meager and consequently they do not yield much.

While attempts are being made to develop technologies for air breathing fish culture, sewage fed fish culture and other systems of cultures

all of which will add to the choice of small scale enterprises, freshwater aquaculturists have still to perfect and evolve better and easier technology for rural ponds and particularly for those which are non-drainable, deep and perennial.

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