Small-Scale Rural Aquaculture in Assam, India – A Case Study

S. K. Das

Abstract

The state of Assam in northeastern India has an excellent sub-tropical climate for the development of fresh water fish culture in a variety of aquatic bodies. Aquaculture not only plays an important role in nutrition but also in the rural economy of the State. A pilot project conducted with a group of resource poor tribal farmers revealed that a production of about 1 800 kg/ha/yr could be achieved from small seasonal homestead ponds through integrated use of locally available biological resources. This implies an excellent opportunity for improving the rural economy through the development of small-scale fish culture enterprises. In this project, a greater emphasis was placed on improving the knowledge and skills of the farmers and their farming practices so that in the future they would be in a position to expand their activities with financial assistance made available locally. Aquaculture being a new activity in the area, this pilot project was only a start in acquainting the farmers with the practice and potential of aquaculture.

Introduction

The state of Assam covers about 30 per cent of the North Eastern Region of India, which has an area of 78 438 km^2 and is located between 21.570N – 29.30°N latitude and 89.460E – 97.30°E longitude. The State has the Brahmaputra and Barak river systems and their numerous tributaries (combined length 4 820 km), a large number of flood plain wetlands (locally called *Beels*) and swamps (112 000 ha).

Despite the vast aquatic resources, Assam has not been able to produce ample fish to cater to the needs of its ever increasing population. Assam's share of the total inland fish production in India is reported to be low (6.55 per cent). As natural fish production is slowly declining, aquaculture is the alternative for producing more fish to meet the demands of the local population.

Rice and fish are the two basic items in the diet of the Assamese people. For 95 per cent of them, fish is an important protein rich food. Assam currently produces about 159 000 t of fish from all sources annually as against an estimated annual demand of 250 000 t. The demand is estimated to increase to 320 000 t in the near future. A substantial amount of fish is brought into the state daily from other states, especially Andhra Pradesh, Uttar Pradesh, Bihar and West Bengal.

Assam has a total population of more than 25 million and a substantial proportion is composed of tribal people. Out of all the plain tribes, Tiwa and Karbi are the best known in the Karbi anglong , Nagaon and Morigaon districts of Assam.

A study conducted by Das and Goswami (2002) on the present status of fish culture being practised by the rural farmers in four villages of two districts of central Assam, viz., Nagaon and Morigaon, clearly established that productivity was very low. The mean fish production in the study area was found to be very poor. There was a requirement for the development of technology for seasonal fish ponds, faster growing fish and quality fish seed. A massive extension program was needed. As fish culture in the small ponds can be operated with resources available within the family, there was an excellent opportunity for the development of small-scale fish culture enterprise.

In many parts of Asia, small-scale, low input aquaculture technologies are seen as an important tool for improving food security, especially in areas where there is a shortage of fresh fish. In Bangladesh, several projects have been undertaken to assist farmer adopt fish culture in small water bodies in and around their homesteads (Ahmed et al. 1995).

The Project

An attempt was made to introduce a farmer participatory small-scale aquaculture extension program in three villages of the Amsoi area in the Nagaon district of Assam under an innovative scheme of the Assam Rural Infrastructure and Agriculture Service Project (ARIASP, World Bank) for three years starting from 1998. The primary objectives of this pilot program were to develop appropriate technologies suitable for the target community and to create a farmer-based extension system. A total of 29 households that possessed small to medium sized ponds (a total of 31 ponds) were selected as the beneficiaries of the project for undertaking a farmer participatory extension program. Most of the ponds were seasonal in nature (Fig.1). All except four of the 29 households lived below the poverty line. Two were landless and 11 owned cultivable land less than one ha. The maximum cultivable area for any household was 5-6 ha. Those who had little or no cultivable area usually worked as daily wage labour. The average rice production was about 2 t/ha. Small field studies were also undertaken on appropriate stocking density, use of wood ash as partial replacement of lime, production of Magur seed (Das 2002) and carp seed using low-cost hatcheries (Das 2003). The farmers participating in this project cultured fish in their family ponds for the first time and actively cooperated in all the small field trials that were undertaken to develop an appropriate method for the specific area and people. In a similar type of aquaculture extension work, Das et al. (1998b) also emphasised a need for more farmer-run field trials.

These resource-poor farmers usually dug out a portion of their land to build the foundations of their thatched houses. The project utilized these depressions, with little renovation, as fish ponds for the project activities. The farmers belonged to a disadvantaged tribal group known as the Tiwa and Karbi whose primary occupation was rice cultivation. For all of them, the most preferred source of animal protein was fish, but they had been able to harvest only a meagre amount of fish from the natural water bodies.

Production of cultured fish from the existing water bodies included in the project was negligible as the water bodies were not utilized for scientific fish farming, indicating low consumption of fish. The price of fresh fish in the local market, ranging from Rs.100 to Rs.250/kg (US$1 = Rs.46.00), was unaffordable for these

Table 1. Benefits and constraints

Benefits	Constraints
Increase in fish availability	Lack of knowledge, skills and experience for fish farming
Food security	Lack of quality fish seeds for stocking in ponds
Income generation	Lack of capital
Employment generation.	Lack of support from Government agencies

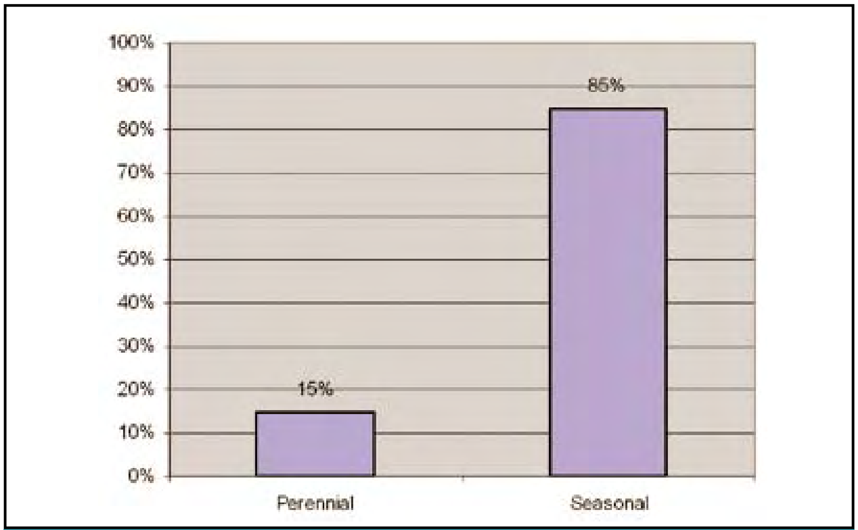

Figure 1. Type of ponds owned by the participating farmers.

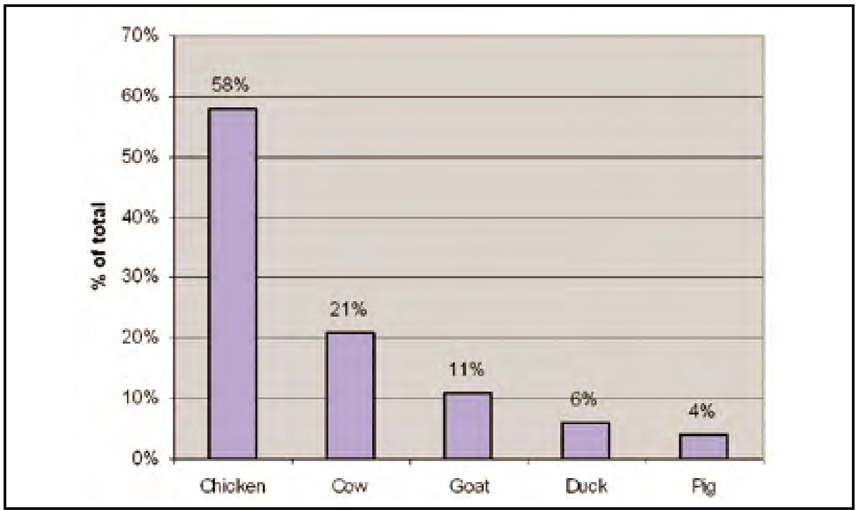

Figure 2. Animals owned by participating farmers.

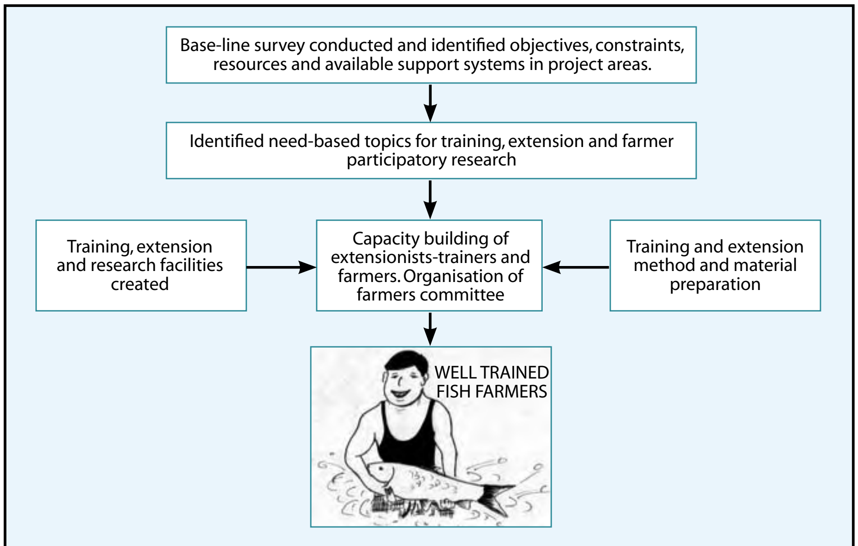

Figure 3. Framework for the small-scale aquaculture extension project.

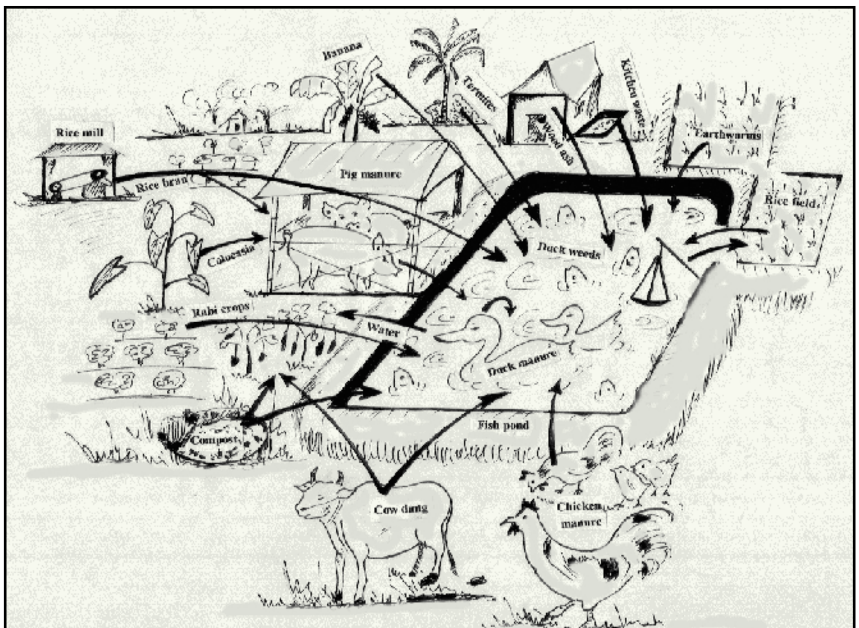

Figure 4. Bioresource flows in a small-scale aquaculture system in the project area of Amsoi, Assam , India.

farmers. Given the very low purchasing power of these farmers, consumption of fresh fish in the area was low.

Initially, a base-line survey was conducted to assess the socio-economic condition, needs and resources of the participating farmers (Fig. 2). It was observed that the farmers lacked the knowledge, skills and experience for fish farming. Several training programs were conducted to impart skills required for fish culture, live-stock farming, integrated farming, fish breeding and hatchery management, fish seed nursing, fisheries extension motivation and organization and micro credit. The participating farmers were trained to culture fish in their ponds using locally available resources. Farmers in the project areas identified the benefits of and constraints on productive fish farming (Table 1).

Extension

An extension strategy was developed to help the farmers help themselves. A farmer's committee was formed with a unanimously selected President, Secretary and an advisor (Fig. 3). A few representatives from each village were also selected, based on their literacy and capability to act as village extension agents. The village extension agents were given specialized training at several locations, including the project site, and were able to train other farmers

Table 2. Relationships between stocking density and fish production.

Stocking density/m²	1998-99 Mean fish production (kg/ha)	Stocking density/m²	1999-2000 Mean fish production (kg/ha)	Stocking density/m²	2000-2001 Mean fish production (kg/ha)
3.0-4.0	1 129.84 (131.92)	3.0-4.0	1 369.40 (458.54)	3.0	1 144.13 (371.06)
1.0-2.99	1 005.96 (373.00)	1.0-2.99	1 091.14 (364.21)		
0.35-0.9	688.85 (161.57)	0.5-0.9	933.55 (381.14)		
-	-	6.97	869.56		

Note: Figures in parentheses are the Standard deviation.

upon their return to their villages. The participating farmers kept records of inputs used and output obtained. The project provided field implements and bicycles to the extension agents to carry out their field activities more efficiently.

Average literacy was poor among the 29 households. A few extension materials with sketches, especially a booklet and a poster, were prepared in the local language and distributed free to all farmers as training material.

In the absence of a local financial support system, the project encouraged and guided participating farmers, especially women, to form self help groups (SHGs) for micro credit. The lone women fishery extension agent was trained in micro credit within and outside the project to motivate other women in the villages to form credit groups. She played an important role in organising the SHGs. This was organised to initiate a financial support system to provide loans for farming activities. The SHGs functioned well with only the farmers' contributions.

Technology and Production

At the start of the project, discussions were held with the participating farmers about species selection. They preferred the fast growing species of carp and Magur fish for family consumption and because of their higher market value. As seed were not easily available, the project had to start a small-scale seed production unit in the second year of operation. The farmers were advised to feed the fish daily, fertilize the ponds periodically and harvest fish at a size of about 250 gm each. Farmers were motivated to culture Rohu, Mrigal, Catla, Silver carp, Grass carp, Java Puthi and Common carp in a polyculture system. On-farm resources such as cow dung, chicken manure, pig manure, rice bran, kitchen wastes, termites, duck weeds and wood ash were used as pond inputs. Most of the farmers were satisfied with the production obtained each year, as it was the first time they had been taught scientific fish farming in small ponds. In the first year, carp fingerlings were distributed to all the 29 families with an agreement that they would pay back the cost of seed after three months of the growing period when they were convinced about the success of the technology. All the farmers paid back the cost of seed within a period of 3-4 months. All the seven species were made available to them during the project period. The farmers were trained to produce seed of all the seven species using the hatcheries developed for them in the village. There were many fish seed vendors who went round the villages on bicycles. The farmers were advised to maintain the recommended stocking density, even if they were unable to maintain the seven species ratio. No inputs were given free of cost. However, some field implements and other essential items were provided by the project, either to the community or for field trial purposes. At the end of the first year, a farmer's day was organized to evaluate the progress made in terms of pond fish production. The successful implementation of the project motivated some farmers in the area to expand their existing fish ponds or to dig new ones.

Results

The results of the project were encouraging. A summary of the fish culture trials conducted over the three years is given in Tables 2, 3 and 4. The results indicated that in small seasonal village ponds, a production of more than 1 800 kg/ha/year can be achieved if scientific methods are followed. The study further indicated that a stocking density of three fish (juveniles) per square meter in a small seasonal pond may yield good fish production (Table 2). It was also observed that farmers could not obtain better fish production from large sized ponds (Table 3) compared to small sized ponds. This may be due to the lack of resources for the required inputs and inadequate management skills. It was noted that production from the pond could be increased if the fish grew to a bigger size before harvest. Most farmers made partial harvests of fish for their family's consumption after the fish attained about 100 gm in weight. Generally, the farmers made the final or bulk harvest when the water level of the pond went down to a minimum as most ponds were seasonal in nature. The surplus fish was either sold at the local market or distributed in the village on any auspicious occasion/ceremony. For fish farming activities farmers spent

Table 3. Relationships between pond size and fish production.

Pond size (m^2)	1998-1999 Mean fish production (kg/ha)	1999-2000 Mean fish production (kg/ha)	2000-2001 Mean fish production (kg/ha)
<100	1 058.87 (174.52)	1 334.33 (199.83)	1 205.35 (200.20)
100-200	1 058.68 (283.28)	1 156.01 (441.36)	1 229.41 (409.92)
200-300	852.15 (184.84)	1 187.39 (571.18)	1 266.92 (588.30)
300-400	1 019.08 (214.70)	1 077.86 (307.83)	996.36 (189.45)
400-500	1 400.40 (849.72)	1 651.47 (977.62)	1 249.98 (75.00)
>500	724.76 (128.35)	1 186.42 (420.83)	848.80 (143.64)

Note: Figures in parentheses are the Standard deviation.

Table 4. Results of fish culture trials conducted between 1998-2001.

Parameters	1998-1999	1999-2000	2000-2001
Minimum culture period (day)	140	120	117
Maximum culture period (day)	285	302	287
Average culture period (day)	182.0 (28.19)	209.24 (48.13)	201.31 (38.90)
Total actual production (kg)	840	1104	1022
Total pond area (m^2)	8 936.30	9 135.85	9 762.35
Minimum production (kg)	574.60 (in 180 days)	328.95 (in 160 days)	712.95 (in 250 days)
Minimum production (kg)	2 345.67 (in 285 days)	2 716.04 (in 297 days)	2 380.95 (in 238 days)
Average Fish production (kg)	939.98 kg/ha/182 days	1 208.42 kg/ ha/209 days	1 046.87 kg/ha/ 201 days
Fish production (kg/ha/yr)	1 885.12 kg/ha/ year	2 110.41 kg/ha/ year	1 901.04 kg/ha/ year

Note: Figures in parentheses are the Standard deviation.

money for the fish seed (Rs.100-150 per 1 000), rice bran, oil cake and inorganic fertilizers. A participating farmer who owned a rice mill provided rice bran at a subsidized rate of Rs.1.50/kg. For a 100 m^2 seasonal pond, an individual farmer spent Rs.200-400 on inputs.

Fish seed production

Seed is the basic input for fish culture. In the first year, the project arranged to deliver the stocking materials (primarily fish seed) for fish culture at the project site from outside sources. In the second year, fish spawn were bought from a Government carp hatchery and the farmers were trained to rear them to fingerlings for distribution. The farmers made some profit on this in the very first trial.

An attempt was also made to produce seed of *Clarias batrachus* as the adult fish fetched a very high price in the market, ranging from Rs.150 to Rs.250/kg. The establishment of a farmer-run small-scale hatchery was a vital component of the basic extension strategy (Das et al.1998a). Therefore, a low-cost, portable and small-scale Magur fish hatching trough was designed and successfully operated by the farmers (Das 2002). A small quantity of Magur seed was produced and sold to the farmers at a marginal profit. This was the first successful farmer operated, village level, small-scale Magur seed production unit in Assam. A low-cost carp hatchery was also designed and commissioned to produce fish seed locally (Das 2003). In the third year, a significant number of fish seeds were produced locally to cater to the needs of the fish farmers. The land required to construct the hatchery was provided by one of the beneficiaries.

Integrated farming

Research carried out by ICLARM (Lightfoot and Pullin 1994) had indicated that there is a potential to increase the number of recycling flows on a farm through aquaculture integration. Although the project's basic aim was to introduce scientific fish culture in this tribal area for increasing fresh fish production, it was soon realized that culturing fish in a small homestead and seasonal pond could not provide an adequate livelihood for a family. The farmers in the area depend on rainfall for paddy cultivation. Therefore, an effort was made to help the farmers to cultivate paddy during the winter months. An STW (shallow tube well) was installed

Farmers produce seed of *Clarias batrachus* using a small-scale rural model hatching trough.

A Tiwa woman at her pond.

at the project site in the third quarter of the second year under the Department of Agriculture's ARIASP supported STW scheme. A group of participating farmers were motivated to share the cost of the STW and cultivate Bodo (a winter variety of rice) paddy in an area of about 1.8 ha to recover the cost of the pump. The farmer collected Rs.7 500/- to pay for the STW and in the third year it was first used to operate the carp hatchery for fish seed production. The farmers were able to plant the Ranjit, a high yielding variety of paddy, and harvested a higher production than with the traditional variety. Seeds of the Ranjit paddy were distributed to more farmers in the next season. However, the farmers could not cultivate *Bodo* paddy again during the winter months as the water table fell and the STW failed to pump out water. Further, the local variety of pig, Doom, was replaced by the Hampshire variety. A farmer co-operator was successful in crossing a large black male with a Hampshire female under the technical guidance provided by the project. Eight piglets were produced. Farmers who reared pigs and ducks along with the fishery earned additional income.

Conclusion

In Assam, aquaculture in small aquatic water bodies such as ponds, *khals,* roadside ditches and small canals holds great potential within the existing farming system. Fish culture in homestead ponds can be operated with resources available within the family as a household enterprise.

In terms of maintaining fresh fish supplies from homestead ponds for family consumption, the project has shown little success. However, the project was able to motivate some of the young village boys to go into farming activities to earn their livelihood. Several farmers around the project site also started fish and pig rearing. Some farmers from non-project areas visited the project areas to get technical assistance from the project beneficiaries. Some of the project's extension workers also provided technical services and gave vaccinations to livestock in non-project areas. A low-cost field laboratory-cum-training centre and a low-cost pig breeding unit were established under the project.

The extension poster prepared on the basic concept of rural aquaculture was appreciated and widely circulated. The initiatives under the project have made a significant contribution to the promotion of aquaculture in the area. However, more field trials under the guidance of scientists are required to refine and improve the technologies for increasing production per unit area of pond.

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Dr. S.K. Das is an Associate Professor at the College of Fisheries, Assam Agricultural University, Raha, Nagaon, Assam, India – 782 103. Presently he is a Professor of Fish Genetics and Reproduction at the College of Fisheries, Central Agricultural University, Lembucherra, Tripura, India- 799 210. E-mail: skdas01@yahoo.com