AQUACULTURE FOR SMALL FARMERS : A TECHNOLOGY DEVELOPMENT AND DISSEMINATION STRATEGY[1]

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Fish, which constitutes the main animal protein intake for people of Bangladesh and provides livelihood to about 8% of population (GoB, 1978), is in short supply in recent years. In rural Bangladesh households mostly obtain their fish requirements by hunting from open waters: 73% households are involved in subsistence fishing (DoF, 1990). There is a shortage of fish due to declining catches from open waters as a result of environmental degradation and increasing fishing pressure. This decline, in conjunction with lack of purchasing power, is resulting in very low fish consumption among low-income groups in rural areas: 4.4 kg per caput per annum, against a national average of 7.9 kg and 22.1 kg among high income groups in urban

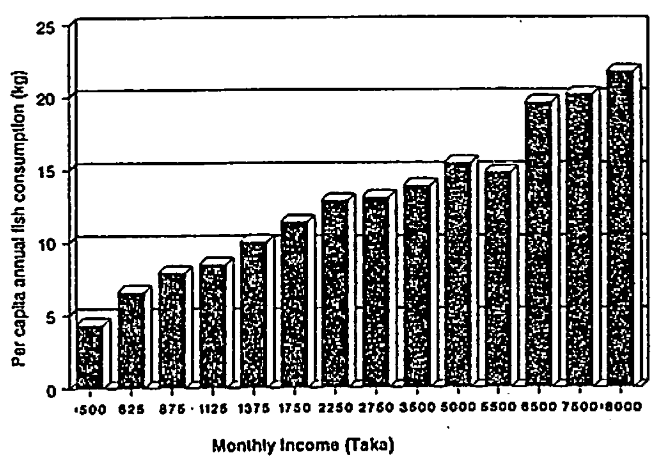

Figure 1: Per capita annual fish consumption in kg, among different household income groups in Bangladesh.

[1] ICLARM Contribution No. 845.

areas (Figure 1). This is resulting in serious and widespread malnutrition among children.

Against this backdrop of declining availability of fish, excellent opportunities exist in rural areas for increased availability of fish to farming families through aquaculture in homestead ponds, ditches, road-side canals, borrow pits, etc., which are presently either under or un-utilised. Development of commercial aquaculture would not help poor farmers because they lack the purchasing power, but small-holder farmers can adopt low-input, small-scale aquaculture to improve their nutrition and income. In the Philippines, Thailand and other countries, backyard aquaculture has been successfully introduced to local communities through operation of small ponds in local elementary schools (Kent, 1986).

The International Center for Living Aquatic Resources Management (ICLARM) with funding from the United States Agency for International Development (USAID), has been assisting the Bangladesh Agricultural Research Council (BARC) and the Fisheries Research Institute (FRI), in developing low-input technologies, for maximising production from available water resources, through optimum utilisation of on-farm resources. The target groups for these studies are the resource-poor, small-holder farmers who constitute the bulk of the population in Bangladesh. The emphasis in the project activities is on on-farm, farmer-participatory research for developing sustainable aquaculture practices that take into consideration farmers' resource base and the agro- ecosystem. The project actively involves extension agencies (mostly NGOs) in the on-farm research stage and subsequently in training and technology dissemination. Bangladesh Rural Advancement Committee (BRAC) is one of the NGOs actively involved in the project activities.

I. REASONS FOR UNDER-UTILISATION OF RURAL WATER RESOURCES FOR AQUACULTURE

With such vast water resources, why is there a shortage of fish in rural areas ? Why is aquaculture not being practised by the farmers? Are there not technologies available for utilisation of these water resources? These are some of the questions that are often raised. The following constraints are relevant:

- poor linkages between research and extension agencies, because of which either the extension agents are not aware of technologies available or do not have confidence in technologies developed by the research institutes;
- whereas technologies developed through on-station research are technically feasible and economically viable, they do not find adoption among farmers as farmers' resource base has not been taken into consideration while developing the technologies, resulting in the technology being beyond the farmers' means;
- the risks involved in high input technologies make the small farmers vulnerable to losses;
- rigidity in technologies disseminated;
- non-availability in rural areas of inputs needed for the suggested technologies; and
- lack of due recognition of the social and economic problems of farmers.

If aquaculture is to contribute to the nutrition and incomes of small farmers these and other constraints that restrain the development need to be addressed.

II. TECHNOLOGY DEVELOPMENT AND DISSEMINATION STRATEGY

Taking into consideration the constraints that impede the development/dissemination/adoption of technologies, the project has been laying stress on the involvement of farmers and developing close linkages between researchers, development workers, and farmers. The strategy followed in this respect is reflected in the flow chart in Figure 2 and detailed below.

Subsequent to basic technology development through studies undertaken in research institutes, on-farm research is undertaken with active participation of farmers. The farmers' resources (water, finances, time, inputs available on farm, and the agro-ecosystem in which the farms are located) are studied, and

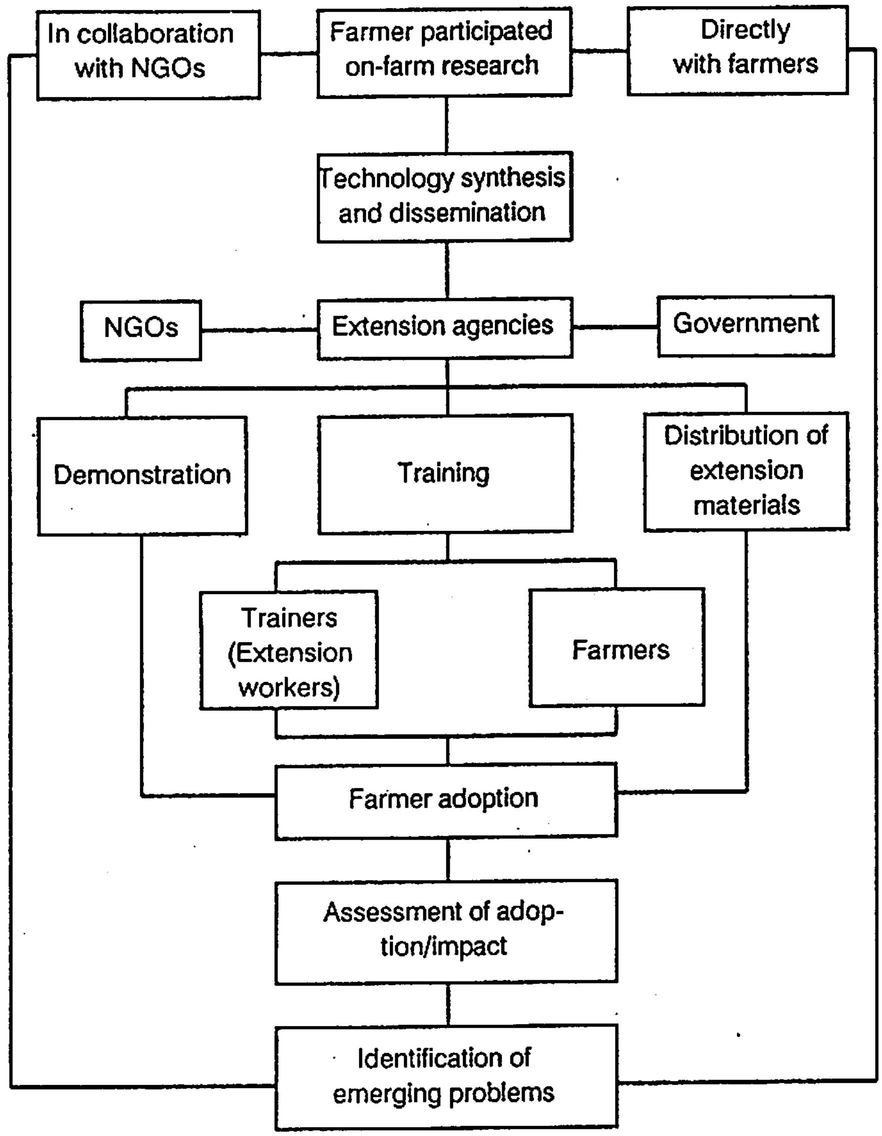

Figure 2: Technology development and dissemination mechanism followed under BARC/ICLARM/USAID Project.

then research designs are drawn up in consultation with the farmers. This at times necessitates making changes in the technology developed through on-station research to suit farmers' needs. At this stage, extension agents are encouraged to participate in the research trials. This has the following advantages: (i) once the technology is proved socio-economically viable, extension agents will have confidence in disseminating the technology, (ii) it reduces the time gap between technology development and dissemination and (iii) along with technology dissemination, extension agencies will be able to ensure the availability of needed inputs such as fingerlings and credit to farmers. Once the technology has proved viable under farmers' conditions, it is then packaged and disseminated through extension agents, both Government and NGOs. Dissemination is done through training of trainers (extension agents) and farmers, field demonstrations, and through production of extension materials such as pamphlets, audio-visuals, etc. After the farmers adopt the technology, surveys are conducted to assess adoption of the technology by farmers and its impact on nutrition and incomes, and identify areas where the technology needs to be further improved or address constraints such as the availability of inputs.

III. CASE STUDY

A case study of technology development and dissemination undertaken in collaboration with BRAC for developing sustainable aquaculture practices in seasonal ponds and ditches is described here.

Ponds, ditches, road-side canals, borrow pits, etc., are common in rural Bangladesh. Most of these are seasonal and are either under or un-utilised for aquaculture because (i) farmers believe that seasonal waters are not suitable for aquaculture and (ii) traditional culture species (Indian carps) do not grow well in seasonal waters (Gupta, in press). Studies undertaken at FRI have indicated the feasibility of culturing short-cycle species such as Nile tilapia (*Oreochromis niloticus*) and silver barb (*Puntius gonionotus*) locally known as Thai sharputi or Rajputi, in seasonal waters using different inputs (Table 1). In view of the fact that if the technology proved viable under farmers' conditions it can benfit a vast number of farmers, on-farm studies were initiated by FRI in collaboration with BRAC in Mymensingh district during 1989. Table

Table 1: Productions, costs, net benefit and cost-benefit ratio of Nile tilapia culture in seasonal ponds in Mymensingh district

Inputs used	Production obtained (kg/ha)	Production cost (Tk/ha)	Net benefit (Tk/ha)	Cost benefit ratio
On-station				
Rice bran and mustard oil cake	3,554	51,590	72,827	1:1.41
Rice Bran	2,739	27,394	54,806	1:2.00
Fertilisers	1,510	17,200	35,675	1:2.07
On-farm				
Rice bran and fertilisers	1,960	21,675	48,925	1:2.26
Farmer adoption				
Rice bran and fertilisers	1,394	9,244	30,930	1:3.34

1 shows that production as high as 3,500 kg/ha in six months was obtained in on-station studies with use of high value inputs such as mustard oil cake (Hussain et. al., 1989). But only low-cost technology using rice bran as feed and fertilisation with cattledung/compost/ chicken manure/inorganic fertilisers was taken for on-farm research, as only this fits the target farmers' available resources.

Such farmer-participatory studies gave fish production of 1.5-2.0 ts/ha in about six months rearing from seasonal ponds and ditches, using cattle dung, and rice bran (Table 1). Because this culture technology is sustainable and uses mostly on-farm resources, BRAC extended the technology to over 1,000 farmers in the subsequent year, through training of extension workers and farmers, and organisation of farmers' rallies.

In 1990, the same process was repeated for experimental culture of silver barb in ten farmers' ponds. After initial success, this was extended to some

2,000 farms in 1991 and has since created wide interest among farmers, resulting in BRAC extending the same to some 20,000 farmers during 1992.

It is interesting to compare at the production obtained, cost of production and net benefits in on-station trials, on-farm trials, and under farmers' adoption (Table 1). Production and net benefits are high in all on-station trials as compared to on-farm trials, but at the same time the cost of production was also high. This indicates that, though production is high, technology may not benefit small farmers due to their limited resources. However, the production farmers obtained using inputs much below the suggested rates was still high compared to the near zero returns they were obtaining in the past from these water resources. High cost-benefit ratios under farmers' adoption, as compared to on-station and on-farm trials, indicate a low risk to the farmers and sustainability of the operation. The costs of production given here include the cost of on-farm inputs used by farmers (cattle dung, rice bran), estimated at prevailing market prices, as if they were purchased off-farm. The actual costs involved for these inputs are much lower when they are available on-farm.

While the technologies tested have proved to be highly suitable for adoption by small farmers, a major constraint to their large-scale dissemination and adoption has been the inadequate availability of fingerlings of Thai sharputi. Hence, BRAC has begun programmes for seed production through establishment of mini-hatcheries and development of a core of trained nursery operators who will be able to meet the demands of the farmers.

IV. CONCLUSION

The experience of this collaborative programme between research and development organisations has shown how sustainable technologies can be developed and disseminated. It has also shown that development of a technology by itself is not a solution to increased production by farmers unless the availability of inputs required for its implementation is assured - otherwise the enterprises will not be sustainable. The technologies suggested here are simple in terms of labour and inputs and they can be undertaken by women, without taking men away from other on-farm or off-farm activities. Efforts are being made by BRAC and FRI to disseminate such simple, sustainable technologies through regular organisation of training programmes, demonstrations and farmers' rallies.

Aquaculture operations are generally assessed in terms of their economic benefits/returns, but not in terms of their contribution to nutrition. In Bangladesh, where emphasis is on alleviation of poverty and malnutrition, importance should be given for programmes which concentrate on fish production using low cost, on-farm inputs. A survey of 113 farmers who have adopted tilapia (assisted by BRAC) has revealed that seasonal ditches as small as 169m^2 can yield an average 23.6 kg of fish: almost equivalent to the national annual consumption of low-income rural households with six family members (Gupta et. al., in press). Moreover, 70% of fish produced is consumed on-farm, improving the nutrition of farming families. Revenue from 23% of fish sold was enough to meet operational costs, making the operation sustainable.

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