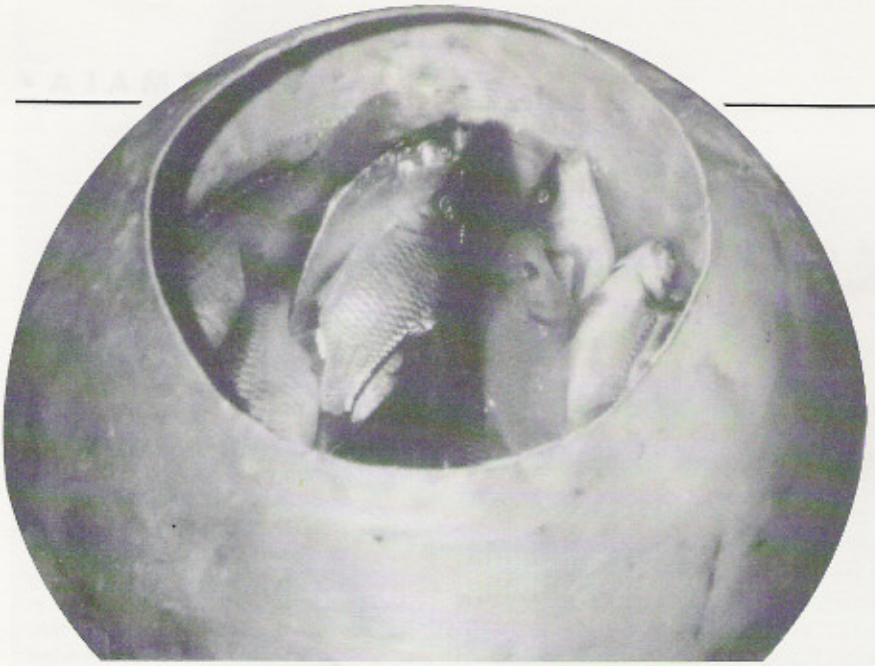

Fish cu

Bangladesh is one of the poorest and most densely populated countries in the world. It relies on rice as its major food source, but cannot grow enough to feed itself. Its mostly rural population depend on fish to supply more than 70% of their annual consumption of animal protein. Yet, the average annual consumption of fish in Bangladesh has declined rapidly in recent years. The major causes of this decline are believed to be increased use of pesticides, reduced access to monsoon season flood plains by fish due to roads and flood control embankments, and overfishing. CARE-Bangladesh began introducing integrated pest management (IPM) activities into an ongoing rice irrigation project in the late 1980's to increase overall food production. The activities continued and intensified in Mirzapur, Manikgonj and Rangpur Districts in 1991, with technical assistance of the Overseas Development Administration of Great Britain.

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Rice pests can normally be controlled by the rice field's own ecology comprised of a complex population of potential insect pests as well as predators and parasites of these insects. The predator-prey relationship can be enhanced for the farmers' benefit through non-chemical means. Most farmers do not like applying pesticides because of the cost, their effect on their health and perceived damage to fish populations. The IPM programme includes training in identifying and monitoring insect populations, experimentation, demonstrations and exchange visits. Training in rice fish cultivation is facilitated the same as IPM training - farmers are given the opportunity to learn about spawning and feeding requirements of fish by means of simple experiments and observations. Farmers involved in the programme are enthusiastic and within a few months, most of them can identify the main beneficial insects and relate why they are beneficial. Insect collections start to appear in tea shops in the local area.

The elimination of pesticides from the rice field is a prerequisite for the cultivation of fish. Fortunately, pesticides, once thought essential for high production of HYV rice in Asia, are now considered to be less important if not totally unnecessary. Besides, rice yields can increase (Kamp 1993; Ramaswamy et al 1992; Pingali 1993).

Learning approach

Farmers must be convinced that forsaking pesticide use will not reduce rice production. To facilitate this, we developed a process-oriented extension and learning methodology. Learning is done in the rice field where extensionists and farmers together observe the interaction of organisms and their effects on rice production. The principle is that farmers discover the answers to their questions themselves. The extensionist is not a trainer but a facilitator. Rice field ecology and pest management strategies are discovered by farmers by means of their active participation in carefully designed experiments. An important part of the process is for extensionists to ask farmers questions and encourage them to talk to each other about what they observe as they carry out these experiments.

Farmer groups

Most of the farmers that CARE works with are very small, owning less than an acre of land. They often sell their labour to other farmers as they cannot live on the production from their small amount of land. They have never cultivated fish in their paddy fields before, and have never thought it possible to do so. When they do experiment with fish, normally they stock fish in a rice plot of less than one quarter of an acre, and invest less than 5 dollars. Women are sometimes involved in the decision to stock fish in the paddy. Salima's experience (see box) is typical of families that stock fish.

We worked with three groups of farmers (see table): 179 farmers cultivating carp (*Cyprinus carpio*) during the 1992 winter irrigated rice season. 121 of them received training in rice-fish culture and 58 in rice-fish culture and IPM. 972 farmers received IPM training, but did not stock fish. From a control group of 60 randomly selected farmers in Rangpur, pesticide use, incidence of pest attack, and crop yields were monitored. All farmers cultivating fish in their rice fields applied voluntarily. Although most farmers stocked their fields with week-old hatchlings, some stocked with fry and small fingerlings. Most fish seed came from private hatcheries while a significant amount came from neighbours' or their own ponds. Most farmers were cultivating HYV rice varieties in approximately one quarter acre plots. They were not given any free inputs by the project. Data was collected on the basis of farmer recall for all farmers in all groups. Farmer recall is as reliable as crop cutting to determine relative rice yields and requires considerably less work (Mendoza, 1988).

Exciting results

In 1991, 63% of project area farmers used pesticides in their rice fields. In Rangpur, which had the highest number of rice-fish

OUR VIEW

The scope for reduced or even total elimination of pesticides is desirable and possible: rice yields can be maintained without pesticides and opportunities are created for production of fish and other aquatic life resources. The poisoning of an ecosystem upon which farmers depend for food with toxic pesticides will not create a sustainable agriculture system, but entirely the opposite.

itting pesticide use

cultivators, 86% of farmers used pesticides. In 1992, virtually all farmers in all areas who cultivated fish in their rice fields completely stopped using pesticides in their rice. The results can be found in the table. Just like Salima's family, farmers discovered that pesticides were not necessarily needed in their rice fields, and with the introduction of fish, they must be discontinued. Farmers in the programme monitor insect populations on a regular basis, and are more aware of what insects are in their paddies and what they are doing. It does not take them long to see that their fields have no more pest insects than their neighbours fields which have been sprayed with pesticides. And they notice many more beneficial insects, as well as fish! Harvest time is one of the best times to influence farmers about reducing pesticide use. As the farmers drain water from their paddies, crowds gather to both watch and participate in the catching of fish. A few farmers are able to harvest quantities of fish worth as much as their rice. Fish in rice fields appeared to have a significant effect on the yield of rice. Much of the increase in rice production is due to better water management, induced by the presence of fish.

Frogs, crabs and snails

Farmers cultivating fish in their rice fields totally eliminated the use of pesticides. Farmers who did not cultivate fish reduced their pesticide use with 76%. To reduce pesticide use, it appears that IPM training is not necessary to encourage farmers cultivating fish in their paddies. However, it is estimated that only 20% of farmers in Bangladesh could cultivate fish in their rice, mainly due to a lack of adequate water, poor water-holding capacity of the soil, and risk of flooding. In programmes only promoting rice-fish cultivation, the remaining 80% of rice farmers who cannot cultivate fish would not receive the benefits of reduced pesticide use. And these could be considerable.

Aquatic organisms like frogs, shrimp, crabs, snails, mussels, and even some insects are potentially more important sources of animal protein for rural populations than fish. They too can be enhanced through the elimination of pesticides. However, very little is known about the effects of pesticides on various aquatic organisms. Snails and mussels are known to build up a concentration of pesticides in them. All water organisms are subjected to granular pesticides when they are applied. In most South East Asian countries, these organisms are eaten by farmers. In Bangladesh, they are usually fed to poultry. Ducks, important in Bangladesh, normally feed in the rice paddies on snails and other aquatic plants and animals themselves. Pesticide residues could potentially affect the health and egg-laying ability of the ducks.

Wild fish benefit

Reduced pesticide use will have positive effects on the natural stocks of wild fish which are considered a critical resource for populating the flood plains at the beginning of the monsoon season. The immediate effects of reduced pesticides on capture fisheries as well as its possible effects on the reproductive potential of these stocks, while difficult to measure, may be significant. We strongly recommend that fish cultivation continues to be a component of a comprehensive IPM programme extended to all rice farmers. ■

Results of 1992 Boro Season IPM Programme, CARE Bangladesh. Kamp, 1993.

Group	*1*	*2*	*3*	*4*
Amount of farmers	121	58	972	60
Trained in	Rice-fish only	IPM and Rice-fish	IPM only	-
Reduction of pesticides	100%	100%	76%	0%
Increase in rice yields	6% over group 3	13% over group 3	10% over group 4	0%
Food/income from fish and aquatic organisms	yes	yes	no	no

Less pesticides and more income

A typical example of a farm family that stocked fish was Salima's family from Manikgonj, 60 kilometres from Dhaka. After her husband attended IPM sessions facilitated by CARE's Field Trainer Kashem, he convinced his wife Salima that they should stock fish in their rice field. As they had little money, Salima sold a chicken and had her son buy carp hatchlings with the money, about $1.50. They stocked them in their rice field. Salima's husband normally applied pesticides, but after learning more about IPM, he felt assured that his rice field would not be affected if he did not apply them this year, and besides, he had fish in his paddy. But after a few weeks, Salima became quite angry with Kashem. She could not find any fish in her rice field. Kashem told Salima not to give up hope, and if she did not harvest any fish, he would repay her the money for the chicken she sold.

About a month later when Kashem stopped by to see how Salima was doing, she was very excited. Her paddy field was full of fish. The rice crop appeared to be better than the year before. They did not apply any pesticides. At the time of rice harvest, Salima's son collected more than 700 fish from their small plot, and their yield of rice went from 330 kg to 400 kg, an increase of 23%! Thinking about the future, Salima decided to keep the fish instead of selling them and stock them again in the upcoming monsoon season rice crop.

After the second season in the rice field, the fish were reaching a much larger size, and now the fish made a considerable amount of noise during their feeding. Many of their neighbours would come by their field in the early evening to just 'listen' to the fish eating. Salima's family began eating some of the fish.

After cultivating the fish in her paddy for a full year, Salima noticed that many of the fish were mature and ready to spawn. She asked Kashem if this was possible. Kashem encouraged Salima to experiment by placing water hyacinth in a small deep area of the paddy. After a few days, Salima discovered that the roots of the water hyacinth were covered with eggs. The carp had spawned onto the roots of the water hyacinth. She began to sell hatchlings and fingerlings to her neighbours, earning more than $20.-, enough to purchase a bicycle for her son-in-law, which she had promised him at the time her daughter was married.

Even after selling and eating a good number of fish, their paddy still had many more fish. With these Salima is planning to produce even more, and feels that money is no longer that problem it used to be.

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