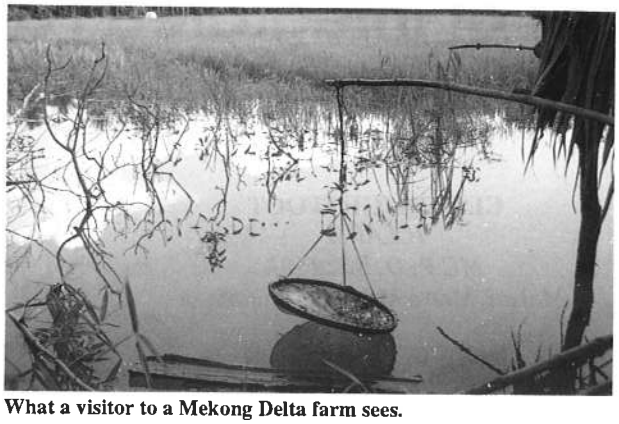
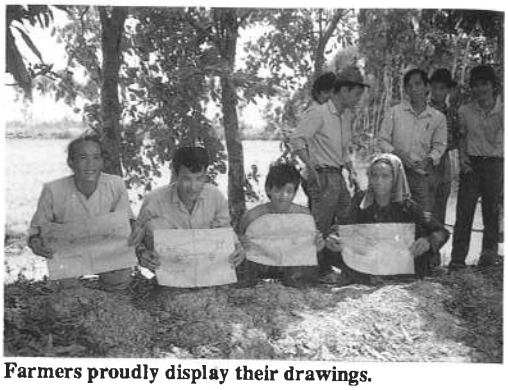
A farmer concentrating hard on his drawing.



What a visitor to a Mekong Delta farm sees.



Farmers proudly display their drawings.

expenses can be reduced by about one-third. So a US$50/ha weeding bill becomes only US$33.40. NPK fertilizer application can be reduced by 28% from 209 to 192 kg/ha without reducing rice grain yield. Even if rice production falls because trenches take up 15% of the rice area the high value of prawn at 20,000 VN Dong/kg (about US$5) compared to rice (282 VN Dong/kg) still makes integration profitable. Incomes from prawns can be two or three times that of rice.

Such pictures are of greatest help to the farmer who now sees how fish, or any other enterprise, can fit into his or her farm. In this way farm pictures become valuable extension tools as well. Extension workers can use them to show other farmers how to integrate fish or vegetables or trees into their farming systems.

Researchers are helped by farm pictures not only because they help them understand farming systems, but also because they provide a framework for formal analysis. The picture tells researchers what data to gather for their input-output analysis and farm budgets. Ecological box models can be constructed when data are gathered on the standing biomass and rate processes shown. Indeed such pictures should preface any farm system modelling exercise.

Readers wishing to learn or exchange their ideas about participatory methods for integrated agriculture-aquaculture farming systems research are invited to write to the authors.

Further Reading

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The Pond Refuge in Rice-Fish Systems*

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Small fishponds on irrigated and rainfed rice farms, whether isolated from the ricefields or connected to them, can be a highly productive asset for farmers. The concept of a small pond as a 'pond refuge' for fish that forage for part of their growth period in the ricefield, for breeding or nursing fish, and for holding fish after rice harvesting results in much higher production. For growout operations it also produces larger fish at harvest and permits stocking of small fingerlings (5-10 g): a most attractive proposition. Such a pond refuge allows great flexibility in integrated rice-fish farming: coupling rice and fish production cycles as and when appropriate and decoupling them to suit different culture cycles when such flexibility is required. The pond refuge system is found in China, Indonesia and Thailand and is currently being tested in the Philippines. One ricefield may have a small pond at one end (Fig. 1), or depending on the topography of the farm, two or more ricefields may be linked to one common pond refuge to reduce the ratio of pond area to the total rice-fish field area (Fig. 2). Plates 1-3 show various aspects of pond refuge systems.

The traditional type of fish refuge in concurrent rice-fish culture in irrigated areas is a small trench, 50 cm wide and 40 cm deep (Plate 4). In the Philippines, such trench refuges for concurrent rice-tilapia culture appear to be too risky because their water may not last: irrigation schedules are unreliable and often delayed. Moreover, fingerlings of 5-10 g cannot be stocked in trench systems and grown to marketable size with short duration rice crops.

*ICLARM Contribution No. 642.

These limitations have led to development of the pond refuge: a small pond connected to the ricefield. The size of the pond varies, but can be about 10% of the ricefield (the fish foraging area) and about one meter deep. An initial comparison between the trench and pond refuge systems favors the latter in terms of fish and rice production and water quality. With the pond refuge, net returns improved to about 40% compared to about 10% for the trench, and could be improved further.

The advantages of the pond refuge are as follows:

1. It is more permanent and cheaper in the long run than the trench, because excavation is needed only once. The trench is a regularly added cost during land preparation for riceplanting and fish stocking.
2. It eliminates the constraints on stocking size of fish and shortness of culture period present with the trench system. Fish can be kept in the pond before land preparation and during field draining. On reflooding the ricefield after harvest, fish can again forage in the ricefield and grow to a larger market size.
3. It offers easy integration with other crops and livestock. Spoil banks resulting from pond excavation create elevated space for vegetables and/or fruit trees. There is easy access for watering them. The pond area may also be planted with taro, water spinach (*Ipomoea aquatica*) or other macrophytes. Organic fertilizers (e.g. pig, goat or chicken manure from sheds located on or near the spoil banks) may be put into the pond and their nutrients will be spread to the whole rice-fish area.
4. It facilitates supplemental feeding of fish in rice-fish systems. The fish learn to spend time in the pond to accept feed.
5. It sustains the farmers' interest in fish culture because fish become available year-round, unlike with the trench system where once the fish are harvested the fish culture activity stops totally until the next rice cropping cycle.
6. It helps to control rice pests. Even with the advent of integrated pest management some pesticides are still needed in rice farming. Confining the fish in the pond refuge by lowering the water level allows chemical spraying without worry about toxicity to fish, water availability and risks to consumers. The water level can be raised and the fish allowed to forage again once toxicity has diminished.

Plate 1. A pond refuge trial in concurrent rice-tilapia culture at a farm in Guimba, Nueva Ecija, Philippines.

Plate 2. Decoupling of a pond refuge and ricefield during rice grain ripening and harvesting at the Freshwater Aquaculture Center, Central Luzon State University, Nueva Ecija, Philippines. At this time the fish stay in the refuge section. After completing harvest, the whole field may be reflooded again for the fish to forage.

Plate 3. In Wuhan, China, the spoil banks of a pond refuge are used for growing vegetables with ensured water availability.

Plate 4. The peripheral trench refuge system also provides raised and enlarged dikes that can be planted with crops such as taro (*Colocasia esculenta*), string beans, mungbeans, and others, as sources of added income. This farm is in Guimba, Nueva Ecija, Philippines.

The pond refuge may not be attractive or applicable in places where government policy requires planting of rice to "all" rice land; and in farms where the depth of excavation (at least 50 cm) will reach the coarse-textured or sandy subsoil, thus resulting to excessive seepage loss.

Development and testing of the pond refuge system has been supported by the Asian Development Bank, Manila and the International Development Research Centre, Canada.

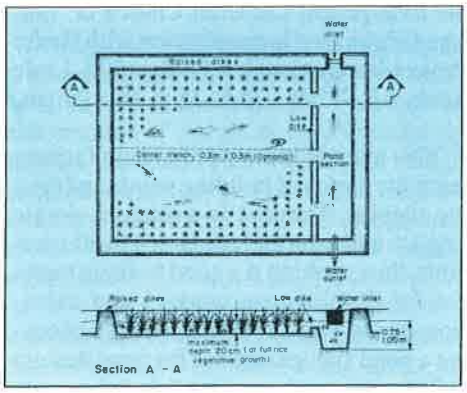

Fig. 1. One rice-fish field with a pond refuge at one end.

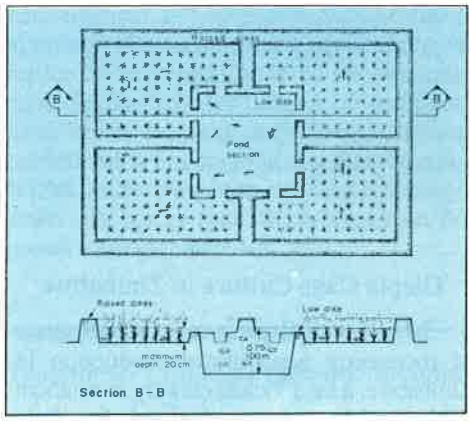

Fig. 2. Four rice-fields with a common pond refuge.