Mang Dionisio Herrera switched over to rice-fish

The rice-fish farming system is one of the approaches to Low-external Input Rice Production (LeIRP). This is a low cost method of producing rice and at the same time the stocked fish provides an environmentally friendly way of controlling pests and grass and it provides nutrients for farm needs. This farming method promotes maximum utilisation of the farm resources. For example, farm-based crops are used as fish feed and as components of farm-waste recycling to produce organic fertiliser. Rice-fish farming makes the farmer more self-reliant and less dependent on outside farm inputs like chemical fertilisers and pesticides. Finally, integration minimises risks while providing a greater variety of nutritious food for the family.

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The farmers in the municipality of Naic are mostly engaged in rice monoculture and very much depend on external farm inputs. In 1994, Barangay Malainin Luma was one of the barangays or villages in Naic identified as a most suitable site for rice-fish farming because of its flatness, good water supply from irrigation and because its major livelihood is rice farming. The LeIRP project aimed to introduce low-external input rice production as an alternative system to provide the farmers in the area with sustainable farming methods, an almost pollution-free environment, less farming risk and with diverse and almost chemical-free food produced on the farms.

In the same year, Mang Dionisio adopted this technology when he started to use his 1,250 m² paddy for rice-fish culture. He was at first reluctant. However, after farmer-to-farmer discussions and cross visits to other farms practising the technology, he was encouraged to try it out. He was backstopped by the author (agricultural technician of the International Institute of Rural Reconstruction) and the agricultural technician of the Naic Municipal Agriculture Office, a partner local government unit in the project for reasons of project sustainability. The project has generated a lot of insights and learnings for all concerned during the process of adoption and while problems surfaced along the way, the benefits were welcomed by the Dionisio family.

The first season

Initially, in the 1,250 m² rice paddy a trench was constructed on two sides of the paddy forming an "L" shape of 1 m deep by 1.23 m wide by 33.3 m long with a total area of about 41 m². There was a shortage of labour and budget to construct this trench. So, Mang Dionisio asked the help of his neighbours through a *bayanihan* scheme. This is a common cultural practice among Filipinos in rural areas. Neighbours provide free labour, while the host provides free food and also drinks during the work. The construction of the trench took 14 days. It was composed of water inlet and outlet, sump, the trench itself and the bunds that separate the fish compartment from the rice paddy with a remaining area of 1,209 m² after the construction of the trench was completed. The trench is the major modification in the rice paddy. It provides shelter and growing space and forms a refuge for fish during the rice harvest period and maintenance operations. For example, the application of chemicals may be harmful to fish. The rice paddy becomes the extension of the grazing area of the stocked fish.

During the ploughing stage of the paddy, five 50 kg bags of organic fertiliser were applied evenly in the paddy simultaneous with cleaning of the bunds. After this, the first harrowing followed and the bunds were repaired to prevent seepage and leakage. The last harrowing was done to flatten and spread the soil evenly in the paddy. At the same time the second lot of five 50 kg bags of organic fertiliser were applied. After the harrowing, levelling of the paddy field followed to prepare for rice transplanting. Before the transplanting, 2,4-D (a herbicide) was applied to suppress the growth of grass in the field (applied only in the first cropping). Four days after the application, the field was irrigated at 1.5 inches deep and the rice transplanting started. Almost all the activities were done by the family. Rice paddy preparation would take about a week or less depending on the availability of water and the will of the farmer to complete it. Chicken manure was bought from another village about 15 kilometres away and was used in making organic fertiliser for the rice.

As the rice grew, the depth of the water was also increased proportionate to the size of the rice. At two weeks old, it was fertilised with Urea at 12.5 kgs and after six weeks, before the panicle initiation, the 16-20-0 NPK (both chemical fertilisers were applied during the first cropping only) and half a bag (25 kg) of chicken manure were applied. No pesticide was used in the first and in the following cropping seasons to protect the fish from poisoning. The rice variety used was PSB-RC4, a high yielding variety which takes about 120 days to grow from planting to harvest time.

Rice results

The initial results were not encouraging because the net income of 436 pesos was below the previous practice (yielding 805 pesos). This was due to the fact that the rice growing area had been reduced and so produced less rice. The yield almost equalled the cost of purchasing external inputs for the farm. The transition period was a crucial moment for everyone. In addition the farmer was now obliged to utilise those available on-farm resources, like compost making, producing fishfood and other related activities instead of

Table 1
Cost and return analysis of the rice-fish farm of Mang Dionisio Herrera at Malainen Luma, Naic, Cavite, Philippines

item	rice	rice-fish culture 1st cropping	2nd cropping	3rd cropping
A. total farm area in m²	1,250	1,250	1,250	1,250
rice yield in cavans	5.5	5.0	5.0	4.5
area devoted to rice in m²	1,250	1,209	1,209	1,209
fish yield in kg	-	15	25	25
area devoted to fish in m²	0	41	41	41
B. Costs/expenses in pesos				
rice component	945.24	1,270.50	1,060.00	910.00
fish component	-	720.00	237.00	220.00
total costs	945.25	1,990.50	1,297.00	1,130.00
total costs per m²	0.76	1.59	1.04	0.90
C. Returns/income in pesos				
rice yield (sold)	1,749.00	1,616.50	1,722.50	1,669.50
fish yield (consumed/gifts)	-	810.00	1,325.00	1,300.00
total returns	1,749.00	2,426.50	3,047.50	2,969.50
total returns per m²	1.40	1.94	2.44	2.38
D. Net income in pesos	803.75	436.00	1,750.50	1,839.50
	0.64	0.35	1.40	1.47
E. Return on investment of rice fish enterprise	0.85	0.22	1.35	1.60

Note: US$ 1.00 is 26 pesos

those external inputs as previously practised in the rice monoculture. Nonetheless, he already saw the beneficial interrelationship of the resources in the farm, like the rice straw for making organic fertiliser, the kitchen waste as fish food, snail as fish food too, etc.

The second and the third cropping season showed a decline in external costs, because Dionisio no longer applied chemical fertilisers and herbicide. However, family labour input increased due to compost making (used mainly as farm fertiliser) and feeding and securing the fish.

The rainy season was delayed during the third cropping which resulted in rationing of water from the irrigation system. Due to water shortage, the paddy was intermittently filled with water so fish activity was limited only to the trench. There was a high incidence of grasses growing in and along the paddy, and thus manual weeding was necessary. The golden snail were prevalent in the field and these were removed manually by family members everyday. The snails were crushed and fed to fish.

From Table 1, the average rice production for the three croppings in rice-fish paddy with an area of 1,209 m^2 was 4.83 cavans (255.99 kg) which amounted to 1,669.33 pesos. This amount is slightly lower than the previous rice monoculture production which yielded 5.5 cavans (291.5 kg) amounting to 1,749 pesos but from 1,250 m^2, the original paddy area. This represents a decline of 9% or 0.0215 kg of rice per m^2 under the new technology. However, market conditions improved to offset this lower rice production and there was a concurrent decline in the expenses of farm external inputs.

Thus, there was an increase in net income under the rice-fish cultivation and this can be seen in Table 1. Again on an area basis, rice yielded an average of 1.38 pesos per m^2 under rice-fish cultivation, which is only 0.01 pesos lower than under rice monoculture. In this case, circumstances combined to minimise the effect of rice production of allocating 3.3% of the paddy area for fish production.

Mang Dionisio's observations on his rice-fish farm as compared to the rice monoculture were (a) the rice grew faster, more robust and taller while the colour is dark green, (b) there were almost no grasses growing in the rice paddy, (c) the organic matter in the soil increased as shown by the blackish colour and putrid odour of the soil, and (d) the used high yielding variety responded unexpectedly well to an almost organic farming system and performed best during the rainy season or when there is enough water from the irrigation system.

Fish cultivation

During the first cropping, the fish fingerlings stocked were 100 pieces (24,390pcs/ ha) of Tilapia (*Oreochromis niloticus*) and 4 pieces (975.6 pcs/ha) of Carp (*Cyprinus carpio*) which were bigger than tilapia. In the second cropping, 150 pieces (36,585.8 pcs/ha) of tilapia fingerlings were stocked. No carp was added since this was not available. During the third cropping, the hardship of getting new tilapia fingerlings necessitated the culturing of the remaining offspring of tilapia stocked in the second cropping but in unknown quantity. Still no carp fingerlings were available for the third cropping.

The plankton growing in the trench and paddy were eaten by the fish. This plankton was maintained by applying urea in the trench (only applied in the first cropping) and organic fertiliser (by putting the organic fertiliser in a perforated plastic or jute sack, tied and staked underneath the trench water). The plankton serves as direct food for the fish. However, rice bran, whenever available, was given twice a day (morning and afternoon) in ad libitum manner. Other supplemental food requirements were gathered within the vicinity of the farm, e.g. the golden snail, azolla, ipil-ipil (*L. leucocephala*) and kangkong (*Ipomoea aquatica*). These were all mixed with the rice bran (if available) before given to the fish. Thirty days after transplanting, the fish were allowed to enter the paddy for more than two months until before the harvest time. The paddy was drained before the rice harvest to allow the return of fish back to the trench. Following the harvest, the fish returned to the paddy once more, allowing them to grow further and eat the existing organisms in the paddy.

Harvesting of the fish was done either all in once or in parts. Partial harvesting was almost done every day by the family for food. The complete harvest was done after the rice harvest by draining the trench completely. All the fish caught were eaten and some were given free to farmers for food or to those interested in growing fish. The weight of the fish caught varied from 25g to about 50g.

Fish results

It was observed that the growth of carps was strong, up to around one (1) kilo per fish during the initial cropping. The abundance of the fish had contributed to the daily food requirements of the family and the total weight of harvested fish for the three croppings was 66 kg (4 kg of Carp and 62 kg of tilapia taken from both partial and complete harvest). The amount of fish shared with the other farmers was only minimal. The equivalent amount in money for fish consumed by the family was 3,435.00 pesos (a significant investment that would otherwise have been spent on food).

The easily propagating tilapia caused high population which resulted in a drop in quality of the fish breed and size. This could be improved by completely replacing the stock. Unfortunately, the remoteness of the source of fingerlings and transportation were another problem.

According to Mang Dionisio's observations, the fish's swimming behaviour seemed to cultivate the soil, especially near the roots of the rice. The presence of the fish also seemingly contributed to the control of weeds in the paddy. Thus, there was less cost and effort needed to remove the weeds or cultivate the soil. He believes the manure of the fish contributed to the increase of soil fertility. It was also observed that the urea applied in the trench triggered only four days of bloom of the plankton while the chicken manure maintained the plankton bloom for almost seven days. This was determined by the green colour of the water after application of fertilisers. The longer the plankton bloom the more food is available for the fish.

Catching the fish by using a fishing rod provided the family and their neighbours with an opportunity to recreate and share the technology.

Water level in the paddy and trench were maintained at a desirable depth by irrigating thrice weekly. Grasses growing on the bunds were regularly trimmed and cracks in the bunds were repaired to prevent the escape of fish and entry of predators or poisonous chemicals. The screens at the water inlets and outlets were regularly changed and the inlets were closed with every chemical application in the adjacent paddies to prevent fish poisoning. They were opened again only after the fourth day of application had lapsed.

Observations

- Labour and time input initially increased under the rice-fish cultivation method but this was compensated by increasing return of investment, diversification and perhaps sustainability.
- Fish stock needs to be in ready supply and there is a decline in quality over time due to stunting.
- Water quality and quantity must be maintained at optimum level. Rice-fish farming should only be attempted where these are assured.
- Farmers generally lack skills in breeding and rearing fish and quickly lose interest in the more difficult aspects eg. acquiring the organic material.
- Neither carp nor tilapia can control the golden snail infestation in the farm.

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