Sustainability and entry points

Maha Yoo played an important role in the farmer-to-farmer extension of rice-fish culture which is the entry-point for the development of integrated farm systems.

Fruit trees become important elements in the integrated rice-fish farm. Photo: Media Center for Development.

One change in a farm system that appears to lead to a large number of other beneficial changes and appears to enhance the evolution of the system, may be called an 'entry point'. Changes like this are usually made by farmers and are often unanticipated by researchers. Ken MacKay indicates how carefully chosen diversity may increase the sustainability of systems. Eventhough rice-fish culture in Northeast Thailand has recently become more difficult due to drought, the entry point concept may be an important methodological tool in assessing sustainability.

Ken MacKay

What is important at a practical level is to determine indicators of sustainability of existing systems and to work with farmers to design new sustainable systems. One such indicator is systems diversity. One of the popular themes of ecosystem theory is the relationship between species diversity and system stability (Odum 1971; Woodwell and Smith 1969). In its simplest form, this theory suggested that simple systems with few species are less stable than more complex systems with a greater number of species. However, this theory has generated considerable arguments. The most recent consensus appears to be that increased diversity does not necessarily produce stability. It is, however, the connectances or linkages between species that are more important for system stability (Connell and Sousa 1983; King and Pimm 1983 and Margalef and Gutierrez 1983)

The relationship between stability and sustainability is much less tenuous, although Holling (1973) suggests the terms resistance and resilience both of which are properties of sustainability. Dover and Talbot (1987) give an excellent review of the ecological principles related to sustainability. They conclude that increasing diversity for its own sake will not necessarily improve sustainability. In fact poorly designed diversity may actually destabilize systems. They concur with the ecological consensus that it is the linkages between components that can increase sustainability. Agroecosystems will have to be carefully designed, considering ecosystem and community structure but also the characteristics of, and relationships among component populations including the humans that inhabit them.

Entry points

Major changes to farming systems are seldom adopted, however, these systems can and do evolve. If you can not get there from here how do you get there? There are some examples in which a change in one component of a system leads to a large number of other changes which increase productivity and sustainability. These changes I call entry points: one change in the system appears to lead to a large number of other beneficial changes and enhance the evolution of the system. These changes are usually made by farmers and are often unanticipated by researchers. There are a number of examples where changing the resource base, for example terracing, water catchments or irrigation result in profound changes to the system. Irrigation is perhaps the clearest example in which a regular supply of water normally results in changes in cropping intensity, productivity, stability and probably sustainability (provided the water supply is renewable and salination does not occur).

Rice-fish culture

There are other examples where the addition of only one component to a system results in considerable positive changes to the system. The introduction of fish into rice cultivation is an example in which increased diversity has increased productivity and sustainability (MacKay et al 1988). I will explore this

system in more detail in search of more clues on entry points.

The integration of agriculture and aquaculture as practiced in the Chinese integrated pond systems has been shown to be highly productive and have a high ecological and energetic efficiency. Considerable effort has gone into trying to adapt this system to conditions in Southeast Asia. Attempts have been made to introduce it to Northeast Thailand with limited success. There appear to be considerable constraints related to the initial cash requirements, risk and operating capital and technical complexity. At the same time a much simpler farmer-to-farmer innovation of rice-fish culture has been spreading rapidly among poor farmers in Northeast Thailand with little or no research support or official extension.

Farmer-to-farmer

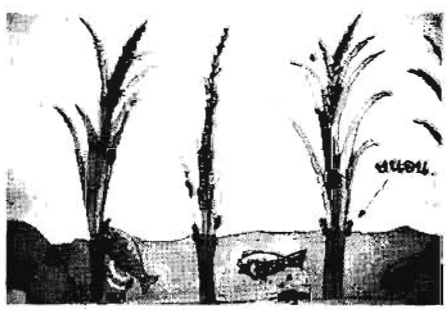
The practice of growing rice and fish together in one field at the same time is traditional in most of Asia. The practice decreased as the green revolution increased. The decrease in multiple cropping and increased use of agricultural chemicals were not conductive to the fish. However, in North-East Thailand rice-fish culture has expanded rapidly in the past ten years. This development is occurring spontaneously from farmer to farmer and it is only recently that government research and extension personnel have been involved. This expansion is occurring in the rainfed area among some of the poorest farmers. These farmers use very few pesticides in their rain fed rice production. A mixture of native and exotic fish species, usually common carp (*Cyprinus carpio*), tilapia (*Sarotherodon nilotica*), and silver barb (*Puntius gonionotus*) are stocked in the rice about ten days after transplanting. Usually a trench is dug in the field to offer a deeper refuge for the fish and make it easier to harvest them. The fish are harvested whenever needed but often after the rice harvest and some are maintained in small ponds during the dry season for food, sale and brood stock.

A list of the benefits from this system at the field, farm and community level based on data from NE Thailand is presented in Table 1. Somewhat similar results are now being shown for Indonesia under irrigated, high-input conditions (Fagi et al 1990). Research to explain many of the benefits of the fish introduction into the paddy system has started only recently and is summarized in dela Cruz (1990).

Evidence of benefits

At the field level the rice-fish combination increases the yield of rice in spite of a reduction in rice planting area due to the trench. Production costs of rice are reduced as less fertilizer appears to be needed probably due to faster turnover of soil nutrients, particularly phosphorus. Consistent evidence is emerging from Thailand, Indonesia and China showing considerable weed, insect and disease control due to the fish although at least for weed control it may depend on the species involved. There is some good evidence form China that fish in rice paddies significantly reduce mosquito populations and incidence of malaria (Wu Neng et al 1989). There is some anecdotal evidence from NE Thailand that land preparation after rice-fish is easier than in adjacent fields which were rice only the previous season. Water management is improved in the rice-fish situation as farmers usually raise the dikes of paddies for fish and they inspect the fields more frequently (daily) than when rice only is grown. Thus any damage (eg. rat or crab holes) to dikes is repaired immediately. In fact the improved water management may account for many of the other benefits of rice-fish culture. More labour is required in rice-fish, primarily the initial investment of raising the dikes and trench preparation, but also for maintenance, daily inspection and harvesting. However, there is no conflict with peek labour demands for other activities and farmers and their children view the daily inspection as recreation. There may be a decrease in native fish production in the paddies. These fish are usually considered as more highly desired species although yields are lower (Fujisaka and Vejpas 1989). In fact some farmers have stopped stocking some fields for rice-fish and preserve them for native fish production (J. Sollows, personal communications)

Consistent evidence is emerging from Thailand, Indonesia and China showing considerable weed, insect and disease control. Drawing: Media Center for Development.



More food and income

Thus at the field level there are considerable impacts of the introduction of fish into rice culture. Rice-fish is therefore being promoted as an entry point for Integrated Pest Management (Waibel 1990) and in Indonesia as means of decreasing phosphorous fertilizer use (Fagi et al. 1990). It is, however, at the farm and village levels where impacts of rice-fish can be seen.

At the farm level the increased income from the rice and fish is probably reflected in higher household incomes but the economic studies only examined agricultural income not total household income. Family nutrition and has probably increased although there have been no targeted nutritional studies. The families consumed about 1/3 of the fish produced (MacKay et al 1988) and women interviewed indicated that fish consumption was greater when fish were raised. This was particularly during times of peak labour demand (transplanting and harvest) to feed the family and additional labourers, and during the dry season. Some farmers would even stock fish prior to transplanting so they would have some fish during this period (Field notes, K.T. MacKay and J. Sollows personal communications).

Animal rearing (chicken, ducks, pigs) often increases after the family has settled on the farm. Photo: IIRR.

The labour pattern at the farm level is also interesting as some farmers have claimed that the increased labour of rice-fish is more than compensated for by decreased labour searching for and catching wild fish although Fujisaka and Vejpas (1989) indicate there is very little labour involved in this activity. Thus rice-fish may result in a total saving of labour for the household.

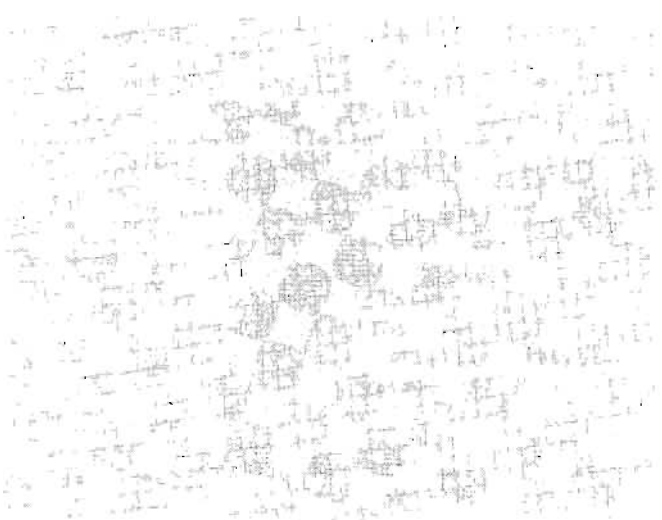
Integrated farm system

Of major interest for our discussion of entry points is the increase in integrated farming. This involves an increase of vegetable, fruit tree, and animal production on the farm. In many areas of NE Thailand the families live in a central village and travel to the farm. These nuclear villages were an important part of the anti-insurgency campaign of the 1970's and early 1980's. There is often a field shed on the farm which the family uses during the wet season particularly at rice harvest but during the dry season the farm is not inhabited and seldom visited. When fish are kept during the dry season in ponds someone has to spend time protecting them from theft. When the farm wife and children visit the farm more often this may lead to planting of fruit and vegetables which are irrigated with pond water. Increased animal rearing (chickens, ducks and pigs) follows, the field hut is fixed up as the family spends more time on the farm during the dry season. In some villages in Roi-et province most of the farmers have moved from the central village to their farms and are now involved in year round integrated agriculture. Seasonal out migration of the males seems to have also decreased. In other villages farmers are specializing in various fish rearing activities. Some are producing fingerlings for sale, other with ponds and enough water are moving to pond culture during the dry season including supplementary feeding.

Thus the changes at the household level have in turn had dramatic effects on the socioeconomics of the village. In addition there are also socio-political effects as in some cases the village leaders fearing loss of their traditional authority have opposed rice-fish culture and the result, migration to the farms. As a result of the above experiences the integration of aquaculture and agriculture is now being promoted as a route to sustainable farming systems (Lightfoot, 1990).

Carefully chosen diversity

The important question, however, is whether the increase in sustainability of the field, farm and village system due to the addition of fish in to the paddy is a unique event or whether it is an example of more general application. I would argue the second case that it is an example of how carefully chosen diversity can contribute to the evolution of the system to a more productive and sustainable level. There are some other examples but very few have been described from the entry point perspective. One example is the development of an agroforestry project in Kenya (Chambers et al 1989). The objectives were to extend an alley cropping package for soil fertility improvement and staff were unsuccessful in obtaining farmer adoption until they changed their approach and emphasized "bottom-up" participation. The farmers adopted the nitrogen fixing trees for livestock fodder, started to produce milk which increased income and the extra manure in turn increased crop yields. All of these results were unanticipated by researchers but contributed to increased productivity and sustainability of the farm household and village system. There are other possible examples that need to be examined in detail. The spread of nitrogen fixing trees in Eastern Indonesia which resulted in the complete change in cattle rearing from open range to housed cut and carry systems is another example. One system that may need the entry point concept is the adoption of contoured rows of trees for soil erosion control. However, there are still problems of adoption of these systems and the evolutionary process has to be examined in more detail (Fujisaka, 1989). ■



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