Rice-fish farming systems in China

- Both rice and fish cultivation have long histories in Asia, where many species and varieties of each originated and were first developed for human use.
- Fish can be raised in rice fields, either concurrently with the rice crop or in rotation with rice. Rice-fish farming can also be practised at different intensities.
- Not only do rice-fish systems use one habitat to produce both an important grain and a protein resource, but they also promote some very beneficial interactions: rice plants provide shade for fish, while fish oxygenate the water.
- The systems also minimize risks for resource-poor farmers, protect natural resources and promote biodiversity.
- As world rice production increases, so too does the adoption of rice-fish farming systems.

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INTERNATIONAL YEAR OF RICE 2004
rice is life

THE SITUATION

Rice is the dominant staple crop of tropical Asia, where it has a long history of domestication and a rich diversity of cultivated ecotypes based on three types of *Oryza sativa* (*indica, japonica* and *javanica*), which are cultivated in different agro-ecological zones for their differing growth, grain and yield characteristics. There are four basic rice agro-ecosystems in China, each with its own peculiar edaphic conditions: irrigated ecosystems, terrace ecosystems, lowland rainfed ecosystems, and flood-prone (very deep water) ecosystems.

In addition, many freshwater fish species originated in tropical Asia, especially carps, catfishes and air-breathing fishes. In China there is now a rich variety of rice-fish farming systems, which are adapted to the country's various cultural, environmental and economic conditions. Rice-fish farming systems form a striking landscape and integrate ecological features and services (e.g. land–water interactions, biological control, nitrogen-fixation) in ways that ameliorate some of the inherent limitations.

Fish culture in rice fields can be concurrent (mixed) or rotational with the rice crop, and it can be practised at different intensities.

Traditional (capture), concurrent and low-intensity fish culture (using no fertilizer and no feed) systems coincide with river floods and promote the culture of very rich fish diversity compared with intensive fish culture. The fish can subsequently be rotated for growth and fattening without rice in the harvested rice fields.

THE BENEFITS OF RICE-FISH FARMING

As well as using one habitat to produce both an important grain and a protein resource, rice-fish systems promote a variety of beneficial interactions. For example, the rice plant provides shade and insects for the fish, as well as organic matter that the fish can use, while the fish oxygenate the water and move the nutrients around, thereby benefiting the rice.

The fish provide biological pest control, and *Azolla* spp. also fix nitrogen for the rice. In addition, complex and diverse food webs of microbes, insects, predators, and cultivated plants and livestock provide benefits to one or both of the system's components.

Rice-fish systems are risk-minimizing and suitable for resource-poor farmers, enabling them to cultivate fruit and vegetables on dikes and bunds and to raise such small livestock (pigs and poultry – especially geese and ducks) as is culturally and economically preferred. Rice-fish systems promote ecological and economic efficiency through the recycling of materials and nutrients and through the synergies between their two components. They safeguard water, soil resources and agrobiodiversity (of both rice and fish) and support a rich cultural diversity and associated management institutions.

Intensive monoculture of rice or fish, on the other hand, leads to short-term gains but long-term non-beneficial effects, including biodiversity loss.

Rice-fish systems provide important ecosystem goods and services: grain, protein (animal and vegetable), promotion of biodiversity, efficient water use, nutrient cycling and retention, and new beneficial microclimates.

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RICE-FISH FARMING AND BIODIVERSITY

From a biodiversity perspective, rice-fish farming systems promote: i) low to moderate genetic diversity in high-yielding rice varieties, owing to intense varietal selection that is primarily for yield and secondarily for system maintenance and economic viability; and ii) moderate to high fish species diversity resulting from the low-level selection of varieties within species.

High biodiversity levels occur in traditional, low-intensity, rainfed systems in which temporal, spatial and genetic diversity result from farm-to-farm variations in cropping systems and confer at least partial resistance to pest attack.

For each agro-ecological, cultural and management system, rice ecotypes have been selected and developed to optimize the hydro-edaphic, vegetative, reproductive and ripening characteristics and to minimize the losses to pests, competitors (such as weeds, organic wastes and metabolites) and environmental hazards (such as cool temperatures, soil acidity and salinity, and floods).

THREATS, CHALLENGES AND SOLUTIONS

Rainfed rice-fish farming systems are put at risk by the excessive application of chemicals, particularly pesticides, the intensification of rice cultivation as a basic staple for the growing human population, the intensification of mono-species fish culture, and irrigation systems.

Rice-fish farming addresses market needs and there is a need to promote traditional rice-fish systems in upstream and remote areas.

There is also a need to assess the policies, institutions and economic incentives that encourage the intensification of rice-fish culture systems to the detriment of agrobiodiversity, so as to define reforms that may conserve traditional, low-intensity, rainfed rice-fish systems.

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GLOBAL IMPORTANCE

As rice production increases all over the world, so too does the implementation of rice-fish systems. The systems are also important for global environmental issues such as:

- climate change, because the emission of greenhouse gases from rice fields is determined by the farming practices adopted, the plant's metabolism and the soil properties – and rainfed systems tend to contribute fewer emissions than irrigated ones;
- water conservation, by retaining floodwaters in shared catchment areas and river basins;
- biodiversity, of both rice ecotypes and fish species; and
- the rice fish system has been identified as "a globally important ingenious Agricultural Heritage System" under FAO-UNESCO-UNDP-GEF programme.

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