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/Rice/, /plant production/, /fish production/, /mixed farming/, /cultivation systems/, /China/ — /appropriate technology/, /ecology/, /economic aspects/, /on-farm research/, /case studies/, /conference reports/, references.


A microfiche edition is available.

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Value of the Rice–Fish Production in High-Yielding Areas of Yuyao City, Zhejiang Province

Cao Zenghao

In Yuyao City, Zhejiang Province, rice–fish farming was developed in the 1950s at scientific institutions, state farms, and some fishery villages. However, because of changes in production relations and farming systems, rice–fish farming soon stagnated. In 1978, it was revived.

Experience has shown that integrated rice–fish production offers economic, social, and ecological benefits. It has become an important way to increase the income of grain-producing households, diversify single-product economies in rural areas, and supply animal protein to improve the nutrition of the people. There are new problems. Rice–fish farming is limited in high-yielding ricefields where labour is limited, where arable land is limited and highly productive, where there are a large number of households that work the land part-time, and where township enterprises are well-developed. However, these contradictions can be mitigated by research and field trials to develop rice–fish farming techniques to produce high yields of rice and fish.

Benefits of Rice–Fish Culture

Recent multilocation trials, demonstrations, and extension efforts in Yuyao City have shown that major benefits can be derived from integrated rice–fish production systems.

Efficient Use of Natural Resources

Yuyao City in the southeast coast (29.39°N, 120°E) has an accumulated temperature of 5073°C, 210 frost-free days, and abundant precipitation and sunlight. It is a high-yielding area that produces a double crop of rice (10–11 tonnes/ha of early and late rice). These temperature, sunlight, and meteorological conditions are also suited to fish culture. In a 1986 study of 107 lowland rice-farming households in Changlou township, fish were cultured in 21.1 ha of ricefields. The output was 6,400 kg/ha of early rice and 5,260 kg/ha of late rice, which was the same output produced in ricefields without fish culture. Adult fish were cultured in 6 ha with an output of 926 kg/ha. Production reached 11,250 kg of rice and 750 kg of fish per hectare, and the value of the output was doubled. Another 15.1 ha were used to produce 499 kg of fingerlings per hectare.

20 Yuyao Aquatic Product Bureau, Yuyao City, Zhejiang Province.
Farmer Yang Tiexian dug ditches in 11% of his 0.18-ha ricefield to breed 120 grass carp, 1000 bream, 750 crucian carp, and 5000 adult carp in early spring. By 10–15 October, he harvested 703 kg (3905 kg/ha) of rice and 100 kg (558 kg/ha) of fish. His experiments were verified by researchers from both Ningbo and Yuyao.

This example illustrates that pits and ditches for fish culture can enhance the growing environment for both rice and fish and can increase economic efficiency. Organic matter in the water (e.g., plankton, benthos, insects, weeds, and organisms harmful to rice) serve as fish food. The movements of the fish stir the water and loosen the soil to improve oxygenation and soil fertility. Fish feces are quality organic manure for rice.

**Intensification of Agriculture**

Farmers in Yuyao City only have about 0.05 ha of ricefields each. The multiple-cropping index has reached 240% and the population continues to grow rapidly. The amount of arable land limits agricultural production. For this reason, agricultural production must be diversified and farming must be intensified to obtain maximum economic, social, and ecological benefits. Rice–fish farming is an effective way to increase productivity when farmland is limited.

Farmer Jin Wanshun and his family contracted 1 ha of ricefields. Since 1984, he has managed this farm using an integrated method that includes growing rice, fish, fruit, and vegetables. In 1987, he implemented the rice–fish system and planting grapes and vegetables on the ridges of 0.7 ha of ricefields. He harvested 12335 kg/ha of rice and 1061 kg/ha of fish. His family sold 5200 kg of commodity grains, 440 kg of live fish, and 150 kg of fingerlings. Calculated on the basis of local prices, his family earned CNY2514 from rice, CNY3305 from fish, CNY1000 from melons and vegetables, and CNY4000 from household sideline products. Of the total income of CNY10500, rice–fish farming contributed 30% to total income and 46% of agricultural income.

Integrated rice–fish production plays an important role in the development of a diversified economy. Its economic benefits are double those obtained in monoculture under the same conditions.

**Creation of a Favourable Ecological Environment**

At present, increased crop yields depend on the application of a large amount of fertilizer. These fertilizers have increased energy consumption and production costs and polluted the environment. In the rice–azolla–fish ecosystem, azolla is a fertilizer and food for the fish. Fish eat insects and weeds, and their feces fertilize the rice plants. This reduces the need to apply chemicals because pests and diseases are minimized and soil fertility is improved.

In Chang Feng Township in 1985, farmer Chen Bingcan and his family contracted 2.3 ha of farmland. They used the rice–fish system and grew rice with azolla in the
spring and fish in the summer and autumn. After 3 years, soil fertility had greatly improved. The Institute of Soil and Fertilizer, Zhejiang Academy of Agricultural Sciences, determined that the organic matter content of the soil had increased from 2.9% to 3.3% and that the nitrogen content had risen from 0.2% to 0.3%. Pest damage was also reduced, and weeds had been reduced by 56 times. There were only 27 weeds/m² in the ricefield with fish and 1,521 weeds/m² in the field without fish. Sheath blight had declined from 47% to 33%. Rice seedlings were transplanted into untilled ricefields, which meant that plowing and weeding were not necessary. The application of fertilizer and agricultural chemicals was reduced by 40%, which lowered production costs and increased income.

A 1987 survey showed that a 1.7-ha ricefield that used the rice–fish integrated production system yielded 2,860 kg of hybrid rice seed, 1,560 kg of rice grain, and 2,860 kg of live fish. The income was CNY6,240/ha, or CNY3,820/ha more than the CNY2,420/ha that was obtained from planting rice alone in a 0.4-ha ricefield.

Limiting Factors

Although Yuyao City has favourable temperature, sufficient sunlight, and 2,915 ha of ricefields for rice–fish farming, there are also limiting factors.

Scattered Plots and Extensive Cultivation

Since the implementation of the production responsibility system, most farmers have only have about 0.2–0.3 ha of arable land. Many have left their farms to work in township enterprises. The resulting labour shortage has limited the development of rice–fish production systems.

Limitation of Traditional Cropping Systems

There are contradictions between the management techniques for the traditional rice-cropping pattern and the rice–fish pattern. For example, when the close planting pattern (12.5 cm x 12.5 cm x 12.5 cm x 10 cm) is adopted for transplanted rice, toxic chemicals are applied to prevent pests and diseases and the field is frequently idle. These chemicals limit rice–fish farming.

Lack of Knowledge of Fish-Culture Techniques

Farmers are experienced in rice farming but lack knowledge about fish culture. Techniques for breeding fish in ricefields have been developed in recent years, but farmers need more technical guidance as well as an effective service system and administration. The supply of fish fry and fingerlings are insufficient. These factors have constrained the development of the rice–fish production system.
Future Needs

**Identification of Development Priorities**

To boost the commodity economy in the countryside and to improve its efficiency and benefits, arable land must be gradually centralized by big rice-grain producers in rural areas. This centralization should be followed by extension information about rice–fish production systems.

**Strengthen Research**

The rice–fish production system lacks a model and must be standardized to be easily adopted by farmers in rice-growing areas. Rice–fish farming techniques should be disseminated through technical training, demonstrations, and on-farm visits.

**Improve Engineering Facilities**

Rice–fish farming facilities must be altered to enhance the symbiotic environment. Scattered and shallow trenches should be converted to centralized and deep trenches that make up 6–8% of the total area of the ricefield. The growth of both rice and fish should be promoted by providing a habitat for fish migration and by changing from square close planting to wide-row close planting. These changes will alleviate the contradictions between fertilizer application, water irrigation, plowing, transplanting, and pest control.

**Enhance Cooperation and Service**

The rice–fish integrated production system is multidisciplinary and combines agronomy with the aquatic products industry. To develop fish farming in ricefields, farmers must be provided with an adequate supply of fish fry and fingerlings, marketing information, and an effective fishery administration to ensure production safety.