Rice–Fish Culture in China

Edited by
Kenneth T. MacKay

International Development Research Centre
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International Development Research Centre
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MacKay, K.T.
Chinese Academy of Agricultural Sciences, Beijing CN
Chinese Academy of Fisheries Sciences, Wuxi CN


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


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Economic Research on Rice–Fish Farming

Jiang Ci Mao and Dai Ge

Since 1978, rice–fish culture has developed very rapidly in China. The area under production has continued to expand, and aquatic production has increased each year. In some provinces, rice–fish production accounts for the largest percentage of freshwater fisheries production (Table 1).

The development of rice–fish farming differs from place to place. In China, rice–fish culture accounted for 2% of freshwater aquatic production in 1982. In 1983 and 1984, the proportion was 2.5% and 3.1% respectively. In Sichuan, rice–fish culture now accounts for 7.6% of freshwater aquatic production.

Rice–fish culture is important part of fisheries production in Sichuan, Guizhou, Hunan, and Jiangxi. In 1949, production from rice-fish culture accounted for 15.5% of the aquatic production of these four provinces. By 1984, this figure was 21.6%. In Guizhou, rice–fish culture represents 75% of total aquatic production. In these provinces, rice–fish farming is common in the hilly and mountainous areas. For example, in Sichuan and Guizhou, about 75% of the production comes from these areas; whereas, in Quin Dong Nan, Guizhou, 85% of aquatic production is supplied by rice–fish farming.

Ricefields are a suitable place for the culture of fry and fingerlings. In Hunan Province, 0.44 billion fish were breed in 38430 ha of ricefields and ponds. These fry and fingerlings can be used to promote fish production in ponds, reservoirs, and lakes.

Economics of Rice–Fish Farming

A survey of 23.8 ha of rice–fish fields was conducted in Jiangxi Province in 1984. The average input cost was CNY660/ha and the average net profit from breeding and selling fish was CNY4590/ha. The cost–return ratio was 7.9. Similar surveys were undertaken in Hunan and Guizhou. In Hunan, a survey of 7.3 ha of ricefields in 1984 showed that the cost–return ratio was 16.0; whereas, in Guizhou, 222.4 ha were surveyed and the ratio was 7.8. For China as a whole, the maximum cost of the rice–fish farming is about 20% of the value of production (input:output ratio 1:5). From these calculations, it can be seen that rice–fish farming provides a good return on investment.

69 Aquatic Bureau of Sichuan Province, Chengdu, Sichuan Province.
Table 1. Fish production from ricefields (as percentage of total fish production) in China and several provinces (1983 and 1984).

<table>
<thead>
<tr>
<th></th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>2.54</td>
<td>3.11</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>—</td>
<td>0.18</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>0.77</td>
<td>1.28</td>
</tr>
<tr>
<td>Anhui</td>
<td>0.55</td>
<td>1.12</td>
</tr>
<tr>
<td>Fujian</td>
<td>3.90</td>
<td>5.39</td>
</tr>
<tr>
<td>Jiangxi</td>
<td>1.90</td>
<td>3.40</td>
</tr>
<tr>
<td>Hunan</td>
<td>4.31</td>
<td>5.76</td>
</tr>
<tr>
<td>Guangdong</td>
<td>0.21</td>
<td>0.45</td>
</tr>
<tr>
<td>Guangxi</td>
<td>3.82</td>
<td>4.59</td>
</tr>
<tr>
<td>Sichuan</td>
<td>22.29</td>
<td>25.16</td>
</tr>
<tr>
<td>Guizhou</td>
<td>79.25</td>
<td>71.08</td>
</tr>
<tr>
<td>Yunan</td>
<td>4.93</td>
<td>7.53</td>
</tr>
</tbody>
</table>

Table 2. Production value of rice–fish culture in Chengdu, Sichuan Province (1984).

<table>
<thead>
<tr>
<th>Type of Ricefield</th>
<th>Area (ha)</th>
<th>Rice</th>
<th>Fish</th>
<th>TV* (CNY/ha)</th>
<th>Ratio TV to Rice Only (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plains 2-season field</td>
<td>206</td>
<td>7895</td>
<td>2053</td>
<td>3172</td>
<td>54.5</td>
</tr>
<tr>
<td>Hills Winter ricefield</td>
<td>80</td>
<td>7670</td>
<td>1994</td>
<td>5534</td>
<td>177.5</td>
</tr>
</tbody>
</table>

* TV total value.

Techniques and Management

Common carp, crucian carp, grass carp, and nile tilapia are raised in ricefields. The integration of fish and rice provides several benefits (e.g., pest control, fertilizer, and reduced need for pesticide). In general, rice–fish culture is a simple technique that is easy to popularize because there is little risk.

Farmers in economically developed areas are not as interested in rice–fish culture because they have relatively high incomes from other means. But for farmers in remote areas, the situation is quite different. In these areas, farmers have few income sources other than crop production. Therefore, rice–fish culture is
attractive because of its low cost and good return. It is one of the best ways for remote areas to improve their economic development.

Rice–fish culture can also be easily popularized in the areas adjacent to cities and towns. Areas adjacent to cities and towns have the advantages of access to information and speed of market feedback. The site of production and the market are close together and the selling price of the fish is relatively high. Therefore, the return on investment is higher than in remote areas.

**Rice–Fish Farming and Agriculture**

Rice and fish are mutually beneficial. Fish can accelerate the growth and increase the production of rice. A large-scale survey of rice–fish culture indicated that rice production was increased by 5-15%. Rice–fish culture, beyond doubt, can promote agricultural production and development.

**Economics**

Before rice–fish culture was introduced in Sichuan, the average rice yield was about 6000 kg/ha and the income was CNY1755/ha. However, when fish were raised in ricefields, the increase in income was CNY150/ha from rice and CNY750/ha from fish. In some areas, the income from selling fish was even higher (Table 2). The production value of rice–fish farming is much higher than rice production alone. Especially in hilly areas, there are many winter ricefields that have deep water storage and hold water for a relatively long time. Under these conditions, the value of rice–fish culture is about three times rice production alone.

Compared with the cost of rice production, which is about 30–50% or even 60% of the value of rice production, the cost of fish grown in ricefields is relatively low (about 20% of the value of production). The economic benefit of rice growing is not as high as fish culture. At present, the unit yield of rice is stable. It is difficult to raise the economic benefit of the ricefield by increasing rice yield. However, improved benefits and production values can be achieved by raising fish in ricefields. Generally, from rice–fish culture the net income will be about CNY600/ha. A maximum net income of about CNY1500/ha is possible and is the goal of many farmers (Table 3).

Fish bring changes to rice cultivation and help achieve remarkable economic benefit. These changes mainly decrease inputs into rice cultivation. The fish eat weeds that compete with rice for fertilizer. The fish also help control plant diseases and insect pests and, therefore, reduce the need for pesticides and the amount of labour needed for weeding. Studies in Sichuan, Hunan, Guizhou, and Jiangxi showed that raising fish in ricefields saved about 8–12 days of labour.

Rice–fish culture improves labour productivity. Labour productivity is a measure of the total products produced in a certain period. Labour productivity reflects the
Table 3. Economic benefits from different forms of fish culture in Sichuan in 1984.

<table>
<thead>
<tr>
<th>Area (x 1 000 ha)</th>
<th>Raising Days</th>
<th>Avg. Fish Harvest (kg/ha)</th>
<th>Avg. Rice Harvest (kg/ha)</th>
<th>Total Income (fish + rice)</th>
<th>Labour (1 day)</th>
<th>Net Invest. (CNY)</th>
<th>Avg. Income (CNY/ha)</th>
<th>Income Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice only</td>
<td>46.7</td>
<td>—</td>
<td>—</td>
<td>4 883</td>
<td>1 689</td>
<td>240</td>
<td>450</td>
<td>639</td>
</tr>
<tr>
<td>Rice-fish</td>
<td>4.8</td>
<td>65</td>
<td>113</td>
<td>5 250</td>
<td>1 913</td>
<td>285</td>
<td>480</td>
<td>720</td>
</tr>
<tr>
<td>Rotation fish</td>
<td>0.5</td>
<td>200</td>
<td>600</td>
<td>6 750</td>
<td>3 534</td>
<td>311</td>
<td>750</td>
<td>2 001</td>
</tr>
<tr>
<td>and rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercrop. rice</td>
<td>0.7</td>
<td>35</td>
<td>Raising fry</td>
<td>5 250</td>
<td>2 484</td>
<td>285</td>
<td>858</td>
<td>998</td>
</tr>
<tr>
<td>and fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sichuan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice only</td>
<td>8.2</td>
<td>—</td>
<td>—</td>
<td>5 273</td>
<td>2 109</td>
<td>240</td>
<td>675</td>
<td>1 434</td>
</tr>
<tr>
<td>Rice-fish</td>
<td>0.3</td>
<td>70–90</td>
<td>83</td>
<td>5 438</td>
<td>2 472</td>
<td>300</td>
<td>837</td>
<td>1 635</td>
</tr>
<tr>
<td>Rotation fish</td>
<td>0.2</td>
<td>200–240</td>
<td>128</td>
<td>5 513</td>
<td>2 588</td>
<td>315</td>
<td>930</td>
<td>1 658</td>
</tr>
<tr>
<td>and rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish culture in</td>
<td>0.08</td>
<td>90–100</td>
<td>879</td>
<td>8 513</td>
<td>6 026</td>
<td>375</td>
<td>1 320</td>
<td>4 706</td>
</tr>
<tr>
<td>half-dry fields</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish culture</td>
<td>0.08</td>
<td>90–100</td>
<td>885</td>
<td>7 575</td>
<td>6 216</td>
<td>27</td>
<td>1 335</td>
<td>4 881</td>
</tr>
<tr>
<td>(ponds+canals)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Net income from fish culture in ricefields as a percentage of income from planting only rice. Labour in Hunan is CNY2.5/day. Net income of Qingcheng in Sichuan includes labour price.
Table 4. Labour productivity of rice–fish culture in Hunan and Sichuan (1984).

<table>
<thead>
<tr>
<th>Form of culture</th>
<th>Area (x 1000 ha)</th>
<th>Average Output (Fish + Rice) (CNY/ha)</th>
<th>Labour (days/ha)</th>
<th>Labour Productivity (Production Value/Labour Day) (CNY)</th>
<th>Labour Productivity of Ricefish Culture per Pure Rice Planting (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice only</td>
<td>46.7</td>
<td>1689</td>
<td>240</td>
<td>7.04</td>
<td>—</td>
</tr>
<tr>
<td>Fish in ricefields</td>
<td>4.8</td>
<td>1913</td>
<td>285</td>
<td>6.71</td>
<td>95.3</td>
</tr>
<tr>
<td>Rotation of fish and rice</td>
<td>0.5</td>
<td>3534</td>
<td>311</td>
<td>11.38</td>
<td>161.7</td>
</tr>
<tr>
<td>Intercropping of rice and fish</td>
<td>0.7</td>
<td>2484</td>
<td>285</td>
<td>8.71</td>
<td>123.6</td>
</tr>
<tr>
<td>Sichuan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice only</td>
<td>8.2</td>
<td>2109</td>
<td>240</td>
<td>8.78</td>
<td>—</td>
</tr>
<tr>
<td>Fish in ricefields</td>
<td>0.3</td>
<td>2472</td>
<td>300</td>
<td>8.24</td>
<td>94.7</td>
</tr>
<tr>
<td>Fish culture in half-dry ricefields</td>
<td>0.08</td>
<td>6026</td>
<td>375</td>
<td>16.07</td>
<td>184.7</td>
</tr>
</tbody>
</table>
Table 5. Survey of rice-fish culture in Sichuan and Jiangxi in 1984.

<table>
<thead>
<tr>
<th></th>
<th>Total Production of Fish + Rice (CNY/ha)</th>
<th>Fish Production Value (CNY/ha)</th>
<th>Increase Because of Fish Culture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sichuan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chengdu Plains</td>
<td>3172</td>
<td>1119</td>
<td>35.3</td>
</tr>
<tr>
<td>Hills</td>
<td>5534</td>
<td>3945</td>
<td>71.3</td>
</tr>
<tr>
<td>Jiangxi</td>
<td>7779</td>
<td>5253</td>
<td>67.5</td>
</tr>
</tbody>
</table>

level of fish-raising in ricefields. Low-level rice–fish farming has lower labour productivity than rice farming. When the ricefield is used to cultivate fry and fingerling the labour input is increased a little. Much higher labour productivity can be achieved by adopting new technical improvements (Table 4).

Land and Water Resources

China is a large country with a large population and a scarcity of agriculture land. Agricultural production occupies an important place in the national economy; therefore, comprehensive use of land and improvements in grain production are important. Rice–fish culture has many advantages: increases in grain yield, production of freshwater fish, an increase in the production capacity of arable land, increased economic returns, and a higher land-utilization ratio (Table 5).

Rice alone cannot make full use of the materials and energy in the ricefield. Rice–fish culture can greatly increase the use of fertilizer and energy, and transform these materials into human food. Water is a precious natural resource. Rice–fish culture makes more comprehensive use of available aquatic resources. The efficiency of water use is increased because more than one use is made of the water.