

# The future of rural income and rice production in China

Economic growth in China's agricultural sector lags behind growth in industry and services, creating an ever widening rural-urban income gap. Yet growth beyond the farm offers new opportunities for farmers in China's more advanced provinces: markets for new crops and increasing farm size. At present, the dual government objectives of increasing rural incomes and increasing rice production are clearly in conflict. Farmers can obtain incomes comparable to non-farm wages only when they stop rice cultivation and switch to more profitable crops. Otherwise, mechanization is necessary to allow large enough increases in farm size to raise household income and maintain national rice production levels.

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Globalization and market integration have contributed to unprecedented economic growth in many parts of East and Southeast Asia, especially in Eastern China. Macro-economic developments have resulted in strong growth of the industry and service sectors, providing employment opportunities at wage rates several times higher than those for agricultural labour. Currently, almost 85 percent of rural households in China have at least one family member working in the non-agricultural sector. Yet agriculture still employs roughly half the labour force and rural incomes are just 30 percent of the urban average.

China's spectacular urban growth offers new opportunities for farmers. Rural-urban migration exerts pressure on farms to expand in size, as migrating farmers rent their land to those who stay behind. This could require changes in the management and performance of farming systems and improve the welfare of the remaining farmers. Farms have been managed mainly by using manual labour and animal traction, but current developments might facilitate, or even require, an increase in mechanization. At the same time, increased urban income creates markets for more expensive products, such as vegetables, fruits and meat. Diversification of agriculture from rice to these high-value products is considered an important means to increase farmers' income and thereby prevent further widening of the rural-urban income gap. However, diversification might jeopardize national rice supply, which remains a concern of the government.

## Calibrating the farm household

The study uses a farm household model to examine the potential of urbanization to spur the development of rice-based farming systems. Taking into account the dual government objective of

increasing farm income and rice production, it also assesses the effects of the expansion of land holdings, crop diversification, and technology. The socio-economic, institutional and natural environments determine the direction and pace of change for farm households and, hence, overall agricultural development. To account for these diverse influences on land use, the farm household model integrates knowledge from economics, soil science and crop science.

Our case-study area is Pujiang county in Zhejiang province. The province has a well-developed non-agricultural economy and is home to China's most active land rental market. Fertile soils and abundant water make Zhejiang and the rest of China's greater Yangtze River Delta one of the world's most productive rice growing regions. In 2002, we carried out an extensive survey among 107 farm households, most of which were small rice farms, vegetable farms and somewhat larger rice-vegetable farms.

We developed a stylized model that covers the core characteristics of these households and maximizes income from crop production, subject to the availability of land, family labour and capital, agricultural technology and market prices. The model can accommodate five different crop activities. We include three prevailing rice systems: one annual harvest of rice using hybrid seed rice; two rice harvests a year, the first an inbred rice variety and the second hybrid seed; two rice harvests a year with hybrid seed rice. All rice crops are transplanted, except early rice with non-hybrid seeds. In addition to rice, we include two frequently observed triple vegetable systems: celery-greens-radish and celery-hot pepper-radish.

Initially, we assume that all operations are performed manually, as was common practice among farmers surveyed. Later, we introduce mechanization in order to meet peak labour demands, a practice that is becoming increasingly popular. For vegetable production, the

main labour peak occurs during the harvest, which unfortunately cannot be mechanized in the short or medium term since there is no machinery that can harvest vegetables on such a small plot without damaging the crop. For rice production, the main peak occurs during transplanting. Secondary peaks for all crops occur during land preparation and for rice an additional peak occurs during the harvest. We introduce mechanized land preparation and harvesting and direct seeding for rice production, and mechanized land preparation for vegetable production.

## The farm household when farm size increases

We first used the model solely for rice production (Table 1) and according to the average resource endowments of rice-farmers in the survey sample: 0.3 hectares (ha) of land and 2.5 workers. The household grows double rice (with hybrid seed for both rice crops). Total rice production for the model household is 3.4 t (mega grams) and income is 2,626 Yuan. Whereas the simulated income is close to the survey average for rice-cultivating households, rice production is significantly higher. The model household grows double rice only. Survey households, on the other hand, grow single rice as well, which has a somewhat lower income but requires less labour and less strict timing - a factor not accounted for by the model. Labour requirements are low and no hired labour is needed.

Next, we allow for vegetable as well as rice cultivation. We first adapt resource endowments to reflect the averages for the vegetable farms. The resulting model farmer grows a rotation of celery, leafy vegetables and garden radish on his entire 0.2 ha. While his farm is only two-thirds the size of the model rice farmer, his capital requirements are about triple and his labour requirements more than double. This results in an income of more than 16,000 Yuan, significantly higher than the surprisingly low income our survey found for pure vegetable farmers.

When we triple farm size to 0.6 ha, the survey average for rice-vegetable farms, the cropping pattern changes. Vegetable labour requirements in peak periods are simply too high to allow vegetable cultivation on more than 0.39 ha. On the remaining 0.21 ha, the farmer grows rice. This general pattern coincides with the survey averages. Moreover, income from vegetable production is about the same for the model household and the average survey household. There is, however, an expected difference in rice cultivation. All of the survey's mixed farms grow single rice, whereas the model farmer grows double rice. Capital requirements are high

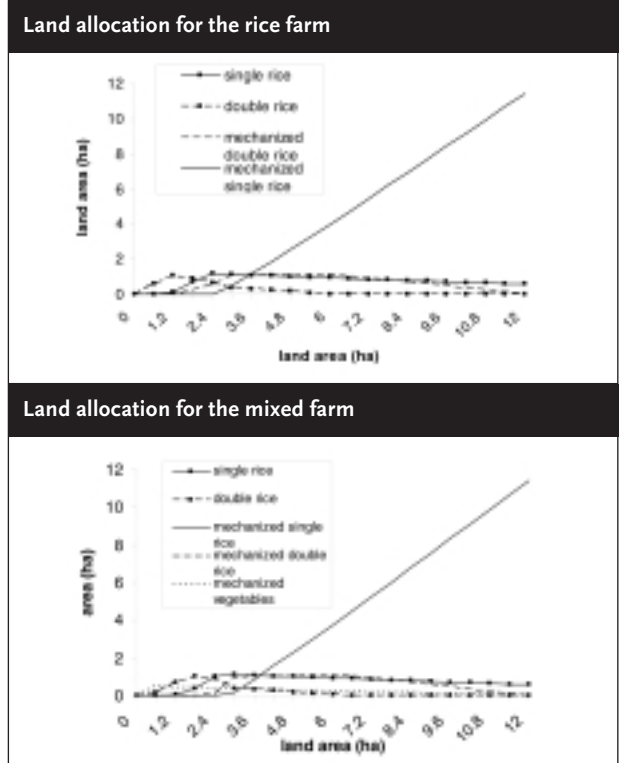


Figure 1  
Simulation of increasing farm size from 0 to 12 ha with steps of 0.6 ha for the two reference farms allowing for mechanization

compared even to the vegetable farm. In summary, the model accurately simulates the shift from pure vegetable production to a combination of vegetable and rice production when farm size increases. The reason behind this shift is limited labour availability during peak periods.

## Mechanization scenario

When we allow mechanization and direct seeding, the farm size that a single household can manage becomes as large as 12 ha (Figure 1). Even with mechanization, labour constraints limit vegetable cultivation to a maximum of almost 0.5 ha. When farm size increases slowly to free up labour for increasingly labour-intensive rice cultivation, until virtually all 12 ha is used for directly seeded, mechanized single rice. A similar pattern can be observed for a rice farmer who starts with non-mechanized double rice cultivation and beyond one hectare shifts to less labour-intensive rice crops until he ends up with 12 ha of single rice of which most is mechanized and directly seeded. Hence, from two or three hectares onwards, both farms become very similar. The main difference is that up to 12 ha, the mixed farm maintains a small vegetable plot, which leads to somewhat lower per hectare rice production but significantly higher income. Mechanization is already preferred for vegetable production at a farm size of 0.6 ha, but rice cultivation is mechanized only slowly beyond 1.8 ha on the rice farm and 2.4 ha on the mixed farm.

## Mechanization: good for rice, irrelevant to vegetables

The spectacular growth of China's non-farm economy offers new opportunities for farmers in China's more advanced provinces. Increased income in the urban sector creates markets for new products, and migrating farmers rent their land to those staying behind. Using a simulation model covering important characteristics of the farmer and his con-

text, we analyse the effects of potential increases in farm size given the farmer's choice to grow rice only or a combination of rice and vegetables. The methodology employed allows exploration of the impacts of expected future developments on agricultural production and rural livelihoods.

Our results show that at the present scale of farming, the dual government objectives of increasing rural incomes and increasing rice production are clearly conflicting. At the present land to labour ratio, rice production renders a per capita income that is less than a quarter of the non-farm wage. Vegetable production, however, obtains five times the rice income and thus can more than compete with the non-farm sector. Specialized training and development of product markets can help farmers currently growing rice to switch to these more profitable crops.

If, as expected, farm size increases in the near future, rising rural incomes and rice production might go hand in hand. Even with mechanization, farmers can only manage relatively small plots of vegetables. Our results indicate that household labour and the limited amount of available hired labour is just enough to specialize in vegetable production at the current land to labour ratio. Simulations show that when farm size increases, labour constraints during vegetable harvests force households to grow rice on the additional land. Mechanization will help farmers to cultivate larger land areas and thus generate more income, but it does not greatly increase land area for vegetables, as the main labour peak of the vegetable harvest cannot be mechanized. <

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Table 1  
Simulation results at average farm and family size for the three major farm types.

Data	Rice farm	Vegetable farm	Mixed farm
Crops allowed	only rice	all crops	all crops
Farm size (ha)	0.3	0.2	0.6
Family labour (full-time labourers)	2.5	2.6	2.5
Results (annual basis)			
Income (Yuan)	2,626	16,139	31,339
Vegetable income (Yuan)	0	16,139	29,531
Labour (days)	87	194	441
Working capital (Yuan)	554	1,622	3,190
Rice production (kg)	3,390	0	2,334
Rice area (ha)	0.30	0.00	0.21
Vegetable area (ha)	0.00	0.20	0.39

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