Discussion Paper DP-03/05

Off-farm Employment, Factor Market Development and Input Use in Farm Production - A Case Study of a Remote Village in Jiangxi Province, China

by

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Abstract:

The objective of this paper is to analyze the impact of off-farm employment on village factor market development, and estimate the effects of off-farm employment on input use in farm production, especially inputs related to the change of land production capacity. Four household groups are distinguished and at group level, they show large differences in terms of household size, number of laborers, income levels and income composition, while small differences on land endowments. They also show to some extent the differences in participations of factor markets, output markets and oxen rental markets and credit markets. A Shangzhu Village social accounting matrix (SAM) is built and represents the major transactions among production activities, institutions and the external market environment. Simulations based on SAM multipliers indicate that for most crops, farm production is expanded in particular by the household groups experiencing the largest income gains, and annual crops have the highest increase of production than others (except perennial crop in last scenario). On average, government investment in infrastructure has strong impact on agricultural production, and the impact of local off-farm employment is smaller than that of migration. Government investment scenario gives the best results for stimulating the development of agricultural labor markets (low- and high-educated labor) as well as the land and oxen renting out, however, migration and local non-farm activities affect mostly in land and oxen renting in for household groups, respectively. Because percentage increase of manure application is higher than that of chemical materials, the impact of off-farm employment on land production capacity could be positive.

Introduction

The massive rural labor flowing into off-farm employment has become a significant phenomenon in the process of China's economic reform. By 2000, almost 200 million people were involved in off-farm employment (Zhang et al., 2002). Non-farm employment reduces the amount of 'surplus labor' in rural areas, and allows rural households to earn other sources of income. Non-farm wage income, self-employment and remittances from migration have become important sources of rural household income. Research shows that the share of income from non-farm sources in the counties of Hunan and Sichuan Provinces is more than 25% of per capita income in China in 1993 (Kung and Lee, 2001). Other studies found that the income growth of most farmers in the late 1980s and 1990s in China can be contributed to increased off-farm employment (self-employed activities and wage employment) (Parish et al., 1995; Rozelle, 1996). Migration as an increasing important off-farm activity has played an important role in household income increase in recent years (de Brauw et al., 2001).

Studies on off-farm employment stress its impact on the development of labor market in the process of rural development (Zhang, et al., 2001; de Brauw, et al., 2002). Off-farm activities become more and more important in promoting other factor market development, which are a key characteristic of the transition of the planned economy to the market economy in China (Kung, 2002). Several recent studies examine the development of rural labor market and the evolvement of off-farm activities in rural China (de Brauw et al., 2002; Zhang et al., 2002; Kung, 2002). Other studies focus on how the income from off-farm employment is distributed and what the consequences are for the income distribution of households in rural areas of China (Kung and Lee, 2001).

Participation in off-farm activities changes resource endowments of households, especially labor and capital used for financing off-farm employment move out of farm production. Households may need to restructure their farm production by changing factor use and variable input use. A recent study in rural China found that the number of migrants has a negative impact on farm yield, but remittances compensate the effect of labor loss. The overall effect of migration on farm yield is slightly negative (Rozelle et al., 1999). Other studies focused on the long-run effects of off-farm activities on farm productivity. De Brauw (2001) examined the impact of migration, especially remittances, on households' farm investment Behavior. He found that migration does not seem to affect household investment in on-farm or off-farm production. Studies by Wu and Meng (1996 and 1997) concluded that labor transfer from farm to non-farm activities has no significant impact on grain production although farmers with a high share of non-farm income invest less in grain production, because there are abundant labor resources in farm production.

Little is known, however, on the impact of off-farm employment on factor use and variable input use, especially on household's input use choice. Farm production is the main linkage between economy and environment in rural China, and factor use and variable input use on farmland are important elements affecting farmland production capacity and environmental quality. How to improve or maintain farmland production capacity and the environment in the long run has attracted a lot of attention (Huang,

2000; Yao, 2002; SEPA, 1999; Niu and Harris, 1996; Huang and Rozelle, 1995; World Bank, 1992; Zhao, et al., 1991).

The development of rural factor markets may play an important role in this respect. With the massive flow of rural labor out of farm production, other factor markets have emerged to some extent. Empirical studies by Yao (2000), Lohmar et al. (2001), and Kung (2002) show the important role of the off-farm labor market in inducing land rental market development. Development of land rental and other rural factor markets induced by incremental off-farm employment will facilitate household market interactions, which may intensify or reduce the impact of off-farm employment on land production capacity because of input use change.

Off-farm employment may affect also the agricultural production and input use of those households within the same village with no members working off-farm. Increased income and expenditure of the household involved in off-farm employment and the village-level factor markets are responsible for such indirect effects. The overall goal of this paper is to analyze the impact of off-farm employment on village factor market development, and examine the effect of off-farm employment (especially local non-farm, self-employment and migration) on village factor use and variable input use in farm production, which are different for household groups within a village. To achieve the goal, this paper has three specific objectives. First, we will explore the development of village land rental markets, oxen rental markets and labor markets along with different types of off-farm activities. Second, we will examine the impact of income obtained from off-farm employment on farm production, especially on factor use and variable input use. Third, we will examine what are the impact of off-farm employment on factor use and variable input use and the implications for land production capacity.

To achieve the first goal, we will distinguish household groups, according to different characteristics that are relevant for off-farm employment and farm production, and examine the involvement of these groups in village factor markets. A modeling approach is then used to achieve the second and third goal. Microeconomic farm household models do not capture the income linkages and the general equilibrium effects within a village. A village social accounting matrix (SAM) may be used to present a picture of market and income linkages of household groups within a village, and the interactions with the world outside the village. A village SAM multiplier model derived from the village SAM can be used to simulate the impact of changes in off-farm income on the level of production, factor use, variable input use and household incomes for different groups within a village. Based on that, the implications of change of factor use and variable input use for land production capacity and environmental quality, is investigated. This is the approach that will be used in this paper to achieve our second and third objectives.

The data underlying this study were obtained from a farm survey organized in the summer of 2000 and the spring of 2001 in three villages in the countries of Yujiang, Guixi and Yanshan of Jiangxi Province in Southeast China. The survey was carried out within the framework of a larger research project on ‘Economic policy reforms and soil degradation in Southeast China’. The survey included questions on income sources and expenditures as well as on inputs and outputs of production activities within the three selected villages. The questionnaire was designed in such a way that the information

collected can be used for constructing village SAMs for these three villages. The three villages were selected to reflect differences in geography and infrastructure (Kuiper et al., 2001). Shangzhu village was chosen for this study, because it is located in a mountain area and physically relatively isolated from the outside markets. Local household and market linkages are expected to be stronger for the remote village than for the other two villages, and the indirect effects of off-farm employment to be larger for the remote village.

Our research area falls in one of the soil degradation areas. The yield of main crops, such as rice, rapeseed and cotton, is much lower in Jiangxi Province than elsewhere in China (Li and Lin., 1998; Huang, 1999). One important reason is that soil organic matter content in cultivated land is lower in Jiangxi than in neighboring provinces, partly because of lower use of green manure and animal manure (Li and Lin, 1998). Farmers in the research area have the tradition to plant green manure and apply animal manure on the farm. Modern input use is also widespread in recent years. This study will examine the extent to which the change of input use from traditional inputs to modern inputs use is related to off-farm employment.

To achieve our objectives, the rest of the paper is organized as follows. In section 2, we will develop a theoretical framework of effects of off-farm employment on village factor market development and factor use and variable input use in farm production. Section 3 describes the household grouping and the socioeconomic characteristics of the household groups in the selected village. In section 4, the village SAM will be presented, while the multiplier simulation results will be presented in section 5. The last part of the paper will discuss the findings and conclusions.

Theoretical Considerations

Off-farm employment enhances the differentiation between households because only some households have access to off-farm activities. In rural China, there are limited off-farm employment opportunities and there are some entry barriers through institutional and non-institutional regimes, for example household registration systems (*Hukou*) and discrimination in finding a job. Many households are excluded from the possibilities of working off-farm. Possession of certain skills/education or social capital (*Guanxi*) is important to gain access to off-farm employment (Zhao, 2001; Zhang et al., 2001). Due to the limited opportunities and strong competition, additional resources of households may be required to gain access to off-farm employment. Hence, differences in human capital, social capital, land or other resource endowments are an important cause of differentials in access to off-farm activities, and differentiation among households (Zhao, 2001; de Brauw and Rozelle, 2002).

Local factor markets may be stimulated when households participate in off-farm activities. Large diversities in factor market development may be observed (Kung, 2002), because institutional barriers and high transaction costs characterize most transactions in developing countries (de Janvry et al., 1991). If there is no labor surplus, off-farm employment absorbs labor out of farm production by reallocating labor time. Labor shortage on the farm may make farmers hire labor or rent out land, which will make land rental markets and labor markets emerge. If there are high transaction costs or

institutional barriers in land renting activities and less costs or barriers in hiring labor, households with members participating in off-farm employment will be more likely to hire labor to compensate for own labor loss. In contrast, if high transaction costs or institutional barriers are involved in hiring labor, the land rental markets will be more developed.

Prevailing institutions, land tenure systems and quota obligations in China hinder household participation in land rental activities (Lohmar et al., 2001). In particular, land use rights are assigned to households by village leaders for a fixed contract period (mostly 30 years at the moment), based on equality among households. Partial redistributions frequently take place, however, to correct for migration or other demographic changes. Land renting activities emerged on a small scale within villages. In some areas of China, 10-15% of land is leased inside the village (Huang et al., 2000). When the constraints hindering households from land rental activities are removed, land rental markets will be further intensified by off-farm employment (Turner et al., 2001; Lohmar et al., 2001; Kung, 2002).

Due to labor moving out and farming seasonality, labor exchange and labor hiring become more important in rural China. Farmers increasingly hire labor for land preparation and harvesting, or rent a small tractor to plow. In mountainous villages, where tractors cannot be used, oxen rental activities and shared oxen ownership are developed. Oxen are very important for farm production in such villages. With the increase of off-farm activities, oxen renting or tractor renting appear as alternative strategies for saving labor.

Off-farm activities usually increase household incomes; households may either use it to expand their production factors (labor or land, depending on institutional barriers) and input use to increase their farm productivity, to invest in non-agricultural activities or to increase consumption. To some extent, households without off-farm activities and no access to credit may be able to obtain credit from households with off-farm employment within the same village.

Nowadays, household-market linkages are widespread in rural China (Benjamin and Brandt, 2002). Household-market exchanges are very important for shaping farm household responses to policy changes. When external shocks occur, the impact of shocks on the household will pass through households by the linkages among them. In a perfect market, shocks will be contained in the price changes in the market. However, high transaction costs (caused e. g. by missing or asymmetric information), risk and institutional barriers may lead to missing markets, imperfect markets or thin markets. If substantial market imperfections exist between a village and the outside world, it may cause inside-village markets (Hoff et al., 1993; Sadoulet and de Janvry 1995; Taylor and Adelman, 1996). Generally, unfavorable physical conditions of some villages cause high transaction costs in trading commodities and factors with the outside world, which may make the village isolated from exchange with the outside world for some of these commodities or factors and results in local exchange between households within the village.

Moreover, existence of village internal markets is also the result of differentiation of households in the village. When households differ in their resource endowments and (as a

result) in their production activities, internal trade will be beneficial to those households. Without differentiation among them, households will be self-sufficient. The typology of village economies developed by Holden et al. (1998) clearly illustrates why households in a village generate strong market exchanges, and why village economies will be important to focus on. Specifically, when households are highly differentiated and transaction costs with the outside world are high, village markets will usually arise, with price formation independent of market prices outside the village (Holden et al., 1998).

Off-farm activities accelerate the differentiation of households in rural China and facilitate market exchanges among households. Therefore, any expansion or reduction of off-farm employment may have important implications for inside-village activities. The existence of high transaction costs between households and the outside village will generate general equilibrium effects on a village economy. The expansion of off-farm employment will usually shift labor out of farm production, which will increase the opportunity costs of the household in farm production and the wage rate at the village labor market if there is no labor surplus in the village. At the same time, increasing income from off-farm activities will induce households to enjoy more leisure (and increase consumption), release cash or credit constraints of the household, and stimulate farmers to use more labor-saving inputs on the farm. The village land or labor markets provide a buffer to compensate the labor-loss effect of households involved in off-farm employment. Application of green manure or animal manure needs much labor input and little or no finance, while use of modern chemical fertilizer needs little labor and much finance. Hence, off-farm employment is expected to stimulate the adoption of labor-saving production technologies that may lead to land production capacity decline in the long run.

The Socioeconomic Characteristics of the Village

Shangzhu Village is 10 kilometers away from a township, but it takes one hour from the village office to the township by bus because the road is sandy. It takes one more hour from the township to Guixi City. Shangzhu Village has 16 village groups *(Cunming Xiaozu),* which are the basis for land distribution, and 32 natural hamlets. Shangzhu Village is a mountainous area and some hamlets are quite far from the village office, which is located along the sandy road in a bigger hamlet named *Xiazhu Hamlet*. The sandy road ends in a neighboring hamlet. Farmers in the remote hamlets need half an hour to 2 hours' walk to reach the village office by mountainous roads. Several years ago there was a mining enterprise in the village (that belonged to the county government) because the soil is very suitable for making *Ciqi*. However, when the mine was depleted, more investment was required for moving further inside the mountain, and the enterprise went bankrupt. Now, only some farmers still carry out mining and simple processing.

The total population in the year 2000 was 2,028 persons, lived over 472 households. A household is defined in our research as people living under the same roof and eating food from the same pot. Some family members temporarily migrated to other places, but they sent income back. We still recorded them as household members. We sampled 109 households, accounting for 23 percent of the total. In some households, all the members migrated outside the village, while in others only the children lived in the village. We did

not interview these households.

The village has four types of land, namely irrigated land (paddy field), dry land, forestland and wasteland. All land is contracted to households except some pieces of forestland. No village level redistribution of land was organized except some limited adjustments of irrigated land in some village groups in recent years. Some pieces of forestland belonging to the village committee were contracted to household groups instead of individual households in the early 1990s. But until 2000, no profits were generated from the forestland because household groups argued with the village committee about how to harvest trees and share benefits. All the paddy land and dry land are located in the mountains, and most of them are built with terraces. Wasteland is seldom cultivated because the area is very small and steep.

The main crops are rice and vegetables. Perennial crops, especially bamboo and bamboo shoots cultivated in the forestland, are also important to households. Labor, chemical fertilizer, animal and green manure, seeds and oxen plowing are the main variable inputs in farm production. Almost no inputs are applied to the forestland, except that farmers sometimes leave bamboo leaves in the field. There are oxen, pig, chicken, duck and fish in livestock production, but duck and fish production are less important.

Local agricultural employment, non-agricultural employment, self-employment and temporary migration are the main types of off-farm activities in the village. Local agricultural employment includes crop harvesting, rice transplanting, bamboo shoots digging, etc. Non-agricultural employment includes wood (bamboo) carpenter, house building, teaching, etc. Self-employment includes shop-keeping, small handcraft making and selling, transportation, etc. We define household members working off-farm and not living together with other household members as migrants. Most migrants worked outside their counties and even their provinces, but they still belonged to their households. They still kept close contacts with the household members who lived inside the village and sent income back.

Household Classification

Because only a limited number of households could be distinguished in a village social accounting matrix (SAM)[1], representative households need to be created. In order to make the results from the SAM to be properly explanatory, four groups in the SAM analysis are of a proper size. Several criteria candidates (social networks, number of educated labor force, land per capita, irrigated land per capita/land per labor force, oxen ownership) for grouping households have been examined very carefully because different criteria for grouping may generate different groups, while servicing for different research aims.

Social network of households could be one of the criteria, because study (Zhao, 2001) shows that social network is a very crucial for households participating off-farm activities, especially migration to the faraway places in China (see more detailed discussion in Shi et al. (2004)). But the contents of social network are quite diversified; it could be the social relationships (*Guangxi*) of the households, kinships network, personal contacts of migrants and other institutions. We defined a proxy variable to examine the possible importance of the social capital on determining off-farm activities (especially

migration), which took the location of family members (not household members) and other household members (working outside province) into account, and found that it is not as significant as we expected (Shi et al., 2004). Hence, we may need to find other data to redefine the social network. Unfortunately, the limitation of the data prohibited this possibility; hence we have to forgo it.

Another possible candidate of criteria was land labor pressure. Land is one of the most scarce farm resources, and labor/land ratio is much higher in China compared with other countries, hence it could be a very important pushing factor for households to find off-farm employment as additional income source. Although the land in China is distributed evenly, there are still to some extent variations of land per capita or land per labor force among households. Although redistribution of land among households still happens in order to adapt the demographic change of the household, the frequency for redistribution land can not be too often and the existence of land holding difference is expected to remain. In a village, the basic redistribution unit of land sometime is the villager small group (*Cunmin Xiaozu*), hence among different village small groups difference on per capita land could be there. Grouping households need to build on the relative stable variables, and land labor pressure could be thought as relative stable to some extent because it was not so often adjusted. In Shangzhu, there are four types of land, irrigated land, dry land, forest land and waste land. Each household has a very small piece of dry land, and irrigated and forestland are relatively much more important. Hence, we put land labor pressure as a possible variable in the analysis of determination of off-farm activities participation and income level, and also checked if the different types of land made any difference. However, none of them performed well in all analyses, and they were therefore not taken as a grouping criterion (see Shi et al., 2004 and Kuiper et al., 2002).

Oxen ownership is another variable. More than 80 percent of farm households keep oxen or share oxen with other households. The empirical estimation (in Kuiper et al., 2002) shows that animal power is very important in fertilizer use of crop production in Shangzhu. Oxen are mainly used for plowing, while oxen manure is an important source of organic fertilizer. Farmers sometimes reapply rice straw back into fields to improve the soil structure, but the rice straw will increase difficulties during rice transplanting, especially for later rice. However, the rice transplanting becomes easier if fields in which straw is applied are plowed more than once. Oxen ownership also indicates in which household hold will have more manure produced. Oxen ownership is used as one of the two criteria for grouping households.

Through the analysis (see in Shi et al., 2004 and Kuiper et al., 2002), we found that the education level of the labor force is very important in household participation in off-farm activities (taking participation of off-farm employment as a whole, no distinguishing different types of off-farm employment). Education level of the labor force could be a proxy variable to explain the difference in off-farm employment of households. Education level of labor force then could be matter for grouping household in village SAM building. The average educational level (we use the number of years schoolings to represent the educational level) of labor force for Shangzhu is around four years. But how many years schooling is really matter for off-farm employment of

households, and how to distinguish the households by different educational level. Four groups of labor force (less than 2 years of schooling, 3 to 4 years schooling, 5 to 6 years schooling and more than 6 years schooling) are incorporated in the analysis (participation in off-farm jobs, especially non-farm jobs (non-agricultural employment, self-employment and migration), see in Kuiper et al., 2002). We found that they positively relate to the educational level (schooling years) of household members. Especially laborers with more than 4 years schooling have a high probability to participate in off-farm activities, particularly in migration (at household level). We define persons aged 16 years or older but younger than 65 years as laborers. Only the township has a middle school, but few teenagers in the village are willing to go there. Many teenagers quit from middle school and study professional skills or work on the farm. After a few years they will follow other people and migrate to urban areas in the end. Educational level (4 years as the threshold) was used as the second criterion for grouping households.

[Insert Table 1 in here]

Four household groups are distinguished (see Table 1). The first group consists of households only having laborers with four years or less schooling, and is named *Households with no educated persons*. The second group is households without an oxen and having at least one to two laborer with more than four years schooling, and is named *Households with no oxen, at least one or two educated person*. The third group consists of households having one or two laborers with more than four years schooling and keeping oxen, and is named *Households with oxen, one or two educated persons*. The last group is the group of households having at least three laborers with more than 4 years schooling, and holding oxen, and is named *Households with oxen, more than two or more educated persons*.

Characteristics of Household Groups

A comparison of the four household groups reveals large differences. Table 2 shows the basic household group characteristics. Because dry land area is very small, it is not presented in the table. The first two groups have more per capita contracted irrigated land than the other two groups. The second group has more forestland, as compared with the other three groups. Another basic visible difference among the groups is the average household size. The first group has a much smaller household size, while the household size of fourth group is the largest. Group 4 also has the largest number of laborers, while group 3 has the largest number of children (non-laborers). Figure A1 and table A1 (in appendix) show the distribution of years of schoolings of labor force for each household group and total sample. Average schooling of labor force of household group 2 is the largest, and group 1 is the lowest.

[Insert Table 2 in here]

T-tests for household size and number of labor force (Table A2) and per capita contracted irrigated land and per capita contracted forest land (Table A3) for four groups

are applied. The results indicate that means of four groups for household size, number of laborers, per capita contracted irrigated land and per capita contracted forest land among some household groups are different at significant level. Except group 2 and 3, all pair groups show significant differences on household size and number of labor force. Group 2 is significantly different from other groups on per capita contracted forest land. Except per capita contracted irrigated land of group 1 is significantly larger (10%) than that of group 3, all pair groups do not show significant differences on per capita contracted irrigated land. These provide complementary evidence that show the four groups are different to some extent on demographic characters and land endowments.

Moreover, the variations on household size, number of laborers, per capita contracted irrigated land and per capita contracted forest land are quite evident for some groups, i.e. within group 2 household sizes of all households are relatively less varied (Table 2). Variations within a household group are also quite relevant to the household grouping, because less variation within a household group on resource endowments may indicate that those households with the same group will be more likely to have universal responses to outside policy shocks, which is one of assumption of household grouping. Although group 2 has large area of forest land compared to other groups, within group 2 among households also shows large variations in forest land. In addition to that, household group 2 and 3 show quite large variations on years of schoolings for all laborers within that group (Table A1).

Table 3 presents the average incomes and income sources of the four household groups. The average per capita income in this village equals 1,386 yuan, or $ 0.46 per capita per day (based on official exchange rate, $ 1=8.30 yuan). Group 1 has the lowest total household income, while groups 1 and 4 have the lowest per capita household incomes. Group 2 (no oxen ownership) has the highest total and average household income. On average, households obtain 43% of their income from off-farm activities, 51% from farm production (paddy, vegetables, perennial crops, livestock, etc.). Six percent of income is from other sources (including government transfer, family member remittances and assistance from relatives). Family remittances are different from migration remittances. Family remittances refer to the money sent by relatives who did not or no longer belong to the household. The second group obtains more than 17% of its income from other sources, 75% of this income consists of family remittances. These family remittances could come from previous household members (which are independent during the survey time), also could be from family members lived in the cities. Other groups have relatively low percentage of income from other sources.

The patterns of four household groups on all types of income are more or less the same, except group 3 has the highest income from farm production (group 2 seems the group always ranked number first in others). However, farm incomes of group 2, 3 and 4 are quite close, and off-farm incomes of group 2 and 3 are similar. Table 3 shows that income level of two groups is above the average level and rest of two are less in all income items.

[Insert Table 3 in here]

Table 4 shows the composition of off-farm income. Remittances by migrated household members constitute the largest component for all household groups. Its share of off-farm income is 62% on average. Households with less educated persons (group 1) obtain a relatively large share of their off-farm income (27%) from agricultural employment. Households with no oxen (group 2) rely more on local non-agricultural employment (43% of their off-farm income). For households with oxen and 1 or 2 educated members (group 3), remittances from migration are the main source of off-farm income (77%). Somewhat surprisingly, however, households with oxen and 3 or more educated members rely less on migration remittances, but relatively more on local non-agricultural employment.

[Insert Table 4 in here]

Output Markets

Food produced for own consumption is a large share of total farm production (see Table 5). Only a few households buy rice for own consumption. In the aggregate level, all household groups are net rice sellers. Since land is distributed equally across households, each household grows paddy and vegetables. Some households with several or all members participating in off-farm activities need to buy rice when they are back in the village during holidays or festivals. They rent out their land when they are absent from village. Although the rent for land is paid in rice in most of the times, the rent sometimes is not enough to meet for their consumption.

The quality of one-season rice is better than that of late rice and particularly early rice. Hence, there is a low percentage of two-season rice being sold; on average 13% of one-season rice and 7% of two-season rice are sold. Vegetables are almost entirely used for own consumption, while perennial crops are largely being sold. The share of livestock products in value terms being sold ranges from about one-third to about two-third between the four groups. Group 2 (no oxen) sells no two-season rice but sells the largest share of its livestock products.

[Insert Table 5 in here]

Agricultural Labor Market

The agricultural labor market offers more diversity (see Table 6). There are two types of outside household labor used in agricultural production, mainly in rice and perennial crop production. These are exchange and hired labor. Exchange labor is used only in rice production, while hired labor is used in rice and perennial crop production. More than 30% of the households use exchange labor in one-season rice production and 14% of them use hired labor. We treated exchange labor as own labor force, because households pay back the same quantity of labor to the households who provide exchange labor. The large shares of exchange and hired labor used by households show that seasonal agricultural labor markets in the village exist. Contrary to the other 3 groups, group 2 uses little exchange labor and relatively much hired labor. All household groups except group 2 are net agricultural labor sellers. Group 2 employs 11% of the total village

agricultural labor, the remainder is employed outside the village.

[Insert Table 6 in here]

Land Rental Market

The land rental market is more developed than the agricultural labor market in terms of percentage of household participating in the village. Forty-five percent of the households take part in land rental markets. Land rental activities take place between households in the village. The share of irrigated land rented in the total cultivated irrigated land is 41%. Only few households participate in dry land and forestland renting. So in the discussion below land refers to irrigated land only. Table 7 presents the area percentage of two types of land in the total cultivated area, the rented from other households and the contracted land. Contracted land is the land contracted from the village collective or villager group; rented land is the rented area from other households within the village. Area percentage of land rented for one-season rice production is much higher than that for two-season rice production, on average it is 17% for one-season rice against 3% for two-season rice.

[Insert Table 7 in here]

Land lease contracts normally last one year or half a year. In 2000, institutional barriers were released in the village, and farmers became free to rent in or out their contracted land. But in previous years it was risky to rent out contracted land. It was possible for the village collective or village group to reallocate the rented land to other households because of quota obligations or other reasons.

Group 2 (no oxen) does not rent land to expand agricultural production. The other three groups, however, rent between 25% and 28% of their cultivated land. It's used mainly for growing one-season rice (Table 7). Each group has few households renting land. Only group 2 is a net 'seller (rented out)' in the land market, the other groups are net 'buyer (rented in)' in the land market. The biggest landlord (rented out land) in the village is the group of households whose entire family or labor force participate in off-farm activities, especially in migration (absent landlords), and they rented out all or large share of their land. These households were not included in our sample. Group 2 only supplies 3 percent of contracted land to the land market, the rest of the rented land in the village comes from absent landlords.

Oxen Rental Market

As an important factor in agricultural production, oxen are used in the land preparation for rice and vegetable production. But most of them are used in the paddy field. Keeping oxen is a labor-intensive and time-consuming activity. Children or older people normally shepherd oxen. The oxen rental market is functioning to some extent, with 12 percent of the households (two cases in each group) hiring oxen in one season rice production. Group 2 (no oxen ownership) is the main group hiring oxen. Group 3 and 4 are the main supplier of oxen in the village.

Credit/Savings

More than half of the households in Shangzhu Village stated that they obtained credit in 2000 and that most of the credit was in cash. Only 34% of the borrowed amount is obtained from households in the same village, especially from friends. The remaining 66% comes mainly from relatives and friends outside the village. Banks, credit cooperative agencies, some shops, and individuals also lend money or lend in kind, but there are few such cases. The picture of the village credit market obtained from the survey is unbalanced in terms of money borrowed and lent. The reason is that most of the households are not willing to be considered as moneylenders. Moreover, some of the households who are most likely to lend money, the absentee landlords, were not interviewed.

Resource use

Agricultural production in the village affects soil quality and environmental quality in a number of ways. First, green manure crops planted last year are important for the yield of this year and can reduce chemical N fertilizer application substantially. Green manure application needs more labor but less capital than chemical fertilizer. The green manure area has decreased gradually each year. Two-season rice has a larger share of the area with green manure planted last year than one-season rice (see Table 8). Reduction of green manure planting application is an important reason for soil problems such as natural compaction or soil blocking (Kuiper et al., 2001; Wei, 1999). Rice production with green manure will help to improve the soil. Second, one-season rice needs less chemical fertilizer than two-season rice because they are applied only once a season and the application is close to half that of the two-season rice (Table 9). Shifting from two-season rice to one-season rice may therefore be beneficial for soil quality and environmental quality. But application of pesticide and herbicide in one-season rice is much higher than that of two-season rice because the planting period of one-season is easy to infect by diseases. Third, animal manure is another important soil-friendly input that substitutes for chemical fertilizer. There is no manure market, which makes manure application closely linked to household livestock production. Less livestock production means less manure availability and possibly less manure application.

[Insert Table 8 in here]
[Insert Table 9 in here]

The Social Accounting Matrix of Shangzhu Village in 2000

A village social accounting matrix (SAM) represents the transactions among production activities, institutions and the outside village. It shows the flows of inputs, outputs and income between sectors, flows of income between production activities and households, expenditures of households on consumption and investment, and goods and services transfers between institutions. The rows of a village SAM show incomes of each account and the columns present the expenditures made by each account. The choice of the accounts and their subdivision are dependent on the research purposes and the types of policy experiment the researchers want to perform.

The structure of the SAM for Shangzhu Village is given in Table 10. It has some similar parts in the structure to the village SAM used by Taylor and Adelman (1996). It comprises 8 parts (namely activities, commodities, factors, institutions, government, saving and investment, transaction costs and outside village). Some parts of the SAM are however different from that of Taylor and Adelman (1996). First, it treats migrants as part of household labor endowments, and migration as an activity and commodity (service) in the SAM. Taylor and Adelman (1996) include only the remittances from migration as factor incomes from outside the village, so migrants are not available for activities in the village. However, migration of rural households has to be treated as part of a household's livelihood because institutional constraints such as the urban registration system (*Hukou*) often discourage migrants from settling permanently in urban areas (de Brauw et al., 2001). Second, we disaggregate all the activity, commodity and factor accounts at household group level. The resulting SAM shows differences between household groups in factor market participation, productive activities and consumption. Savings and investment are used as the balance account to balance the rows and columns in the SAM. Household expenditure is most likely to be overstated and less accurate, so we used the savings and investment account to balance income and expenditure of household groups.

In the Table 10 and Table A4 (in appendix), each sub-account in every account is presented in detail. Activity accounts represent two major parts, one is for all the production activities, and the other is for all the transaction activities, for example in land, labor and oxen rental activities. Production activities are specified as rice production, vegetable production, perennial crop, livestock, manure production[2] and fuel wood collection. Rice production has been divided into four types of production (one-season rice with and without green manure planting in last year, and two-season rice with and without green manure planting in last year). For the aim of this study, fuel wood collection and manure activity are included as separate activities. Commodity accounts are divided into three parts, products/goods (agricultural and manufactured), services (labors etc.) and rented factors. Factor accounts are divided into sub accounts such as irrigated land, dry land, forest land, low educated labor, high educated labor and capital, and they are the factors households have in the village. Institution accounts are specified as five household groups, and household group 5 represents the absent group of the village, which provides the rented land in the village and receives the income form land renting. Government account includes the village committee and township government. To simply the analysis, we did not separate them. Saving and investment is used for balancing the SAM, and rest of world account refers to outside the village but links with activities inside village by trade. The last account is the sum up the columns and rows.

[Insert Table 10 in here]

Total village GDP is 3133,590 Chinese Yuan. The relative importance of different production activities (derived from the SAM) is given in Table 11. One-season rice (15%), perennial crops (19%), and livestock production (12%) are the most important sources of farm income; two-season rice and vegetable production provide much smaller contributions. Agricultural off-farm work contributes only 3% to the total village GDP. A

very important sector is the non-farm sector, which accounts for 42% of GDP. Income from migration activities, particularly from educated labor, is the most important component of non-farm GDP.

[Insert Table 11 in here]

Model and Simulations

Model

To examine the impact of off-farm employment on factor use and variable input use and agricultural production within the village, we apply a SAM multiplier model. Household models can capture household responses to outside shocks, but do not cover the interactions among households. Especially when household linkages within a village are strong, such indirect effects can be very important. Village-wide models that capture the linkages among households are needed to conduct policy analysis in such cases (Taylor and Adelman, 1996). Village social accounting matrixes (SAMs) and village SAM multiplier models have been applied, for example to villages in Mexico, Zambia and India, to examine the village-level implications of relevant policy options and recommend appropriate development strategies (Taylor and Adelman, 1996; Holden et al., 1998; Parikh and Thorbeche, 1996; Taylor and Vogel, 1988). In this study, we will use a village SAM multiplier model to examine the impact of off-farm employment on factor use and input use and further effects on farm production and farmland production capacity change.

A village SAM multiplier model can be used to analyze the impact of remittances from non-farm employment, self-employment or migration on agricultural production and input use of household groups. Such changes reflect the income effect of off-farm employment, which is an important element of off-farm employment. But this approach is not suitable for analyzing the effect of reduced labor availability or reduced consumption of migrated persons resulting from off-farm employment and migration. All production and consumption relationships in a village SAM multiplier model are linear; substitution effects (e. g. between labor and other input in farm production) are not taken into account. Village SAM multiplier models take into account linkages between different production sectors and income/expenditure effects within the village. They capture the direct and indirect income and demand effects, but not the local price changes resulting from income and demand changes. Multi-markets or computable general equilibrium (CGE) models can be used to analyze such local price changes. In this paper, we will focus on exploring the income and expenditure effects of off-farm employment on different household groups within a village. Substitution and price effects will be examined in a village-CGE model in another paper.

Three accounts in the village SAM are considered exogenous accounts; these are rest of world (i. e. outside the village), government, saving and investment. Other accounts are treated as endogenous. The first step is to convert the SAM into a coefficient matrix by dividing each endogenous element in the matrix by its column sum. The resulting coefficient matrix A_n represents the average expenditure propensities of the endogenous accounts.

Fixed price multipliers can be obtained as follows (e. g. Parikh and Thorbecke, 1996):

$$dy_n = (I-A_n)^{-1}dx = M_A dx,$$

Where dy_n is the change in production or incomes of village activities (all endogenous accounts), dx represents an exogenous change in the demand for village goods (export) and services (labor exports), A_n is the coefficient matrix of average expenditure propensities, and I and M_A are the identity matrix and multiplier matrix, respectively. Multiplier analysis shows how the production or incomes of endogenous accounts will be affected by a change in exogenous demand or government investment.

Table 12, 13, 14 and 15 compare the model results of different scenarios. We took 156,680 Chinese Yuan, which is 5% of village GDP, as the total injection (policy simulations) in all simulations. Five scenarios are presented:

1) With rapid economic growth and urban expansion, farmers will get more opportunities to work in the urban sector; laborers with high education level are most likely to find a job and get high payment. Hence, the first scenario is a 23% increase in income from high-educated labor migration to the urban sector.
2) Assuming migration activities will keep the same pattern as before, both low-educated and high-educated labor migration will increase proportionally. Hence, we injected migration income to low educated and high educated labor migration income proportionally.
3) Development of the local economy is one of the important ways to promote rural development, because local non-farm activities have strong linkages with farm production. Hence, instead of migration, we injected the income into local non-agricultural employment and self-employment. We assume that only high-educated labor has access to the employment.
4) Here, we assume that both high and low educated laborers have access to local non-agricultural employment and self-employment. The injection is distributed proportionally.
5) Poor rural infrastructure is a major cause of poverty in the village economy. So an alternative scenario is for the government to invest 99,100 (around 60% of the injection) *yuan* in local non-agricultural employment, involved in infrastructure construction, which will be proportionally distributed to high-educated labor and to low-educated labor. In addition, commodity exports due to village road construction, which raises the demand for rice, vegetables, perennial crops and livestock products by outside the village 7842, 225, 28160, 21339 *yuan*. Hence, the total injection is 5% of GDP.

Simulations

Multiplying these injections by the multiplier matrix, we obtain the total (i. e. direct and indirect) effect of the injections on farm production, agricultural factor use and variable input use, factor market participation and total income.

The simulation results for farm production, subdivided by major crops, are shown in Table 12. The figures in the table show the percentage changes as compared to the base situation represented in the SAM, and it holds also for the remaining tables. For most

crops, production is expanded in particular by the household groups experiencing the largest income gains. Additional income from off-farm activities is mainly spent on food (annual crops). Income from low-educated migration has a strong impact on annual crop production activities and livestock production of group 1. The additional income effects on annual crop and livestock production of low-educated labor from migration, is stronger than that from local off-farm employment. Infrastructure investment raises production of perennial crops and livestock, by increasing the external demand for these products. Local off-farm employment benefits especially group without oxen (group 2), which is less involved in agricultural production, no land hiring in, mainly producing one-season rice.

Comparing the general effects of five scenarios on stimulating agricultural production (group average), infrastructure investment always has the best simulation results for stimulating all types of agricultural production on average. Except the fifth scenario, the impact of additional income effects from migration (both low and high educated labor) is stronger than that of other three scenarios, which means it stimulated the agricultural production of each group more evenly. The impact of additional income form local off-farm employment by high educated labor is the smallest in those four scenarios because it group 2 benefits mostly and other groups are relatively less. The impact of local off-farm employment scenario is smaller than that of migration.

[Insert Table 12 in here]

Table 13 presents the changes in the use of inputs, affecting soil quality and environmental quality. In contrast to manure production, the use of fertilizer, pesticides and herbicides is not subdivided by household groups in the village SAM. We therefore present aggregate results for the latter. Because manure is one of outputs from livestock production, the result for increase of manure production is the outcome of additional income effect of off-farm employment on livestock production and crop productions.

In aggregate level, the last scenario (scenario 5) has the largest increase of manure production, and also fertilizer, pesticide and herbicide use. Other four groups show the same tendency as the impact of additional income on agricultural production. Increase of manure production is always higher than that of fertilizer, pesticide and herbicide use in all scenarios, which may indicate that the land production capacity and environmental quality will be improved. It shows that increasing demand of livestock products by additional income will also lead to more manure produced (supply driven) and applied to the field (in SAM we did not consider the manure storage).

It should be noted, however, that these results show the effects of additional incomes earned by off-farm employment. The impact of reduced labor availability is not analyzed in the SAM multiplier model. Because manure application is a relatively labor-intensive activity, the results in Table 13 are likely to change considerably when changes in opportunity costs of labor are taken into account. This requires, however, a change in modeling approach from a fix-price to a flex-price model, which will be the topic of another paper.

[Insert Table 13 in here]

The simulation results of the 5 injections for the village factor market participations are shown in Table 14. One account is used in the SAM for agricultural labor hiring activity, so we cannot distinguish between household groups, only between low- and high-educated laborers. The infrastructure investment scenario gives the best results for stimulating the development of local agricultural labor markets both for low-educated and high-educated labor. All 5 scenarios have a slightly higher impact on high-educated agricultural employment than on low-educated agricultural employment, except scenario 2.

Scenario 5 also has the largest impact on land renting out and oxen renting out. We may therefore conclude that factor market development is stimulated mostly by local infrastructure investment. Migration (scenarios 1 and 2) stimulates in particular land renting in by household group 3, the group that is most involved in migration (see Tab. 4). Non-agricultural wage employment and self-employment (scenarios 3 and 4), on the other hand, stimulates in particular land renting in by household group 4, one of the two groups that earn most from this type of employment. The other group (group 2) does not rent in land (Tab. 7). Oxen renting is stimulated much more by non-agricultural wage employment and self-employment than by migration (see last two rows of Tab. 14). The same scenarios (3 and 4) also have a much larger impact on oxen renting in by household group 2, the group that is involved most in non-agricultural wage employment and self-employment (Tab. 4).

The changes in participation in land, oxen rental markets and agricultural labor hiring of group 1 (in scenario 1 and 3) present the indirect effects of off-farm income increase, because we only injected the income increase to high-educated labor, which group 1 does not possess. Scenarios 2 and 4 show the difference when also low-educated labor participates in migration and local non-farm activities. Both land renting in and oxen renting in increase significantly for household group 1, the group that depends most on agriculture for its income (Tab. 2).

[Insert Table 14 in here]

Table 15 shows the simulation results for household income levels of the four groups. As expected (see Tab. 4), group 3 benefits most from migration (scenarios 1 and 2), while groups 2 and 4 benefit most from non-farm wage employment and self-employment (scenarios 3 and 4). Migration of low- and high-educated labor (scenario 2) has the highest impact on average income, while infrastructure investment (scenario 5) has the smallest impact.

[Insert Table 15 in here]

The first simulation (increase income from only high-educated migration members) shows the indirect effects of migration of other household groups on the income of group 1. Because group 1 does not have high-educated members (hence no direct migration

income), the income increase of group 1 results from village market exchange, for example the increased use of hired agricultural labor. The second simulation (increase both high and low-educated labor migration incomes) shows substantial income gains for this group when low-educated labor participates in migration as well. The percentage income increase for household group 1 in the second simulation is much higher than that of the rest of simulations. For group 4, however, the group with the lowest per capita income level, this scenario gives worse results than the others.

Conclusions

In this paper, we have examined the impact of off-farm employment on farm production, factor market development and factor use and variable input use in farm production. By using education and oxen ownership for grouping households, four household groups are distinguished. At aggregate group level, they show large differences in terms of household size, number of laborers, income levels and income composition, while they have small differences on land endowments (except large forestland group 2 has).

Participation in output markets, factor markets (agricultural labor and land), oxen and credit/savings are also presented. In the aggregate level, all four groups are net rice sellers. They have small differences in one-season rice and perennial crops selling, and large differences in selling two-season rice (not for group 2) and livestock products (group 2 is the largest one and group 1 is the smallest one). A very small share of vegetables in group 3 and 4 was sold, and group 1 and 2 did not sell vegetables. The percentage of households using exchange labor for group 1, 3 and 4 in one-season rice and two-season rice production is larger than using hired labor. Contrary to the other three groups, the percentage of households in group 2 using hired labor is much larger than using exchange labor. Group 2 and 4 also use hired labor in perennial crop production. More than 19 percent of cultivated irrigated land for one-season rice of group 1, 3 and 4 is rented, and on average 3 percent for two-season rice. Group 2 is not involved in land renting in. Only a few households of group 1 and 2 rent in oxen from group 3 and 4.

The four household groups also show differences in manure, fertilizer and herbicide and pesticide use in rice production, which are related to land production capacity and environmental quality. In one-season rice production, manure using per land of group 1 is the highest one, and fertilizer and herbicide and pesticide per land using of group 2 is the highest one. In two-season rice, group 1 is ranked the first in both manure and fertilizer use, and group 4 is ranked the first in herbicide and pesticide use.

Through application of a village SAM multiplier analysis, a comparison of the four household groups by 5 scenarios reveals significant differences of off-farm employment impact on farm production, factor use and variable input use and income change. For most crops, farm production is expanded in particular by the household groups experiencing the largest income gains, and annual crops have the highest increase of production than others (except in last scenario, perennial crop has the largest increase). Comparing the general effects of five scenarios on stimulating agricultural production, the impact of local off-farm employment is smaller than that of migration.

The scenario of government investment in infrastructure gives the best results for stimulating the development of local agricultural labor markets (low-educated and high-educated labor) as well as the development of land renting out and oxen renting out. All five scenarios have a slightly higher impact on high-educated agricultural employment than on low-educated agricultural employment, except scenario two. Comparing the impact of migration and non-agricultural wage employment and self-employment on development of land renting in and oxen renting in, we found that impact of migration on development of land rental market is stronger than that of the latter, for oxen renting, it is on the contrary.

The simulation results reveal the positive impact of off-farm employment on land production capacity and environmental quality because percentage increase of manure application is higher than that of chemical materials (fertilizer, etc.). However, this analysis could not capture the effects of labor costs change and manure storage. Because manure application is a relatively labor-intensive activity and the impact of reduced labor availability is not analyzed in the SAM multiplier model, the results are likely to change considerably when changes in opportunity costs of labor are taken into account.

The simulation of increase of both low and high educated labor migration shows substantial income gains for the first group, which does not have high-educated members. The percentage income increase for the first household group in this simulation is much higher than that of the rest of simulations. However, for the group (group 4) with the lowest per capita income level, this scenario gives worse results than the others. Investment in infrastructures does not give very good results on increase of income in general. The first household group, which depends most on agriculture for its income, shows the large indirect effects of off-farm income increase. Because of the limitation of SAM multiplier model, the finding for the impact of off-farm employment on land production capacity and environmental quality is quite weak. CGE model is needed to incorporate comprehensively to examine the effects of off-farm activities on those.

Appendix

[Insert Figure A1, TableA1, A2, A3 & A4 in here]

Acknowledgements
Paper had been presented in international conference on 'Economic Transition and Sustainable Agricultural Development in East Asia' held in Nanjing, October 20-22, 2003. The authors would like to thank Hans Opschoor and Arie Kuyvenhoven for their comments on a draft version of the paper, Marijke Kuiper for her helpful comments in village SAM building and comments from the participates in the conference and the book editor Max Spoor; all remaining shortcomings are authors'. Financial support by the Netherlands Ministry of Development Cooperation (DGIS-SAIL program), the European Union (EU-INCO program) and Nature Science Fund of China (70403007) is gratefully acknowledged.

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References:

Adelman, I., Taylor, E. and Vogel S., 1988. Life in a Mexican Village: A SAM Perspective, *Journal of Development Studies,* Vol. 1: pp 5-24.

Benjamin, D., and Brandt, L. 2002. Property Rights, Labor Markets, and Efficiency in a Transition Economy: The Case of Rural China. Working paper: Department of Economics, Toronto: University of Toronto, 2002.

De Brauw, A. 2001. Migration and Investment in Rural China. American Agricultural Economics Association Meeting, August 5-8, 2001, Chicago, Illinois-selected paper.

De Brauw, A., Huang, J., Rozelle, S., Zhang, L., and Zhang, Y. 2002. The Evolution of China's Rural Labor Markets during the Reforms. *Journal of Comparative Economics,* Vol. 30 2.

De Brauw, A., and Rozelle, S. 2002. Household Investment through Migration in Rural China. Working paper, University of California at Davis.

De Brauw, A., Taylor, J., E., and Rozelle, S. 2001. Migration and Source Communities: A New Economics of Migration Perspective from China. Working paper, University of California at Davis.

De Janvry, A., Fafchamps, M., and Sadoulet E. 1991. Peasant Household Behavior With Missing Markets: Some Paradoxes Explained. *The Economic Journal*, Vol. 101: pp 1400-1417.

Hoff, K., Braverman, A., and Stiglitz, J., E. (Eds.) 1993. *The Economics of Rural Organization. Theory, Practice, and Policy*. Oxford University Press, Oxford.

Holden, S., T., Taylor, J., E., and Hampton, S. 1998. Structural Adjustment and Market Imperfections: A Stylized Village Economy-wide Model with Nonseparable Farm Households. *Environment and Development Economics,* Vol. 4: pp 69-87.

Huang, G. 1999. Farmland Resource and Its Sustainable Use in Jiangxi Province. ACTA Agriculture Jiangxi, Vol., 11, (*in Chinese*).

Huang, J. 2000. Land Degradation in China: Erosion and Salinity. A Report Submitted to World Bank, March, 2003.

Huang, J. and Rozelle, S. 1995. Environmental Stress and Grain Yields in China.

American Journal of Agricultural Economics, Vol. 77: Nov.1995: pp 853-864.

Huang, X., Heerink, N., Ruben, R., and Qu, F. 2000. Rural Land Markets and Economic Reform in Mainland China. In: A. Tilburg, H. Moll, and A. Kuyvenhoven eds. *Agricultural Markets Beyond Liberalization*. Kluwer Academic Publishers, pp. 95-114.

Kuiper, M., Heerink, N., Tan, S., Ren, Q., and Shi, X. 2001. Report of Village Selection for the Three Village Survey. Department of Development Economics, Wageningen University.

Kuiper, M., Shi, X., Heerink, N. 2002. Report of the Household Classification. Department of Development Economics, Wageningen University.

Kung, J. K. S. 2002. Off-Farm Labor Markets and the Emergence of land Rental Market in Rural China. *Journal of Comparative Economics,* Vol. 30: pp 395-414.

Kung, J. K. S., and Lee, Y. 2001. So What If There Is Income Inequality: The Distributive Consequences of Nonfarm Employment in Rural China. *Economic Development and Cultural Change,* Vol. 50 1: pp 19-46.

Lohmar, B., Zhang, Z., and Somwaru, A. 2001. Land Rental Market Development and Agricultural Production in China. American Agricultural Economics Association Meeting, August 5-8, 2001, Chicago, Illinois-selected paper.

Li Z., and Lin, X. 1998. Changes of Soil Organic Matter Content and the Way to Improve it in Cultivated Land of Red Soil Region. Research on Red Soil Ecosystem. Press of Chinese Agricultural Science and Technology, 1998. Beijing, in Chinese.

Niu, W. and Harris, M. W. 1996. China: The Forecast of its Environmental Situation in the 21st Century. *Journal of Environmental Management,* Vol. 47: pp 101–114.

Parikh, A., and Thorbecke, E. 1996. Impact of Rural Industrialization on Village Life and Economy: A Social Accounting matrix Approach. *Economic Development and Cultural Change,* Vol. 2: pp 351-377.

Parish, W., Zhe X., and Li, F. 1995. Non-farm Work and Marketization of the Chinese Countryside. *The China Quarterly,* Vol. 143: pp 697-730.

Rozelle, S. 1996. Stagnation Without Equity: Patterns of Growth and Inequality in China's Rural Economy. *China Journal*, Vol. 35: pp 63-96.

Rozelle, S., Taylor, J. E., and de Brauw, A. 1999. Migration, Remittances, and Productivity in China. *American Economic Review,* Vol. 89 2: pp 287-91.

Sadoulet, E. and de Janvry, A. 1995. *Quantitative Development Policy Analysis*. The John Hopkins University Press, Baltimore.

Shi, X., Heerink, N., and Qu, F. Factors Driving Off-farm Employment Participation Choices – An Empirical Analysis for Jiangxi Province, China. Paper prepared for International Symposium on 'China's Rural Economy after WTO: Problems and Strategies', Hangzhou, P.R. China, June 25-27, 2004.

State Environment Protection Administration SEPA. 1999. China National Planning for Eco-Environment Construction. *China Water Conservation,* No. 2: pp 14-18.

Taylor, J. E., and Adelman, I. 1996. *Village Economies*. The Press of Syndicate of the University of Cambridge, American.

Turner, M., Brandt, L., and Rozelle, S. 2001. Local Government Behavior and Property Rights Formation in Rural China. Working Paper. Department of Economics, Toronto: University of Toronto.

Wei, J. 1999. On Implementation of 'Fertile Soil Program' in Red Soil Exploitation. *Journal of Jiangxi Agricultural University*, Vol. 21 2 in Chinese.

World Bank. 1992. China Environmental Strategy Paper. Washington, D.C. Document of World Bank, 1992.

Wu, H. X., and Meng, X. 1997. Do Chinese Farmers Reinvestment in Grain Production?. *China Economic Review,* Vol. 72: pp 123-134.

Wu, H. X., and Meng, X. 1996. The Direct Impact of Relocation of Farm Labor on Chinese Grain Production. *China Economic Review*, Vol. 72: pp 97-104.

Yao, S. 2002. China's Rural Economy in the First Decade of the 21st Century:

Problems and Growth Constraints. *China Economic Review*, No. 13, pp 354-360.

Yao, Y. 2000. The Development of the Land Lease Market in Rural China. *Land Economics*. Vol. 76 2: pp 252-266.

Zhang, L., Rozelle, S., and Huang, J. 2001. Off-farm Jobs and On-farm Work in Periods of Boom and Bust in Rural China. *Journal of Comparative Economics* Vol. 29: pp 505-526.

Zhang, L., Huang J., and Rozelle, S. 2002. Employment, Emerging Labor Markets, and the Role of Education in Rural China. *China Economic Review,* Vol. 13: pp 313-328.

Zhao, Q. 1991. Land Degradation and Control. *China Land Science,* Vol. 5, No. 2: pp 22-25 in Chinese.

Zhao, Y. 2001. The Role of Migrant Networks In labor Migration: The Case of China. Paper presented at the International Conference on Urbanization in China, Xiamen, June.

Endnotes:
1. Because too many groups in a SAM will cause the problems for explaining the results properly, and sometime it is very difficult.
2. Manure production activities include manure collection from the stable, fermentation, and transportation to the field.

Table 1. Criteria used for grouping households

No. of Persons with More Than 4 Years Schooling	Oxen Ownership	
	No	Yes
0	Group 1	Group 1
1~2	Group 2	Group 3
3 or more	Group 2	Group 4

NB: Oxen ownership includes sharing oxen with other households.

Group 1: Households with no educated (no more than 4 years) persons

Group 2: Households with no oxen, at least 1~2 educated (more than 4 years) person

Group 3: Households with oxen, 1~2 some educated (more than 4 years) persons

Group 4: Households with oxen, 3 or more educated (more than 4 years) persons

Data source: Calculated based on the data set, the same for other tables.

Table 2. Basic household group characteristics

Household Groups	No. of Households	Population	Average Household Size	Average no. of laborers	Per Capita Contracted Irrigated Land	Per Capita Contracted Forestland
Group 1	16	46	2.87 (1.41)	2.25 (1.23)	1.37 (0.46)	0.55 (0.57)
Group 2	14	57	4.07 (0.92)	3.29 (0.91)	1.32 (0.94)	1.14 (1.45)
Group 3	35	152	4.34 (1.33)	2.86 (1.26)	1.19 (0.37)	0.58 (0.67)
Group 4	44	222	5.04 (1.14)	4.02 (0.79)	1.17 (0.40)	0.60 (0.60)
All groups	109	477	4.37 (1.41)	3.39 (1.21)	1.23 (0.50)	0.65 (0.78)

Notes: Standard deviations in the brackets.

Table 3. Average income per household from different sources Unit: *Yuan*

Household Groups	Total Income	Per capita Income	Farm Income	Off-farm Income	Other Sources
Group 1	3587	1248	2133	1335	119

Group 2	8055	1978	3249	3384	1422
Group 3	6529	1503	3404	3018	108
Group 4	5960	1181	3160	2437	363
All groups	6064	1386	3099	2584	381

Table 4. Composition of off-farm incomes per household Unit: *Yuan*

Household Groups	Agricultural Wage Employment	Non-agricultural Employment	Self-employment	Remittance from Migration	Total
Grou p 1	356	56	173	750	1335
Grou p 2	0	1441	286	1657	3384
Grou p 3	226	134	332	2326	3018
Grou p 4	178	685	273	1302	2437
All groups	197	513	279	1595	2584

Table 5. Percentage of main crops being sold

Household Groups	One-season Rice	Two-season Rice	Vegetables	Perennial Crops	Livestock Products
Group 1	11%	7.4%	0.0%	93%	34%
Group 2	14%	0.0%	0.0%	91%	63%
Group 3	13%	8.4%	0.8%	84%	51%
Group 4	14%	10.7%	2.6%	94%	47%
All groups	13%	6.6%	0.85 %	90%	49%

Table 6. Percentage of households using exchange and hired labor in rice production and perennial production

Household Groups	Exchange Labor		Hired Labor		
	One-season Rice	Two-season Rice	One-season Rice	Two-season Rice	Perennial Crop
Group 1	38%	13%	6%	0%	0%
Group 2	7%	0%	36%	0%	14%
Group 3	31%	9%	11%	3%	0%
Group 4	36%	9%	11%	0%	7%
All groups	31%	8%	12%	1%	3%

Table 7. Percentage of rented and contracted irrigated land area by crop type

Household Groups	One-season Rice		Two-season Rice		Total
	Rented	Contracted	Rented	Contracted	
Group 1	23%	58%	2%	16%	100%
Group 2	0%	92%	0%	8%	100%
Group 3	24%	60%	4%	12%	100%
Group 4	19%	62%	5%	15%	100%
All groups	17%	68%	3%	12%	100%

Table 8. Percentage of area with green manure planting in previous year by type of land and crop

Household Groups	One-season Rice		Two-season Rice		Total Rice Area *(mu)*
	Rented	Contracted	Rented	Contracted	
Group 1	11%	16%	100%	72%	75.2
Group 2	n.a.	25%	n.a.	0%	68.6
Group 3	5%	16%	33%	46%	218.4
Group 4	44%	31%	48%	45%	305.8
All groups	20%	22%	60%	41%	668

n.a.= not applicable.

Table 9. Chemical fertilizer use and pesticide and herbicide use, and manure application per household group per land (*yuan/mu*)

Household Groups	Manure		Fertilizer		Herbicide and pesticide	
	One-season	Two-season	One-season	Two-season	One-season	Two-season
Group 1	18.7	69.7	33.7	89.5	5.7	0.2
Group 2	10.3	29.3	37.9	56.7	11.5	0

Group 3	8.5	21.5	29.5	70.2	9.7	2.7
Group 4	9.3	17.7	26.9	67.9	8.7	2.9
All groups	10.6	27.3	30.1	71.4	8.9	2.3

Table 10. The structure of the village SAM for Shangzhu

Receipts	**Expenditures**							
	1. Activities:	**2. Commodities:**	**3. Factors:**	**4. Institutions:**	**5. Government:**	**6. S-I:**	**7. ROW:**	**8. Total:**
1. Activities:								
a. Farming and Livestock b. Manure Activity c. Fuel Wood Collection d. Factor Renting e. Agricultural Labor Work f. Non-farm Activities g. Migration h. Transaction i. Leisure		A. Village Production and Factor Transactions						*Total Production and Transactions*
2. Commodities:								
a. Agricultural Products b. Manure c. Fuel Wood d. Rented Factors	B. Village			D. Household	E. Taxes in Kind	F. Seeds for	I. Goods and	*Total*

e. Agricultural Labor Work f. Non-farm Activities g. Migration h. Transaction i. Leisure j. Agricultural Inputs k. Livestock Feed l. Other goods	Input-output Table C. Transaction Activities			Consumption	to Government	Next Year G. Capital Investments	Services Exports	*Demands*
3. Factors: a. Labor b. Land c. Capital	J. Value-added in Village Production							*Factor Income*
4. Institutions: a. Household Groups			K. Payments to Households				L. Family Remittances	*House hold Income*
5. Government:				M. Taxes in Cash				*Gover nment Income*
6. Savings and Investment:		N. Seeds from Last Year		O. Saving				*Total Savings*
7. Rest of World:		Q. Imports	Q. Imports		R. Transfers			*Import s*
8. Total:	*Total*	*Total*	*Total*	*Househol*	*Governme*	*Total*	*Exports*	

	Costs	*Supply*	*Factors*	*d Expenditures*	*nt Expenditures*	*Investments*

Table 11. Village GDP distribution among activities

Contribution to GDP (in percentage)			
SECTOR	Percentage	SECTOR	Percentage
One-season Rice	10.1	Agricultural Work by Low Educated Labor	1.8
One-season Rice and Green Manure	4.4	Agricultural Work by High Educated Labor	1.6
Two-season Rice	1.8	Non-agricultural Work by Low Educated Labor	0.5
Two-season Rice and Green Manure	2.2	Non-agricultural Work by High Educated Labor	8.4
Vegetables	4.8	Self-employment by Low Educated Labor	0.8
Perennial crops	18.9	Self-employment by High Educated Labor	4.1
Livestock	11.8	Low Educated Labor Migration	3.5
Manure Production	1.2	High Educated Labor Migration	24.2
SUM on-farm	55.2	SUM off-farm	44.9

Table 12. Simulation results for farm production (% output changes)

Farm Production Scenario		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
One-season Rice	Group 1	2.50	6.11	2.29	3.41	5.41
	Group 2	4.13	4.59	8.25	7.70	8.93
	Group 3	7.30	6.64	3.74	3.54	4.77
	Group 4	4.97	4.67	6.36	6.50	7.75
	All groups	5.24	5.50	5.16	5.25	6.60
Two-season Rice	Group 1	2.61	6.38	2.39	3.56	5.33
	Group 2	4.77	5.30	9.52	8.89	9.20
	Group 3	7.66	6.97	3.93	3.71	4.65
	Group 4	5.18	4.87	6.63	6.78	7.77
	All groups	5.54	5.82	5.51	5.59	6.59
Other Annual Crops Production	Group 1	2.48	7.42	2.20	3.77	5.30
	Group 2	4.86	5.53	10.69	9.96	10.23
	Group 3	8.91	8.18	4.65	4.39	4.56
	Group 4	6.04	5.86	7.51	7.62	8.04
	All groups	6.29	6.79	6.22	6.32	6.80
Perennial Crop Production	Group 1	0.16	0.59	0.14	0.28	7.03
	Group 2	0.44	0.51	1.01	0.94	7.49
	Group 3	1.58	1.43	0.74	0.70	6.68
	Group 4	0.42	0.39	0.55	0.56	7.27
	All groups	0.76	0.77	0.61	0.61	7.07
Livestock Production	Group 1	1.84	5.70	1.62	2.85	5.62
	Group 2	1.82	2.08	4.15	3.86	8.41
	Group 3	5.56	5.06	2.84	2.67	5.47
	Group 4	4.01	3.77	5.26	5.38	7.90
	All groups	3.91	4.25	3.81	3.94	6.85

Table 13. Simulation results for input use (% changes)

Land Use Scenario		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Manure Production	Group 1	2.53	6.43	2.30	3.52	5.37
	Group 2	4.47	5.01	9.27	8.65	9.42
	Group 3	8.16	7.44	4.23	4.00	4.65

	Group 4	5.49	5.18	6.93	7.06	7.88
	All groups	5.78	6.07	5.68	5.76	6.67
Chemical Materials	Fertilizer Use	5.43	5.61	5.29	5.38	6.60
	Pesticide and Herbicide	5.50	5.62	5.50	5.56	6.72

Table 14. Simulation results for factor market participation (% changes w. r. t base situation)

Factor Market Development Scenario		1	2	3	4	5
Agricultural Labor Hiring	Agricultural Employment by Low Educated Labor	3.18	3.53	2.56	2.64	5.61
	Agricultural Employment by High Educated Labor	3.47	3.28	3.77	3.75	6.48
Land Renting in	Group 1	2.51	6.13	2.30	3.43	5.40
	Group 3	7.35	6.69	3.77	3.56	4.76
	Group 4	5.01	4.71	6.42	6.56	7.75
	All groups	5.45	5.67	4.74	4.92	6.25
Land Renting out	Group 2	5.44	5.53	5.24	5.31	6.59
	Absentee landlords	5.44	5.53	5.24	5.31	6.59
Oxen Renting in	Group 1	2.52	6.37	2.29	3.50	5.38
	Group 2	4.33	4.82	8.74	8.16	9.11
	All groups	3.36	5.64	5.30	5.67	7.12
Oxen Renting out	Group 3	4.23	4.92	8.36	7.89	8.89
	Group 4	4.23	4.92	8.36	7.89	8.89

Table 15. Simulation result for household incomes (% changes)

Income Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Group 1	2.18	8.04	1.84	3.74	5.01
Group 2	4.90	5.62	11.20	10.43	10.49
Group 3	10.13	9.16	4.75	4.47	3.91
Group 4	7.01	6.55	9.15	9.41	8.52
All Groups	7.03	7.49	6.93	7.12	6.78

Figure A1. Distribution of years of schoolings of labor force for Shangzhu

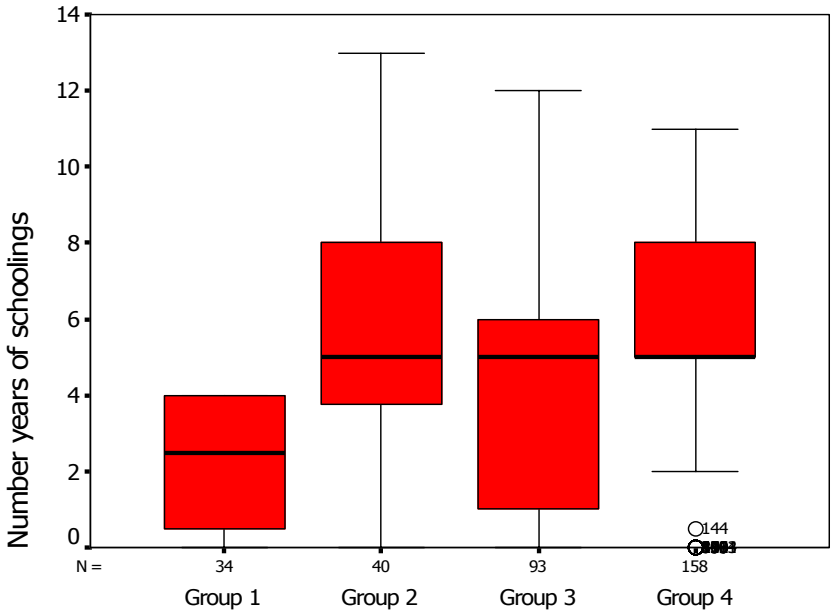

Table A1. Description statistic for education level (years of schoolings) of all labor force of four household groups

Years of Schoolings	Group 1	Group 2	Group 3	Group 4	Total
Number of Cases	34	40	93	158	325
Mean	2.25	5.76	4.05	5.61	4.83
Maximum	4	13	12	11	13
Stand Deviations	1.56	3.15	3.04	2.40	2.85

Group 1: Households with no educated (no more than 4 years) persons

Group 2: Households with no oxen, at least 1~2 educated (more than 4 years) persons

Group 3: Households with oxen, 1~2 educated (more than 4 years) persons

Group 4: Households with oxen, 3 or more educated (more than 4 years) persons

Table A2. T-tests for differences of household size and number of laborers among four household groups

		Group 1	Group 2	Group 3	Group 4
		Total labor force			
Household Size	Group 1		-2.74***	-	-
	Group 2	2.71***		1.64**	6.82***
	Group 3	3.60***	0.70	1.15	-
	Group 4	6.17***	2.90***	2.53***	2.92***
					5.01***

Notes: Group definition is the same with last table.

Below the diagonal, all T-values are the results for left hand variable, and above the diagonal are the T-values for the variable writing in second row of the table. Positive sign of the t-values denote level of column group of corresponded variable is larger than that in row. If it is negative is another way around.

***, ** and * denote significant at 1% level, 5% level and 10% level, respectively.

Table A3. T-tests for differences of per capita irrigated contracted land and per capita contracted forest land among four groups

		Group 1	Group 2	Group 3	Group 4
		Per Capita Contracted Irrigated Land			
Per Capita Contracted	Group 1		0.22	1.59*	0.17

Forest Land	Group 2	1.48*		0.72	0.79
	Group 3	0.03	-1.90**		0.04
	Group 4	1.62*	-2.05**	0.16	

Notes: Group definition is the same with table A5-1. Other definitions are the same with last table.

Table A4. Description of all activities for all each account

Activities		**Commodities**			**Factors**	**Institutions**
Production	*Transaction*	*Products*	*Services*	*Rented Factors*		
One-season Rice	Irrigated Land Rent in	Rice	Draught Power	Irrigated Land	Irrigated Land	Household Group 1
One-season Rice with Green Manure	Irrigated Land Rent out	Vegetable	Agricultural Labor	Oxen	Dry Land	Household Group 2
Two-season Rice	Oxen Rent in	Bamboo	Non-agricultural Labor	Agricultural Labor	Forest Land	Household Group 3
Two-season Rice with Green Manure	Oxen Rent out	Straw	Self-employment			Household Group 4
Vegetable	Transaction	Livestock	Migration		Low Educated Labor	Household Group 5
Perennial Crops		Livestock Manure	Leisure		High Educated Labor	
Livestock Production		Processed			Capital	

Manure Activity Fuel Wood Collection Agricultural Works by Low Educated Labor Agricultural Works by High Educated Labor Non-agricultural Works by Low Educated Labor Non-agricultural Works by High Educated Labor Self-employment by Low Educated Labor Self-employment by High Educated Labor	Manure Fuel Wood Feed of Livestock Other Inputs of Livestock Food Non Food Durable Goods Transaction Goods		

Low Educated Labor Migration			
High Educated Labor Migration			