AWAY FROM THE FARM?

The Impact of Off-farm Employment on Farm Production, Factor Market Development and Sustainable Land Use in Jiangxi Province, P. R. China

A thesis submitted by

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Shi Xiaoping
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1 Introduction

1.1 Introduction

Off-farm employment is becoming an important source of income for rural households in developing countries, where farmers have embraced it as part of their income diversification strategy. Hence, farm household production activities have not only become linked with spaces that are geographically close to, albeit outside the village, but also with more distant places. Off-farm employment provides a high proportion of the total income of rural households in many developing countries. Empirical evidence shows that it represents almost 32 percent of the income of rural households in Asia between the 1970s and the 1990s and 35 percent for East-Asia in the same period (Reardon et al. 1998). In China the figure in 2000 was around 50 percent (de Janvry et al. 2005).

Almost three decades of economic reforms, opening up to foreign trade and a growing influx of foreign direct investment have led to high economic growth rates in China. Agricultural reform was a major pillar of the fundamental economic reforms undertaken by the Chinese government since 1978, resulting in a gradual transition from a centrally planned economy towards a 'socialist market economy'. The emergence in the early 1980s of the 'household production responsibility system' (HRS) allowed individual families to lease land from the collectives, ensuring that almost all households had access to land. It gave great incentives for growth in agricultural output and has contributed to significant improvements in the supply and the quality of food products.

One significant phenomenon in rural China is the increasing number of farm households that are involved in off-farm employment. The growth of rural township and village enterprises (TVEs) in the 1980s and private enterprises (PEs) in 1990s were the main factors in absorbing a

huge number of rural labourers, and the driving force for economic growth and increases in household income in rural China throughout the reform period. However, they also contributed to growing income inequalities between areas where TVEs and PEs are widespread (mainly the coastal provinces) and areas that largely lack such off-farm employment opportunities. With the gradual release of the constraints imposed by the 'household registration system' (*Hukou*) [1] and increasing regional disparities rural migration has become very important in China.

According to the statistical report by the NBSC (2001), total rural-urban migration in China in 2000 amounted to more than 131 million people, of which 26.4 percent had migrated away from their own province. Migration to cities, particularly to work in construction projects and the service sector, is becoming the most important source of off-farm employment in rural China. Raising farmers' incomes in rural China is receiving increased attention from policy makers, as is evident from the three 'Number One' policy documents published since 2004 and the 11th Five Year Plan (covering the period 2006-2010). Public policy gives particular attention to those instruments that can help to facilitate the migration of farm households from non-coastal areas to non-farm sectors. Hence, it can be expected that rural-to-urban migration will accelerate even more in the near future.

China's agriculture is characterised by a scarcity of land, abundant labour and small-scale production using little mechanisation. The overwhelming majority of crop production comes from tiny farms, averaging just 0.65 ha. In 2005, there were some 200 million of these (OECD 2005). Given the prevailing scarcity of agricultural land in rural China, much of the income growth for rural households has to come from off-farm employment, and some studies indeed show that most of income growth of farm households during the 1990s can be attributed to off-farm employment (de Brauw et al. 2002). A recent study in North-West Jiangxi shows that farmers with off-farm employment enjoy higher incomes than those without (Murphy 2000). In 2002, 70 percent of the increased income of rural households in China was attributable to off-farm employment (Sun 2003).

Given the scarce land resources available to rural households in China, off-farm employment is a major livelihood strategy, through which rural households can best employ their resource endowments. However, in spite of the high population pressure and the scarcity of farmland, farm-

land resources still represent an important source of household income for those households that remain in rural areas, as well as supplying food to the urban populations. Therefore, maintaining the agricultural production base and improving farmland productivity are also given high priority in Chinese policy making, which recognises that this is an important aspect of guaranteeing an adequate food supply in the long-term.

In the past, China has been able to boost food production by increasing the amount of land used for agriculture. In recent years, however, the area of cultivated land has been decreasing, and the focus has shifted towards using more fertilizer, pesticides and mechanical inputs to increase productivity. China is now the world's largest producer and user of chemical fertilizers and manure (OECD 2005). But this highly intensive use of chemicals within farming is creating its own problems. The use of fertilizers in China is around 280 kg per hectare, one of the highest levels in the world. Given high population density and scarce water resources, non-point source pollution from agricultural run-off continues to put pressure on water resources and agricultural ecosystems. It raises questions over the sustainability of the current mode of agricultural production growth in China and the implications for long term production capacity and the environment.

In rural areas of China farm households provide the main links between the economy and the environment. Changes in farm production caused by increasing off-farm employment, whether a result of reduced labour availability or increased household earnings, can have an important impact on land resource use, which is the base for agricultural production and rural development. Changes in input use and choice of production technology are also likely to have important implications for environmental quality and the productive capacity of China's land resources. Thus achieving sustainable land use in China implies an urgent need to understand household responses to increased participation in, and earnings from off-farm employment, and their subsequent impact on agricultural production and resource use. Insights into these links will have important policy implications regarding rural development, as well as reveal the influence (both beneficial and detrimental) that policy interventions targeted at improving rural household welfare, meeting food security or protecting the environment, can have on attaining one or more of the other policy targets.

1.2 Research questions

The main research question of this study focuses on examining the extent to which farm household participation in different types of off-farm employment affects farm production, input use, factor market development and income. The factors affecting off-farm activity choice may, however, differ between sub-categories of off-farm activities. Consequently, obtaining a better understanding of the factors that influence participation decisions in different off-farm activities (self-employment, local employment, migration), and of the relative importance of these factors, may contribute to improved understanding of the factors driving participation in off-farm employment and its consequences for sustainable agricultural development. They can further contribute to the formulation of policies to enhance rural household incomes, while improving the long-term productive capacity of farmland and maintaining environmental quality.

In order to shed light on these issues this research develops an analytical framework to assist in understanding the impact of off-farm activities on farm household agricultural production and sustainable land use in South-East China. Although agricultural reforms and institutional changes have been implemented since 1978, market mechanisms are only gradually developing, displacing the traditional plan-based system which still continues to function, at least partially. Hence, the analysis takes place in the context of agricultural product markets which function quite well (Huang & Rozelle 2006), but in view of many remaining imperfections in factor markets (see Benjamin & Brandt 2002, Bowlus & Sicular 2003, Carter & Yao 2002, Kuiper 2005). The imperfections in the factor market may lead to factors only traded within the village and therefore factor market becomes village markets. Off-farm participation in a village may affect also those households who do not participate in off-farm employment through such village markets. This case study focuses on village factor markets, as in the areas under study there was relative little connection between village and outside markets.

Jiangxi Province was selected for this study[2] as it is a major rice growing area in China and a province with a high degree of out-migration. The share of agriculture in GDP was 21.9 percent in 2002, 6.5 percent higher than the national level (15.4 percent) (NBSC, 2003). It is one of the areas with the most migrants to coastal areas, with more than 10 million rural dwellers migrating away from the Province in 2000 (NBSC,

2001). Thus, Jiangxi Province presents an ideal case study for meeting the objective of this research. The specific research questions can be listed as follows:

1. Which factors determine the participation of households in different types of off-farm employment?
2. How, and to what extent, have village markets developed in rural areas?
3. What is the impact of off-farm employment on factor market development?
4. What effects does the reallocation of labour from on-farm to off-farm activities have on production, input and factor use and farm household incomes?
5. What are the implications of farm household labour re-allocation for sustainable land use and the rural environment?

1.3 Methodology

To answer these questions, a number of different approaches will be used, namely a multinomial probit model, a village Social Accounting Matrix (SAM) multiplier model, a household model and a village-wide Computable General Equilibrium (CGE) model. The multinomial probit analysis will be used to explain off-farm participation decisions and the relative importance of different factors. Demographic and human capital characteristics, household resources and local institutions and village characteristics are included in the model. To answer the second research question, the existence of internal village markets is examined in detail and their importance in applying to the village SAM and CGE model is also investigated.

Although the SAM multiplier approach is based on some rather unrealistic assumptions, it is still widely used for examining linkages between economic actors and for analysing the structure of an economy. In this study it is mostly used to provide a comparison with the application of a village CGE model. Although the SAM multiplier approach assumes fixed prices and poses no limits on production expansion, it can be taken as illustrative of an extreme situation which could occur in the CGE model when all non-tradable commodities become tradable. As such it provides a useful benchmark for comparison with the CGE model. A household model analysis is also used in this study to analyse the importance of linkages between households within a village. The results from

the household model are also compared with those from the village CGE model.

Non-separable household model

Most household models developed to date assume that a household faces perfect input and output markets (de Janvry et al. 1991). Neoclassical theory considers the farmer as an individual decision maker concerned with questions such as how much labour to allocate to the cultivation of each crop. It also assumes the existence of perfect markets including those for commodities and factors (Ellis 1993). But if these markets are absent or when farm households face large price bands for certain commodities or factors, they may become self-sufficient in these commodities or factors (de Janvry et al. 1991, Sadoulet & de Janvry 1995). Between these two extreme cases, imperfect markets exist, including transaction costs and asymmetric information. Most farm households in developing counties can be regarded as semi-commercialised and fall between these two extreme cases (Sadoulet & de Janvry 1995).

As discussed in the introduction, rural China is characterised by large imperfections in its factor markets. When such market imperfections are present, neoclassical farm household models cannot adequately represent household responses and behaviour because household consumption and production decisions cannot be separated (Singh et al. 1986, de Janvry et al. 1991). This study, therefore applies a non-separable household model to examine the impact of off-farm employment on household production decisions (factor and input use, crop choice and income).

Village SAM multiplier approach

Village social accounting matrices (SAMs) are designed to capture the complex inter-linkages within a village between production activities, village institutions, and the outside world. Village SAMs show the input and output flows, and also highlight how income flows between productive sectors and village households, the channelling of household incomes into consumption and investments, and the exchange of goods and factors between the village and the rest of the world (Taylor & Adelman 1996). A village SAM multiplier approach will be applied to provide a snapshot of how household production activities and incomes are affected by the additional income generated by off-farm employment. Moreover, the results from the model will also provide a benchmark for comparison with the village Computable General Equilibrium (CGE)

model. The village SAM will be used as a starting point for building a village CGE model.

Village Computable General Equilibrium model

Recently a new approach has been developed to analyse village economies using a micro-level computable general equilibrium model (Taylor & Adelman 1996). This village (or micro) computable general-equilibrium (CGE) approach provides substantial advantages over a village SAM multiplier approach in exploring village or local economy-wide impacts of policy and market changes. When transaction costs or institutional bottlenecks create village markets that function independently of the outside world, interactions between village households in such factor and/or commodity markets create local income linkages and general equilibrium feedback effects. Village CGE models can be used for analysing farm household responses in this context.

Based on the village SAM, a village CGE model will be calibrated and applied to simulate the impact of off-farm employment on household production decisions. Using the results of the model simulations, the effects of farm household behaviour change on sustainable land use and the rural environment can be investigated by analysing relevant farm household production decisions, such as labour allocation, fertilizer and manure use.

1.4 Structure of the study

This study is divided into three main parts. Table 1.1 shows which chapters address the five specific research questions (set out in section 1.2). Chapters 2 and 3, address research question 1, namely the factors influencing the participation of households in agricultural employment, local non-farm employment, self-employment and out-migration.

Table 1.1
List of specific research questions addressed in the chapters

	Chap. 2	Chap. 3	Chap. 4	Chap. 5	Chap. 6	Chap. 7
Question 1	X	X				
Question 2			X	X	X	X
Question 3				X	X	X
Question 4	X			X	X	X
Question 5	X			X	X	X

Chapter 2 first reviews the general literature on off-farm employment in China. It develops a framework of analysis in order to better understand how off-farm employment affects farm factor and variable input use and their environmental implications. This chapter also examines the development of rural local factor markets and their role in modifying the impact of off-farm employment on rural resource use. Chapter 2 serves as the theoretical foundation of chapters 5-7.

Chapter 3 more specifically examines the relative importance of four sub-categories of off-farm employment, and the factors that drive individual participation in these sub-categories within three villages in Jiangxi Province. A multinomial probit model is used to analyse the off-farm participation decisions of farm households.

Chapter 4 of this study analyses possible village household interlinkages through markets. It first reviews the literature on the evolution of markets in rural China and then makes a comprehensive examination of village markets in the same three villages in Jiangxi Province. The presence of internal village markets will be examined in detail, in order to investigate their importance in applying the model.

The following three chapters of this study focus on the effects of labour reallocation and increasing wages for off-farm employment on agricultural production, input and factor use and household income. A SAM multiplier approach, a CGE model and a household model are used (in chapters 5, 6 and 7, respectively) to examine the impact of off-farm employment on the land rental market (only in SAM multiplier model), and the markets for hiring agricultural labour and oxen. Chapter 7 also provides a comparison of the results obtained with the different models.

Chapter 5 examines the impact of the income obtained from off-farm employment on farm production, especially on factor use and variable input use, for different household groups within the same village, and the implications of changes in factor use and variable input use. Input use variables (manure, fertilizer, pesticides and herbicides) are used as 'proxies' to examine the impact of off-farm employment on land production capacity (LPC) and environmental quality (EQ). A village social accounting matrix (SAM) multiplier model is applied using the data from one of the three sample villages in Northeast Jiangxi, namely *Shangzhu* village. This selection was mostly made on the basis of the relative isola-

tion of this village from outside markets, implying the existence of stronger household inter-linkages.

Chapter 6 uses a Computable General Equilibrium (CGE) model specially developed for the same village to examine the impact of off-farm employment on farm production, factor use, variable input use, and incomes. Such a model overcomes some of the main limitations of the village SAM multiplier model by incorporating consumption behaviour, price responses and substitution possibilities between production factors and inputs. The *Shangzhu* village SAM is used to calibrate the CGE model. A distinction is made between the increase in participation in off-farm employment and higher wages from off-farm employment, which are treated as two separate bundles for simulation with the CGE model. These two results are compared in order to get insights into the so-called lost-labour and income effects of off-farm employment.

In chapter 7 a partial equilibrium household model is used to examine the impact of off-farm employment on farm production, variable input and factor use, and incomes. The same two bundles of simulations used in Chapter 6, are maintained and the results again compared. This chapter then examines and compares the differences in the results obtained from the three types of models used for analysing the impact of off-farm employment on factor market development, input and factor use and income. Chapters 6 and 7, examine not only input use (as in the SAM multiplier model), but also use switching of rice production, as a 'proxy' to examine the impact of off-farm employment on LPC and EQ. Chapter 7 also assesses the importance of interactions among households within the village for analysing household responses on input and factor use and switching of production by comparing the results from the three types of model.

The concluding chapter, chapter 8, reviews the main findings of the research, draws out their policy implications, and makes suggestions for further research. This chapter highlights the new findings from this study concerning the impact of off-farm employment on agricultural production, variable input and factor use, household income and their implications for land production capacity and environmental quality.

The present study attempts to contribute to the existing literature in a number of ways. First, it provides an in-depth analysis of the relative importance of four sub-categories of off-farm employment, and the factors driving participation of individuals in these sub-categories. It does so by

using empirical evidence from three villages in Jiangxi province. Empirical studies of off-farm employment in China have thus far paid relatively little attention to explaining differences in participation between different sub-categories of off-farm employment.

The second intended contribution of this study is that it is, to the author's knowledge, the first study that empirically examines the extent to which village markets have developed in China. Again it does so by using data from three villages in Northeast Jiangxi province. The resulting analysis provides in-depth insights into the development of local village markets and provides a rationale for the application of village-wide models in this study.

The village SAM multiplier approach is used to analyse the impact of off-farm employment on farm production, variable inputs and factor use, and incomes in a remote village in Jiangxi province. It is also used to examine the direct and indirect income and expenditure effects of off-farm employment on different household groups within the village on their farm production, variable input and factor use, and incomes, taking into account the existing household interactions within the village. The major production linkages between household groups within the village consist of renting land and oxen renting and hiring agricultural labour.

The village CGE model is applied to examine the impact of off-farm employment on farm production, variable input and factor use, and incomes. Markets for oxen rental and agricultural labour are incorporated into the model. An additional innovative aspect of this study is the comparison of results from the village CGE model with those of the household model and the SAM multiplier model for the same village. Freezing the linkages between household groups in the *Shangzhu* CGE model enables the development of a household model. Comparing the simulation results of the impact of off-farm employment between the household model and the CGE model gives us insights into the relative importance of linkages between households in the village. Comparing the simulation results of the CGE model with those of the SAM multiplier model provides insights into the relative importance of market imperfections, i.e. the non-tradability of specific commodities and factors at the household or village level, and into household responses to off-farm employment.

Major differences were observed when comparing the outcomes of the simulation exercises. These were most notable in terms of switching production, input use, and factor market participation. The SAM multi-

plier model does not consider market imperfections, but considers all factors and commodities are to be perfectly tradable. In the village CGE model, some commodities are (considered to be) household non-tradables, while others are (considered to be) village non-tradables. This is the main difference between a SAM multiplier model and a village CGE model. The household model, on the other hand, only considers household non-tradables, but not village non-tradables. These differences are crucial for understanding the differences in results between the three model approaches.

Notes

1. Liu (2005) gives a detailed explanation of the *Hukou* system: "There are two types of *Hukou* system in China, pertaining to urban and rural populations, respectively. Recruitment by state-owned enterprises, acquiring a university degree, demobilization from military service and others were the main channels for individuals in rural areas to obtain an urban *Hukou* during the 1960s and 1970s. The *Hukou* system was most effective in controlling population movement when it was associated with the food ration system that was established in 1955. The benefits associated with an urban *Hukou* usually include subsidized housing, healthcare, pension, and other benefits. In addition, an urban *Hukou* entitles its holders to the subsidized education system, welfare programs, and community cultural activities. Rural residents have no such entitlements. Since the 1980s, there have been some changes in the *Hukou* system, by the introduction of two special types of residential registration, i.e., the so-called temporary residential permit and the blue-stamp *Hukou* or blue card. But these are not administered by the central government; instead, the design and implementation are up to local governments. In recent years, the direct purchase of an urban *Hukou* has become possible. Despite these changes, the *Hukou* system continues to differentiate opportunity structures for the entire population on the basis of position within a clearly defined spatial hierarchy, i.e., urban above rural and well-developed above less-developed cities. If rural *Hukou* holders attend schools in urban cities, they must pay fees and tuitions that are substantially higher than those paid by local residents. While much anecdotal evidence suggests that the impact of the *Hukou* system on rural–urban inequality is considerable, quantifying this impact is important for the purpose of policy reforms."

2. This study is part of a project that received financial support from the Netherlands Ministry of Development Cooperation (DGIS-SAIL program) and the European Union (INCO-DC program). The collaboration in this project involves three institutes (Wageningen University, the Institute of Social Studies;

both in The Netherlands, and Nanjing Agricultural University in China). Four PhD candidates have worked in this project and carried out field work in the same area within Jiangxi Province.

2 Theoretical framework

2.1 Introduction

Off-farm employment, and especially the massive flows of migration from rural to urban China, has recently attracted great attention from policymakers and researchers because of the impact that these have on household income, income distribution, rural natural resource use and environmental sustainability. Off-farm employment is an important phenomenon in developing countries, and the interaction between off-farm employment and on-farm production has been examined in detail. Empirical studies have tried to estimate the effects of agricultural growth on rural non-farm activities (Hazell & Hojjati 1995, Haggblade et al. 1989). However, less emphasis has been given to examining the effects of off-farm employment on farm income, and most available studies only provide a theoretical explanation. Some studies have examined how remittances from migrants influence agricultural income and that from other off-farm activities (de Brauw et al. 2002, Reardon 1997).

Off-farm employment involves the movement of labour from farm production to off-farm activities. There are several theoretical models to examine labour reallocation and its implications, for example the Lewis and Todaro model and the neo-classical two-sector model, human capital theory and new economics of labour migration (NELM) (Taylor & Martin 2001, Stark 1991, Becker 1975, Todaro 1969, Lewis 1954). They focus on explaining the motivations of labour movement and its impact on rural economies.

The emergence of off-farm activities and village factor markets is one of the outcomes of economic policy reforms in rural China. Development of village factor markets is very important in increasing the efficiency of factor allocation in rural China. Increasing off-farm employ-

ment has become one of the important factors in pushing the emergence of other factor markets (Kung 2002, Yao 2000). Village factors markets include those for land, labour, oxen and tractors. The impact of off-farm employment on agricultural production is closely linked to the development of local factor markets, which in turn modify the effects of off-farm employment on agricultural production, especially on the use of factors and variable inputs in agricultural production. However, less research emphasis has been given to examining how rural factor markets influence each other, and how they have developed during the reforms in China.

To better understand how off-farm employment affects farm factor and variable inputs use and the environmental implications of this, more attention needs to be given to examining the development of rural local factor markets and their role in modifying the impact of off-farm employment on rural resource use. This chapter develops an analytical framework to do this. The framework is shown in Figure 2.1. Households within a village vary in their participation in off-farm employment because of demographic factors, educational level and asset status. They participate in village labour, land rental and other factor markets. The institutional environment shapes such factor market linkages between households. For example, land tenure arrangements greatly affect land rental and selling activities. Transaction costs in labour hiring influence the use of hired labour in farm production. Further reform of the land tenure system may accelerate the development of village land rental market and compensate for an under-developed agricultural labour market. (The development of village markets will be presented in detail in chapter 4). A change in off-farm activities will affect the shadow prices of household endowments, and as a consequence will influence household consumption, factor and variable input use in farm production and farm investment decisions, such as investments related to land conservation activities. The development of village factor markets plays a crucial role in this process.

The relationships shown in Figure 2.1 are discussed in this chapter, which is organized as follows. The second section outlines the development of off-farm activities in rural China as a background for the framework. The third section discusses the impact of off-farm employment on agricultural production, while the fourth section reviews household linkages and their implications for the effect of off-farm employ-

ment on farm production through village markets. The fifth section addresses the possible impact of off-farm employment on sustainable land use and environmental implications. The last section sets out the modelling approach that will be used in subsequent chapters.

2.2 The development of off-farm activities in rural China

In the early 1950s, one of the priorities of China's economic strategy was the development of heavy industry. The organization of the agricultural sector in collectives and the procurement quota system became important pillars of this strategy. Cheap food was delivered to urban areas, and the household registration (*Hukou*) system made it difficult to migrate to cities. There were only limited possibilities for rural residents to change their occupation and place of registration. Most farmers were only engaged in agricultural production, and only a few rural residents worked in small factories of communes in some of the coastal areas of rural China (Giles 2002, Saith 1987). The government purchased all agricultural output except that used for farm households' own consumption, and food for the urban population was distributed through state-run market channels. This policy kept grain prices low for urban residents, reduced living costs in urban areas and assisted in keeping industrial wages low. However, it meant that the income of rural farmers was low compared with urban residents as purchasing prices were greatly depressed. This situation persisted until economic reforms that started since 1978. At that time the rural non-farm economy (RNFE) was hardly developed (Gilbert & Wahl 2000, Yang & Zhou 1999, Carter 1997).

These economic reforms also started a gradual 'open door' policy. Since the introduction of the household responsibility system (HRS)[1] in rural areas in the early 1980s, agricultural production underwent extraordinary growth. A series of reforms related to the urban sectors were also implemented, such as restructuring state-owned enterprises and developing a private enterprise sector. The reforms gradually changed some of the previous 'urban bias' of policies, such as the quota system and price system of agricultural production, which discriminated against agriculture and rural labour[2]. Rural workers started to have greater job opportunities. Large income differentials between agricultural and non-agricultural activities gave strong incentives for labourers to move to non-agricultural activities. In 1981, less than 20 percent of rural households were engaged

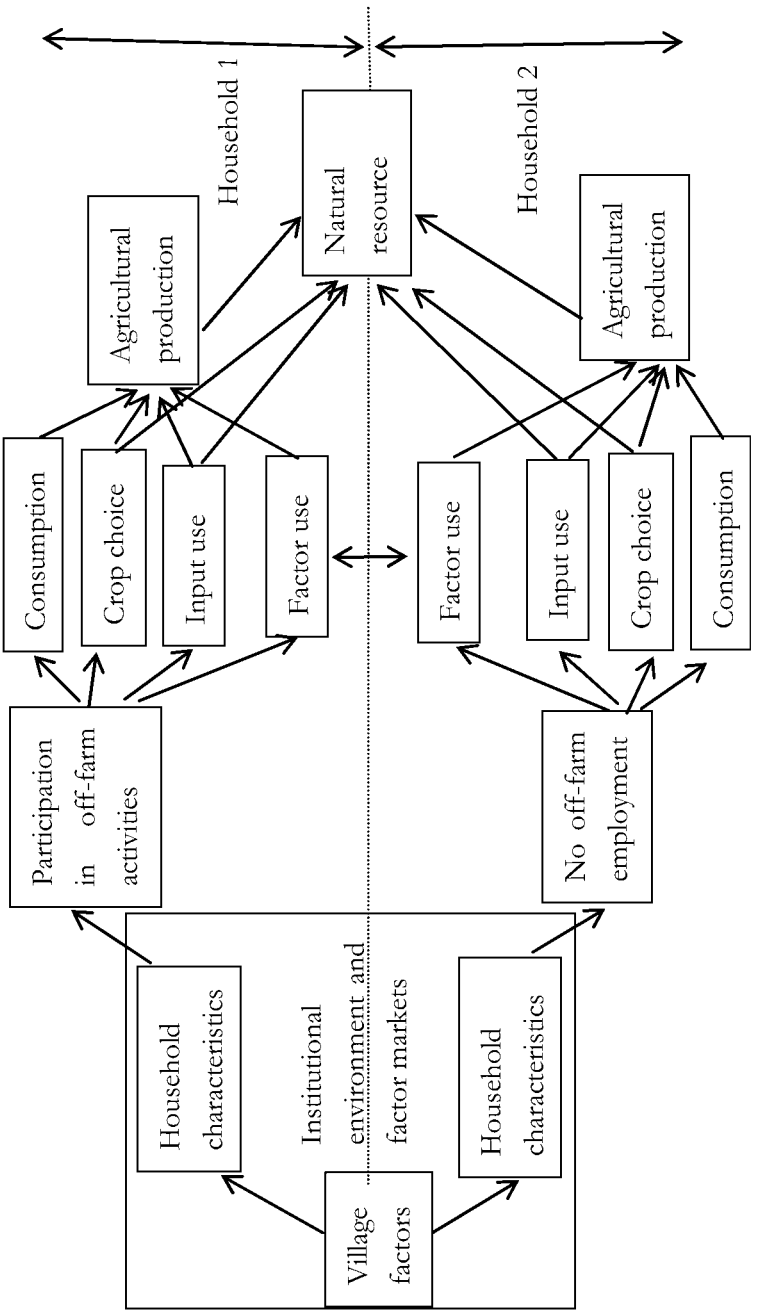

Figure 2.1
Theoretical framework

in off-farm activities, and less than 10 percent worked full-time away from the farm (de Brauw 2001).

Non-agricultural labour markets were a localized phenomenon that first occurred near the coast and on the outskirts of large cities. During the mid- and late 1980s, township and village enterprises (TVEs) became one of the booming sectors of the economy and brought a substantial increase in the incomes of rural households, although still essentially in areas near the coast. Households in less developed areas or remote villages had fewer opportunities to work in TVEs. Between 1980 and 1994, the number of rural TVEs grew from 0.5 million to 8.75 million. By the mid-1990s, rural enterprises employed around 120 million workers, equal to 64.6 percent of the national industrial workforce (Yao 1999).

By the year 2000, nearly 200 million people (or about 40 percent of rural labourers) participated in off-farm activities, including working in TVEs and out-migration (Zhang et al. 2002). There were about 100 million rural migrants working temporarily in cities in 2005 (Liu & Chen 2005). Since the mid-1990s, and with the development of the urban sector, increasing numbers of rural labourers have migrated to cities for employment. However, because of the household registration system, most of them are still classified as rural residents, even if they may work full time in cities. Migration across counties and provinces became a very significant activity for households in remote areas or with a less developed local TVE sector. In recent years, with reforms of the TVEs, growth in local employment has slowed down, and out-migration has become the largest component of off-farm labour activities. Income from off-farm activities has been a major contributing factor to the income increases of rural household in the late 1980s and 1990s (Parish et al. 1995, Rozelle 1996).

The development of off-farm activities reflects uneven development across regions in rural China. The lack of local TVEs, the household registration system, the land tenure system with insecure property rights, and the obligatory production quota in agriculture provide important constraints on off-farm activities and to the movement of labour between regions (Somwaru et al. 2001). Employment opportunities in TVEs are unevenly distributed among households because of different social connections and political capital at village or local level (Giles 2002). Migration is more important in areas with few TVEs. Social networks, educational level and experience of household members all play a

role in household access to migration opportunities. Households in villages with former migrants seem to migrate more, and members with better education and experience in off-farm employment are more likely to find jobs and better payment in cities (Zhao 1999a). Household characteristics are therefore very important influences on households' access to off-farm activities (Zhang et al. 2002).

In summary, off-farm activities have provided new and rapidly expanding options for farmers to obtain extra incomes in rural China over the past two decades. Income from off-farm activities has come to dominate the income of farm households. However, because of uneven economic development, institutional barriers, geographic conditions, and differences in household characteristics, off-farm activities are not evenly spread across regions and households.

2.3 Off-farm employment and agricultural production

Participation in off-farm employment and the income flow resulting from it can induce important household responses in terms of consumption and farm production. It is important to understand what factors influence household choices and the motivation of such choices. The literature has a rich tradition of describing patterns of migration and studying determinants of off-farm choice in China (Zhang et al. 2002, Hu 2002, de Brauw et al. 2002, Hare 1999, Du 1999, Zhao 2001). These, and others studies, have tried to explain the motivation of household participation in off-farm activities using different analytical frameworks. Generally, the decisions of rural household members to participate in off-farm activities are driven by "pull" and "push" factors. Chapter 3 will discuss these factors in more detail.

Several theoretical models have tried to capture the factors behind labour reallocation. The models of Lewis (1954) and Todaro (1976) addressed the role of wage differences (expected urban wage) between farm and non-farm sectors or between rural and urban sectors in determining a household's choice in entering into non-farm activities or migration. Taking a different avenue, human capital theory addresses the question of migrant selectivity, by merging neoclassical and Todaro's analyses with migration theories. It explains why migrants are those with skill-related attributes (Becker 1975, Taylor & Martin 2001). Finally, the theory of the new economics of labour migration (NELM) emphasizes that migration decisions are part of household decision-making (Stark

1991, Taylor & Martin 2001). Migration decisions are also considered as a major response of households to market failure, for example to a missing credit market.

Low-income economies are generally characterized by abundant labour resources in agricultural production and persistent market imperfections (Cook 1999). Off-farm employment shifts household resources from farm production to off-farm activities, hence reduces labour availability for farm production (but not necessarily the labour actually used in farm production). In addition, off-farm employment can also affect farm production through the income effect of participation in off-farm activities and through a reduced local consumption requirement of households when one or more members involved in off-farm activities are absent for shorter or longer periods.

2.3.1 The effects of labour moving out of farm production

Involvement in off-farm employment in rural China (w^o: wage rate of off-farm employment) shifts the labour resources of a household from farm production (w^{ac}: wage rate of agricultural employment) or leisure to off-farm agricultural employment, non-farm employment (TVEs) (w^{nw}: wage rate of non-farm employment), self-employment (w^{se}: marginal return of self-employment) and migration (w^m: marginal return of migration). In classical and neoclassical (including Harris-Todaro) labour movement models, non-farm activities (which differ from off-farm employment by not including agricultural employment) affect agricultural production by reducing the labour input in farm production. Development economists assume that there is substantial surplus labour in the traditional (usually interpreted as agricultural) sector. The macro development model of Lewis (1954) presumed that in the early stages of development more and more labourers are shifted to the industrial sector without any reduction in total agricultural output, because marginal labour productivity in agricultural is equal to zero. In the model, non-farm activities competing with agricultural production for labour will not provoke an agricultural output decline, and therefore there will be no upward pressure on rural agricultural wages (w^{ac}). However, an important paper by Sen (1966) explained the issue of surplus labour by making the distinction between surplus labourers and surplus labour hours. Using a simple household theoretical model, Dinwiddy & Teal (1996) showed that withdrawing one member of the workforce will only lead to a zero

decline in agricultural output if the marginal rate of substitution between consumption and leisure is constant. But empirical work done by Rosenzweig (1988) suggests that labour in the agricultural sector cannot be strictly regarded as 'surplus'.

To simplify the analysis, it can be assumed that a household expects to equalize returns in all activities. It means that household labourers have equal wage rates in all activities. If all household labourers are confronted with the same prices and wages, for instance in a perfect market environment, we will see that wages and marginal products of activities (MP_L^n: marginal product of labour working in non-farm activities and MP_L^a: marginal product of labour working in agriculture) of all household labourers will be equalized across household members ($w^m=w^{se}=w^{nw}=w^{ac}=MP_L^n=MP_L^a$). But household labourers may face certain constraints in their access to some markets. For example, as discussed above, non-farm employment was a localized phenomenon in rural China in the 1980s. Empirical evidence indicates that political power is very important in determining access to jobs in local non-farm employment (mainly in TVEs) (Cook 1999, Yao 1999). Households that have access to local off-farm employment may work for a limited time at a given wage rate. Wages in such rationed activities (w^{nw}) have typically been set higher than the marginal product of labour in farm production ($w^{nw}=MP_L^{nw}>MP_L^a$).

It is a reasonable assumption that the labour qualities of household members are not homogeneous and thus not perfectly substitutable across activities. Factors such as gender and differences in educational levels may therefore cause differences in access to off-farm activities for household members. The opportunity costs of labour therefore vary not only between households, but also within them, among household members, because of these differences in access to off-farm activities ($MP_{L,i}^a=MP_{L,i}^o \neq MP_{L,j}^a=MP_{L,j}^o$, for household members i and j, $i \neq j$).

In terms of access to local non-farm employment, household members may have different marginal returns to labour. Self-employment may interact with own farm production, when households use the output from their farms as inputs in self-employment. It may also be related with other non-farm activities in terms of investment needed in self-employment. For example, some households have bigger land endowments, which can reinforce their capacity for self-employment by in-

creasing access to credit or having more inputs for these self-employed activities.

Human capital theory provides an important explanation of why farm households have different access to off-farm employment, especially that involving migration. Differences in wage rates of off-farm employment and participation in migration can be explained by workers' skill-related attributes, such as experience and educational levels (Becker 1975, Taylor & Martin 2001). Empirical evidence from rural China shows that educational levels, social networks and other household characteristics (such as number of labour force, etc.) determine their access to migration and income from it in (Rozelle et al. 1999, Zhao 1999a). Therefore, household members with better access to migration have higher a marginal opportunity cost of labour in farm production. Such household members will try to equalize the opportunity cost of their labour across activities, agricultural as well as non-agricultural ($w^{m}=MP_{L}^{a}=w^{ac}=MP_{L}^{nw}$).

In rural China, institutional barriers (the registration system, quota obligations) constrain households' participation in off-farm labour markets, which means that households cannot work off-farm as much as they want. In theory, as long as wages from off-farm activities are higher than the (shadow) wages of farm production, farm households will dedicate their time to off-farm activities. However, land tenure and quota obligations prevent households from moving their labour out of farm production because they are afraid to lose their contracted land. They therefore may retain more labour in farm production than is economically optimal in order to fulfil quota obligations. Given the threat from village committees to reallocate land, the existence of less-developed village land and labour markets, the risk-averse strategies of households and the low substitutability of labour, households may retain relatively much of their own labour in farm production. All these factors reduce the incentives to allocate labour to off-farm activities, even though the marginal returns from farm production lower than the marginal returns from off-farm activities ($w^{o}=MP_{L}^{o}> MP_{L}^{a}$).

Household members will also experience different marginal utility of time (leisure) because of differences in access to off-farm activities caused by institutional barriers and other factors affecting participation. Household members with better access to off-farm employment enjoy higher wage rates. This induces an increase of the marginal utility of time (leisure), which means that household members with better access to off-

farm employment will have higher marginal utility of time than other household members. Household members who work part-time in off-farm activities may equalize their marginal utility of time (MU_l) with the marginal product of farm production instead of the marginal product of off-farm employment, which will be higher. Because household members with access to off-farm employment may also work part time in farm production, all household members will equalize marginal utility of time, which equals the marginal product of farm production ($w^o = MP_{l,i}^o > MP_{l,i}^a = MU_{l,i}$). As a result household members will differ in their marginal utility of time/leisure ($MU_{l,i} \neq MU_{l,j}$). An increase of off-farm employment will raise household marginal utility of leisure, and households will decrease their own labour input in farm production until the marginal product of labour in the farm equals the marginal utility of leisure. To the extent that a village agricultural labour market exists, the marginal product of labour in farm production will be equalized among households ($w^{ac} = MP_{l,}^a$). In rural China, farm production is not a uniform activity; it includes crop production, livestock production and perennial crops. It is assumed here that farm households can use their labour for different farm production activities and this will lead to an eventual equalization in the marginal products of different farm production activities.

In a perfectly neoclassical world (without surplus labour and other market imperfections), off-farm labour is paid the marginal value of a person's production before he or she left farming. However, the neoclassical model does not explain the situation in the developing world in which there are many market imperfections and institutional barriers (Hoff et al. 1993). High transaction costs in village factor markets cause them to be underdeveloped and imperfect. Land sale or rental markets could equalize the differences of farm production efficiency between households. An agricultural labour market could equalize labour production efficiency in farm production. However, the land tenure system in rural China prohibits selling land and therefore diminishes households' incentives to exchange their land use rights (Lohmar et al. 2001). The high cost of monitoring hired labour increases transaction costs for hired labour. The lack of an agricultural labour market (due to high transaction costs) makes it difficult for farm households without access to non-farm employment to work in on other peoples' land. Moreover, households with better access to non-farm employment cannot retain the same

amount of labour use in their farm production as before because of these imperfections in village labour markets. This leads to a gap in the marginal product of labour in agricultural production among those households that participate in off-farm employment and those that don't.

In recent years, village factor markets have started to emerge in rural China. Household differentials in the marginal utility of time (leisure) create incentives to exchange local agricultural labour (w^{ac}), which may compensate for the family labour loss in farm production ($wi^{ac}=MP_{Li}{}^{a}=MLU_{Li}$). The functioning of village agricultural labour markets determines the scale of labour hiring (change of labour use) in farm production. The wage rate of village agricultural labour will increase through the demand in increase for village agricultural labour. Development of other village factor markets may further modify the impact of off-farm activities on farm production.

In summary, the above model of labour reallocation in farm production deviates from the standard model of labour allocation in that the marginal product of labour is determined by a series of factors.

- First, given the earning differences between off-farm activities and on-farm production, increased participation in off-farm employment will further enhance the effects of labour moving from farm to off-farm employment or on-farm production. The impact of off-farm activities on resources use will pass through the decreasing labour availability in farm production. Labour moving out of agricultural production also means a loss of human capital, which plays a very important role in farm production.
- Second, as a result of household differentials in labour endowments, gender composition, human capital, social and political capital and other characteristics, households and their individual members have differential access to off-farm employment. Labour moving out of agricultural production will change the marginal product of labour in farm production, the marginal utility of leisure of participating households and wages in village labour markets. Differential access between households to off-farm employment will generate incentives for households with better access, to hire labour to compensate for their own labour loss.
- Third, to the extent that village factor (labour and land) markets develop, they will modify the effects of labour loss on farm production and diminish the labour loss effects on farm production and input

use change experienced by households participating in off-farm employment.

2.3.2 Income effect of off-farm activities

The income effect of off-farm activities on household farm production and total income may also be very important. The income effect of off-farm activities has been specifically examined by studies that quantify the share of off-farm income in total income, and the impact of off-farm activity income on income inequality among households (Zhu 2002, Kung & Lee 2001, Reardon et al. 1994). Off -farm employment reduces the amount of 'surplus labour' 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 incomes. Research shows that the share of income from non-farm sources in the counties of Hunan and Sichuan Provinces was more than 25 percent of average per capita income in China in 1993 (Kung & Lee 2001). Other studies found that the income growth of most farmers in rural China in the late 1980s and 1990s can be attributed to increased off-farm employment (self-employed activities and wage employment) (Parish et al. 1995, Rozelle 1996). Migration has become an increasingly important off-farm activity and as such has played an important role in household income increases in recent years (Taylor et al. 2003).

The impact of off-farm employment income on food production and the goal of increasing agricultural productivity in rural China has also been examined. Rozelle et al. (1999) found that remittances from migrants have positive effects on yield and partly compensate for the labour loss effects of migration, but the overall effects of labour loss and additional income on farm yields were slightly negative. Other studies have 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 behaviour. He found that migration does not seem to affect household investment in on-farm or off-farm production. Wu and Meng (1996a, b) found that the total impact of labour transfer on grain output was expected to be positive in the near future because the increased total income could compensate for part of the labour loss effect by reinvestment in grain production. In the long run, however the effect may become negative because the marginal

product of labour becomes positive as more and more labourer shifts out of grain production.

Figure 2.2 shows a framework of how off-farm employment income can affect on-farm production and household consumption. Off-farm income can be spent on improving the consumption level of farm household. For example, Murphy (2000) observed a substantial increase in the building of new houses after households in the village she studied obtained a certain amount of off-farm income.

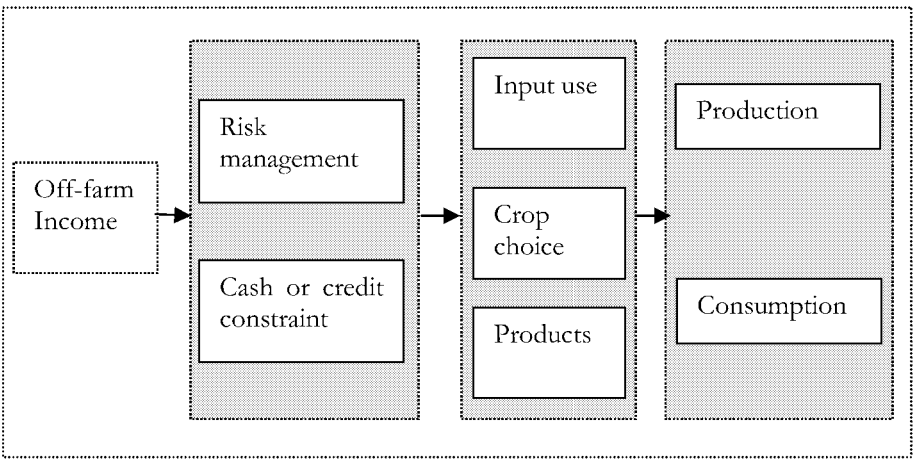

Figure 2.2
Channels of off-farm income into farm production and consumption

The new economics of labour migration (NELM) theory emphasizes the role of remittances sent by migrants in overcoming local market constraints and stimulating financial intermediation, such as credit or insurance (Taylor & Martin 2001, Taylor et al. 2003, Rozelle et al. 1999). Studies on migration in rural China have emphasized the role of migrant remittances in overcoming credit or cash constraints for households (Taylor et al. 2003). In comparison, in Senegal, farmers started to use non-farm income to purchase inputs, which were previously provided by a government supported credit programme (see Reardon et al. 1994). Income obtained from off-farm employment can either be reinvested in agricultural production to improve productivity or spent on consumption. Reardon et al. (1994) mention a series of conditioning factors, in-

cluding the physical conditions (infrastructure for on-farm production), the economic and institutional environment, the characteristics of non-farm and farm activities, and the question of control of the farm and non-farm enterprises, which influence such decisions.

Under particular market failures, off-farm income might help to overcome cash or credit constrains which previously limited farmers' access to land, labour and other input markets or to manufactured products. Evidence shows that off-farm income also serves as collateral and thus possibly improves access to credit for the farmer (Reardon et al. 1994). It can also be used as part of a survival strategy in managing risk, as farm income strongly depends on weather conditions, and off-farm income usually does not. Off-farm income is often used to spread risks. After harvest failure, labourers may try to find off-farm employment to compensate for their income loss. With a buffer of cash from off-farm activities, the farmer may also move more resources from production of staples for consumption, towards cash crops.

Income from off-farm employment significantly increases total household income. Research done by Parish et al. (1995) and Rozelle (1996) revealed that wage earnings and income from self-employed activities contributed to most of the increase in rural incomes during late 1980s and 1990s in rural China. Many studies have emphasized the importance of off-farm activities in the increase of rural incomes (Kung & Lee 2001, Sun 2003). Increased income of rural households also raises the leisure requirements of households. Thereby, if there is an imperfect village agricultural labour market, households may reduce labour inputs in farm production, and use less labour-intensive inputs in farm production. Income from off-farm employment can be an important factor in driving a shift from labour-intensive to labour-saving farm technologies, for example the use of purchased fertilizers instead of (green) manure. It can also affect crop choice by influencing the marginal utility of leisure and reducing cash and credit constraints. For example, the switch from two-season rice to one-season rice production maybe related to increased off-farm employment.

In a case study from Kenya (Burger 1990), it was shown that income from off-farm employment does lead to more cash-intensive farm production. He found an increased use of purchased inputs and hired labour in tree crops and food production. For example, additional income encouraged farmers to shift to hybrid maize production, which is more

cash and labour-intensive than with cash crops. There is less shifting towards less labour-intensive and more cash-intensive cash crops, because food markets are less reliable, and the lack of an adequate marketing structure.

2.3.3 Impact of local consumption reduction of households with off-farm activities

Besides the labour and income effects of off-farm employment on agricultural production, the induced local consumption reduction effects should be also taken into account. Members of households participating in off-farm employment, especially through migration, will reduce their local consumption within the village. If farm household production and consumption are linked to each other (as in the non-separable household model) a reduction in local food consumption or other items by household members working away from the farm will have a direct impact on household production decisions. These induced consumption reduction are usually disregarded in the literature. In China, Murphy (2000) found that migration reduced food consumption and increased rice sales, in Wanzei County, Jiangxi Province. Similarly households with members working away from the farm may also experience a reduction of fuel wood consumption as well as collection, thereby also inducing a labour reduction effect. Chen et al. (2006) found that both fuel wood and coal consumption reduced in the research areas[3] (*Banqiao* and *Gangyan* village, Yujiang and Yanshan County, Jiangxi) as a result of increased off-farm employment.

2.4 Off-farm employment, local household linkages and agricultural production

All the studies about the impact of off-farm employment on agricultural production and productivity are based on household models (Taylor et al. 2003, Rozelle et al. 1999, Wu & Meng 1996a, 1996b); they examine the income effect of off-farm employment (especially migration) together with the labour-loss effect (Rozelle et al. 1999, Wu & Meng 1996a, 1996b). However, none of these studies take local household linkages into account, which might affect the results obtained from the household models. Not only that, but off-farm employment is also one of the important factors driving the emergence of local household linkages. Hence,

any analysis of the impact of off-farm employment on agricultural production and changes in input use that neglects the role of household linkages and the influence that off-farm employment has on these is likely to be incomplete. This section provides a framework that describes how household linkages and their role in formulation the responses of households. Chapter 4 explores empirical evidence concerning these household linkages

2.4.1 Off-farm employment, household differentiation and household linkages

Off-farm employment can play an important role in enhancing differentiation among households, as not all households and household members have the same access to different off-farm activities. In rural China there are limited, although rapidly growing, off-farm opportunities, but there are also major barriers to entry because of institutional and non-institutional regimes, for example household registration systems (*Hukou*) and discrimination in finding a job (Gilbert & Wahl 2000). Rural households may not be able to take up the opportunity to work off-farm if they cannot meet one of more conditions. For example, possession of certain skills, education levels and/or social capital (*Guanxi*) is important in finding off-farm work (Shi et al. 2006, de Brauw & Rozelle 2002, Zhao 2001, Zhang et al. 2001, Yao 1999). The limited opportunities and strong competition mean that additional household resources may need to be expended to gain access to off-farm employment. Differences in human and social capital, land or other resource endowments are an important cause of differential access to off-farm employment, and thus differentiation among households (Shi et al. 2006, Zhao 2001, de Brauw & Rozelle 2002, Yao 1999).

Off-farm activities may induce the development of local factor markets, for a number of reasons. Firstly, off-farm employment absorbs labour from the farm. The resulting labour shortage may induce the farm household to hire labour or rent out land, which will stimulate land rental and labour markets. Second, incomes from off-farm employment will not only reduce credit or other market constraints, but may also provide a source of credit for households within the village that lack off-farm employment. In developing countries, the reach of formal banking systems in rural areas is quite limited, and it is difficult for farmers to obtain loans or credit from them. Hence, local credit markets may develop

as a form of compensation for the failure of formal institutions. Third, if there are high transaction costs or other institutional barriers in land renting activities and low costs in labour hiring and no surplus labour, households with members participating in off-farm employment are likely to use more hired labour to compensate for their own labour loss. In contrast, if the hiring of labour involves high transaction costs, there may be an inverse process of land rental market development.

Evidence from rural China shows that out-migration induces farmers to rent out their land to other households or to hire in labour in peak season to compensate for the labour shortage. In reality off-farm activities are increasingly becoming one of the main factors stimulating factor market development in rural China (Benjamin & Brandt 2002, Kung 2002, Lohmar et al. 2001), where land use rights are assigned to households within a village on the basis of equality, with frequent redistributions of land within the villages to correct for demographic changes. Empirical studies by Yao (2000), Lohmar et al. (2001) and Kung (2002) show the important role of the off-farm labour market in inducing land rental market development. In some areas of China, around 10-15 percent of land is leased within the village (Huang et al. 2000). The rural land rental market can make an important contribution to improving land allocation efficiency. However, it is also argued that some institutions, particularly land tenure systems and quota obligations, hinder land rental activities (Lohmar et al. 2001, Rozelle et al. 1999). The removal of these constraints is likely to further intensify the development of land rental markets as a response to accelerated off-farm employment (Kung 2002, Lohmar et al. 2001, Turner et al. 2001).

As more households engage in off-farm activities, other village factor markets can also be expected to appear, and linkages between households will become stronger. Great diversities in factor market development may be observed (Kung 2002), due to institutional barriers and the high transaction costs that are characteristic of most developing countries (de Janvry et al. 1991). Labour migration and the seasonality of farming have led to the exchange and hiring of labour becoming more important in rural China. Farmers increasingly hire labour for land preparation and harvesting, or rent a small tractor for ploughing. In mountainous villages, where tractors cannot be used, oxen rental activities and shared oxen ownership have been developed. Oxen are very important for farm production in such villages. The increase of off-farm

activities means that renting oxen or tractors are now becoming viable alternative labour saving strategies.

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

2.4.2 Household linkages and internal-village markets

Nowadays, household-market linkages are widespread in rural China (Benjamin & Brandt 2002). These household-market exchanges are very important in shaping farm household responses to policy changes. When external shocks occur, their impact on the households will pass through households by the linkages among them. In a perfect market, shocks will be contained by the price changes that occur in the market.

However, high transaction costs (caused e.g. by missing or asymmetric information), risk and institutional barriers may lead to missing, imperfect or thin markets. If substantial market imperfections exist between a village and the outside world, internal-village markets may develop (Hoff et al. 1993, Sadoulet & de Janvry 1995, Taylor & Adelman 1996). Generally, the unfavourable physical conditions of some villages (such as remoteness) will lead to high transaction costs in trading commodities and factors with the outside world. This will reduce possible exchanges between the village and the outside world for some (or all) of these commodities or factors and can result in greater local exchange between households within the village.

The existence of internal-village markets is also the result of differentiation between households within a village. When households differ in their resource endowments and (as a result) in their production activities, they will benefit from internal trade. Without differentiation among them, they would be self-sufficient. The typology of village economies developed by Holden et al. (1999) clearly illustrates why households in a village generate strong market exchanges, and why it is important to focus on village economies. Specifically, when households are highly differentiated and transaction costs with the outside world are high, village mar-

kets will usually arise, and price formation will be independent of market prices outside the village (Holden et al. 1999).

2.4.3 Off-farm employment, local internal markets and agricultural production

Increase in off-farm activities will not only accelerate the development of village factor markets, but also deepen their effects on household farm production. High transaction costs between households and the world outside the village will generate general equilibrium effects on a village economy. These local household linkages or local factor markets will evidently shape the responses, in terms of agricultural production and input use, of households involved in off-farm employment as well as those not involved. Hence, in trying to capture the impacts of off-farm activities on the rural economy, the linkages induced by off-farm employment on land, credit, labour and other markets need to be taken into account.

The expansion of off-farm employment usually shifts labour out of farm production, which will increase the opportunity costs of the household in farm production. This will increase the wage rate at the village labour market, if there is no labour surplus in the village, and decrease the land rental price in the village. A higher village wage for agricultural labour, gives strong incentives for households, both with off-farm employment and without it, to shift their production technologies to less labour-intensive ones. Thus the farm production of households who participate less or not at all in off-farm activities will also be influenced. The village land or labour markets provide a buffer to compensate the labour-loss effect of households that are involved in off-farm employment.

Moreover, increasing income from off-farm activities will induce households with off-farm employment to enjoy more leisure (and increase consumption), reduce their cash or credit constraints and stimulate farmers to use more labour-saving inputs on the farm. This will also have an effect on households without off-farm income. Meeting the requirements of households for cash or credit will further stimulate farmers to use more fertilizers and other modern labour-saving inputs. More income from off-farm activities will also change the price of renting capital goods (tractors, oxen) in village markets.

Increasing participation in off-farm activities will reduce labour availability within households, and may have effects on crop choice, for ex-

ample a shift from two-season to one-season rice. This increased income may further enhance the effects of less labour availability in the farm. These effects will also hold for households with little or no off-farm work, through village markets for land, labour and other factors. Off-farm activities, especially migration, will greatly reduce the local food consumption needs of participating households and may also have effects on crop choice and variable input use on the farm. All theses changes will have an impact on farm production of households, whether or not they are participating in off-farm activities.

2.5 Impact of off-farm employment on sustainable land use

Off-farm employment may also have important implications for sustainable land use, as it may affect agricultural production patterns and levels, as well as the choice of techniques – especially inputs used. The definition of sustainability used here is provided by FAO from its conference in Den Bosch (Netherlands) in 1991

> ....the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in agricultural, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically, and social acceptable (FAO 1991).

This is a land resource oriented elaboration of the definition of sustainable development derived from the Brundtland Report[4]:

> Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all compatible and enhance both current and future potential to meet human needs and aspirations (WCED, 1987: pp 46, Opschoor 2003).

In the context of this study the FAO's emphasise on agricultural development that does not degrade the environment and for appropriate, and socially as well as economically, acceptable technology is highly relevant. This study therefore uses environmental quality and land productivity as key elements in discussing and assessing the sustainability of land use.

The China Agenda 21 Declaration states that the government will aim to coordinate the relationships between economic and social development, resource utilization and environmental protection. Hence, the sustainable utilization of resources and preservation of a healthy environment are intended to be major components of China's sustainable development strategies (PRC 1994). China is vulnerable to land degradation, due to its climate and geography and large population (Li et al. 1997). Increasing population and resource use intensity have led to increasingly severe land degradation in China in the past few decades. Policy makers have indicated their awareness of the issue and recently announced a shift in policy emphasis towards long term sustainable development (Wang et al. 2004).

Some studies argue that cultivated land in China is suffering from soil degradation, but it is difficult to assess the extent or degree to which this influences agricultural production (Heilig 1999). Our research area (Jiangxi province) is an area affected by soil degradation. Furthermore, the yield of main crops, such as rice, rapeseed and cotton, is much lower in Jiangxi Province than elsewhere in China (Li & Lin. 1998, Huang 1999). One important reason is that soil organic matter content in Jiangxi's cultivated land is lower than in neighbouring provinces, partly because of lower use of green manure and animal manure (Li & Lin 1998). Farmers in the research area traditionally planted green manure and applied animal manure on their farms. However, modern input use (notably chemical fertilizers) has become widespread in recent years, and in many cases has replaced green and animal manure as a means of regenerating soil fertility.

Different input and output combinations in farm production have different implications for soil quality and rural environment change, and are important components of sustainable resource use. The OECD (1993) has developed an approach to trace the environmental repercussions of human activity, including human responses to environmental change, in what it calls the Pressure-State-Impact-Responses Framework (see OECD 1993: pp 10). This sees human activities as giving rise to environmental pressures in the form of pollution, waste, and resource depletion. These cause changes in environmental quality and resource availability, impacting on those who are exposed to these changes. These people or groups may respond to these impacts by adaptation or mitigation – that is, coping with these changes by using protective devices or

substituting one resource or input by another, or by trying to change the activities that gave rise to these environmental pressures, so that the impacts do not occur, or only at lower levels.

In the case of agricultural activities, environmental pressures (like the use of fertilizers, pesticides and herbicides) will lead to the changes in the state of the environment ('environment quality') by altering the chemical properties of the land, groundwater, rivers, sea, and air. Thus, the productivity of the land may be adversely affected, and risks to animal or human health may arise. This in turn may affect "agents" such as farm households, enterprises (including farms) and policy makers. These agents will then react, e.g. by changing their agricultural production patterns and levels, and input substitution. This research did not have the information needed to identify changes in environmental quality (such as nitrogen (N) levels or pesticide residues in ground water or rivers) but it is still possible to identify changes in input use (such as fertilizers, pesticides and herbicides, green manure) in farm production. Thus, changes in these environmental pressure indicators, (levels of pesticides, fertilizers and herbicides use), will be used as "proxies" for long term changes in land production capacity (LPC) and in environmental quality (EQ).

Increasing use of chemical inputs in agricultural production in rural China has attracted much attention. For example, overuse of nitrogen fertilizer over the past 10-20 years has resulted in non-point source (NPS) pollution from crop production becoming a major cause of water pollution, and the situation is projected to get worse (Norse 2005, Zhu & Chen 2002). Decreasing use of organic manure in agriculture is contributing to a decline in the quality of farmland, particularly in terms of organic matter content and an increase in environment pollution. Much of the unused N from human and animal excreta will eventually end up in lakes and rivers as a pollutant (Zhu & Chen 2002). There are also rising concerns about pesticide and herbicide use in rural China. Hence, pesticides, fertilizers and herbicides used, seem to be useful proxies for changes in environmental quality in China.

Off-farm employment not only shifts resources away from farm production (like labour), but may also bring about a change in the resources used. Changes in labour availability may result in technological changes and additional incomes from off-farm employment will also affect agricultural production patterns, inputs and factor use, with associated changes in the pressure on nature resources used in agricultural produc-

tion. Therefore, off-farm employment may have quite complex and possibly mixed effects on the sustainability of rural resource use.

In our research area and study sites[5], linkages between farm production and resource use were identified during meetings with local researchers and policy markers and through field trips. Soil compaction is occurring in rice fields, landslides on mountains and soil erosion is evident in the highlands. These, have been identified as major soil degradation problems in this area (Kuiper et al. 2001). They are closely related with farm input use, crop choice and energy consumption.

Farm households have a long tradition of green manure planting and applying animal manure in production fields, providing nutrients and improving soil quality. This not only increases the yields of paddy, but also the efficiency of nutrient take up from chemical fertilizers. However, in recent years, farmers have started to use more chemical fertilizer and less organic manure, which is making soil compaction a serious problem. This may be offset, partly or wholly by farmers shifting from two-season rice planting to one-season rice. The system of double-cropped rice is much more intensive and shifting to a one-season rice system may improve soil quality through less intense use of chemical inputs. Our surveys and interviews with local researchers showed less green manure planting which may also cause a decrease in soil quality. Application of green manure or animal manure requires much labour input and little or no finance, compared to the use of modern chemical fertilizer, which needs little labour and much finance. Since off-farm employment is expected to stimulate the adoption of labour-saving production technologies, this may lead to a long term decline in land production capacity and have important implications for environmental quality.

Soil erosion is also occurring in highland soils cultivated with cash crops (e. g. peanuts). This land is not terraced, and is therefore suffering from soil losses during the rainy season. These losses may also be related to off-farm employment through the reduced availability of labour (increasing the need for mechanization), increased cash availability (for financing seeds and chemical inputs for cash crops) and reduced local food consumption needs (inducing a shift from food to cash crops).

Many households collect firewood to meet much of their energy consumption requirement, for cooking food and heating during the winter. Continuous fuel wood collection in mountainous areas is a very real source of environmental degradation, and increasing the frequency of

landslides. Less labour availability and rising income levels may reduce wood consumption, and this may lessen the pressure on forests and reduce the number of landslides.

This study does not examine soil erosion in highland soils, as this is only an issue in one of the surveyed villages (in a hilly area), which was not the village used for the village model analysis (the model uses data from a remote mountainous village). Firewood consumption is very important in the village selected for the village-wide model, but it was not possible to collect enough data on this, so this issue is not incorporated into the village model. However, in the subsequent analysis of the village economy, the potential linkages between off-farm employment of households and soil degradation will be examined in more detail. This will be done by firstly analyzing how off-farm employment influences household input (fertilizer, manure, pesticide and herbicide) use, and crop choice behaviour and then by looking at the implications of these choices for sustainable land use.

2.6 Choice of modelling approach

A household model can capture the direct and internal equilibrium feedback effects of households to outside shocks such as a change in off-farm employment, but it cannot be used for analyzing the effects of interactions between households. Yet, when household linkages are very strong within a village but not with the wider economy, it becomes very important to analyse the village economy. A village wide model can capture the linkages amongst households and be used as a valid method for undertaking policy analysis (Taylor & Adelman 1996). Village-wide models (either village social accounting matrix (SAM) multiplier models or village computable general-equilibrium (CGE) models) have only been relatively recently developed and the literature is still patchy. Research with these tools has been done for a limited number of countries, including Mexico (Taylor & Adelman 1996), Zambia (Holden et al. 1999) and India (Parikh & Thorbecke 1996). Use of the village SAM model has thus far been limited to incorporating price responses and substitution possibilities. Hence, production and consumption activities have only been modelled by the Leontief approach and no prices appeared in the model. A village CGE model, offers more choice in modelling production technologies and consumption pattern and can also model price

changes. More explanations about these differences can be found in chapter 5.

Village-wide models have been used to examine different research topics, but they have not been widely used to examine the impact of off-farm activities on the village economy and the implications for sustainable resource use by households. One exception to this is Kuiper (2005) who developed a CGE model to examine the impact of migration on household farm production, income and exportation using data from Jiangxi Province. The model developed by Taylor & Adelman in Mexico examined the effects of migration on the local economy, focusing on the income effects of migration (Taylor & Adelman 1996). Research in India by Parikh & Thorbecke (1996) analysed the impact of the development of the non-farm sector on rural development in terms of income and poverty. This study will examine the impact of off-farm employment on household input use, crop choice and energy consumption for a relatively remote Chinese village. By using a village SAM multiplier model and a village CGE-model to address these issue it will provide an innovative contribution to the existing literature.

Notes

1. More explanations to the household responsibility system can be found in Chapter 4.

2. However, according to Fan et al. (2002), public investments in the 1990s still discriminated against poor rural areas.

3. Their research areas are the same with this study.

4. Our Common Future (WCED -World Commission on Environment and Development), (1987).

5. Description of the research area is to be found in chapter 3.

3 Factors driving farm household participation in off-farm employment - An empirical analysis for three villages in Jiangxi province[1]

3.1 Introduction

Given the scarce land resources and 'surplus' labour of rural households in China, working off-farm is an important livelihood strategy of rural households. As explained in previous chapters, more and more farm households are becoming involved in off-farm employment. However, as elsewhere they can adopt a variety of livelihood strategies. Barrett et al. (2001) found that limited risk-bearing capacity, weak financial institutions and limited resources provide strong incentives for farm households to build a portfolio of activities that will stabilize income flows and consumption and minimize the risk of shortfalls. This leads to households having diversified employment and income patterns. In China, the development of local non-farm employment opportunities by township, and village, owned and private enterprises and the gradual easing of constraints on free movement to the cities (*Hukou* system) have provided increasing off-farm employment opportunities to farm households. However migration of rural labour is still constrained to some extent by institutional and other factors, while local non-farm employment opportunities differ greatly between regions. Hence, the extent to which farm households can diversify their production activities and income patterns, and the question of which farm households will benefit the most, are important issues for researchers and policy makers.

Empirical studies show that social networks, income gaps, land constraints and household composition are important factors in determining

the options for households' participation in off-farm activities (Zhao 2002, Zhu 2002, Du 2000). Because the nature of off-farm activities differs, so do the factors affecting choices over, and access to, these off-farm activities. For instance, a social network is an extremely important factor in migration to cities (Zhao 2002), while political capital is important for finding local non-farm work (Yao 1999, Cook 1999). Individual characteristics, as well as household composition and other attributes of the household to which a person belongs, play a role in decisions about off-farm employment and their choice of off-farm activity.

Consequently, obtaining a better understanding of the factors, which influence participation decisions in different types of off-farm activities, and the relative importance of these factors in determining participation in these different types of off-farm activities may contribute to policies that are more able to raise rural household incomes, diversify incomes and enhance risk management. The objective of this chapter is, therefore, to examine which factors drive participation in different types of off-farm activities in China.

The rest of the chapter is organized as follows: A brief theoretical background about determinants of participation in off-farm activities is provided in section two. Research area selection and data set are described in the third section. The nature of off-farm activities in the chosen research areas is described in the fourth section. Model choice and estimation results are discussed in section five. The chapter ends with a summary and some concluding comments.

3.2 Theoretical Considerations and Chinese Rural Realities - "Push" and "Pull" factors

Rural households' participation in off-farm activities supplements and diversifies their incomes, increases their welfare, and reduces the risks involved in agricultural production. Increased labour supply to off-farm activities may reflect an ex post response to a realized shock (Kochar 1999) or an ex ante decision based on the need for alternative sources of income in a risky environment (Rose 2001, Barrett et al. 2001). An empirical study by Giles (2002) shows that off-farm activities have been used as a means of smoothing shocks in agricultural production in rural China.[2] Participation in such activities may be more important for households with credit or liquidity constraints, because participation in off-farm activities can make it possible for farm households to invest in the

farm, to purchase or rent equipment, finance initial investments, and invest in skill development (De Brauw 2001).

Choices about participating in off-farm activities are made by rural household members located in a particular environment. Their choices are based on their own resource endowments, the local institutions which shape the household's responses in terms of consumption and farm production, and other factors. Factors determining participation in off-farm activities can be classified as "push" and "pull" factors.

The earnings differential between non-farm and farm sectors is one of the important "pull" factors that motivate household members to participate in non-farm activities. This is at the heart of the Harris-Todaro model. The model states that the migration of rural workers depends on the difference between the rural labour wage and the expected urban wage, where the latter can be defined as the urban wage multiplied by the probability of finding a job in the city. If the expected wage is larger than or equal to the rural wage, the rural worker will move to the urban area (Zhao 2005, Taylor & Martin 2001, Gillis et al. 1996). The large income gap between urban and rural sectors is the main incentive for rural household members to migrate to the cities in China (Zhu 2002). Preference for working in off-farm activities and other social factors, for example a more colourful life in cities, can be other types of "pull" factors (Wu et al. 2003).

"Push" factors driving rural labourers to seek off-farm employment include land constraints, risks in farm production, and rural market failures, such as imperfect or missing insurance, consumption and credit markets. They drive rural labourers to find other sources of income or ways to loosen these constraints (Reardon et al. 2001, Taylor et al. 2003, Rozelle et al. 1999, Zhao 1999b, Nabi 1984). In a perfect market environment, the rewards for working on-farm and working off-farm are equal. Farm households will reallocate their time to off-farm work until the marginal return of labour in off-farm activities is equal to the marginal return of labour from on-farm production. However, low-income economies are generally characterized by abundant labour resources in agricultural production and persistent market imperfections (Cook 1999, Zhao 1999b). If a farm household faces agricultural labour market imperfections, working off-farm will affect leisure and labour input into farm production. If a household faces non-farm labour market imperfections, labour cannot be diversified as much as desired.

Agricultural labour market imperfections occur when family labour and hired labour are imperfect substitutes, when the labour of the household members cannot be fully substituted, or when monitoring hired labour involves high transaction costs. Off-farm labour participation decisions by one family member will interact with the decisions of other household members in poor rural areas (Du 1999). When a land market is absent, agricultural labour market imperfections imply that household production decisions cannot be separated from consumption decisions. Farm and family characteristics therefore influence households' and individual decisions about off-farm labour participation.

Non-farm labour markets are segmented and characterized by entry barriers. As a result, access to off-farm activities will be difficult for specific groups of farm households. In particular, it is more difficult for poor farm households (Reardon 1997) and for farm households with fewer social connections (*Guanxi*) or fewer connections to local policy makers to gain access to employment in TVEs, private enterprises (PEs) or other local non-farm activities (Xia & Simmons 2004, Giles 2002, Zhao 2003, Zhang & Li 2003, Cook 1998, Yao 1999, Kung 1999).

The absence of local TVEs and PEs in a region limits local employment opportunities. Geographic location plays an important role in the local development of small enterprises. In China areas close to big cities or to the coast have more developed local enterprise sectors. Labour markets in these areas are more developed, especially in areas dominated by PEs, such as Zhejiang Province (Kung & Lee 2001). Poor infrastructure may restrain the movement of labour across regions, due to the high costs involved in migration (Xia & Simmons 2004, Somwaru et al. 2001)

Institutional barriers may also prevent farm households from participation in off-farm activities. Examples include the household registration system (*Hukou*), which constrains the movement of labour, insecure rural land tenure rights, which make farmers reluctant to leave their farms, or the grain production quota system, which (until recently) required farmers to fulfil their obligations before they could dedicate time to off-farm activities (Gale 2002, Lohmar et al. 2000, Kung 2002, Kung & Liu 1997, Brandt et al. 2002, Liu et al. 1998, Rozelle et al. 1999).

The development of agricultural land markets may affect also off-farm labour participation. Farm households in China can lose their land use rights if they do not cultivate their land or rent it to other households. However, in some areas land rental markets are absent or underdevel-

oped, and fear of losing land rights make farmers weary to look for off-farm employment.

When capital markets are incomplete, farm capital is determined more by life-cycle accumulation than by intergenerational transfers. Ahituv & Kimhi (2002) examine the simultaneous decision making about off-farm labour supply and farm capital investment. Using a finite-horizon life-cycle model estimated from a two-period panel data set for Israeli farm households, they found that off-farm work and farm capital accumulation are negatively related and farmers tend to revert to working on the farm later in the life cycle. Farm investment behaviour in the earlier period affects the choice between off-farm and farm work in the later period.

Studies of off-farm employment have paid much attention to the role of individual characteristics, for example gender, age, education level and working history, in gaining access to off-farm employment (Zhang et al. 2002, Kung & Lee 2001, Du 2000, Du 1999, Xia & Simmons 2004, Zhao 1999a, Zhao 1997). Less emphasis has been given to farm household characteristics and to household decision making. The theory of new economics of labour migration (NELM) emphasizes that the decisions of migrants are part of the decisions of the migrant's household (Stark 1991, Taylor & Martin 2001). It stresses that migration decisions are an important way for rural households to overcome credit constraints (through remittance flows) and insurance constraints (through income diversification). Empirical studies by Kimhi (2004), Zhao (1999a), Rosenzweig & Stark (1989) and Nabi (1984) show that collective household labour supply decision making is important and that individual off-farm participation decisions are part of household strategies. For instance, in rural India, the migration of women for the purpose of marriage contributes significantly to reducing the variability of household food consumption (Rosenzweig & Stark 1989). Even in a developed farm sector as in Israel, the presence of adult children in a family is found to reduce the labour supply to off-farm activities of parents, especially that of female ones (Kimhi 2004).

The theories on off-farm employment participation summarized above treat off-farm employment as a single entity. However, the factors driving participation in off-farm employment, are likely to vary between different categories of off-farm activity. In Latin American, for example, more educated rural household members tend to avoid agricultural wage

employment and prefer non-farm wage employment over non-farm self-employment (Reardon et al. 2001).

Previous studies on China also indicate that the determinants of off-farm labour force participation may differ significantly between different sub-categories. Former migrants who return to a village bringing access to a social network within the city are very important for new migrants from the same village to find jobs in a city (Zhao 2003). A significant component of migration activity in China is seasonal, so-called 'circular migration' (Hare 1999, Zhao 2002). Travel costs may therefore be an important factor in decisions on this type of migration (Xia & Simmons 2004).

The presence of children in a household can form a bottleneck to migration, and can more easily be combined with self-employment or agricultural employment within the same village. When elderly persons are living within the same household, they often take over much of the responsibility for raising children, thereby facilitating participation in non-agricultural off-farm employment by the parents.

Until recently local officials played a critical role in allocating employment, because most TVEs were collectively owned. Political connections were therefore an important factor in villagers' access to off-farm employment in local TVEs (Yao 1999, Xia & Simmons 2004). Local non-farm opportunities provided by PEs are primarily allocated by means of market mechanisms, which means that social capital and political connections play a negligible role (Kung & Lee 2001).

The initial asset status of farm households is important for starting an own business, especially where there are missing credit markets. They are also important for financing the initial costs involved in gaining access to off-farm employment. Self-employment requires managerial skills to run a business.

Because some jobs require certain skills and because of limited off-farm employment opportunities and strong competition among households, farm households with better education/human capital have higher chances of obtaining non-agricultural employment (Kung & Lee 2001, Zhang et al. 2002, Du 1999, Zhao 1997). The role of human capital in agricultural off-farm employment is likely to be limited.

This chapter makes a detailed empirical analysis of factors determining participation in different types of off-farm employment. Empirical studies of off-farm employment in China have thus far paid relatively

little attention to explaining differences in participation between different sub-categories of off-farm activities. Exceptions are studies by Zhao (1997), de Brauw et al. (2002) and Xia & Simmons (2004). Zhao (1997) uses data from 1,820 households in Sichuan Province (collected through the fixed observation rural survey system) to analyse the choice between agricultural employment, local non-agricultural employment and migration. The study finds that the gender, education and marital status vary significantly between these three types of off-farm employment.

De Brauw et al. (2002) uses data collected from 610 rural households in 60 villages in 6 provinces (Hebei, Liaoning, Shaanxi, Zhejiang, Hubei and Sichuan) to examine the determinants of participation in self-employment, local employment and migration. Although the results point to important differences especially between self-employment and the other two types of off-farm work, these are not explained. Xia & Simmons (2004) use data from nine villages in Xinmin county, Liaoning Province to examine labour participation in off-farm wage labour, self-employed enterprises and out-migration activities. The study finds important differences in the impact of education, demographic and political factors in influencing participation in these types of off-farm employment. Our study contributes to the literature by focusing on a region that is close to the coastal provinces, but where local TVEs and PEs are not well-developed. As a result, non-farm employment and self-employment opportunities are limited and migration is the major off-farm employment option in the research area. Moreover, building on the theoretical framework presented in this section, it seeks to explain off-farm participation decisions in terms of individual characteristics and household resources as well as institutional factors.

3.3 Area selection and data description

This chapter uses data collected in a village survey (for the year 1998) and a farm household survey (covering the year 2000) in Jiangxi Province. The data were collected as part of a research project on economic policy reforms, agricultural incentives and soil degradation in Southeast China. Jiangxi Province is located in Southeast China and has an area of about 166,000 km^2. It represents about 1.8 percent of the surface of the P. R. of China and contains about 3.5 percent of its population. It borders Fujian, Guangdong, Zhejiang, Hunan, Hubei and Anhui Provinces. The economy of Jiangxi Province is dominated by agricultural production.

Agriculture contributed 21.9 percent of the GDP of the province in 2002, 6.5 percent more than the national average. Its GDP per capita in 2002 was equal to 5,829 yuan (US $ 705), 71 percent of the national average (Statistical Yearbook of China 2003).

Village survey in Jiangxi Province for the year 1998

In 1999, a survey was held in Northeast and South Jiangxi Province to explore differences between villages in terms of off-farm employment, soil degradation, and other variables of interest to the project. Respondents were also asked to compare the situation in 1998 with that in 1992. The survey was carried out in two prefectures (Shangrao and Ganzhou), 6 counties (Yanshan, Guangfeng, Dexing, Dingnan, Chongyi and Yudu), and four villages in each county. In total, 24 villages and 1,001 households were surveyed. The two prefectures were chosen because soil degradation is considered a serious problem in these regions. The counties, villages and households were selected randomly.

Household survey in three villages in Jiangxi Province for the year 2000

Detailed data collection on off-farm employment, household and individual characteristics, and other relevant variables for the year 2000 was carried out in three villages in Jiangxi Province in August 2000 and the beginning of 2001. The villages were selected according to a series of criteria, which included level of economic development, market access and geographical conditions. The selection process involved consultation with local researchers and policy makers and several site visits. The three villages are considered representative of the diversity of rural conditions that can be found in Northeast Jiangxi Province and in a much larger hilly area of Southeast China with rice-based production systems (Kuiper et al. 2001). The three selected villages are *Banqiao* in Yujiang County, *Shangzhu* in Guixi City and *Gangyan* in Yanshan County. They are sited in three townships, three counties and two prefectures (Yingtan and Shangrao). The approximate location of the three villages is shown in Figure 3.1.

Table 3.1 gives a basic description of the three villages:

- *Banqiao* is located in a hilly area. Farmers cultivate rice on terraced lowland and cash crops (particularly peanuts and fruit trees) on sloping land. It is possible for them to transfer some rice fields into cash crop land. *Banqiao* is located close to a major national road and to a

prefecture capital, and close to a peanut wholesale market. The quality of the roads connecting its hamlets, however, is bad.

- *Shangzhu* is located in a mountainous area. Its transportation infrastructure is very bad. All the hamlets in *Shangzhu* are located in a mountainous area, and are mostly only connected by footpaths. Rice is cultivated in terraces in the valleys and lower mountain ranges. The main cash crops are bamboo and bamboo shoots.
- *Gangyan* is a very large village in terms of population and is located in a plain area. Rice fields are quite flat and little land is used for cash crop, although rice fields in this area can easily be converted to cash crop land. Vegetables are the main cash crop. *Gangyan* is quite close to a county capital and an old national road. The quality of the roads connecting its hamlets is good.

More information about the villages can be found in the village selection report in Kuiper et al. (2001).

Figure: 3.1

Location of the three sample counties

Table 3.1
Description of the three villages

		Banqiao	Shangzhu	Gangyan
Location	Prefecture	Yingtan	Yingtan	Shangrao
	County	Yujiang	Guixi	Yanshan
	Township	Honghu	Tangwan	Wang-er
	Distance to major road (km) [3]	5	10	3
	Road quality	Poor	Very bad	Good
Population	Inhabitants	1 007	2 064	3 120
	Households	257	529	721
	Hamlets	4	16	7
Land	Farmland/capita (mu[4])	1.23	1.14	1.63
	Paddyland/capita (mu)	0.99	0.92	1.24
	Dryland/capita (mu)	0.23	0.05	0.38
	Upland/total land (mu)	60-70%	97%	'plain'
Agricultural Production	Main crops	Rice, peanuts, fruit trees	Rice, bamboo, bamboo shoots	Rice, vegetables
	Irrigation condition	Irrigated	Rain-fed or irrigated with conserved water	Irrigated

Source: Kuiper et al. (2001).

Around 23 percent of the households in each village were interviewed, giving a total number of 340 interviewed households, 56 in *Banqiao*, 110 in *Shangzhu*, and 174 in *Gangyan*. Each household was interviewed twice, in August 2000 and the beginning of 2001. Data includes demographics of households, land use, soil degradation problems, agricultural production inputs and outputs (rice, seasonal crops, forest and livestock), non-agricultural production, off-farm employment, land tenure, and credit. For all commodities and production factors, the sources and destination

(inside household, inside village, inside county, inside province, or outside province) were recorded as well.

3.4 Participation in off-farm activities within the research areas

The two surveys categorized off-farm activities in which farm households participate in different ways. The survey for 1998 distinguished two types of off-farm activity: agricultural employment and non-agricultural activities. In the survey for 2000 distinguished four types of off-farm employment, local agricultural employment, local non-agricultural employment, self-employment and (temporary) migration inside China. Local agricultural employment includes crop harvesting, rice transplanting, digging bamboo shoots, fertilizing, and pest management. Local non-agricultural employment includes wood (bamboo) processing, house building, teaching, etc. Self-employment includes trades such as shop-keeping, handicrafts and selling, and transportation. Household members working off-farm and living apart from other household members are defined as migrants. Most migrants (89%) work outside their counties and even their provinces (81%), but are still considered as household members as they keep close contacts with the other household members living inside the village and because they usually send income home.

The next two sections, describe household participation in off-farm activities in Jiangxi Province looking firstly at the two selected prefectures (1998 data) and then at the three selected villages (2000 data). The main similarities and differences between these two surveys will be discussed in the following section.

3.4.1 Off-farm activities in Northeast and South Jiangxi Province in 1998 and 1992

Data from the 1999 in two selected prefectures in Jiangxi Province survey show that more than 70 percent of farm households participated in off-farm activities, and more than 28 percent had more than one member involved in off-farm activities. Less than 2 percent of these off-farm workers worked in agricultural employment.

More than half of the off-farm activities are located outside the village. Handicrafts and working for other farmers were the main off-farm ac-

tivities within the villages, but there were only a limited number of such cases. TVEs in Jiangxi Province are not as developed as they are in coastal provinces, so employment in these was limited within the surveyed villages. There were important differences between the counties or villages in Jiangxi Province in this respect. Most household members involved in off-farm activities spent more than half of their time on them.

Compared with 1992, 43.7 percent of the farm households indicated that they spent the same amount of time working off-farm as they did in 1992, and 48.5 percent said that they had increased the time working on off-farm activities (Table 3.2). Only 7.8 percent of the interviewed households has reduced the time they spent working off-farm. Forty-four percent of households indicated that their welfare had improved, while 30.6 percent indicated that it had declined since 1992.

Table 3.2
Working time change and welfare change comparison, 1998 with 1992

	Time Spent of Off-farm Employment (%)	Welfare (%)
Decrease	7.8	30.6
No Change	43.7	25.5
Increase	48.5	44.0

Source: Calculated from the 1998 survey dataset.

Table 3.3
Reasons given for household welfare change from 1992 to 1998

Reasons	Whole Sample (%)	Households with Positive Welfare Change (%)
Agricultural income	11	11
Non-agricultural activities	36	74
Other reasons	28	15
No change	25	-
All	100	100

Source: Calculated from the 1998 survey dataset.

Table 3.3 shows the reasons given for changes in household welfare between 1992 and 1998. Non-agricultural activities were mentioned by

36 percent of farm households as the cause of the welfare change. Only 11 percent attributed the change to agricultural income, whereas 28 percent of the households mentioned other reasons. If we look at responses from households that experienced positive changes in welfare between 1992 and 1998, the role of off-farm employment is even more prominent. Within this sub-sample, 74 percent indicated that non-agricultural activities are the main factor in improving their life, while only 26 percent attributed improvements to agricultural income or other reasons.

3.4.2 Participation in off-farm activities in three villages in Northeast Jiangxi Province in 2000

In the year 2000, 83 percent of surveyed households in the three villages in Northeast Jiangxi Province had at least one member participating in off-farm employment (see Table 3.4). In *Gangyan* village, the participation rate was as high as 93 percent. In *Banqiao* and *Shangzhu*, it was 72 percent and 73 percent, respectively. Thirty percent of the households in the three villages had one member involved in off-farm employment, and 53 percent had two or more such members.

The involvement in different types of off-farm activities in 2000 is summarized in Table 3.4. Off-farm agricultural employment is more important in *Shangzhu* (with 20 percent of the households involved), the remote village, than in the other two villages. 29 percent of the households in the three villages have members participating in local non-agricultural employment. Only 14 percent of households were involved in self-employment in the three villages.

Migration is the most important type of off-farm employment, with 64 percent of the households involved in it. Most of these households (35 percent) had one member involved in migration in 2000; 22 percent had two migrating members, and only 7 percent of the households had three or more such members. There are important differences between the three villages in terms of participation in migration. In *Gangyan* village, 76 percent of the households were involved in migration, whereas in *Banqiao* this was only 46 percent, and in *Shangzhu* 53 percent. Non-agricultural employment was the second most important type of off-farm employment, with 29 percent of the households participating in it. Again, participation was highest in *Gangyan* village (33 percent of households).

Table 3.4
Number and percentages of households with members involved in different types of off-farm activities in the three villages, 2000

Different Types of Off-farm Activities	Number of Members	Banqiao		Shangzhu		Gangyan		Total	
		Cases	%	Cases	%	Cases	%	Cases	%
Agricultural employment	0	50	93	87	80	147	88	284	86
	1	4	7	16	15	11	7	31	9
	>1	0	0	6	5	10	5	16	5
Local Non-agricultural employment	0	41	76	83	76	112	67	236	71
	1	9	17	22	20	39	23	70	21
	2	4	7	4	4	15	9	23	7
	>2	0	0	0	0	2	1	2	1
Self-employment	0	44	81	95	87	145	86	284	86
	1	7	13	6	6	19	12	32	10
	2	3	5	4	4	4	2	11	3
	> 2	0	0	4	4	0	0	4	1
Migration	0	29	54	51	47	41	24	121	36
	1	14	26	31	28	70	42	115	35
	2	9	17	19	18	44	26	72	22
	> 2	2	4	8	7	13	8	23	7
Off-farm[5] employment	0	15	28	29	27	12	7	56	17
	1	18	33	27	25	55	33	100	30
	>1	21	39	53	49	101	60	175	53

Source: Calculated from the 2000 survey data.

The average time households spent on off-farm activities and the average incomes obtained from off-farm activities are presented in Table 3.5. On average, households spent more time on migration than on the other types of off-farm activities. Very limited time is spent on off-farm agricultural employment.

Review studies for Latin America and Africa (Reardon 1997, Reardon et al. 2001) also found that agricultural wage employment is a relatively minor off-farm activity. However, they also found that migration is much less important than local non-agricultural employment, which is clearly not the case in our research area. A recent study for China based on an 'almost nationally representative sample of 60 villages in 6 provinces of rural China' found that migration had become the dominant

form of off-farm activity in 2000, with almost half of the individuals working off-farm being migrants (de Brauw et al. 2002). In our research area, migration was even more dominant in 2000 (see Tables 3.4). Moreover, more than 80 percent of the migrants lived and worked outside the province as compared to almost 40 percent of the migrants in the sample of de Brauw et al. (2002).

Table 3.5
Average hours spent and income obtained from off-farm activities per participating household

Activity	Ban-qiao	Shang-zhu	Gan-gyan	Average
Agricultural Employment (n= 42)				
Time spent (hours)	32.0	333	98.3	211
Income (Yuan)	66.7	992	337	645
Wage rate (Yuan) [6]	2.08	2.76	3.26	2.93
Local Non-agricultural Employment (n= 80)				
Time spent (hours)	1 243	1 472	1 384	1 389
Income (Yuan)	2 999	2 514	3111	2 916
Wage rate (Yuan)	2.41	2.36	2.48	2.44
Self-employment (n= 44)				
Time spent (hours)	3 356	2 366	2 196	2 446
Income (Yuan)	6 038	2 503	2 495	2 851
Return per hour (Yuan)	1.19	1.87	2.88	2.46
Migration (n= 215)				
Time spent (hours)	3 287	3 421	3 360	3 368
Remittances (Yuan)	1 859	1 472	2 918	2 340
Remittances per hour (Yuan)	0.39	0.41	0.89	0.68
All Off-farm Activities (n= 246)				
Time spent (hours)	2 489	2 664	2 732	2 678
Total income (Yuan)	4 014	2 977	4 469	3 995
Income per hour (Yuan)	0.71	1.06	1.48	1.26
Percentage of time in total (%)	38	41	40	40
Percentage of income in total (%)	37	49	46	46

Source: Calculated from the 2000 survey data.

There are two important differences between the three villages in the time spent on each activity. In *Shangzhu*, the remote and relatively poor village, the time spent on agricultural employment is 3 – 10 times greater in the other two villages. Households in *Banqiao* village spent about 50 per cent more time on self-employment than in the other two villages. This is probably due to the easy access to product markets in this village. There are only small differences between villages in the average time that households spent on other types of off-farm employment. Within the villages, however, there are large differences between households in the time spent on each type of off-farm activity.

The incomes per hour from all four types of off-farm employment are highest in *Gangyan* village, the village with the highest participation rate in off-farm employment. This is particularly true for migration and self-employment, which provide households living in *Gangyan* village much higher incomes than they do in the other two villages. Surprisingly, the average wage rate for agricultural employment in the three villages is higher than the hourly incomes from the other three types of off-farm employment. However, this type of employment is mainly restricted to peak seasons and is rather intensive. Moreover, in some cases it involves a simultaneous renting out of oxen and labour; hence is included the wage rate of agricultural employment. The average incomes from migration are lower than the incomes from the other three types of off-farm employment. These incomes only include to the remittances sent back to the household in the village, and therefore exclude earnings consumed or saved, by the migrant away from home.

Although hourly incomes from off-farm employment are highest in *Gangyan* village, the share of income obtained from off-farm activities is highest in *Shangzhu* village. This is because agricultural incomes in *Shangzhu*, the remote village, are significantly lower than in the other two villages[7]. As a result, off-farm income contributes an average 49 per cent of income to households involved in off-farm employment in *Shangzhu* village, compared to 46 per cent in *Gangyan* village and 37 per cent in *Banqiao* village. When including households with no off-farm work, the share of income generated by off-farm work ranges from 27 percent in *Banqiao* village to 41 percent in *Gangyan* village, with an average of 38 percent for all three villages. These off-farm shares are comparable to the shares found in synthesis studies by Reardon et al. (1998) and Reardon et al.

(2001) for East Asia (35%) or other parts of the world (South Asia: 29%, Africa: 42%, Latin American: 40%).

3.4.3 Insights into off-farm activities obtained from the two surveys

The information from the 1999 survey is relatively limited in comparison the 2001 survey, but some general conclusions can be drawn from the two surveys. In *Banqiao* and *Shangzhu*, the participation rate in off-farm activities in 2000 was similar to the average level found in the survey for 1998. In *Gangyan* village, however, the off-farm participation rate in 2000 (93%) was considerably higher than the average for 1998. Non-agricultural activities are the main types of off-farm activities in both surveys. Agricultural employment is less important in terms of both the percentage of participating households and (as found in the 2000 survey) of income obtained.

Both surveys found that many households had more than one member participating in off-farm activities. In the 2001 survey some households had more than two migrated members. If there were examples of households that were not interviewed because the entire family or all the adults in the family had migrated, migration as income generation activity would have been even more important. The figures for migration incomes in Table 3.4 are relatively low compared with the income from local non-farm employment and self-employment as they only include the remittances from migration income.

Off-farm income is a very important contributor to total income and welfare. In 1998, more than 70 percent of the households that experienced welfare increases since 1992 contributed these increases to non-agricultural activities. In 2000, around 46 percent of farm household income came from participation in off-farm activities. The returns from off-farm activities are higher than those from farm production in terms of hourly returns[8]. If total migration income would be taken into account, instead of remittances, off-farm employment would contribute even more to total income.

3.5 Econometric model specification and estimation

3.5.1 Model specification

The model used for the regression analyses explains participation decisions from the characteristics of an individual, the available resources of the household to which an individual belongs, and local factors. In order to examine whether individual characteristics, household resources and local factors have the same effect on participation in different types of off-farm activities, the model is estimated separately for each of the four types of off-farm activities distinguished in the survey.

A multinomial probit model is used to examine individual household members' participation in off-farm activities. In contrast to the multinomial logit model, that was applied in previous studies of off-farm employment choices in China (Xia & Simmons 2004, Zhao 1997), the multinomial probit model does need an assumption of independence of irrelevant alternatives (IIA). The multinomial probit model, however, is computationally burdensome. Recent developments in computer hardware and software have made it possible to apply this method to our data set.[9] The model is specified as:

$$\mathbf{Y}_i = \mathbf{c}_{0i} + \mathbf{c}_{1i}\mathbf{X}_1 + \mathbf{c}_{2i}\mathbf{X}_2 + \mathbf{c}_{3i}\mathbf{X}_3 + \varepsilon_i, \quad (1)$$

where

$\mathbf{Y}_i$ = polychotomous variable representing participation of an individual in off-farm activity type i;

$\mathbf{X}_1$= (column vector of) demographic and human capital characteristics of the individual;

$\mathbf{X}_2$ = (column vector of) household resources and characteristics;

$\mathbf{X}_3$ = (column vector of) local institutions and village characteristics;

$\mathbf{c}_{0i}$, $\mathbf{c}_{1i}$, $\mathbf{c}_{2i}$, $\mathbf{c}_{3i}$ = (row vectors of) coefficients to be estimated;

ε_i = error term with standard properties;

The dependent variable is a polychotomous variable that equals 0 if a labour force member does not participate in off-farm employment, 1 for agricultural employment, 2 for non-agricultural employment, 3 for self-employment, and 4 for migration. Only "push" factors are included in the model; no information is available on "pull factors" in the data set. Table 3.6 gives an overview of the definitions and sample statistics of the variables that are used in the regressions.

Table 3.6
Variable definitions and sample statistics

Set	Independent Variables	Variable Definitions	Mean	S. D.	Min.	Max.
X_1	Age	Age	37.2	13.4	17	66
	Education	Number of schooling years	5.02	2.99	0	16
	Gender	Gender of individual member (1= male)	0.52	0.50	0	1
X_2	Children	Number of children (aged 0-7) in household	0.26	0.50	0	3
	Elderly	Number of elderly (aged 65+) in household	0.21	0.46	0	2
	Labour	Number of labourers in household	3.45	1.29	1	11
	Irrigated	Contracted irrigated land area (in mu)	5.60	2.12	1	15
	Dryland	Contracted dry land area (in mu)	0.47	0.63	0	5
	Forest	Contracted forest land area (in mu)	1.45	2.78	0	15
	Durables	Current value of total durables (in Yuan)	1 451	2 060	-643	16 763
	Social	Social capital dummy variable (1= link outside province)	0.56	0.50	0	1
X_3	Renting	Land rent dummy variable (1= household rents out land)	0.09	0.29	0	1
	Banqiao	Village dummy variable (1= Banqiao)	0.15	0.36	0	1
	Gangyan	Village dummy variable (1= Gangyan)	0.55	0.50	0	1

Table 3.7 gives the expected sign of each explanatory variable for each equation. Four demographic and human capital variables are distinguished. The first variable listed in the table is the age of the individual. The squared term is added to the equation to account for nonlinearities in the impact of age. Younger individuals are more likely to be involved in migration, because they often do not have their own family to take care of. Older people are more likely to be involved in either on-farm work or local off-farm employment. Local off-farm work can more easily be combined with living in the village. Moreover, older people are likely to have more experience and more contacts that are useful in finding local off-farm jobs. Life-cycle effects may play a role in the choice of older people in returning to the farm. Younger people may use part of their off-farm earnings to invest in the farm or in their house, and return to their farm after a number of years and get married (Zhao 2002). Panel data are required to estimate such life-cycle effects. If different generations have similar life cycles, cross-section analyses can also be used for estimating the role of life cycle effects in off-farm/on-farm time allocation decisions (see Kimhi 2004 for an example). In the rapidly changing Chinese society, however, off-farm employment is increasingly dominated by young workers (de Brauw et al. 2002). Estimates based on the cross-section data set can therefore provide only rough indications of such life cycle effects.

Education can play a role in obtaining job information. Moreover, people with higher education are usually more productive, and have better opportunities to find off-farm employment. In agricultural employment, however, education generally plays only a minor role. Given the age and education level of an individual, males are more likely to be involved in off-farm employment than females due to the predominance of typical male jobs (in construction, mining, and so on) among off-farm jobs and the traditional role of women in a family. Gender (measured by a dummy variable that equals 1 for males) is therefore expected to have a positive impact.

Participation in off-farm employment depends not only on the characteristics of the individual in question, but also on those of the household to which an individual belongs. The number of dependents (children and elderly) in a household can have mixed effects on off-farm participation. On the one hand, more dependents in a household lead to a need for higher incomes to satisfy their food and other needs. On the

other hand, more dependents means that more time is needed to take care of them and therefore less time is available for other household members to off-farm work. Elderly people, however, may also take care of young children in a family, making it possible for the parents to work more, either on-farm or off-farm. Individuals aged between 16 to 65 years, who are healthy and working or searching for employment are defined as labour force members. A higher number of labour force members in a household is likely to increase the likelihood of each of them working off-farm, given the limited opportunities for expanding farm production.

Table 3.7
Expected signs for explanatory variables in the models

Independent Variables		Expected Signs			
		Agricultural Employment	Non-farm Employment	Self-employment	Migration
X_1	Age	+	+	+	-
	Age2	-	-	-	-/+
	Education	-/+	+	+	+
	Gender	+	+	+	+
X_2	Children	-/+	-/+	-/+	-/+
	Elderly	-/+	-/+	-/+	-/+
	Labour	+	+	+	+
	Irrigated	-	-	-	-
	Dryland	-	-	-/+	-/+
	Forest	-	-	-/+	-/+
	Durables	-	-/+	-/+	-/+
	Social	-/+	/+	-/+	+
X_3	Renting	+	+	+	+
	Banqiao	-/+	+	+	+
	Gangyan	-/+	+	+	+

When a household has a large area of irrigated land contracted from the village group or village committee this can be expected to reduce the need to work off-farm. The same holds for forest land and dry land. Dry land and forestland are mainly used for growing cash crops and bamboo. These sources of cash income can be important for financing migration, which may be very costly especially in the initial stage, or for starting a

private business. The net impact of the contracted area of dry land and forestland on migration and self-employment can therefore be either negative (reduced land scarcity) or positive (increased cash availability).

According to the theoretical framework presented in section 3.2, poor farm households feel more pressure to find alternative sources of income than richer ones. On the other hand, rich households have more resources to finance their migration. Asset-rich households have more opportunities for starting their own business and also perhaps for gaining access to local non-farm employment. Therefore, we expect the current value of total durables of a household to have a negative impact on off-farm agricultural employment (poverty effect), whereas the impact on migration, self-employment and local non-agricultural employment is indeterminate.

Personal relationships (*Guanxi*) and other types of social capital may play an important role in obtaining off-farm employment in China. It is not easy to measure and the data set only contains limited information that can be used for to estimate this. To measure social capital for individuals, a dummy variable is defined that equals 1 if other household members are working outside the province or when relatives who live outside the province send money to the household. It is different from the definition used by Zhao (2003), who measured social capital as the number of earlier migrants from a village. The observations here are limited to just three villages, making it difficult to apply a similar definition. Instead, the definition here focuses on kinship relations at the household level, which are very relevant in rural China. Relatives and friends play important roles in assisting other individuals to find a job, including transfers of job information, provision of temporary accommodation and food, and so on (Zhao 2000, Meng 2000, Murphy 2000, Cook 1998). Unfortunately the dataset does not contain information on connections to local policymakers, which may play a role in gaining access to local wage employment (Yao 1999, Cook 1999).

Local institutions such as land markets may affect the incentives for off-farm employment. Renting out land, defined as a dummy variable in the model, is expected to facilitate off-farm employment, especially migration. It is important for households considering migrating to ensure that all their contracted land remains in cultivation otherwise they may lose use rights to it. Moreover, renting out land reduces the land available for on-farm production, and increases the cash available for initial migra-

tion or self-employment (but only if households are paid the rent in cash, which is not always the case).

Finally, two dummy variables for *Banqiao* and *Gangyan* village are added to the model to control for unobserved factors that may systematically differ between the three villages. Better access to information and lower transportation costs for households in these two villages (as compared to households living in *Shangzhu* village) are assumed to provide better opportunities for migration and local non-agricultural employment. Agricultural wage employment usually occurs within one's own village, so these systematic differences are likely to be irrelevant factors for participation in agricultural work.

3.5.2 Estimation results

The estimation results of the multinomial probit analysis are presented in Table 3.8. To examine the effect of distinguishing between different types of off-farm employment, regression results for off-farm employment as a whole are presented in the last column for comparison. The estimated equations perform satisfactorily in terms of goodness of fit. The results for each of the four types of off-farm employment are discussed first and these are then compared to the results for off-farm employment as a whole.

The results for demographic and human capital characteristics show that age has a significant impact on involvement in all four off-farm employment types. For agricultural employment and local non-farm employment, age has a positive sign while the lifecycle effects (age square) are all negative. These results are consistent with those of Zhang et al. (2002) and Kung & Lee (2001). They imply that, up to a certain age, older individuals are more likely to work in these two types of off-farm employment than younger people. The age at which off-farm employment participation is at its maximum (the 'turning point') is 37.5 years for agricultural employment and 33.5 years for local non-agricultural employment. Age is found to have a negative impact on migration and self-employment: young people are more likely to migrate and to be self-employed than older people.

Education is found to have a significant positive effect on migration, as is commonly found in migration studies. But education does not affect self-employment and local wage employment in the sample. For self-employment, this finding is consistent with the results obtained by

de Brauw et al. (2002) in their study of 6 rural provinces, although they did find that education had a positive impact on local wage employment. In a study of Sichuan Province, Zhao (1997) found a stronger impact of education on local non-agricultural employment than on migration. Local employment is relatively more important in Sichuan Province than in Jiangxi Province; 53 per cent of people involved in off-farm employment in Zhao's sample were employed within their own county. The results of this analysis suggest that the role of education in gaining access to local off-farm employment is much less important in areas like our research area, where employment opportunities in local TVEs and PEs are limited and where migration dominates off-farm employment.

The gender dummy variable has a significant and positive impact on all four types of off-farm employment, showing that males have a higher likelihood of participating in off-farm employment than females. This is consistent with many studies indicating that women in rural China take more responsibility in taking care of children and household affairs (Zhang et al. 2002, Zhao 2002, de Brauw et al. 2002, Kung & Lee 2001, Zhao 1997). The estimated coefficients for agricultural and local non-agricultural employment in the regression analyses are 1.5 – 2 times larger than that for migration. Hence, the bias against women is larger in local employment than in migration.

Household characteristics also have some significant effects on the off-farm participation decisions of individuals. The number of young children has a statistically significant negative impact on migration. The presence of young children in a household is difficult to combine with work outside the region, so limits migration, but not other types of off-farm employment. Another interesting finding is that the presence of older persons in a household stimulates migration but not the other types of off-farm employment. In many Chinese families, grandparents now play an important role in raising children because both parents have full-time jobs. The results indicate that the presence of grandparents makes it easier to find off-farm employment through migration. Earlier studies of the impacts of dependants on migration and local off-farm employment in China found that the dependency ratio had no significant impact on migration in Sichuan Province (Zhao 1997), while it had a small positive impact on migration and a larger positive impact on off-farm self-employment in Liaoning Province (Xia & Simmons 2004).

These studies did not distinguish between young dependents and elderly people.

The number of labourers in a household has a significant positive impact on migration and a significant negative impact on agricultural off-farm employment. Rural households need a certain minimum labour input in on-farm agricultural activities in order to cultivate the (little) land they have and to harvest the crops. Local wage employment and self-employment can relatively easy be combined with such agricultural activities, but not migration (see also the time spent on these activities; Table 3.5). A larger household labour force size frees more members from such agricultural activities and allows them to search for off-farm employment in other provinces. The negative impact of labour force size on off-farm agricultural employment suggests that some of these migrating household members were previously involved in off-farm agricultural activities. Previous research for six provinces in China found that the size of the household labour force affects not only migration, but also self-employment and local off-farm employment (de Brauw et al. 2002). Due to the limited local off-farm opportunities in the research area, surplus labourers appear to choose to migrate and not other types of off-farm employment.

Different types of contracted land per labour force had may play different roles for a household. They are not only production factors, but may also serve as sources of cash income. Irrigated land mainly produces rice, while dry land and forestland produce cash crops and wood products. The regression results indicate that households with a relatively large area of irrigated land are less likely to be involved in migration and local off-farm employment, but not in the other two types of off-farm employment. Land scarcity therefore seems to play an important role in non-agricultural wage employment decisions. The amount of dry land and forestland do not have a statistically significant impact on the four types of off-farm employment, except for the negative impact of forestland on non-agricultural employment. This finding suggests that increased land availability dampens the push effects through increased cash availability and even, in the case of forestland and non-agricultural employment, exceeds the push effect.

Table 3.8

Regression results of individual participation in four different types of off-farm activities (multinomial probit regression)

Dependent Variable: Off-farm Activities Participation of Individuals										
	Agricultural Employment		Non-agricultural Employment		Self-employment		Migration		Off-farm participation	
	Coef.	Z	Coef.	Z	Coef.	Z	Coef.	Z	Coef.	Z
No. of Observations					1003					
Demographic and human capital characteristics										
Age	0.23***	3.01	0.13**	2.32	0.08	1.41	-0.06*	-1.77	-0.01	-0.64
Age^2	-0.0031***	-3.33	-0.002***	-2.70	-0.0013*	-1.71	-0.0001	-0.27	-0.0004	-1.24
Education	-0.06	-1.46	0.06	1.53	0.06	1.30	0.11***	4.13	0.07***	3.62
Gender	1.75***	5.67	1.28***	5.54	1.00***	4.07	0.86***	6.12	0.78***	8.26
Household resources										
Children	0.02	0.09	-0.22	-1.04	-0.25	-1.10	-0.33**	-2.45	-0.21**	-2.41
Elderly	0.31	1.35	0.06	0.24	0.06	0.21	0.32**	2.12	0.21**	2.05
Labour	-0.23*	-1.90	-0.02	-0.23	0.07	0.66	0.13**	2.10	0.05	1.30
Irrigated	0.03	0.53	-0.10*	-1.66	-0.08	-1.30	-0.07**	-2.04	-0.04*	-1.80
Dryland	0.26	1.40	-0.15	-0.69	0.07	0.67	0.07	0.64	0.06	0.71
Forest	-0.17	-0.36	-0.18**	-2.28	-0.16	0.76	0.06	0.22	-0.01	-0.60
ln(Durables)	-0.11*	-1.83	0.15	0.27	0.01	0.09	-0.02	-0.38	-0.02	-0.91
Social	0.70	0.24	-0.12	-0.48	-0.05	-0.18	-0.17	-1.05	-0.01	-0.95

Continued

Local institutions and village characteristics										
Renting	0.38	0.24	-0.33	-0.61	-0.16	0.86	0.97***	4.10	0.52***	3.24
Banqiao	-0.71	-1.61	-0.59	-1.56	0.11	0.30	-0.25	-1.00	-0.21	-1.31
Gangyan	-0.17	-0.60	0.13	0.49	0.15	0.52	0.54***	3.12	0.28**	2.40
Constant	-5.49***	-3.37	-3.68***	-3.13	-3.63***	-2.79	0.53	-0.93	0.23	0.48
Wald Chi^2			372.8						Pseudo R^2	23.3
Log-likelihood			-814.5						-528.1	

Notes: * Denotes statistically significant at 10% level;
** Denotes statistically significant at 5% level;
*** Denotes statistically significant at 1% level.

Household wealth is found to have a significant negative impact on agricultural employment. This result confirms the finding of Rozelle et al. (1999) that poor households are eager to find alternative sources of income. But in this research area, poor households can apparently only gain access to agricultural employment, not to the other three types of off-farm employment.

The network variable is not significant for all three types of off-farm employment. As discussed above, it is defined as a dummy variable that equals 1 if other household members are working outside the province or when other relatives who live outside the province send money to the household. On the one hand, the presence of kinship relationships at the household level is expected to stimulate migration. On the other hand, when one or more household members are already involved in migration (or when relatives send money to the household), the need for other household members to search off-farm employment is less. These results are consistent with those of Kung and Lee (2001) who find that social networks do not facilitate obtaining non-farm employment, because non-farm employment is primarily allocated by means of market mechanisms.

Renting out land has a significant, positive impact on migration. Households involved in renting agricultural land to other households seem to opt for the type of off-farm employment that cannot be combined with working on the farm, an option which also reduces household food consumption. The impact on the other three types of off-farm employment does not differ significantly from zero.

As discussed in section 3.4, households in *Shangzhu* village (the remote village) rely more on agricultural off-farm employment than households in the other two villages, whereas households in *Gangyan* (the plain-area village) are more involved in migration than households in the other villages. The estimated coefficients for the village-level dummy variables in the agricultural employment equation are insignificant for both *Banqiao* village and *Gangyan* village. This suggests that the difference in agricultural employment between *Shangzhu* and the other two villages is largely explained by differences between these villages in the factors specified in the model; differences in village-specific factors (market access, economic development, geography) do not have a significant effect. In the migration equation, however, the estimated coefficient for the *Gangyan* village dummy variable is positive and significantly different

from zero. This implies that village-level factors may contribute positively to the relatively high migration rate in the village, in addition to the other factors specified in the model.

Regression results for off-farm employment as a whole are shown in the last two column of Table 3.8. They confirm that education level, male gender, presence of older people in a household, land renting out, and village-level factors for *Gangyan* have a significant positive impact on off-farm employment, while the presence of young children and the area of contracted irrigated land have significant negative effects. However, such an aggregate analysis misses some crucial insights that can be gained by distinguishing between different types of off-farm employment. In particular:

- no age effect is found, whereas the separate analyses reveal that younger people are more involved in migration while older individuals are more likely to work in agricultural employment and local non-farm activities;
- the presence in a household of young children (reducing participation) and older people and renting out land (increasing participation) only affect migration, not the other three types of off-farm employment;
- education only affects participation in migration, but not in other types of off-farm employment;
- no impact is found for asset availability, whereas the separate analyses show that household assets reduce the need for participation in agricultural employment;

The results therefore confirm that empirical analyses of factors that drive participation in off-farm employment should distinguish between sub-categories of off-farm employment. This finding differs substantially from the research results obtained by de Brauw et al. (2002), which found consistent effects for migration, local wage employment, and (to a lesser extent) self-employment.

3.6 Summary and Conclusions

This chapter has analysed differences between four sub-categories of off-farm employment: agricultural employment, local non-agricultural employment, self-employment, and migration, for three villages in Jiangxi

Province. Migration is the most important type of off-farm employment in these villages in terms of participation rates and time spent on it, but the contribution of migrant remittances to household incomes is smaller than the incomes earned from self-employment and local non-farm employment (Tables 3.4 and 3.5). A comparison of survey results for 1998 and 2000 in Jiangxi Province revealed that a large majority of farm households participate in off-farm employment. Agricultural employment is a minor activity, both in terms of time spent on it and its contribution to household incomes. The two surveys indicate that off-farm income provides a very important contribution to total income and welfare.

The empirical analysis of the factors driving participation in each of the four types of off-farm employment (Table 3.8) using data collected in the year 2000 (held in three villages) reveals that the presence of young children in a household restrains participation in migration, but not in other types of off-farm employment, where working and child care can more easily be combined. The presence of elderly people in a household stimulates migration, as they frequently take care of small children in Chinese society. Education has a positive impact on migration, but not on other types of off-farm employment. Hence, education plays a negligible role in gaining access to local off-farm employment. It is also evident that the difference between males and females in access to off-farm employment is much larger for local non-agricultural employment than it is for migration and self-employment.

Households with few assets are more involved in agricultural employment, probably because they are more eager to find additional income sources but lack access to the other types of off-farm employment. Farmers who rent their land out to other farmers tend to opt for migration. Farmers who cannot rent their land to others opt for local wage employment and self-employment, which can be combined with working on the farm, in order not to run the risk of losing their land rights.

Given the prevalence of surplus labour in rural areas and the scarcity of land, improving off-farm employment opportunities is an important way of increasing rural household incomes, particularly in poor areas in the West and other parts of China. The Chinese government recognizes that the population increases in Shanghai, Beijing, Guangzhou and other mega-cities in China is approaching its limits, and realizes that future off-farm income-earning opportunities for rural households should when-

ever possible be created in these regions and provinces. Thus, local wage employment and self-employment should be stimulated more in the near future. Such a policy should not only focus on creating new employment opportunities in regions where out-migration predominates, but should also take individual preferences for the different types of off-farm employment into account.

The results of the regression analyses indicate that demographic factors play an important role in this respect. The trend towards smaller rural families with fewer young children, resulting from China's population policy, and the gradual ageing of China's population both stimulate migration outside one's own county or province. It is also noticeable that the gender bias in local wage employment is much larger than in migration, and that education stimulates migration but not participation in the other three types of off-farm employment. Policies to promote rural off-farm employment in relatively poor regions like the research area should therefore preferably focus on creating more employment opportunities for women and educated people in order to reduce the incentives for migration to other provinces.

Land policy may play a role in this respect too. Households with fewer land resources participate more in migration. The question may therefore be raised whether the distribution of land use rights should continue to be based on household (and/or labour force) sizes. A land distribution policy that takes into account a household's comparative advantage in agricultural production or off-farm income earning opportunities may be more efficient and also contribute to equity. The further development of land rental markets, which are still absent or incomplete in many regions, may play a similar role. The reduced availability of land and potential gains from renting out land will stimulate households with a comparative advantage in off-farm employment to exploit these advantages and reduce their agricultural activities. In areas with sufficient local off-farm employment opportunities for women and educated people, such households are more likely to prefer local employment opportunities over migration outside the province. Comparing the results for different sub-categories of off-farm employment with those for off-farm employment as a whole, shows significantly different results, and indicates that it is necessary and important to distinguish between different sub-categories of off-farm employment.

Notes

1. A paper based on this chapter, co-authored with Nico Heerink and Futian Qu, will be published in *China Economic Review* (forthcoming, 2007).

2. The data used in this study come from annual village surveys held in 44 villages of Shanxi, Jiangsu, Anhui and Henan Provinces during the period 1986 to 1997 covering roughly 3,100 households.

3. Distance refers to the hamlet where the Party Office is located; for other hamlets the distance is usually larger, particularly in *Shangzhu*.

4. One mu equals 1/15 ha.

5. Off-farm employment in the last row is the aggregation of four types of off-farm activities. This is the same in Table 3.5.

6. Hourly wages and incomes per hour are calculated from household data. The results will differ from those obtained by dividing wages (incomes) by time spent on an activity at the village level when the wage rate (income per hour) and the time spent on an activity are correlated (see e.g. Heerink 1994: section 2.2.6).

7. Incomes per capita are 1,720 yuan in *Banqiao*, 1,042 yuan in *Shangzhu*, and 1,854 yuan in *Gangyan* respectively for the households in the sample.

8. The hourly return of family labour involved in farm production is estimated to be around 0.68 Yuan in *Gangyan* village (Kuiper 2005) and around 0.5 Yuan in *Shangzhu* village (Shi 2003).

9. We used STATA version 9 for estimating the multinomial probit model.

4 Village economies: rural markets development in the three villages of Jiangxi Province, China[1]

4.1 Introduction

Since the economic 'open-door' policy and economic reforms, rural factor, input and output markets have emerged in rural China, but with many imperfections (see Benjamin & Brandt 2002, Bowlus & Sicular 2003, Carter & Yao 2002, Kuiper 2005). The gradual emergence of such markets is one of the important characteristics of transition economies. However, their development can be hindered because of poor rural infrastructure, lack of supporting institutions, remaining institutional constraints and inappropriate government interventions. Most studies (Huang & Rozelle 2006, Fleisher & Yang 2004, Lohmar et al. 2001) focus on the impact of macro policies and institutional reform on market development. However, there is a lack of empirical studies, despite the fact that well functioning markets will greatly improve factor allocation and production efficiency.

The overall aim of this chapter is to move towards an assessment of the development of village markets in our research area, capture the characteristics of increasing interactions within such markets and evaluate the household linkages to see if their strength justifies building village models to analyse such markets. Specifically, there are two objectives. First, a comprehensive examination of these different village markets will be provided. Both the demand and the supply side of these markets will be examined and the question of whether they are integrated with the outside world or whether they are internal village markets with few or no links to the outside world will be examined in detail. Second, the chapter will try to evaluate the household linkages to see if their incorporation

into the model analysis is justified. Based on this information, conclusions will be drawn on how village markets are developing and if the village economy approach is a suitable method for analysing the effects of increasing off-farm activities in rural Jiangxi, Southeast China, where the data was collected.[2]

When some products or factors are village non-tradable (and household tradable)[3], exogenous shocks will generate equilibrium effects on village activities. It will change the effects of exogenous shocks or policies on households in that village (Taylor & Adelman 1996, Chapter 2). If some major product or factor markets are internal village markets, and these factors or products are village non-tradable but household tradable, it is important that empirical studies of the effects of such exogenous shocks or policies take this into account. However, the importance of internal village markets in rural China is not clear. To the author's knowledge there has been no research to date that examines the presence or importance of village household linkages.

To achieve the above mentioned objectives, the chapter is organized as follows: the next section will briefly discuss the institutional background of village market development and provide theoretical considerations which show the possible interactions among village markets or households. The development of village markets in the research area is discussed in the third section of this chapter by exploring the household survey data collected for three villages for the year 2000. Finally, conclusions on the development of village markets and of the need to apply a village economy approach are presented in the last section.

4.2 Institutional background and theoretical considerations

Evolution of rural markets takes place within a certain institutional environment, for instance in China, almost all agricultural land is collectively-owned by the village and households have only use rights by contracting land from the village collective. Rural labour movement to the cities is highly restricted by the household registration systems in China (although in recent years, it has started to loosen). The gradual diminishing of institutional constraints on land and labour markets will no doubt improve their development (de Brauw et al. 2002, Kung 2002, Chapter 2). Lohmar et al. (2001) address the relationship between land tenure reform and land rental market development, indicating that grain quota obliga-

tions and village land reallocation activity discourage the latter. Removing these constraints will further encourage the development of land rental markets. Increased access by rural labour to local off-farm employments and migration will attract more 'surplus' labour out of agriculture. Introduction of more private traders and competition in markets for agricultural products will generate the development of agricultural commodity markets (Huang & Rozelle 2006).

Interlinking of rural markets (a common phenomenon in developing countries) means that development of one type of market is strongly related to the development of other types of markets. For instance, reform of the land tenure system and development of land markets will also bring about the development of a credit market because land can be used as collateral. The credit market can also be related to product markets through 'trade-credit linkages' (Hoff et al. 1993). There is little research into the interactions of factor markets in China and the consequences of the development of each type of market, with the exception of some research on interactions between off-farm labour and land rental markets in rural China (Kung 2002, Murphy 1999). Given the egalitarian distribution of land, off-farm employment is the most likely factor to create differences in land productivity among households. It can provide a very important motivation for households to undertake land transactions. Interactions can also be related to off-farm activities in connection to the development of credit markets, because 'cash' flow from off-farm employment can be a source of credit or collateral for credit.

4.2.1 Land tenure reform and land rental market

The introduction of the Household Responsibility System (*HRS*) in the late 1970s brought about fundamental changes in agricultural production, giving more incentives to individual households and introducing more decentralized decision-making. Farm households replaced the village collectives as the basic production unit. Agricultural land was distributed in complicated ways. In general, it was distributed according to household size or household labour force or a mix of the two. In some areas, land quality, distance of plots from place of residence, male or female labour and number of young dependents were also considered in the distribution of agricultural land. The HRS individualized residual income and some management rights to agricultural land (Liu et al. 1998). It was the first step towards a more prosperous agriculture in China. From 1978 to

1984, grain output increased at an annual average rate of 5 percent, and the gross value of agriculture by 7.7 percent (Lin 1992).

In addition, households were responsible for their individual profits and losses, and were able to purchase everything except land and to dispose of all production, subject to meeting contract quotas. Households signed contracts for up to 15 years with village collectives or other entities which remained the owners of the agricultural land. Once households met their quota obligations, for instance for grain or cotton, they were generally free to determine what crops to grow and to whom to sell their produce. This allocation of land use rights to individual households has stimulated the development of decentralized markets for agricultural products and services (Krusekopf 2002). However, different forms of contracts to households or groups of households were implemented for different types of agricultural land (Shi et al. 2004b). In this study, the land that has been contracted (allocated) to households without payment to the village collectives is called "contracted land".[4]

However, the distributional rigidities and insecurities of HRS have a negative effect on the investment decisions of households. They also have meant that farms remained fragmented and small (Tan et al. 2006). This tenure structure increases tenure insecurity for farm households in rural China because the collective owners[5] maintain the right to reallocate use rights among farm households, and some villages and collective groups actively exert this right. Beginning in 1987, several schemes have been tested to resolve the problems arising from egalitarianism in land allocation and scale diseconomies.[6] However, they have not been put in place at a national level. Nevertheless, since 1993 central government has extended the duration of land contracts to 30 years (Liu et al. 1998, Kung 1994). Although in August 2002, a new rural land contract law was issued, it was still not clear this will increase tenure security or not. With land use rights held by households under the HRS system and village collectives retaining ownership rights, the land tenure system has been referred to as a two-tier system (Dong 1996).

The right to rent one's use rights to another farm household (transfer rights) has become increasingly common and legally sanctioned, and a limited land rental market has emerged in rural China. In an environment without private ownership rights, renting land is the only way for households to transfer land among themselves (Lohmar et al. 2001). Liu et al. (1998) found that the majority of villages permit farmers to lease, or give

out, land freely[7]. Buying and selling land have not been allowed as there is a concern among policy makers that land transfers will lead to a concentration of land in the hands of a few households, leaving many households landless. Given the importance of agricultural land for households in less-developed areas and the collective ownership of land at the village level, land rental activities are assumed to take place within villages, even within villager groups. Hence, land rental markets are internal village markets, as confirmed in the study by Lohmar et al. (2001)[8].

4.2.2 Rural labour markets

The background for the development of off-farm employment was given in Chapter 2, in which it was shown that off-farm employment of rural households has greatly expanded in recent years. The increase of non-farm activities creates more opportunities for rural 'surplus' labour to work off the farm. As discussed in chapters 2 and 3, a number of factors (at individual and household levels) contribute to differences in participation in non-farm employment. Equally, regional and village level factors may be also important in determining participation in non-farm activities. The development of township and village enterprises (TVEs) and private enterprises (PEs) play a very important role in providing households with such possibilities to work in local non-farm jobs. However, in rural China the development of TVEs and PEs has been mostly confined to coastal areas. Hence, households in less developed areas usually have fewer possibilities to work in local TVEs or PEs.

For households from less developed areas migration is therefore the predominant option in terms of non-farm activities. Migrants live away from their family, and work outside their village, county, and often even their own province. Hence, rural labour markets for non-farm activities have strong external links. Only a limited number of non-farm activities can be characterised as village internal markets, and here local political power (and social networks) often play quite an important role in the recruitment of workers (Yao 1999).

The development of the agricultural labour market has not been widely examined in the literature. However, given the massive out-migration and the seasonality of agricultural production, exchanging and hiring in agricultural labour can play very important roles. Because hiring labour for agricultural production involves high costs for monitoring and providing incentives, households may tend to hire labourers from the

same village or hamlet, as they know each other very well. Hence, the agricultural labour market may be another important internal village market.

4.2.3 Development of other markets

There is convincing empirical evidence that agricultural commodity markets in different regions in China have become increasingly integrated, and that their transaction costs continue to fall (Huang & Rozelle 2006, Huang et al. 2004, Park et al. 2002). Huang et al. (2004) further found a high degree of integration between regional and inland markets, as village grain prices were not affected by the local village grain output in their sample 'nearly national representative sample' of 60 villages in 6 provinces. For input markets, Qiao et al. (2003) find that the fertilizer market has become more integrated in recent years, although there are still many markets that are not integrated. They also found transportation costs to have a small, but significant, impact on fertilizer prices. To the author's knowledge no research has examined the development of other input markets.

Increases in income levels and the 'cash' flow of households from off-farm employment provide possibilities for households that are less or not at all involved in off-farm employment to obtain credit. Given high transaction costs[9] involved in borrowing, the credit market may also be expected to be internal to a village. However, the credit market could also be interlinked with other (external) markets, for example with those for products or inputs, in which case it would also be externally connected.

Oxen and machine rental markets for agricultural production may also develop when off-farm employment increases, especially given the increasing scarcity of agricultural labour that off-farm employment may give rise to in rural areas. There is a very high moral hazard in oxen rental activities, because households who rent out oxen may be afraid that the households that rent them will abuse their oxen. Therefore, oxen rental markets will develop based on trust and kinship relationships, and are therefore also likely to be village-based.

4.3 Village markets and household linkages

Emergence of village factor, input and output markets is a positive step towards improving factor allocation efficiency, and will benefit households by providing more competitive prices for agricultural outputs and inputs. Below the potential for developing village markets will be examined on an individual basis.

4.3.1 Land rental market development

Land provides the basic source of income for rural households in rural Jiangxi. Land use rights were distributed according to family size at the beginning of the land distribution process in 1982. In the three research villages land is classified as either irrigated, dry land or forestland. Most land was distributed to households, but some forestland was kept as village property (Shi et al. 2004b). In 2000, after almost 20 years of reforms, household demographics had changed, while off-farm activities and labour migration had influenced the endowments of rural households. In response to the demographically induced changing land requirements of households, land adjustments have been frequently implemented. Land renting among households also occurs frequently, especially in recent years.

Land rental activities exist in each of the three studied villages, with the transactions taking place between the households in the same village - even within the same hamlet. Lohmar et al. (2001) also find that most transactions only take place between households in the same village or hamlet.

Table 4.1 shows leases of irrigated, dry and forestland between farmers. The table shows the situation for all the interviewed households in the three villages. In total, 338 households are included in the analysis. The average contracted irrigated land per household is much larger than the contracted dry land and forest land areas. The average cultivated land per household is larger than the average contracted land per household (for all three land types). This means that households leasing land must obtain it from households who are not involved in the survey. Lohmar et al. (2001) found in their research area that it is possible for households to rent in land from the village collective. However, no evidence was found of this in the survey. The discrepancy between average cultivated land and average contracted land can only be explained by absent households

involved in migration, who could not be interviewed, renting their land out, and/or by possible inconsistencies in data collection.

Table 4.1

Land rental market in the three villages (all households) *unit: mu*[10]

	Irrigated Land		Dry Land		Forest land
	In	Out	In	Out	In
Average contracted land per household	5.62		0.47		1.47
Average cultivated land per household	7.69		0.69		1.64
Average rented land area	2.1	0.3	0.1	0.02	0.2
Rented land as a share of contracted land (%)	-	4.4	-	4.6	-
Rented land as a share of cultivated land (%)	28.0	-	11.5	-	9.0
Maximum size of rented land	38.0	8.0	6.0	2.7	31.0
Total for all households	719.0	85.0	27.0	7.3	51.0

Notes: 'In' denotes 'rented in' and 'Out' denotes 'rented out'.
Total number of cases is 338; two cases are missing for forest land.
The surveyed households did not report any renting out of forest land.

Table 4.2 shows data about the households that participated in land rental markets. Households mainly rented in irrigated land, with 45.8 percent of the households renting in some irrigated land in the survey year. This figure is much larger than that reported in Kung's study (2002), in which 24.5 percent of the households rented land from other households in 1998.[11] Only a few farmers participated in other types of land rental activities in the three villages: 6.5 percent of all farmers rented in dry land, while only 0.5 percent hired in forestland. The irrigated land rental market thus is much more important than the markets for the other land types. On average rented-in irrigated land accounts for 28.0 percent of total irrigated cultivated land (Table 4.1) for all households, and 44 percent of the cultivated land of households participating in land rental markets (Table 4.2). The average size of rented-out irrigated land as a share of total irrigated contracted land is only 4.4 percent (Table 4.1) for the whole sample but 43 percent for the households that rent out irrigated land.

The number of households renting in land in the sample is larger than that of households renting out land. For irrigated land, the difference is very large: 45.8 percent of the households rented in irrigated land, while only 9.2 percent of the households rented out land. Lohmar et al. (2001) also had comparable findings. One possible explanation is that households rented their land out to several other households. However, the renting in and out of land does not balance at the village level: 719 mu is rented in while 85 mu is rented out by the households in the sample. There are two alternative explanations. One is that farmers who rented out land were away from the village for off-farm work, and thus could not be interviewed. Another possible explanation is that farmers did not want other people to know that they rented out land, because the village committee could then take the land away and redistribute it to other farmers.

Table 4.2

Land rental markets in the three villages (participating households) *unit: mu*

	Irrigated Land		Dry Land		Forest Land
	In	Out	In	Out	In
Households participating in land market (%)	45.8	9.2	6.5	2.0	0.5
Average contracted land per household	5.5	6.4	0.9	1.4	0.1
Average cultivated land per household	10.42	4.2	2.1	0.7	25.6
Mean of leased area	4.6	2.8	1.2	1.0	25.0
Rented land as a share of contracted land (%)	-	43	-	72	-
Rented land as a share of cultivated land (%)	44	-	60	-	97

Note: Sampled households did not report forest land renting out.

Tables 4A.2, 4A.3 and 4A.4 (see appendix to this chapter) have the same structures as Table 4.1, displaying the same type of information, by village. The numbers of valid cases in the three villages are 56, 110 and 173, for *Banqiao*, *Shangzhu* and *Gangyan*, respectively. It can be seen from these tables that the average area of contracted irrigated land in *Gangyan* is larger than in the other two villages. *Banqiao* has more dry land than

the other two villages, while *Shangzhu* has more forestland than the other two villages. Comparing land rental market participation between the three villages, shows that the average rented in area of irrigated land in *Shangzhu* is lower than in the other two villages. However, the shares of leased land as a percentage of cultivated land for households participating in the land market are very similar between the three villages. *Banqiao* has the highest percentage of households renting in land: 55 percent, compared to 45 percent in *Shangzhu* and 43 percent in *Gangyan*. Rental activities for dry land are more important in *Banqiao* than in the other two villages. Forestland leasing is negligible in all three villages (Tables 4A.2, 4A.3 and 4A.4).

Combining the data in Tables 4A.2, 4A.3 and 4A.4 with the numbers of absent households in appendix Table 4A.1, it is possible to check the extent to which the difference between irrigated land rented in and rented out at the village level can be explained by absent farm households who rent out their land. Assuming that absent households rent out all their contracted land, the gap caused by absent households can be estimated as:

$$Diff(HI - HO)_{sample} = \overline{A}_{contracted} * \frac{Ahh}{Phh} * S_{size}$$

where $Diff\ (HI - HO)_{sample}$ is the difference between irrigated land rented in and rented out at village level caused by absent households; $\overline{A}_{contracted}$ is the average contracted irrigated land in the villages; Ahh is the number of absent households in village and Phh is the number of households present in village; and S_{size} is the sample size. Correcting for absent households reduces the gap by 46 percent (from 104 to 57 mu) for irrigated land in *Banqiao*, by 50 percent (from 143 to 71 mu) in *Shangzhu* and by 35 percent (from 386 to 248 mu) in *Gangyan* (see Table 4.3).

Table 4.3

Gap between irrigated land rented in and rented out in the sample *unit: mu*

Village	Banqiao	Shangzhu	Gangyan
Gap from survey	104.4	143.2	385.7
Gap after adjusting from absent households	56.5	71.2	248.0

In summary, irrigated land rental markets are more important than the other types of land rental markets in all three villages, both in terms

of number of households participating, and in terms of the amount of rented land. The exception is *Banqiao*, where more dry land is available and about a fifth of farmers rented in additional dry land. So, in *Banqiao* dry land rental markets also need to be taken into account. Although forest land is very important for some farmers in *Shangzhu*, only a few of them engaged in forestland leasing. Forest land leasing can thus be ignored in land rental market analysis. Participation in irrigated land rental activities shows a consistent pattern for the three villages.

Households absent from the village explain 35 to 50 percent of the difference between rented in and rented out irrigated land at the village level. But there still is a large unexplained difference. Lohmar et al. (2001) explain the discrepancy from households who misunderstood the difference in the question between land renting out and from renting of land from the village collectives. In their research areas it was possible for households to rent land from village collectives, but the same situation did not exist in our research area. The remaining discrepancy may be explained as due to reluctance among farmers to tell interviewers that they were renting out land, although this is not proven.

Table 4.4
Payment modes for renting irrigated land in the three villages

Village	Banqiao		Shangzhu		Gangyan		Total	
Payment mode	Cases	Percentage %	Cases	Percentage %	Cases	Percentage %	Cases	Percentage%
Village fees	2	6.5	5	10.2	37	50	44	12.9
Paddy	19	61.3	39	79.6	28	37.8	86	25.3
Cash	6	19.4	2	4.1	2	2.7	10	2.9
Other*	1	3.2	1	2	3	3.9	5	1.5
Payment for cultivating	2	6.4	2	6.4	4	5.2	8	23.5
No payment	1	3.2	0	0	0	0	1	0.3
Total	31	100	49	100	74	100	154	45.3

Note: *: Includes combinations of payment modes

Table 4.4 shows the different modes of payment for irrigated land in the three villages. Irrigated land rent is paid for either in cash or in kind. Most farmers who rented in land paid rent. But one household did not need to pay, and in eight cases people renting in were even paid by those renting out land ('payment for cultivating' in the table). The reason could

be that a farmer with idle land could be punished by the village committees. The village committees may take their land away or they may get poor quality land in the next round of land distribution. So, in a few instances households are willing to pay money to other farmers to cultivate the land. More than half of the households paid the rent in kind (paddy). In 44 (out of the 154) cases, households renting in land paid the village fees affiliated to the rented land. These fees include agricultural tax and fees (to the village committee (*Cun Tiliu*) and fees by the township government (*Xiang Tongchou*).

4.3.2 Agricultural labour markets

Agricultural labour markets can provide other types of potentially important linkages between farmers within villages. There are two mechanisms for using outside labour in agricultural production, exchange and hiring-in. Exchange occurs when farmers help each other during the busy seasons. This normally takes place between relatives, friends and other farmers. Exchange labour normally does not require cash payment or payment in kind, but requires a pay back in labour. Hiring involves farmers paying for the labour that they use. Payment for hired-in labour can be in money or food (including cigarettes and drinks) or a combination of the two. Unfortunately, information about the sources of exchange labour and hired in labour for 2000 was missing from our data set. During exploratory research in 1998 in the same province it was found that more than 90 percent of hired-in labour came from within the same villages, and mostly from the same hamlets. Hence, it can be reasonably safely assumed that exchange labour and hired labour mainly come from within the same village, or even the same hamlet.

The agricultural labour market in the three villages is diverse, with .the hiring in of labour for harvesting and transplanting being the main types of labour hiring in all three villages. Tractors or oxen are often hired in with labour for land preparation.

Table 4.5 shows the number of households cultivating early, one-season and late rice and the percentages of them using exchange and hired labour for each type of rice. More farmers use exchange labour than hired labour. In *Banqiao* and *Gangyan*, hired labour is less used in one-season rice production than in other types of rice, because it coincides with a slack season for agricultural production.[12] Farmers can thus use more exchange labour instead. On average, farmers in *Gangyan* use

more hired labour than farmers in the other two villages for early and late rice production. This may be because, as discussed in chapter 3, more households in this village are involved in migration. *Shangzhu* has the highest use of hired labour in one-season rice production, which is the main type of rice production in this village. More than 30 percent of the households in *Gangyan* are involved in the agricultural labour markets. In the other two villages, these percentages are lower. But, for one-season rice in *Shangzhu* and late rice in *Banqiao* the participation rates are also close to 30 percent (for exchange and hired labour together).

Table 4.5
Percentages of households using exchange and hired labour in rice production

Crop		Village			
		Banqiao	Shang-zhu	Gangyan	Total
Early rice	Number of cultivating households	56	44	168	268
	Households using exchange labour (%)	5.4	9.1	29.8	21.3
	Households using hired labour (%)	3.6	0.0	13.7	9.3
One-season rice	Number of cultivating households	10	99	106	215
	Households using exchange labour (%)	20.0	32.3	26.4	28.8
	Households using hired labour (%)	0.0	14.1	6.6	9.7
Late rice	Number of cultivating households	55	47	163	265
	Households using exchange labour (%)	21.7	15.0	19.8	19.3
	Households using hired labour (%)	9.1	4.2	19.6	14.7

In *Banqiao* and *Gangyan*, most households planted early and late rice. In *Banqiao* a few households also cultivated one-season rice, while in *Gangyan* also more than half of the households also planted one-season rice. No household was found not planting rice in *Gangyan*. In *Shangzhu*, 90 percent of households planted one-season rice while less than half of the households planted early and late rice. *Shangzhu* is located in a moun-

tainous area and some of the rice land is located in the mountains. Water temperature is quite low during spring and there is not enough sunshine during spring for rice growing. So one-season rice is more suitable for *Shangzhu*. Hence, most households in *Shangzhu* have more or less the same peak season for agricultural labour use, and it is difficult to exchange labour for one-season rice production. This probably explains why farmers in *Shangzhu* use more hired labour than exchange labour in rice production. A further reason is that the peak season for one-season rice is in the middle of the year, which makes it costly for migrated household members to come back home to help.

Table 4.6 shows the importance of exchange and hired labour as a share of total labour use (including own household labour) for each type of rice. The table shows that exchange labour is relatively important compared to hired labour. Use of exchange labour is similar across the three villages, although more hired labour is used in *Shangzhu* and *Gangyan* than in *Banqiao*.

Table 4.6
Shares of exchange and hired labour in total labour use in rice production

	Exchange labour		**Hired labour**	
Banqiao	Mean	Std. Dev	Mean	Std. Dev
Early rice	18.0	17.1	2.9	1.3
One-season rice	-	-	-	-
Late rice	22.7	19.0	11.5	11.6
Shangzhu	Mean	Std. Dev	Mean	Std. Dev
Early rice	13.3	3.4	-	-
One-season rice	21.3	14.8	16.3	11.7
Late rice	22.6	10.5	21.6	-
Gangyan	Mean	Std. Dev	Mean	Std. Dev
Early rice	13.0	12.7	11.7	10.5
One-season rice	18.2	12.2	11.5	9.0
Late rice	17.6	15.3	8.6	9.2
Total	Mean	Std. Dev	Mean	Std. Dev
Early rice	13.6	12.5	11.1	10.4
One-season rice	19.9	13.7	14.8	10.9
Late rice	19.5	15.8	9.4	9.6

Table 4.7 presents information on the use of exchange and hired in labour in different rice production activities for each village. It shows that farmers commonly use exchange and hired labour during peak seasons, e.g. for harvesting and transplanting. Hired labour is also used in *Gangyan* for land preparation. Use of exchange and hired labour is more diversified in *Gangyan*, compared to the other two villages. For example, in *Gangyan* farmers also use exchange and hired labour for fertilizing and pest management, although these activities are more difficult to monitor.

In *Shangzhu*, households' use of exchange labour and hired labour is concentrated on a few activities particularly land preparation (only hired labour), transplanting and harvesting. This clearly shows the seasonality of the labour market in *Shangzhu*. The use of external labour is more scattered in *Banqiao* and *Gangyan*. In *Gangyan*, exchange labour and hired labour use are more evenly distributed between the three types of rice production. Hired in labour is more concentrated on a small number of activities than exchange labour. There was no evidence of any permanent hired labour in the three villages, probably due to the small size of the farms and the seasonality of demand.

Table 4.8 shows the use of exchange and hired labour in other major crops in the three villages. Peanut and watermelon are mainly produced for selling, while sweet potato is mainly grown for own consumption and as pigs' feed. Vegetables are not included in the table because very few households use exchange or hired labour in their production. The use of exchange labour in major crops is generally smaller than in rice production, with the exception of *Banqiao*, where it is larger. This is probably because *Banqiao* has good quality roads and is located relatively close to a major road and a big city, so it is relatively easy for households to sell their cash crops. In *Shangzhu* no exchange or hired labour is used for other crops than for rice. This is because *Shangzhu* is located in a mountainous area, where it is very difficult to sell cash crops outside the village. Crops grown for own consumption need and justify much less labour input.

Table 4.7

Households using exchange and hired labour in different production activities in %

Villages	Activities	Exchange labour			Hired labour		
		ER	OR	LR	ER	OR	LR
Banqiao	Land preparation	1.8	0	1.8	1.8	0	1.8
	Second fertilizing	1.8	0	0	0	0	0
	Transplanting	3.6	20	10.9	1.8	0	3.6
	Pest management	1.8	0	1.8	0	0	0
	Harvesting	5.4	20.0	16.4	0	0	5.5
	Transporting	0	0	1.8	0	0	0
	Marketing	0	0	3.6	0	0	0
	Field visiting	0	0	0	0	0	1.9
Shangzhu	Nursery	0	0	0	0	1.0	0
	Land preparation	0	1	0	0	3.1	4.3
	Second fertilizing	0	0	0	0	1.0	0
	Transplanting	2.7	23.2	12.8	0	3.0	2.2
	Weeding	0	1.0	12.3	0	0	0
	Harvesting	2.7	22.2	12.8	0	12.1	2.2
	Transporting	0	0	2.1	0	0	2.2
Gangyan	Nursery	5.7	1.9	1.8	3.5	1.0	5.6
	First fertilizing	1.2	0.9	0	0	0	0
	Land preparation	2.9	2.8	1.8	13.8	6.1	13.0

Continued

	Second fertilizing	1.1	0	0.6	0	0	0
	Transplanting	25.3	17.1	12.3	1.7	1.9	1.9
	Weeding	0.6	0	0	0	0	0
Gangyan	Pest management	1.8	0	0.6	1.6	0.9	1.9
	Harvesting	8.6	14.2	9.2	3.6	1.9	8.6
	Transporting	0	1.0	1.2	0	1.0	1.8
	Marketing	0	0.9	0.6	0	0	0
	Field visiting	0	0.9	0	0	0	0

Notes: ER, OR and LR denote early rice, one-season and late rice, respectively.
Field visits include time spent on inspecting the fields.

Table 4.8
Households using exchange and hired labour in other major crops

Village	Banqiao	Shangzhu	Gangyan
Main types of crops	Peanut and watermelon	Sweet potato	Peanut and sweet potato
Number of households planting crop	21.0	53.0	123.0
Households using exchange labour (%)	4.8	0	4.1
Households using hired labour (%)	9.5	0	3.3

Table 4.9 summarizes the use of exchange and hired labour in the major categories of agricultural production (rice, other main crops, perennial crops and livestock production) as well as the share of exchange and hired labour in total labour use in agricultural production. Exchange and hired labour in rice is much more commonly used than in the other categories. In *Shangzhu* a relatively high share of hired labour in all production is used compared to the other two villages.

To check the balance between village demand and supply of agricultural labour, Table 4.10 shows the total hired in and hired out labour use in agricultural production for rice, other crops and vegetables for each village. In *Banqiao* and *Gangyan*, the interviewed farmers use much more labour from outside their family than they supplied themselves to other farmers. In *Shangzhu*, however, the hiring out of agricultural labour is much larger than the hiring in of labour by the interviewed households. The survey data did not contain information about where the hired labour comes from. An exploratory village survey carried out by the same research team in Northeast and Southern Jiangxi Province in 1998 found that only 9.8 percent of hired agricultural labour came from outside the village and 89.5 percent came from within the same hamlet. It is not clear therefore what causes the large discrepancies reported in Table 4.10.

An attempt was made to examine to the extent to which the demand and supply of agricultural labour matches at the hamlet level. Table 4.11 shows the results. It also shows large discrepancies between the agricultural labour hired in and hired out within the hamlets by the interviewed households.

Table 4.9

Use of exchange and hired labour in agricultural production in %

Production Categories		Village			
		Ban-qiao	Shang-zhu	Gan-gyan	Total
Rice	Households using exchange labour	25.9	36.4	33.9	33.4
	Households using hired labour	14.8	14.3	25.9	20.3
Other main crops	Households using exchanged labour	4.8	0	4.1	2.9
	Households using hired labour	9.5	0	3.3	3.3
Perennials crops	Households using exchanged labour	0	0.9	0	0.3
	Households using hired labour	0	2.8	0	0.9
All Production	Households using exchanged labour	28.6	37.3	50.0	42.4
	Households using use hired labour	17.9	14.5	28.2	22.1
	Share of exchange in total labour use	10.1	9.6	6.0	7.8
	Share of hired labour in total labour use	3.0	8.0	3.7	5.0

Note: Livestock production is not included because only one respondent used hired labour in livestock production.

Table 4.10

Hired out/in labour use in crop production in the three villages Unit: hrs.

	Village		
	Banqiao	Shangzhu	Gangyan
Total hired out labour	96	2994	948
Total hired in labour	748	1248	2917

4.3.3 Oxen/tractor rental markets

At the time of the survey, both oxen and tractor rental activities were taking place in the three villages. In *Shangzhu* (the remote village), tractors were not used in agricultural production or for transportation due to

the poor infrastructure and geographic conditions (as most land consists of small-scale terraces). As can be seen from Table 4.12, 1.8 percent and 22 percent of households in *Banqiao* and *Gangyan* respectively rented tractors, mainly for ploughing and transportation. These two villages have more flat land and large-scale improvements of agricultural land were carried out in *Gangyan* two decades ago. Only a few households own tractors in the village. These households provide ploughing services (including labour time) to other households in the same village and sometimes also in neighbouring villages. There are no data, however, on how many households in each village own a tractor and provide ploughing services to other households.

Oxen renting took place in all three villages. Only 3.6 percent of the households in *Banqiao* rented oxen for late rice production, while 3.6 percent of households in *Shangzhu* rented oxen for both one-season and late rice production. In *Gangyan*, 0.6 percent, 6 percent and 8 percent of the households rented oxen for early, one-season and late rice production, respectively.

4.3.4 Credit markets

Increased income from off-farm employment may create new household linkages through money lending, with households with little or no involvement in off-employment being able to borrow money from households participating in off-farm employment. Hence, this section examines the development of credit markets, with a focus on informal markets. Table 4.12 presents the participation of households in the credit market, while Table 4.13 presents the sources of credit in each village. A large number of households in each village receive credit, ranging from 53 percent in *Shangzhu* to 77 percent in *Banqiao*. Most of the credit is provided in cash. Less than half of the households received credit from within their own village, while most of the credit (70.7 percent for *Banqiao*, 67.2 percent for *Shangzhu* and 65.3 percent for *Gangyan*) is obtained from outside the village.

Table 4.11

Agricultural hired labour balances at the hamlet level *Unit: hrs.*

Village	Hamlet	Out	In	Village	Hamlet	Out	In
Banqiao	1	11	332	Shangzhu	1	427	188
	2	25	8		2	0	0
	3	60	245		3	0	0
	4	0	163		4	60	0
	Sum	96	748		5	0	0
Gangyan	1	0	705		6	0	26
	2	80	182		7	0	274
	3	200	197		9	192	24
	4	306	800		10	0	0
	5	284	689		11	630	0
	6	30	220		12	1 685	45
	7	0	177		13	0	99
	Sum	948	2 917		14	0	240
					15	0	308
					16	0	44
					Sum	2 994	1 248

Table 4.12
Percentages of households participating in various markets

		Banqiao			Shangzhu			Gangyan			Total		
		All	Out	In	All	Out	In	All	Out	In	All	Out	In
Land renting In	Irrigated	55	-	55	45	-	45	44	-	44	46	-	46
	Dry	21	-	21	3	-	3	5	-	5	7	-	7
	Forest	0	-	0	2	-	2	1	-	1	0.8	-	0.8
Agricultural labour use	Exchange	29	n.a.	n.a.	37	n.a.	n.a.	50	n.a.	n.a.	42	n.a.	n.a.
	Hiring in	18	n.a.	n.a.	15	n.a.	n.a.	28	n.a.	n.a.	22	n.a.	n.a.
Credit borrowing	Cash and kind	77	52	21	53	20	17	56	37	20	56	39	19
Seed	Early rice	100	73	27	40	39	1	95	22	73	78	36	42
	One-season	18	11	7	89	80	9	60	39	22	63	47	15
	Late rice	91	61	13	40	37	6	93	80	13	76	62	11
Inputs bought (early rice)	Manure	38	0	38	16	0	16	36	0.6	36	30	0.2	30
	Fertilizer	98	82	16	38	35	3	98	98	0	79	75	3.5
	Tractors	1.8	0	1.8	0	0	0	22	0	22	11	0	11
	Oxen (early rice)	0	0	0	0	0	0	0.6	0	0.6	0.3	0	0.3
	Oxen (one-season)	0	0	0	3.6	0	3.6	6	0	6	4	0	4
	Oxen (late)	3.6	0	3.6	0	0	0	8	0	8	5	0	5
Land renting out	Irrigated	11	-	11	7	-	7	10	-	10	9.4	-	9.4
	Dry	4	-	4	1	-	1	3	-	3	2.4	-	2.4
	Forest	0	-	0	0	-	0	0	-	0	0	-	0

Continued

Agricultural	Exchange	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
labour supply	Hiring out	5.4	0	5.4	9.1	1.8	6.4	9.2	1.1	8	8.5	1.2	7
	Early rice	21	20	1.8	0	0	0	28	22	0.6	18	14	0.5
	One-season rice	13	13	0	26	20	4.5	30	28	1.1	26	23	2
	Late rice	60	48	5.4	6.3	3.6	0	41	37	0.6	33	28	1
Output sold	Peanut	64	63	2	-	-	-	-	-	-	64	63	2
	Water-melon	16	16	0	-	-	-	-	-	-	16	16	0
	Sweet po-tato	-	-	-	-	-	-	0.6	0.6	0	0.6	0.6	0

Notes: 'All' = households participating in market;
'Out' = Bought / sold outside village;
'In' = Bought / sold inside village;
'n.a.' = not available;
'-' = not applicable.

Farmers obtained credit from different sources, such as banks, cooperatives, shops/traders, private moneylenders or from friends and relatives. Bank and cooperatives (formal institutes) provided only a small share. Only 9.4 percent of households received credit from these formal institutes. Credit from friends and relatives is the most important source in each village, providing credit to 68.2 percent of the households in these villages.

4.3.5 Seed, manure and fertilizer markets

Other inputs beside production factors may also generate linkages between households in a village. In Table 4.14, sources of seed for early, one-season and late rice are presented. More than 60 percent of seed for the three types of rice are bought from outside the village, because the seed used is, to a large extent, hybrid seed. The only exception is seed of early rice in *Gangyan* which is mainly self-produced seed. The share of seed bought from outside the village in *Shangzhu* is higher than in the other two villages, because more one-season rice is planted here.

Table 4.13

Households credit types, sources and provider in the three villages

Unit: Number of households and %

Village	Credit types		Source		Type of provider					
	Cash	Kind	Within village	Out-side village	Bank	Coop-eratives	Shop	Private	Friends and relatives	Other
Banqiao	38	5	12	29	0	4	3	12	19	3
%	88.4	11.6	29.3	70.7	0.0	9.8	7.3	29.3	46.3	7.3
Shangzhu	57	1	19	39	2	4	3	1	45	3
%	98.3	1.7	32.8	67.2	3.4	6.9	5.2	1.7	77.6	5.2
Gangyan	87	11	34	64	6	2	11	7	67	0
%	88.8	11.2	34.7	65.3	6.5	2.2	11.8	7.5	72.0	0.0
Total	182	17	65	132	8	10	17	20	131	6
%	91.5	8.5	33.0	67.0	4.2	5.2	8.9	10.4	68.2	3.1

Notes: Number of cases in *Banqiao*, *Shangzhu* and *Gangyan* are 56, 110 and 174, respectively.
% means percentages of participating households that borrow in cash or kind, where they borrowed from and which types of provider.

Table 4.14
Sources of seed for rice production

	Banqiao			Shangzhu			Gangyan			Total		
	ER	OR	LR	ER	OR	LR	ER	OR	LR	ER	OR	LR
	No	No	No	No	No	No	No	No	No	No	No	No
Own farm	7	4	12	1	10	5	111	26	15	119	40	32
Hamlet	3	0	4	0	0	0	14	6	6	17	6	10
Village	5	0	1	0	0	2	2	6	2	7	6	5
Outside village	41	6	34	43	88	37	38	67	139	122	161	210
Total	56	10	51	44	98	44	165	105	162	265	213	257
Own farm (%)	12.5	40.0	23.5	2.3	10.2	11.4	67.3	24.8	9.3	44.9	18.8	12.5
Hamlet (%)	5.4	0	7.8	0	0	0	8.5	5.7	3.7	6.4	2.8	3.9
Village (%)	8.9	0	1.9	0	0	4.5	1.2	5.7	1.2	2.6	2.8	1.9
Outside village (%)	73.2	60.0	66.7	98.0	89.8	84.1	23.0	63.8	85.8	46.0	75.6	81.7

Notes: ER, OR and LR denote early, one-season and late rice, respectively.
No. refers to the number of cases.

Table 4.15 shows the sources of chemical fertilizer use and manure use in early rice. All households planting early rice used fertilizer. 95.5 percent of these households obtain fertilizer from outside the village, and other from inside village. Similar patterns can be observed for chemical fertilizer use in one-season rice and late rice, and for pesticide and herbicide use in early, one-season and late rice (not shown in the table).

Table 4.15
Sources of manure and fertilizer in early rice production

	Banqiao		Shangzhu		Gangyan		Total	
	M.	F.	M.	F.	M.	F.	M.	F.
Own farm (%)	37.5	0	42.9	0	37.5	0	38.3	0
Hamlet (%)	0	12.7	0	2.3	0	0	0	3.0
Village (%)	0	3.6	0	4.6	0	0	0	1.5
Outside village (%)	0	83.7	0	93.1	0.6	100	0.4	95.5
Not used (%)	62.5	0	57.1	0	61.9	0	61.3	0

Notes: M. means manure and F. means fertilizer.

Table 4.15 also shows manure use in early rice production. Less than half (38.7%) of the farmers use manure in early rice production. The table shows that manure only comes from the own farm, except for one household in *Gangyan* that obtains manure from outside the village. Results for manure use in one season rice and late rice also indicate that manure is almost without exception obtained from the own farm.

4.3.6 Output markets

To examine whether there are any internal village links between farmers through selling of agricultural products, Table 4.16 shows the destinations of rice, the major agricultural output in the three villages. At the time of the survey, farmers could consume the rice, exchange it with other farmers within the village, submit it as public grain, sell as a quota obligation, or sell at the market. Few farmers submitted rice as public grain[13], so this is not included in the table. Instead, most households pay money to village committee. The table shows that more households in *Banqiao* and *Gangyan* sell rice than in *Shangzhu*. The share of total output that is sold is also lowest in *Shangzhu*. Most of destinations that rice is sold are to outside the villages. The share of one-season rice sold is higher than of the other two types.

Other crops were also planted in each village, but only one or two of these accounted for any significant share of the planted area. Table 4.17 presents the output destinations of the one or two other main crops in each village. In *Banqiao*, crop planting is more market oriented than in the other two villages, where production mainly is for own consumption. *Banqiao* is located close to a main road and there is a nearby wholesale market for selling peanuts.[14] Hence, peanuts make up a larger proportion of total marketed output in *Banqiao*. Other crops grown in the three villages are not presented in the table as they are mainly grown for self consumption.

Table 4.16
Destinations of rice supply

	Total	Exchange		Quota		Sold			
	Cases	%	Output share	%	Output share	%	Within village (%)	Outside Village (%)	Output share
Early rice									
Banqiao	54	7.4	25.4	3.7	5.8	22.3	1.9	20.4	32.0
Shangzhu	44	4.3	10.4	0.0	0	0.0	0.0	0.0	0
Gangyan	158	1.9	17.9	6.3	32.9	24.7	0.6	24.1	45.0
One-season rice									
Banqiao	10	20	11.8	0.0	0	70.0	0.0	70.0	88.0
Shangzhu	99	14	17.6	3.0	5.1	27.3	5.1	22.2	32.0
Gangyan	106	1.9	10.7	13.2	59.6	48.1	1.9	46.2	82.0
Late rice									
Banqiao	55	5.5	18.6	1.8	15.4	54.6	5.5	49.1	80.9
Shangzhu	47	11.0	43.9	2.1	50.0	8.5	0.0	8.5	39.7
Gangyan	163	7.9	12.5	14.7	34.0	40.5	0.6	39.9	46.5

Notes: % means percentages of households involved in rice exchange, sold as quota or sold to the markets.

Table 4.17
Main crops marketing in three villages

Destination	Village	Banqiao			Shangzhu			Gangyan			Total cases
		Cases	%	AS.	Cases	%	AS.	Cases	%	AS.	
Peanut	Own	42	91.3	32.8	-	-	-	52	100	98.4	94
	Exchange	1	2.2	0.3	-	-	-	3	5.6	1.6	4
	Sold	40	87.0	67.9	-	-	-	0	0	0	40
	Total	46	-	-	-	-	--	52	-	-	98
Watermelon	Own	17	100	73.8	-	-	-	-	-	-	17
	Exchange	3	17.6	3.87	-	-	-	-	-	-	3
	Sold	9	52.9	22.9	-	-	-	-	-	-	9
	Total	17	-	-	-	-	-	-	-	-	17
Sweet potato	Own	-	-	-	40	100	100	43	100	96.8	83
	Exchange	-	-	-	0	0	0	1	2.4	1.13	1
	Sold	-	-	-	0	0	0	2	4.7	0.94	2
	Total	-	-	-	40	-	-	43	-	-	83

Note: AS: average share of products in total.

4.4 Summary and Conclusions

Households in *Banqiao*, *Shangzhu* and *Gangyan* in Jiangxi province are all involved in different factor, variable input and output markets, although there are substantial variations in household participation in these markets between the three villages. In each village, there are exchanges taking place inside the villages as well as outside the village.

Renting of irrigated land is a typical village market. The market for irrigated land is much more important in all three villages, than the markets for dry land and forest land, although there is also a significant market for dry land in *Banqiao* (21 percent of households hired in). There exists a large gap between the amount of irrigated land hired in and that hired out within the households in the survey. Adjusting this gap for absent (= migrated) households narrows the differences in all the three villages, but there still is a considerable unexplained difference.

Agricultural labour markets are also mainly village markets and these have developed, to some extent, in all three villages. Between 29-50 percent of the households in the three villages use exchange labour in agricultural production and this accounts for 6-8 percent of the total labour used in agricultural production. Between, 15-28 percent of households in the three villages use hired labour, which accounts for an average of 5 percent of total labour input in agricultural production. Results of a village survey carried out in Northeast and South Jiangxi Province in 1998 indicates that most hired agricultural labour comes from within the same hamlet. The use of exchange labour and hired labour is more important in the production of rice than in other crops.

Farmers in *Gangyan* are the only ones to use tractors to any significant extent in agricultural production. Oxen are used in all three villages, with a very low share of the households in each village using hired oxen (Table 4.17). About one third of households borrowing money obtain this credit from inside their villages. The others obtain credit from outside the villages, with friends and relatives as the most important source.

Markets for variable inputs are mainly outside the villages. Rice seed is largely bought outside the village, except early rice seed in *Gangyan*. Fertilizers, pesticides and herbicides are also largely bought outside the village, while manure is almost entirely produced on the own farm.

Rice to a large extent is used for self consumption and to some extent is exchanged internally within the village. In *Banqiao* and *Gangyan*, more

than half of the households sell one-season rice, with a large share of total production of one-season rice being sold. Selling rice outside the village is much more important than selling inside the village. Other agricultural products are mainly produced for self consumption. The only exception is peanuts in *Banqiao* which are mostly sold outside the village, being close to market outlets.

Village linkages among households in the three research villages mainly consist of market activities of households on the markets for land, agricultural labour, and tractor and oxen rental. Hence, village economies play an important role in farm household behaviour in the research areas. Village models (such as village SAM multiplier and CGE models) are suitable tools for capturing the major village internal linkages (with an emphasis in this case on land, agricultural labour, and tractor/oxen renting) and to give a full picture of village household activities.

4.5 What next? An analysis of *Shangzhu* village

In the following chapters, will take *Shangzhu* village as a case study to empirically examine the impact of off-farm employment on agricultural production, input use and factor use by households participating in off-farm employment as well as households within the same village that are not involved in off-farm employment. The result also allows the drawing of some inferences for the resulting changes in land production capacity and environment quality in the village. Because *Shangzhu* village is a remote village (see the introduction to the three villages in Chapter 3), the linkages between households are expected to be stronger and are more likely to be internal linkages. The remoteness means that such linkages are not likely to be removed or changed in the short term. A case study focusing on such a village may therefore provide important insights into the role of village linkages in shaping household responses, and as a result provide valuable policy recommendations for stimulating grain production and household incomes and improving land production capacity and environmental quality in remote rural areas.

Notes

1. A paper based on this chapter and part of chapter 2, co-authored with Futian Qu, Nico Heerink and Marijke Kuiper, was published in *China Rural Survey* (2004, No. 1, pp. 44-55. in Chinese).

2. More information about data collection and description is presented in chapter 3. All the data used in this chapter are calculated from this data set, except those specifically indicated.

3. Village non-tradable products or factors mean that they can only be traded inside village and between households, but are non-tradable outside the village.

4. Lohmar et al. (2001) called this type of land 'responsibility land'. They use the term 'contracted land' for land that is contracted from the village collective against payment to the village collectives, which happens frequently for parcels of fruit orchards in the village in Shangxi province that is investigated in their study.

5. The entities of collective owners can be village collectives or villager groups (*Cunmin Xiaozu*).

6. Such as two-farmland system and three-land system.

7. This study collected data from about 77 villages in four provinces.

8. The survey covered 825 farm households and 30 villages in 5 provinces across China.

9. Borrowing activities in rural area mainly happen between friends, relatives and the people with kinship, lending to unknown people normally requires a third party guarantor. Normally, farmers lack collateral for obtaining credit.

10. One mu equals 1/15 ha.

11. The results are from a survey conducted by the Ministry of Agriculture in 6 Chinese provinces. The share of households renting land was highest in Zhejiang Province (33 percent).

12. Early rice is planted in the early spring and late rice is planted after early rice. So, the growth periods for early and late rice are shorter than of one-season rice. The late rice growth period can also be longer than the early rice period. Seed for each type of rice is quite different and the quality of one-season and late rice are better than of early rice because of the longer growth period.

13. Public grain is agricultural tax paid in kind.

14. More detailed information about Banqiao and the other two villages can be found in chapter 3.

4 Appendix:

Table 4A.1 presents the number of absent households in each hamlet for the three villages. An absent household is defined as a household in which the adults or the whole family were away from home during the survey time, probably because of off-farm work (migration). Data on the number of absent households in each hamlet was collected by asking this information from households who were present at the time of the survey. For small hamlets, it was generally easy to give a precise answer, but for large hamlets it was more difficult and the data obtained are therefore less reliable. At the village level, no official data was available on the number of absent households. For some hamlets it was not possible to collect the data because of time limitations.

Table 4A.1
Absent households in the three villages in 2000

Hamlets	Absent households	Percentage	Total number of households
Banqiao			
Xujia	1	3.1	32
Shangbanqiao	7	11.3	62
Chengjia	14	20	70
Xiabanqiao	16	20	80
Gangyan			
Shangcheng	4*	5.7	70
Xinlu	-	-	120
Shanlicheng	5	10	50
Gangyan1	20	8.3	240
Gangyan2	1*	-	250
Zhangjiawan	28	21.5	130
Lijiayang	47	75.8	62
Shibi	-	-	-
Shangzhu			
Xiazhang	15/16	44	36
Xiazhu	10	27	37
Xi-nan	6	7.5	80
Fangjia	11	33	33
Yushan	23*	55	42

Shangzhu	-	-	-
Zhongzhu	-	-	-
Zuixia	-	-	-
Tianhu	-	-	-
Minken	-	-	-
Banshiken	-	-	-
Hongqi	-	-	-
Xiyuan	-	-	-
Chejia	-	-	-

Notes: '-'means the data were not collected.
* The respondents were unsure.

Table 4A.2
Land rental market in Banqiao unit: mu

Banqiao	Irrigated land		Dry land		Forest land
	In	Out	In	Out	In
All households					
Average contracted land area	5.47		0.82		0.15
Average cultivated land area	7.61		1.73		0.16
Mean leased area	2.23	0.37	0.43	0.05	0
Rented land as a share of contracted land (%)	-	6.7	-	6.1	-
Rented land as a share of cultivated land (%)	29	-	24.8	-	-
Maximum size	16	6.5	6	2.2	-
Total leased land in the village	124.9	20.5	24.1	3.2	0
Participating households participants					
Number	31	6	12	2	0
Average contracted land per household	5.04	6.9	1.23	2.3	-
Average cultivated land per household	9.41	3.31	3.03	1.7	-
Mean leased area	4.02	3.41	2.01	1.6	-
Rented land as a share of contracted land (%)	-	49.4	-	69.6	-
Rented land as a share of cultivated land (%)	42.6	-	66.3	-	-

Note: The sampled households did not report any forest land renting out and in.

Table 4A.3
Land rental market in Shangzhu (% and mu)

Shangzhu	Irrigated land		Dry land		Forest land
	In	Out	In	Out	In
All households					
Average contracted land area	5.08		0.28		2.73
Average cultivated land area	6.42		0.45		3.06
Mean leased area	1.54	0.22	0.008	0.004	0.29
Rented land as a share of contracted land (%)	-	4.3	-	1.4	-
Rented land as a share of cultivated land (%)	23.9	-	1.7	-	9.4
Maximum size	16	6.5	6	2.2	0
Total leased land in the village	167.2	24	0.9	0.5	31
Participating households participants					
Number	49	8	3	1	2
Average contracted land per household	4.86	4.7	1.0	1.0	0.2
Average cultivated land per household	8.27	2.47	1.47	0.5	31.2
Mean leased area	3.42	3.0	0.3	0.5	31
Rented land as a share of contracted land (%)	-	70.3	-	50.0	-
Rented land as a share of cultivated land (%)	41.2	-	20.4	-	100.0

Note: The sampled households did not report any forest land renting out.

Table 4A.4
Land rental market in Gangyan (% and mu)

Gangyan	Irrigated land		Dry land		Forest land
	In	Out	In	Out	In
All households					
Average contracted land area	6.02		0.47		1.11
Average cultivated land area	8.51		0.51		1.23
Mean leased area	2.46	0.23	0.012	0.02	0.12
Rented land as a share of contracted land (%)	-	3.8	-	4.2	-

Continued					
Rented land as a share of cultivated land (%)	29	-	2.3	-	9.7
Maximum size	38	8	0.6	2.7	20
Total leased land in the village	426.69	41	2.05	3.6	20
Participating households participants					
Number	76	18	8	5	1
Average contracted land per household	6.01	6.9	0.31	1.13	0
Average cultivated land per household	12.24	5.25	0.64	0.23	20
Mean leased area	5.69	2.41	0.29	0.9	20
Rented land as a share of contracted land (%)	-	34.5	-	80.0	-
Rented land as a share of cultivated land (%)	46.4	-	45.3	-	100

Note: * The sampled households did not report any forest land renting out and in.

5 Off-farm employment, factor market development and input use in farm production - a case study of a remote village in Jiangxi province[1]

5.1 Introduction

The massive volume of rural labour flowing into off-farm employment has become a significant phenomenon in the process of China's economic reform. Participation in off-farm activities changes the resource endowments of households, as the labour and capital used for financing off-farm employment move out of farm production. As a result households need to restructure their farm production by changing factor and variable input use. Little is known, however, on the impact of off-farm employment on these aspects and household's choices in this regard. The theoretical framework about the impact of off-farm employment on household's factor and variable input use was explained in detail in chapter 2.

Farm production is the main linkage between the economy and the environment in rural China, and factor use and variable input use on farmland are important elements affecting the land's productive capacity (LPC) and environmental quality (EQ). The issue of how to improve or maintain farmland production capacity and the environment in China in the long run has attracted substantial attention (Huang 2000, Yao 2002, SEPA 1999, Niu & Harris 1996, Huang & Rozelle 1995, World Bank 1992, Zhao et al. 1991).[2]

Development of land rental and other rural factor markets, which may be further induced by increasing off-farm employment, will facilitate household market interactions, intensifying or diminishing the impact of

off-farm employment on LPC and EQ. Because of household market interactions, off-farm employment also affects the agricultural production and input use of those households within the same village, without members working off-farm. Increased income and expenditure of households involved in off-farm employment and the village-level internal factor and other markets are responsible for such indirect effects. The responses of households without, or with less involvement in off-farm employment, will also produce secondary effects on households with off-farm employment via internal village markets. Hence, the existence of internal village markets will change the impact of external shocks on household production and consumption behaviour.

The aim of this chapter is to analyse the impact of different types of off-farm employment (especially local non-farm, self-employment and migration) on village factor market development, and examine the effects of off-farm employment on factor use and variable input use on farm production, which will differ between households within the same village. To this end, this chapter explores three specific issues. First, it explores the development of village land rental markets, oxen rental markets and agricultural labour markets along with different types of off-farm activities (local non-farm activities, self-employment and migration). Second, it examines the impact of income obtained from off-farm employment on farm production, especially on factor use and variable input use, for different household groups within the same village. Third, it investigates the implications of change of factor use and variable input use for LPC and EQ.

In addressing the first objective, household groups are distinguished according to characteristics that are relevant for off-farm employment and farm production in order to examine the involvement of these groups in factor markets. A modelling approach, using the same household groups, is then used to achieve the second and third objectives. As discussed in chapter 2, microeconomic farm household models are useful tools for analysing farm household behaviour, but they do not capture the income linkages and the general equilibrium effects within a village. A village social accounting matrix (SAM) will be used to present a picture of the market and income linkages between household groups within a village, and the interactions with the world outside. To this end a village SAM multiplier model will be used, that is derived from the village SAM 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 this analysis the implications of changes in factor use and variable input use on LPC and EQ are investigated.

The data used in this analysis were described in chapter 3. The survey included questions on income sources and expenditures as well as on the inputs and outputs of production activities within the three selected villages. The questionnaire was designed so that the information collected could be used for constructing village SAMs for these three villages (Kuiper et al. 2001). *Shangzhu* village was chosen for this study, as it is located in a mountainous area and is physically relatively isolated from external markets. Thus local household and market linkages are expected to be stronger than in the other two villages, and the indirect effects of off-farm employment are therefore expected to be larger.

To achieve these objectives, the rest of the chapter is organized as follows. In section 2, develops a theoretical framework of the effects of different types of off-farm employment and investment in infrastructure on village factor market development and on factor use and variable input use in farm production. The third section describes the household groupings, the state of development of factor and output markets and the use of nature resources in the selected village. In section 4, presents the village SAM, and the multiplier simulation results are presented in section 5. The last part of the chapter will present a summary and discuss briefly the findings.

5.2 Theoretical considerations

After more than two decades of market oriented reforms, household-market linkages are widespread in rural China. The discussions in chapter 4 showed that land, agricultural labour, oxen/tractor and credit market linkages could be expected, and that rental markets for these factors (excluding credit) are supposed to be the village internal markets. Therefore, when examining the impact of off-farm employment it is very important to incorporate such village household linkages.

A village social accounting matrix (SAM) represents the transactions between production activities, institutions (households, enterprises, government, and village collective) and the external market environment. It shows the flows of inputs, outputs and income between sectors, income between production activities and households, household expenditures

in relation to consumption and investment, and transfers of goods and services between institutions. The rows of a SAM show incomes of each account and the columns the expenditures made by each account. They should balance. The choice of accounts and their subdivision depends on the research purposes and the types of policy simulation the researchers want to perform.

A village SAM multiplier model can be used to analyse the impact of income or remittances from non-farm employment, self-employment or migration on agricultural production and input use by different household groups. Such changes reflect the income effect of households participating in off-farm employment, but this approach is not suitable for analyzing the effect of reduced labour availability or the reduced domestic consumption caused by of migration. As it is impossible to put constraints on a single factor account in a village SAM, this implies that all factors change proportionally within any production activity. The consumption level in a village SAM only responds to changes in income level and it cannot respond to a decrease in consumption units within households. All production and consumption relationships in a village SAM multiplier model are linear; substitution effects (e. g. between labour 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 a village. They capture the direct and indirect income and demand effects, but not the local price changes resulting from income and demand increases. Multi-market or CGE models can be used to analyse such local price changes. This chapter focuses on exploring the income and expenditure effects of off-farm employment on different household groups within a village. The substitution and price effects will be examined in a village-CGE model in the next chapter.

5.3 Socioeconomic Characteristics of the Village

Shangzhu village is only 10 kilometres away from the nearest township, but it takes one hour from the village office, located in one of the larger hamlets (*Xiazhu*) 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. It lies in is a mountainous area and some hamlets are quite distant from the village office. The more remote

hamlets are between half an hour and two hours walk along mountainous tracks from the village office. Several years ago there was a mining enterprise in the village (that belonged to the county government) as the soil is very suitable for making porcelain (*Ciqi*). However, when the mine was depleted, more investment was required for expand the mine further into the mountain, and the enterprise went bankrupt. A few farmers still carry out mining and simple processing.

The total population in the year 2000 was 2028 people, in a total of 472 households (defined as a group of people living under the same roof and eating food from the same pot). Some family members temporarily migrate to other places, but they send back income. They were recorded as household members. In all 109 households were sampled, which is 23 percent of the total. In some households, all the members had migrated away from the village, while in others only the children lived in the village. These households were not interviewed.

The village has four types of land: irrigated land (with paddy fields), dry land, forestland and wasteland. All land is contracted to households except for some pieces of forestland. There has been no village level redistribution of land in recent years, except for limited adjustments of irrigated land in some village groups. In the early 1990s some pieces of forestland belonging to the village committee were contracted to household groups instead of individual households. However, until 2000 no profits were generated from this forestland, because household groups argued with the village committee about how to harvest trees and share the benefits. All the paddy and dry land are located in the mountains, and most of them are terraced. Wasteland is seldom cultivated because the areas involved are 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. Labour, chemical fertilizer, animal and green manure, seeds and oxen ploughing are the main variable inputs in farm production. Almost no inputs are applied to forestland in the field. Livestock production consists of oxen, pig, chicken, duck and fish, with the latter two being less important. A description of the different types of off-farm employment can be found in chapter 3.

5.3.1 Household Classification

A village social accounting matrix (SAM) can only be used to distinguish a limited number of household groups. As our sample comprises only 109 households, it was decided to distinguish not more than four groups within the village SAM. Obviously, different criteria can be used, generating different groupings. These criteria should be tailored to the objective(s) of the research. Because the focus of this research is on the impact of off-farm employment on agricultural production decisions, the main grouping criteria employed were the resources that households have for generating off-farm income and for generating agricultural income.

Several indicators of off-farm employment resources (such as social networks, education level of household members) and for agricultural production resources (oxen ownership) were carefully examined. The social network of households can be an important determinant of access to off-farm employment. Zhao (2001) shows that social networks are crucial factor in households' participation in off-farm activities, especially migration to faraway places in China (see also Shi et al. 2006). However, the contents of social networks are quite diversified. They consist of social relationships (*Guangxi*) of households, kinship networks, and personal contacts with migrants and other institutions. Our data set contains only limited information on social networks, namely information on household members who have already migrated outside the province and information on remittances (sent by relatives). Earlier exploratory regressions on the impact of such social relationships on participation in off-farm employment did not show statistically significant results (Shi et al. 2006).

Another important potential resource for off-farm employment is the education level of household members. Our exploratory analyses (Shi et al. 2006, Kuiper et al. 2002) indicated that the educational level is a very important determinant of participation in off-farm activities. The average educational level (using the number of years of schooling) of the labour force in *Shangzhu* is around four years. Workers with more than 4 years of schooling have a higher probability (at household level) of participating in off-farm activities, particularly migration. The educational level (with 4 years as the threshold) was therefore used as a criterion for grouping households.

Ownership of oxen is an important resource for earning agricultural income and an important determinant of input use levels in the village. More than 80 percent of farm households keep oxen or share them with other households. They are mainly used for ploughing and their manure is an important source of organic fertilizer. Farmers sometimes reapply rice straw on their fields to improve the soil structure, but this increases difficulties in rice transplanting, especially for late rice. The transplanting becomes easier if the fields in which straw is applied are ploughed more than once. An exploratory analysis (Kuiper et al. 2002) shows that oxen ownership is a particularly important determinant of fertilizer use in crop production. As a result it was decided to use oxen ownership as the second criterion for grouping households.

Table 5.1
Criteria used for grouping households

No. of people 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

Notes: NB: Oxen ownership includes sharing oxen with other households.
Group 1: Households with no-one with more than 4 years education;
Group 2: Households with no oxen, at least 1 educated (more than 4 years) member;
Group 3: Households with oxen, 1~2 educated (more than 4 years) members;
Group 4: Households with oxen, 3 or more educated (more than 4 years) members.
Data source: Calculated based on the data set, the same for other tables.

Using these two criteria, four household groups can be distinguished (see Table 5.1). The first group, "*Households with no educated people*", consists of households having no members with more than four years schooling. The second group "*Households with no oxen and at least one educated person*" consists of households that do not own oxen and have one or more member with more than four years schooling. The third group "*Households with oxen, one or two educated people*" consists of households owning oxen and having one or two members with more than four years schooling. The last group is the group of households having at least three members with more than 4 years schooling, and holding oxen "*Households with oxen, at least three educated people*".

5.3.2 Characteristics of household groups

Table 5.2 shows the characteristics of the four household groups and the substantial differences between them. The first two groups have more contracted irrigated land per capita than the other two groups and the second group has more forestland than the other groups.[3] Another basic visible difference among the groups is average household size. The first group of households are much smaller household size, while the household size of the fourth group is the largest. Group 4 also has the largest number of people of working age, while group 3 has the largest number of children.

Table 5.2
Basic household group characteristics

Household Groups	No. of House-holds	Popu-lation	Average House-hold Size	Average no. of Workers	Per Cap-ita Con-tracted Irrigated Land	Per Cap-ita Con-tracted Forest-land
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)

Note: Standard deviations in the brackets.

Table 5A.1 in the appendix shows the average number of schooling years of labour force members for each household group and for the total sample. This is highest amongst household groups 2 and 4, and lowest in group 1. The results of pair wise t-tests for household size and number of workers for the four groups are presented in appendix Table 5A.2. The results indicate that the mean household sizes and labour force sizes are significantly different from each other for all combinations of household groups, except for household groups 2 and 3. Table 5A.3 in the appendix makes a similar comparison of the mean values of per capita irrigated land and forest land for the four household groups. It

shows that group 2, the group with no oxen, has significantly higher levels of forest land per capita than the other three groups. In addition, group 1 has a significantly smaller area of forest land per capita than group 4, and a significantly larger area of irrigated land per capita than group 3. All other differences in irrigated and forest land endowments between the four groups are not statistically significant. These results provide complementary evidence that the four groups differ in demographic characteristics and land endowments.

Table 5.3 presents the average incomes, sub-divided by income source, for 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 the official exchange rate in 2000, 1 USD = 8.30 *yuan*). Group 1 has the lowest total household income, and 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 percent of their income from off-farm activities, 51 percent from farm production (paddy, vegetables, perennial crops, and livestock), and 6 percent from other sources (including government transfers, family member remittances and other assistance from relatives). Family remittances are different from migration remittances. Family remittances refer to the money sent by relatives who do not, or do no longer, belong to the household. Group 2 obtains more than 17 percent of its income from other sources, with 75 percent of this type of income consisting of family remittances. The four household groups have very similar patterns of income sources, except for group 2 which obtains a relatively small share of its income from farm production.

Table 5.3
Average income from different sources per household group (Yuan)

Household Groups	Total Income	Per capita Income	Farm Income	Off-farm Income	Other Sources
Group 1	3 587	1 248	2 133	1 335	119
Group 2	8 055	1 978	3 249	3 384	1 422
Group 3	6 529	1 503	3 404	3 018	108
Group 4	5 960	1 181	3 160	2 437	363
All groups	6 064	1 386	3 099	2 584	381

Table 5.4 shows the composition of off-farm income. Remittances by migrated household members constitute the largest component for all

household groups. These contribute an average of 62 per cent of off-farm income. Households with less-educated people (group 1) obtain a relatively large share of their off-farm income (27 percent) from agricultural employment. Households with no oxen (group 2) rely more on local non-agricultural employment (43 percent of their off-farm income). For households with oxen and 1 or 2 educated members (group 3), remittances from migration are the main sources of off-farm income (77 percent). Somewhat surprisingly, however, households with oxen and 3 or more educated members (group 4) rely less on migration remittances, but relatively more on local non-agricultural employment.

Table 5.4
Composition of off-farm incomes per household group (Yuan)

Household Groups	Agricultural Wage Employment	Non-agricultural Employment	Self-employment	Remittance from Migration	Total
Group 1	356	56	173	750	1 335
Group 2	0	1 441	286	1 657	3 384
Group 3	226	134	332	2 326	3 018
Group 4	178	685	273	1 302	2 437
All groups	197	513	279	1 595	2 584

Output Markets

Food produced for domestic consumption makes up a large share of total farm production. Since land is distributed equally across households, all households grow paddy and vegetables. Only a few households buy rice for their own consumption. On aggregate, all household groups are net rice sellers. Although some households with several or all their 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 the village. Although the rent for land is mostly paid in rice, it is sometimes not enough to meet their consumption needs.

The quality of one-season rice is better than that of late rice and particularly early rice. Hence, less two-season rice is sold: 6.6 percent of the produce, compared to 13 percent of one-season rice (Table 5.5). Vegetables are almost entirely for self consumption, and perennial crops are

largely marketed. Overall, the share of livestock products that are commercialized ranges from about one-third to about two-third in value terms. Group 2 (households with no oxen) sells no two-season rice but sells the largest share of its livestock products.

Table 5.5
Percentage of main crops sold (%)

Households	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

Agricultural Labour Market

The agricultural labour market shows greater diversity (see Table 5.6). Non-household labour in agricultural production is mainly used in rice and perennial crop production and come in two forms: exchange and hired labour. Exchange labour is used only in rice production, while hired labour is used in both rice and perennial crop production. 31 percent of the households use exchange labour in one-season rice production, while 12 percent use hired labour. These large shares of exchange and hired labour show the existence of seasonal agricultural labour markets in the village. The household groupings vary in the extent to which they make use of them: There are broad similarities in the use of these two forms of labour between groups 1, 3 and 4. Group 2 (with no oxen and one educated household member), however, makes relatively little use of exchange labour and significantly more use of hired labour. All the household groups, except group 2, are net agricultural labour sellers. Group 2 employs 11 percent of the total village agricultural labour, the remainder is employed outside the village.

Table 5.6
Percentage of households using exchange and hired labour in rice and perennial production (%)

Household Groups	Exchange Labour		Hired Labour		
	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

Land Rental Market

The land rental market is more developed than the agricultural labour market; with 46 percent of households in the village participating in land rental activities, which take place between households residing in the village. Some 20 percent of cultivated irrigated land is rented (Table 5.7). However few households participate in renting dry land or forestland. Thus, the discussion below only refers to irrigated land. Table 5.7 compares the land rented from other households and the contracted land for different household groups. Contracted land is the land contracted from the village collective or villagers' group; rented land is the area rented from other households within the village. The percentage of land rented for one-season rice production is much higher (17 percent) than that for two-season rice production (3 percent).

Table 5.7
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

Land lease contracts normally last only one year or a half year. In 2000, institutional barriers were reduced in the village, and farmers had greater freedom to rent out their contracted land. Previously it was risky to rent out contracted land, as it remained possible for the village collective or villagers' group to reallocate rented land to others because of quota obligations or other reasons.

Group 2 (no oxen) does not rent in land to expand agricultural production. The other three groups, however, rent between 24 and 28 percent of the land that they cultivate, mainly for growing one-season rice (Table 5.7). Each group has few households that rent out land. Yet only group 2 is a net 'seller (renting out)' in the land market, with other groups being net 'buyers. The biggest 'absentee landowners' in the village are the group of households whose entire family or labour force participates in off-farm activities, especially in migration ('absent landlords'); they rent out all or a large share of their land. However, these households could not be interviewed and therefore were not included in the sample. This group provides the vast majority (97%) of contracted land to the rental market, with the rest coming from group 2

Oxen Rental Market

Oxen are an important production factor, and are used in preparing land for rice and (to a lesser extent) vegetable production. Keeping oxen is a time-consuming activity and normally is the responsibility of children or elderly people. The oxen rental market functions to a some extent, with 4 percent of the households hiring oxen for one-season rice production. Group 2 (no oxen ownership) is the main group that hires oxen. Group 3 and 4 are the main suppliers.

Credit/Savings

More than half of the households in *Shangzhu* village stated that they obtained credit in 2000, and that most credit was received in cash. Only 32.8 percent of the borrowed amount was obtained from households in the same village, usually from friends. The remaining 67.2 percent mainly came from relatives and friends outside the village. Banks, credit cooperative agencies, some shops, and individuals also lent money or lent in kind, but there were few such cases. The picture of the village credit market derived from the survey is an unbalanced one in terms of money borrowed and lent. This is partly because most households are not

willing to be seen as moneylenders and partly because some of the households who are most likely to lend money, the 'absentee landowners', were not interviewed.

5.3.3 Resource use

Agricultural production in the village affects soil quality and environmental quality in a number of ways. Green manure crops planted during the previous year are important for the yield of the current year and can reduce chemical fertilizer (nitrogen) and manure application substantially. Using green manure needs more labour but less capital than chemical fertilizer. The area planted with green manure area has decreased gradually each year. In 2000, two-season rice was substantially more likely to have been preceded by green manure in the previous year than one-season rice (see Table 5.8). The reduction of green manure planting contributes to soil problems, such as natural compaction or soil blocking (Kuiper et al. 2001, Wei et al. 1999). Rice production with green manure helps to improve the soil.

Table 5.8
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

Note: n.a.= not applicable.

However Table 5.9 shows that two-season rice is also more likely to have fertilizer applied than one-season rice. One-season rice is cultivated will receive close to half the dose of land with two-season rice (Table 5.9). In this respect a shift from two-season rice to one-season rice may be beneficial for soil quality and environmental quality. However, the application of pesticides and herbicides to one-season rice is higher than that in two-season rice, because the planting period of one-season makes

the crop more susceptible to diseases. Animal manure is another important environmentally friendly soil input that substitutes for chemical fertilizer. This is more widely used on two-season rather than one-season rice. However as there is no manure market, its application is closely linked to household livestock production. A decrease in livestock production therefore means a reduction in manure availability and possibly also in manure application.

Table 5.9
Use of chemical fertilizer, pesticide, herbicide, and manure per household group (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

5.4 The Social Accounting Matrix of *Shangzhu* Village in 2000

The structure of the SAM for *Shangzhu* is shown in Table 5.10. It comprises 7 main entries (activities, commodities, factors, institutions, government, savings and investment and outside village). While it is similar in some respects to the model used by Taylor & Adelman (1996) there are also a few deviations from it. Firstly, it treats migrants as part of the household labour endowment, and migration as an activity and commodity (service). Taylor & Adelman (1996) only include the remittances from migration as factor incomes from outside the village, assuming that migrants are not available for activities in the village. However, the migration of rural households has to be treated as part of a household's livelihood strategy, rather than a permanent change of status, because institutional constraints such as the urban registration system (*Hukou*) often discourage migrants from settling permanently in urban areas (de Brauw 2001).

Secondly, this model has disaggregated all the activity, commodity and factor accounts at the level of the household group. Thus, the resulting SAM shows the differences that exist between household groups in factor market participation, productive activities and consumption. Savings and investment are used as the balance account in order to balance the rows and columns. Household expenditure is more likely to be overstated and less accurate, hence the savings and investment account is preferred as a means of balancing income and expenditure of household groups.

In Table 5A.4 (in appendix), each sub-account within every main entry is presented in detail. Activity accounts are divided into two major parts, production activities and factor transaction activities (for example land, labour and oxen rental activities). Production activities are further divided into rice production, vegetable production, perennial crops, livestock, manure production and fuel wood collection. Rice production has been sub-divided into four types of production (one-season rice with and without green manure planted in the preceding year, and two-season rice with and without green manure planting in preceding year). Because of the focus of this study on sustainable resource use fuel wood collection and manure activity are included as separate activities.

Commodity accounts are divided into products (agricultural and manufactured), services and rented factors. Factor accounts are divided into irrigated land, dry land, forestland, poorly -educated labour, well-educated labour and capital, as these are the factors that households in the village have available. The institution account distinguishes five household groups, with the last one representing households that are absent from the village, who provide much of the rented land in the village, while receiving income from rents. The last two accounts in Table 5.10 have not been sub-divided. The government account includes both the village committee and township government. These were kept together in order to simplify the analysis. The rest of the world account refers to the world outside the village; linked to activities within village through trade.

Total village GDP is 3,133,590 Yuan. The relative importance of different production activities (derived from the SAM) is given in Table 5.11.The most important sources of farm income are: one-season rice (14.5 percent), perennial crops (18.9 percent) and livestock production (11.8 percent). Two-season rice and vegetable production provide mu

Table 5.10
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 c. Manure activity d. Fuel wood Collection e. Factor Renting f. Agricultural Labour g. Non-Farm Activities h. Migration i. Transactions j. Leisure		A. Village Production Factor Transactions						*Total Production and Transactions*
2. Commodities:								
a. Agricultural Products b. Manure c. Fuel Wood d. Rented Factors e. Agricultural Labour f. Non-Farm Activities g. Migration h. Transaction i. Leisure	B. Village Input-output table C. Transaction activities			D. Household Consumption	E. Taxes in kind to Government	F. Seeds for Next Year G. Capital Investments	I. Goods and Services Exports	*Total Demands*

Continued

j. Agricultural Inputs k. Livestock Feed l. Other goods								
3. Factors: a. Labour b. Land c. Capital	J. Value-added in village production							*Factor Income*
4. Institutions: a. Household Groups			K. Payments to Households				L. Family Remittances	*Household Income*
5. Government:				M. Taxes in cash				*Government Income*
6. Savings and Investment:		N. Seeds from last year		O. Saving				*Total Savings*
7. Rest of World:		Q. Imports	Imports		R. Transfers			*Imports*
8. Total:	*Total Costs*	*Total Supply*	*Total Factors*	*Household Expenditures*	*Government Expenditures*	*Total Investments*	*Exports*	

smaller contributions. Agricultural off-farm work contributes only 3 percent to the total village GDP. A very important sector is the off-farm sector, which accounts for 44.9 percent of GDP. Income from migration activities, particularly from educated labour, is the most important component of off-farm GDP (24.2 percent).

Table 5.11
Village GDP distribution among activities

Contribution to GDP (in percentage)			
Sector	**Percentage**	**Sector**	**Percentage**
One-season rice	10.1	Agricultural work by low educated labour	1.8
One-season rice and green manure	4.4	Agricultural work by high educated labour	1.6
Two-season rice	1.8	Non agricultural work by low educated labour	0.5
Two-season rice and green manure	2.2	Non agricultural work by high educated labour	8.4
Vegetables	4.8	Local business by low educated labour	0.8
Perennial crops	18.9	Local business by high educated labour	4.1
Livestock	11.8	Low educated labour migration	3.5
Manure production	1.2	High educated labour migration	24.2
SUM on-farm	55.2	SUM off-farm	44.9

5.5 Model and Simulations

5.5.1 Model

To examine the impact of off-farm employment on factor and variable input use and on agricultural production within the village, a SAM multiplier model was applied. While household models can capture household responses to outside shocks, they do not cover interactions among households. When household linkages within a village are strong such indirect effects can be very important. In such cases village-wide models that capture such linkages are needed for policy analysis in such cases

(Taylor & Adelman 1996). SAMs and village SAM multiplier models have been applied to villages in Mexico, Zambia and India, to examine the village-level implications of policy options and recommend appropriate development strategies (Taylor & Adelman 1996, Holden et al. 1999, Parikh & Thorbecke 1996, Adelman et al. 1988). This study uses a village SAM multiplier model to examine the impact of off-farm employment on factor and variable input use, farm production, and farmland production capacity change.

A village SAM multiplier model can be used to analyse the impact of remittances from non-farm employment and income from self-employment on agricultural production and household groups' patterns of input use. Such changes reflect the income effect of off-farm employment, which is one important element of off-farm employment. However, this approach does not capture is the effect of reduced labour availability or reduced consumption by absent household members involved and migration. In a village SAM multiplier model all the production and consumption relationships within a village are linear, and substitution effects (e. g. between labour and other inputs in farm production) are not taken into account. This type of model gives insights into the linkages between different production sectors and into the income/expenditure effects within the village that may arise from changes in the renting in and out of production factors. They capture the direct and indirect income and demand effects, but not the local price variations that result from changes in income and demand. These can be analysed using multi-market or computable general equilibrium (CGE) models (see chapter 6). This chapter focuses on the income and expenditure effects of off-farm employment on different household groups within a village.

Three accounts in the village SAM are considered to be exogenous; these are rest of world (i.e. outside the village), government, and savings 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.

Following Parikh & Thorbecke (1996), fixed price multipliers can be obtained as follows

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

In this equation dy_n is the change in production or incomes from village activities (all endogenous accounts), dx represents an exogenous change in the demand for village goods (exports) and services (labour exports), A_n is the coefficient matrix of average expenditure propensities, and I and M_A are the identity and the 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.

For the purpose of analysis a total injection of 156,680 Yuan (5 percent of the village GDP), was used as a basis for policy simulation. Five scenarios are presented:

1) With rapid economic growth and urban expansion, farmers will have more opportunities to work in the urban sector; labourers with a high education level are most likely to find a job and get higher payment. Hence, the first scenario is an increase in income from the migration of well-educated labour to the urban sector.
2) Assuming migration activities maintain the same pattern as before, poorly -educated and well-educated labour migration will increase proportionally. Hence, in the second scenario the additional income in injected as flowing proportionally to these two groups.
3) Development of the local economy is one important way to promote rural development, as local non-farm activities have strong linkages with farm production. Hence, instead of migration, the same income was injected into local non-agricultural employment and self-employment. It is assumed that only high-educated labour has access to this type of employment.
4) The fourth scenario assumes that both well - and poorly -educated labourers have access to local non-agricultural employment and self-employment and the injection of income is distributed proportionally.
5) Poor rural infrastructure is a main cause of rural poverty. Hence, an alternative scenario is for the government to invest 99,100 Yuan (around 60 percent of the total injection) into local non-agricultural employment involved in infrastructure construction. This injection is assumed to be proportionally distributed between the two labour groups. In addition, the village road construction resulting from this public investment is assumed to increase the demand for rice, vegetables, perennial crops and livestock products from outside the vil-

lage: to the value of 7,842, 225, 28,160 and 21,339 Yuan respectively. Thus the total injection is once again 5 percent of the village GDP.

5.5.2 Simulations

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

The simulation results for the production of major crops and livestock are shown in Table 5.12. The figures in the table show the percentage changes compared to the base situation represented in the SAM, (a protocol followed in the remaining tables). In most cases it is the household groups that experience the largest direct income gains that expand their crop production the most. Additional income from off-farm activities is mainly spent on food (annual crops). When comparing the results for scenarios 1 and 2, it is evident that income from the migration of poorly educated households has a strong positive impact on annual crop production activities and livestock production of group 1. Comparing scenarios 2 and 4 shows that an increase in off farm employment among poorly-educated households has a much smaller effect on annual crop and livestock production than when the same group migrates. Infrastructure investment (scenario 5) raises the production of perennial crops and livestock by increasing external demand for these products. Local off-farm employment (scenarios 3 and 4) especially benefits group 2 (households without oxen) which is less involved in agricultural production and obtains a relatively large share of its income from local non-agricultural employment (Table 5.4).

Of these five scenarios, infrastructure investment gives the best results in terms of stimulating agricultural production (6.6 – 7.1 percent increase). The migration of poorly and well educated labour has a stronger impact on production activities than the other three scenarios, and local off-farm employment of well-educated labour shows the smallest effects. The latter scenario mostly benefits group 2, which is the group with the weakest economic links with the others.

Table 5.12
Simulation results for farm production (% output changes)

Farm production		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 5.13 presents the resultant changes in the use of those inputs that affect the quality of soil and the environment. The village level SAM only draws out the differences in manure production between the different household groups. Manure is an output from livestock production, and any increase in manure production is directly related to the changes in livestock production resulting from increased off-farm incomes. By contrast, the use of fertilizer, pesticides and herbicides is not subdivided

by household groups in the village SAM and these are therefore presented as aggregate results.

At the aggregate level, scenario 5 causes the largest increase of manure production, and also of fertilizer, pesticide and herbicide use. The other four scenarios show broadly similar tendencies in terms of agricultural production. The increase in manure production is slightly higher than that of fertilizer, pesticide and herbicide use in all four scenarios, which seems to indicate that land productivity and environmental quality will improve slightly.

It should be noted that these results only show the effects of the additional incomes earned by off-farm employment. They do not show the impact of reduced labour availability as this was not captured in the SAM multiplier model. Because manure application is a relatively labour-intensive activity, the results in Table 5.13 are likely to change when changes in opportunity costs of labour are taken into account. This requires a change in the modelling approach from a fix-price to a flex-price model, which is outside of the scope of this chapter, but is dealt with in chapter 6.

Table 5.13
Simulation results for input use (% changes)

Input use scenario		1	2	3	4	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
Chemicals	Fertilizer use	5.43	5.61	5.29	5.38	6.60
	Pesticides and herbicides	5.50	5.62	5.50	5.56	6.72

The simulation results for village factor market participation are shown in Table 5.14. The SAM uses one single account for agricultural labour hiring, so it is not possible to distinguish between household groups, only between poorly and well educated workers. Once again the infrastructure investment scenario (scenario 5) shows the largest impact on local agricultural labour markets – for both categories of labour. All

five scenarios show a slightly higher impact on agricultural employment amongst well educated workers except for the low- and high-educated migration scenario (scenario 2).

The infrastructure scenario also shows the largest impact on the renting of land and oxen. It may therefore be concluded that local infrastructure investment is the most effective way of stimulating the development of local factor markets. Migration (scenarios 1 and 2) particularly stimulates land renting in by household group 3, the group most involved in migration (see Table 5.4). Non-agricultural wage employment and self-employment (scenarios 3 and 4), on the other hand, mostly stimulate land renting in by group 4, one of the two groups that earn most from this type of employment (group 2 does not rent in land; see Table 5.7). The renting out of oxen is more stimulated by non-agricultural wage employment and self-employment than by migration (see last two rows of Table 5.14). The same scenarios (3 and 4) also have a much larger impact on oxen renting in by group 2, the group that is most involved in non-agricultural wage employment and self-employment (Table 5.4) and has the higher production increase.

Scenarios 1 and 3 simulated the effects of income increases for well-educated labour, which group 1 does not possess. The changes in participation in land, oxen rental markets and agricultural labour hiring for group 1 in these two scenarios therefore present the indirect effects on this group of income increases in the other groups. Under both scenarios their involvement in renting in land and oxen increases greatly, and this is significant as this group depends more on agriculture for its income than the others (Table 5.2).

Table 5.14
Simulation results for factor market participation (% changes w. r. t base situation

Factor Market Development Scenario		1	2	3	4	5
Agricultural Labour Hiring	Agricultural employment by low-educated labour	3.18	3.53	2.56	2.64	5.61
	Agricultural employment by high-educated labour	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

Continued						
	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 land-lords	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 5.15 shows the simulation results for household income levels among the four groups. As expected (see Table 5.4), group 3 benefits most from migration (scenarios 1 and 2), while groups 2 and 4 benefit most from off-farm wage employment and self-employment (scenarios 3 and 4). The migration of poorly and well educated labour (scenario 2) has the highest impact on average incomes, while infrastructure investment (scenario 5) has the smallest impact. Under scenarios 1 and 3, group 1 benefits from village market exchanges by around 2 percent, less than half of the 5 percent injected into the economy in this scenario analysis. Total income gains in the village are strongest under scenario 2 (increase in migration for poorly and well educated labour). The indirect effect on village income under this scenario equals 7.49 – 5.00 = 2.49 percent.

Table 5.15
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

5.6 Summary and Conclusions

This chapter has examined the impact of off-farm employment on farm production, factor market development, and factor use and variable input use in farm production for *Shangzhu* village, a remote village in Northeast Jiangxi Province. Four household groups were distinguished within the village, using on the number of educated household members (as a resource for earning off-farm income) and oxen ownership (as a resource for earning agricultural income) as criteria.

More than 30 percent of the households use exchange labour in one-season rice production, and 14 percent use hired labour. This relatively high proportion of exchanged and hired labour shows the existence of seasonal agricultural labour markets within the village. Three of the four groups show similar balances their use of hired –in and exchange labour (and the proportions thereof). Group 2 however (the group that does not own oxen), uses little exchange labour and relatively more hired labour. All household groups except for group 2 are net agricultural labour sellers.

The land rental market is more developed than the agricultural labour market; with 45 percent of households in the village participating in land rental activities, which take place between households residing in the village. Some 20 percent of the cultivated irrigated land is rented. Only a few households participate in dry land and forestland renting. Group 2 (no oxen) does not rent land to expand agricultural production. The other three groups, however, rent between 24 and 28 percent of their cultivated land, mainly used for growing one-season rice. Group 2 is the only net seller (renting out) in the land market, the other groups are net buyers (renting in).

There is a smaller oxen rental market, with 4 percent of the households hiring oxen for one-season rice production. Group 2 (no oxen ownership) is the main group that hires-in oxen. Of the three groups that own oxen, the ones with at least one well-educated member (groups 3 and 4) are the main suppliers of oxen services in the village.

In contrast to the markets for agricultural labour, land and oxen services, the market for credit is not limited to the village. More than half of the households in the village receive credit, but only one third of the amount borrowed is obtained from households within the same village. The remaining two third mainly comes from relatives and friends outside

the village; banks, credit cooperative agencies, and shops play a negligible role.

The impact of increased incomes from off-farm employment on farm production, factor use and variable input use and income change for the four household groups was examined by means of a village SAM multiplier analysis. Five different scenarios are distinguished, each providing a total injection equal to 5 percent of the village GDP. It was found that infrastructure investment (scenario 5) gives the best results in stimulating agricultural production. It has, however, the smallest impact on household incomes. Of the other four scenarios, the migration of poorly and well educated labour (scenario 2) shows a stronger impact on all production activities and has the largest impact on household incomes.

Government investment in infrastructure also has the largest impact on local agricultural labour markets (for both categories of labour) as well as on renting land and oxen. Factor market development within the village is most stimulated by local infrastructure investment. Migration mostly stimulates land renting in among the household group that mostly involved in migration, while local off-farm employment mostly stimulates land renting by one of the two groups that earn most from this type of employment (the other group does not rent in land). Oxen renting is stimulated much more by local off-farm employment than by migration.

The simulation results also reveal that off-farm employment tends to have a small positive effect on land productivity and environmental quality, because manure application increases more than chemical input use in all scenarios, except the infrastructure investment scenario. It should be remembered, however, that manure application is a relatively labour-intensive activity and the impact of reduced labour availability bought about by off-farm employment cannot be analysed with a SAM multiplier model.

The analysis shows considerable indirect income/expenditure linkages within the village. Total income gains within the village range from 6.8 to 7.5 percent, implying that indirect income/expenditure gains amount to 1.8 to 2.5 percent. This is also evident through the household group with no well educated household members (group 1), which sees its income increase by around 2 percent in response to increases in the off-farm incomes of households with well educated members (scenarios 1 and 3).

SAM multiplier models can provide useful insights into the linkages between households and into the strength of income/expenditure linkages. However they do not take into account the potential changes in village prices for production factors and other commodities that are only traded within the village. A village CGE model is needed to incorporate such general equilibrium effects into the analysis and such an analysis forms the basis of chapter 6.

Notes

1. A paper based on this chapter and part of chapter 2, is published in Spoor et al. (2007), pp 181-209.

2. More specific linkages between household decisions and LPC and EQ are explained in chapter 2, the impact of off-farm employment on LPC and EQ will be mediated through these linkages.

3. Figures for available dry land area are omitted from the Table as these were very small.

5 Appendix:

Table 5A.1
Description statistic for education level (years of schoolings) of all labour force of four household groups

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

Notes: Group 1: Households with no educated persons more than 4 years;
Group 2: Households with no oxen, at least 1 person educated more than 4 years;
Group 3: Households with oxen, 1~2 persons educated more than 4 years;
Group 4: Households with oxen, 3 or more persons educated more than 4 years.

Table 5A.2
Results of t-tests for differences of household size and number of labourers among four household groups

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

Notes: Group definition is the same with 5A.1.
All t-values presented below the diagonal refer to differences in household size between the two groups in question. The t-values presented above the diagonal refer to differences in labour force sizes. A positive sign of the t-value indicates that the mean value for the group listed in the column group exceeds the mean value of the group listed in the row. If the value is negative, the reverse is the case.
***, ** and * indicates statistical significance at 1% level, 5% level and 10% level, respectively.

Table 5A.3

Results of t-tests for differences of per capita irrigated contracted land and per capita contracted forest land among four household groups

		Group 1	Group 2	Group 3	Group 4
Per capita contracted forest land		Per capita contracted irrigated land			
	Group 1		0.22	1.59*	0.17
	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 as in Table 10A.1.
All t-values presented below the diagonal refer to differences in p.c. forest land between the two groups in question. The t-values presented above the diagonal refer to differences in p.c. irrigated land. A positive sign of the t-value indicates that the mean value for the group listed in the column group exceeds the mean value of the group listed in the row. If the value is negative, the reverse is the case.
***, ** and * indicates statistical significance at 1% level, 5% level and 10% level, respectively.

Table 5A.4
List of all entries within 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 labour	Oxen	Dry land	Household group 2
Two-season rice	Oxen rent in	Bamboo	Non agricultural labour	Agricultural labour	Forest land	Household group 3
Two-season rice with green manure	Oxen rent out	Straw	Business		Low educated labour	Household group 4
Vegetable		Livestock	Migration		High educated labour	Household group 5
Perennial crops		Livestock manure	Leisure		Capital	
Livestock production		Processed manure				
Manure activity		Fuel wood				
Fuel wood collection		Feed of livestock				
Agricultural works by low educated people		Other inputs of Livestock				
Agricultural works by high educated people		Food				
Non agricultural works by low educated people		Non food				

Continued

Non agricultural works by high educated people	Durable goods	
Self-employment by low educated people		
Self-employment by high educated people		
Low educated people migration		
High educated people migration		

6 Indirect Impact of Off-farm Employment on Factor Market Development and Input Use in Farm Production

6.1 Introduction

Chapter 5 analysed the impact of off-farm employment on factor market development, input use and farm production in a remote village in Jiangxi Province by using a village social accounting matrix (SAM) multiplier model. This chapter will apply a village computable general equilibrium (CGE) model using the same village data set to examine the same issues. The village CGE model overcomes a major limitation of the village SAM multiplier model by incorporating price response, consumption behaviour and allowing for the possibilities of substituting between production factors and inputs. It therefore captures direct and indirect income effects, consumption and leisure effects as well as substitution effects. A comparison of the results of the village CGE model with the village SAM multiplier model is presented in chapter 7.

As discussed in chapters 2 and 4, village factor markets in *Shangzhu* village have already developed to some extent because of increased participation in off-farm employment. The *Shangzhu* village SAM multiplier model captures the additional income effects (both first and second round) of increased participation in off-farm employment. However, all production activities in a village SAM multiplier model are modelled as Leontief technologies which do not allow for substitutions among factors and inputs in farm production or among commodities in consumption. All prices of factors, inputs and commodities in a village SAM multiplier model are fixed as it is impossible to allow for price changes in the model.

The overall objective of this chapter is to examine the effects of off-farm employment on factor market development, input and factor use and farm production, as well as further implications for land production capacity (LPC) and environmental quality (EQ).[1] The impact of increased participation in off-farm employment and rising off-farm income (at a given rate of off-farm participation) will be examined separately. The chapter assesses the extent to which the effects of simulations of increased participation in off-farm employment will differ from increased off-farm wages.

To achieve these objectives, the remainder of the chapter is organized as follows. In section 2, the major characteristics of the *Shangzhu* village CGE model will be presented together with the major differences between it and the SAM multiplier model. In the next section, simulation results for increased participation in off-farm employment and increased off-farm income (at a given rate of off-farm participation) will be presented and discussed, separately. Section 4 compares these two sets of simulations. The last section will include a summary of the main findings and draw some conclusions, focusing on the policy implications.

6.2 Major characteristics of the *Shangzhu* CGE model

The *Shangzhu* village CGE model blends microeconomic household models with so-called economy-wide modelling. Widespread imperfections in village markets imply that the production and consumption decisions of households cannot be separated (Benjamin 1992). In the study area there are particular imperfections in the agricultural labour, land rental and credit markets.. The *Shangzhu* village CGE model incorporates these market imperfections. The model structure and equations are presented in the appendix.

The model consists of five equation blocks: (a) a household production block, (b) a household consumption block, (c) a commodities block, (d) a price block, and (e) a set of village constraints. The village model is an adapted version of the CGE model for *Gangyan* village that was developed within the same project (Kuiper 2005).[2] Specific features of *Shangzhu* village are incorporated into the model, but the basic structure is the same.

The *production block* includes 15 production activities. It consists of rice (including: one-season rice with green manure, one-season rice without green manure, two-season rice with green manure, and two-season rice

without green manure), other crops (vegetables and cash crops), perennial crops (bamboo), oxen, other livestock (pigs, chicken, dogs and geese), manure processing activity, fuel wood collection and off-farm activities (village agricultural labour, local non-farm employment, self-employment and migration).

Rice, other annual crops, perennial crop, other livestock activities (excluding oxen), manure processing and fuel wood collection are modelled as Cobb-Douglas production activities, with inputs including household's own labour, irrigated land, dry land, forest land, oxen service, purchased inputs, renting factors and self-produced inputs.

Oxen production is modelled as a mark-up activity. Inputs include household's own labour, capital, feed, and other inputs. Maintenance of oxen requires both fixed inputs and variable inputs while oxen produce fixed outputs (for instance manure and calves) and variable outputs (oxen services). The combination of fixed and variable inputs and outputs requires the use of a mark-up cost pricing rule. This pricing rule consists of the marginal costs of oxen services plus an extra term (the mark-up) which assures that the price paid for oxen services also covers the fixed costs of oxen production. Oxen service is traded inside the village, and the equilibrium price of oxen services in the village market will adjust to meet the demand and supply of the oxen service in the village markets.

All off-farm activities are modelled as Leontief one. A distinction is made between the off-farm activities carried out by poorly-educated labour and highly-educated labour. Hence all off-farm activities only have one input, either poorly-educated labour or highly-educated labour. This is a rather bold assumption, because various other inputs may in fact be used, especially for local self-employment, where the households involved are likely to need to make certain basic investments. Due to lack of data on those inputs, the modelling of all off-farm activities has been simplified by introducing only one major input in each activity.

Another issue related to modelling off-farm activities is the wage received for off-farm employment, which is substantially different from the shadow wage of household labour.[3] To handle that problem, different types of off-farm employment are treated as different types of off-farm products, with the assumption that all the product prices of off-farm activities are exogenous (village tradable products[4]) with the exception of village agricultural labour.

During field visits, it was found that the agricultural labour market is an internal village market. During the peak season, the wage rate for agricultural labour is much higher than the shadow wage for household labour. As discussed in chapter 4, hiring labour for agricultural production mainly takes place during the peak season, and the labour input intensity during that period is much higher than household labour input in other seasons. The wage rate for agricultural labour for the peak season was obtained, and the calculated shadow wage for household labour refers to a whole season or even one year. Hence, it is not surprising that a large difference was found between them. To account for this seasonality, the wage rate for agricultural labour was fixed at the observed level in the *Shangzhu* SAM. This also reflects observations from the field visits that the wage rate of agricultural labour normally is adjusted on an annual base and this price is generally common knowledge in the village. The wage rate of agricultural labour is fixed informally, and does not necessarily need to be negotiated each time.

The demand and supply of agricultural labour in the village market needs to be balanced by adjusting quantities of labour, given the fixed labour hiring price. Given seasonality and general labour surplus we assume that the village market for agricultural labour is driven by the demand for labour, and supply follows demand. As there is fixed agricultural labour wage in the village during the peak season, it is impossible for household groups to compete with each other on price. It is therefore assumed that household groups participating in the village agricultural labour market supply a fixed amount of labour equal to the level observed in the SAM.

As mentioned above, the product prices of off-farm activities are fixed. However, the product prices of off-farm employment differ from the input price (the shadow wage of household labour). Hence, profits for off-farm activities are introduced into the model. Profit is the outcome of subtracting the labour input cost from the values of each type of off-farm employment output. Profits from off-farm activities can be negative or positive, depending on the differences between input and output prices. For some groups the profits from migration are negative because the survey only recorded remittances. Migrants usually send only a part of their income back home, because they spend part of their income where they work and live.

As explained in chapter 2, farm households that want to get involved in off-farm activities face some major constraints (such as *Hukou* system), which restrict farm households from participating as much as they would like in off-farm employment. Thus, although the returns from off-farm activities are much higher than those from farming, some households cannot participate in off-farm employment, while other households participate less than they would like. In the *Shangzhu* CGE model, therefore assumes that opportunities for off-farm employment for each household group are fixed, and sets these at the level observed in the SAM.

To simplify the CGE model construction, it is assumed that the products produced by local non-farm activities and self-employment are sold only to outside village markets. In reality, however, households in the village may consume part of the produce of self-employment. However, lack of data prevents making a realistic distribution between self-consumption and market sales in the model. This will reduce the impact of local linkages in assessments of the impact of non-farm activities on household's other production activities, consumption and incomes, and the shocks in local non-farm activities and self-employment may therefore differ less from that of a shock in migration.

Land rental activities are very important as many households in the research area are involved in this activity. As discussed in chapter 4, absentee households (either whole families that have migrated outside the village while keeping their rural citizenship, or families in which the adults have migrated and left their children at home) are the major suppliers of land to the village land rental market, leasing their land to households that remain in the village. One household group in the village also rented out land but its share of the total is small. Incorporate these features of the land rental market into the model is very problematic. First, because the extent to which absent households will return to the village is not known. Since it was not possible to interview these households, the reasons for migration and likelihood of it becoming permanent are not clear, nor is there precise information about the sizes of these absent households. Second, modelling land rental activities in the village model involves a knowledge of the institutional features (such as how often adjustments are made to contracted land) at the county, township, and village level that affect land renting activities. Only limited knowledge about these factors was available. Hence, the level of land

rental activities in the model was set at the level observed in the village SAM.

The *consumption block* includes all the commodities which households produce themselves or buy from outside the village as well as leisure (both for poorly-educated labour and highly-educated labour). Consumption decisions of different types of households are modelled as Cobb-Douglas utility functions. The utility function implies that households spend a fixed share of their incomes on different groups of consumption goods. Goods which are village tradable have exogenously determined prices and changes in income will result in changes in the quantity of those goods consumed. However, for household non-tradable goods adjustments to the quantity consumed will also depend on shadow price changes arising from changing incomes of household groups.

The *commodities block* consists of a set of household commodity balances to complete the household component in the village model.

The *price block* specifies the relevant decision-making prices for the households. Price bands between effective purchase prices and effective sale prices have been introduced into the model. Households choose their position in the market depending on the differences between household shadow prices and effective market prices. Prices for village tradable commodities are determined exogenously, those for village non-tradables are determined at the village level, while the prices of household non-tradables are determined by household demand and supply.

As discussed in chapter 5, there are four household groups, differentiated according to education level and ownership of oxen. Initially two of these groups are net renters out of oxen and the other two household groups are net renters in of oxen although one of the groups does own oxen and produces its own oxen services themselves. The household groups without draught animals will rent oxen services in until the marginal return from the service is equal to the price for the service in the village markets. The situation for household groups owning draught animals is more complicated. The shadow price of oxen services for each household group should be equal to the marketed oxen service price in the village market. Hence, each household group will make a decision on renting in or out oxen services depending on its producer costs for and demand for these services.

The *village constraints* block is an important feature of the village model that is absent in household models. Village constraints complete the village model by adding trade balances for commodities traded within, but not outside, the village. These trade balances determine the price of village non-tradables by balancing total demand and supply within the village for each village non-tradable. In the case of village tradables, the total flow of money in and out of the village (summed over all village tradables) needs to balance. These money flows are captured by a village balance of payments[5], recording all money flows (also including remittances received by households) in and out of the village.

6.3 Policy simulations

With the continued rapid economic growth and expansion of the urban sectors in China, more job opportunities will be created and more rural labourers will move to the urban sector (De Brauw et al. 2002, Zhang & Song 2003, Zhu 2003). Thus we firstly simulate an increase in off-farm employment by simply increasing the percentage of the household labour force working off-farm. This is followed by a simulation of the impact of an increase in the wages (for self-employment is higher income) from off-farm employment at a given rate of off-farm participation. With the rising costs of living in the big cities and the accumulation of human capital by migrant workers, there is a pressure for increasing the wages of migrated labourers in the urban sector and those in local non-farm activities (Cai 2006, Cai & Wang 2005). Increased wages from off-farm employment will affect farm household decision making regarding farm production and input use. In this simulation the share of the labour force participating in off-farm employment is not affected by higher off-farm wages (for self-employment is higher income). Instead the percentage increase in off-farm wages is set equal to the percentage increase of participation in off-farm employment used in the first simulation to allow comparison of the results.

Changes in off-farm employment, especially migration, will lead to a decrease of domestic household expenditure and further impact on household production behaviour. This study will not take the effects of the reduced domestic consumption by absent migrant members into account, as the model, as used, is unable to handle this.

Hence, there will be two bundles of simulations with the *Shangzhu* CGE model. The first will simulate the effects of increased participation

in off-farm employment, and the second will simulate the effects of higher off-farm wages. As in the previous chapter an injection of 5 percent of the GDP of *Shangzhu* village is used. This is distributed proportionally across the three types of off-farm employment[6].

Each bundle contains five scenarios, designed so that they can be compared with the simulations done with village SAM multiplier model in chapter 5. Table 6.1 shows the detailed definitions of each simulation. The first simulation in the first bundle involves a 39.3 percent increase in participation in migration of only highly-educated labourers, and the second simulation takes a 35.8 percent increase in migration of both poorly and highly-educated labourers[7]. This percentage increase is proportional to the shares observed in the village SAM, and is kept constant in the simulations in the second bundle. The third simulation in the first bundle involves a 39.2 percent increase in participation in local off-farm employment (local non-farm employment and self-employment) by highly-educated labourers only. The fourth simulation in the first bundle takes a 36.2 percent increase in participation in local off-farm employment by both highly- and poorly-educated members.

Table 6.1
Simulation definitions

Simulations		1	2	3	4	5
		Migration		Non-farm and self-employment		Non-farm employment
First bundle (Participation) /Second bundle (Increase wage)	Poorly-educated labour	-	+ 35.8%	-	+ 36.2%	+ 32.0%
	Highly-educated labour	+ 39.3%	+ 35.8%	+ 39.2%	+ 36.2%	+ 32.0%
	Price change	-	-	-	-	+2% for outputs -2% for inputs

The fifth simulation in the first bundle involves a 32.0 percent increase in participation of both poorly and highly-educated people solely in local non-farm employment (3 percent of the village's GDP was injected) with a concomitant 2 percent decrease in agricultural input prices and a 2 percent increase in output prices. It was very difficult to find

comparable ways of building an equivalent scenario between the village SAM and the CGE model. In the SAM analysis, 2 percent of GDP was injected to represent an increase of demand for rice, vegetables, and perennial crops and livestock products from outside the village. This same simulation cannot be formulated in the village CGE model, because the model treats demand for those agricultural outputs as endogenous. Hence, it is only possible to simulate price changes for those products in the village CGE model and this is done through a combination of increasing output prices and decreasing input prices.

The second bundle of simulations within the village CGE model focuses on increases in wages from off-farm employment, rather than increased participation. In all these simulations, the percentage increases are the same as in the first bundle of simulations. The fifth simulation, however, consists of a 32.0 percent increase in wages from local non-farm employment for both poorly and highly-educated labourers, while the other part of the injection (2 percent of GDP) is kept the same as before.

6.3.1 Simulation results for increased participation in off-farm employment

Increased participation in off-farm employment reduces the labour available for farm production and households may therefore restructure their farm production and their consumption to adapt to this new situation. The simulated impacts on farm production, input use, the development of factor markets and income are presented in this sub-section.

Farm production

The results for farm production, subdivided by major crops, are shown in Table 6.2. We first discuss the results for simulations 1 to 4 because they are more comparable. The results show that increased participation in off-farm employment causes a shift away from two-season rice, other annual crops, perennial crop and livestock (excluding oxen) production, towards one-season rice production. This increases by more than 9 percent in the first four scenarios. Two-season rice and livestock production (excluding oxen) decrease greatly. The results of the first four scenarios clearly show that farm households shift to less labour-intensive farm production because of reduced labour availability.

In the first four scenarios the levels of decrease in two-season rice and livestock production are much higher (more than 26 percent) than in other annual crops production because a high proportion of other annual crops are for households' own consumption. Hence, there is limited potential for reducing such production. Two-season rice and livestock (excluding oxen) production are more labour intensive and are also linked to each other, because fodder for livestock mainly originates from two-season rice production, with only a small share bought at the market. This is why two-season rice and livestock (excluding oxen) production jointly decline so dramatically. Perennial crop production also decreases in the first four scenarios, but the levels of decline are relatively small.

Increasing migration shows a much stronger impact than increased local off-farm employment on perennial crops and other annual crop production, and to a lesser extent on other production activities,. The reason is that the major group(s) differ in these two simulations. Increased participation in migration mainly affects household groups 3 and 4, the supplier of oxen services in the market. Therefore, they reduce own production and supply more oxen services to the market, leading to a decrease in the price for oxen services in the village market of 6 and 5 percent in the first two scenarios[8], respectively. By contrast, household group 2 is the group most affected by increased participation in local off-farm employment (scenarios 3 and 4). Hence, household group 2 needs less oxen services in scenarios 3 and 4 and household groups 3 and 4 supply less to the market. Oxen service prices therefore undergo smaller changes, and changes in production activities are also smaller in scenarios 3 and 4.

To a certain extent, individual household groups show different responses to these shocks. The main reason is that group one is a net renter of oxen services and group two has no oxen. Hence, a decrease of oxen service prices in the village markets makes groups 1 and 2 shift to production activities which use more oxen services[9]. Household group 1 therefore shows a shift to types of production that make use of oxen service in scenarios 1 and 3. This group 1 has no educated labour (so labour availability for this group decreases in scenarios 2 and 4, but not in scenarios 1 and 3). This group shifts its production to one-season rice

Table6.2

Higher participation: simulation results for farm production (% output changes)

Farm Production		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly & highly-educated migration	Highly-educated local employment	Poorly & highly-educated local employment	Agricultural prices & educated local employment
One-season Rice	Group 1	6.9	8.1	3.4	2.1	0.2
	Group 2	15.4	15.3	6.0	7.0	15.0
	Group 3	12.1	13.3	11.1	10.6	3.4
	Group 4	8.1	10.2	10.6	10.2	-17.1
	All groups	10.0	11.4	9.5	9.1	-5.3
Two-season Rice	Group 1	3.3	-8.3	2.0	-1.5	48.7
	Group 2	-29.3	-27.7	-22.2	-20.7	-16.3
	Group 3	-86.3	-71.2	-48.3	-42.9	29.2
	Group 4	-83.2	-77.7	-53.9	-52.7	49.2
	All groups	-69.9	-64.2	-43.3	-41.5	40.5
Other Annual Crops	Group 1	0.2	-9.1	-2.7	-2.8	-9.9
	Group 2	0.5	0.0	1.2	0.8	-0.6
	Group 3	-10.0	-9.1	-2.2	-2.2	-10.5
	Group 4	-7.5	-7.0	-1.7	-1.8	-8.2
	All groups	-6.7	-7.3	-1.7	-1.8	-8.4

Continued

Perennial Crops	Group 1	-2.6	-4.6	-1.0	-1.3	-17.2
	Group 2	-0.3	-0.4	-1.7	-1.6	-1.3
	Group 3	-2.4	-2.0	-0.1	-0.1	-2.0
	Group 4	-9.7	-8.2	-0.8	-0.7	-10.3
	All groups	-4.8	-4.3	-0.7	-0.7	-6.3
Livestock (Excluding oxen)	Group 1	17.8	-9.3	4.5	-2.3	117.9
	Group 2	-21.9	-21.2	-16.1	-15.1	-11.7
	Group 3	-45.9	-46.0	-31.4	-29.8	5.2
	Group 4	-46.0	-45.9	-33.6	-32.7	42.9
	All groups	-37.5	-39.1	-27.3	-26.7	26.5

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 to 2 educated members;
Household group 4: draught power and more than 3 educated members.

only when labourer availability and oxen service prices decrease, under scenarios 2 and 4. However, there are also differences in the response of household group 1 in scenarios 1 and 3. Although this group does not experience any direct decrease in its labour availability, it increases the labour hiring out because of additional demand in scenario 1 but decreases its hiring out of labour in scenario 3 (changes in hiring out labour are explained later this chapter). In scenario 1, demand for hiring out labour increases by other groups and household group 1 has to supply more hiring out labour and decreases its labour availability with lower oxen service price in the village market. Hence household group 1 increases its livestock production by 17.8 percent in scenario 1 and increases its two-season rice production by 3.3 percent to supply fodder. The responses of household group 1 in scenario 1 are stronger than that in scenario 3.

Household group 2, the group with no oxen, shows a shift to producing one-season rice and other annual crops in the first four scenarios, with the shift to one-season rice being stronger in scenarios 1 and 2 and the shift to other annual crops being stronger in scenarios 3 and 4. This is because this group experiences the most income gains (see Table 6.6) in these two scenarios and experiences a greater decrease in labourer availability (due to higher participation in local off-farm employment). Household group 2 tries to increase other crop production to meet its own consumption needs in scenarios 3 and 4, thus explaining the lower level of increase in one-season rice under scenarios 3 and 4, compared to scenarios 1 and 2.

The simulated responses of household groups 3 and 4 show consistent patterns across the first four scenarios. In the village SAM, household groups 3 and 4 were observed to rent out oxen in village markets and have a relatively high proportion of their labour involved in migration. Hence, the effects of reduced labour availability for these two groups of households are much stronger in scenarios 1 and 2 than in scenarios 3 and 4. For example, household group 4 decrease perennial crop production by 9.7 percent and 8.2 percent in scenarios 1 and 2, respectively, but only by 0.8 percent and 0.7 percent in scenarios 3 and 4. Changes in other crop production show similar tendencies.

The fifth simulation includes not only increased participation in local non-farm employment (for both poorly and highly-educated household members) but also increased input and decreased output prices of agri-

cultural commodities. Household group 1 increases its livestock production dramatically (by 117.9%) because of the increasing profitability of livestock production and reduced labour availability (due to increased leisure consumption) and increases two-season rice production to provide fodder. Household group 2 has the highest labour constraints (with a high share of income from local non-farm employment) and for them agricultural production is less important. For this group livestock production is a labour-intensive activity, whereas for other three groups it is capital-intensive. Hence, the farm production of household group 2 shifts from livestock to less labour-intensive (one-season rice) production. The other three groups shift to capital-intensive livestock production and two-season rice production.

The responses of household group 1 to scenarios 1 and 3 clearly demonstrates the indirect effects of off-farm employment on their farm production, due to this group 1 having no highly-educated members. The responses of this group to these two scenarios are caused by changes in the price of oxen services in the village market and the availability of hired labour.

Green manure

Each type of rice production (one and two year) is divided into two subtypes according to whether or not green manure was applied in the fields in the previous year. Applying green manure is a very important and traditional method for maintaining soil fertility in *Shangzhu* village. It decreases fertilizer use in the following year. The effects of higher off-farm employment on these four different sub-types of rice production are presented in Table 6.3.

The general effects of reduced labour availability on shifting between one-season and two-season rice vary. At the village level, all four scenarios increase the production of one-season rice with green manure, while one-season rice without green manure decreases in scenarios 1 and 2 (but hardly changes in scenarios 3 and 4). Both sub-types of two-season rice production decline in all four scenarios. It seems that the reduced labour availability in these four scenarios is largely responsible for these switches in rice production switches.

Table 6. 3

Higher participation: simulation results for rice production switching (% changes)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly and highly- educated migration	Highly- educated local employment	Poorly and highly- educated local employment	Agricultural prices and educated local employment
One-season Rice without Green Manure	Group 1	28.7	30.2	20.2	10.0	20.7
	Group 2	61.4	61.2	22.3	28.4	60.7
	Group 3	-7.4	8.4	10.0	12.2	21.3
	Group 4	-89.2	-63.3	-20.8	-22.0	-86.7
	All groups	-28.0	-11.7	0.4	0.03	-17.4
One-season Rice with Green Manure	Group 1	-100.0	-100.0	-78.7	-36.6	-100.0
	Group 2	-100.0	-100.0	-35.0	-46.5	-100.0
	Group 3	125.0	41.4	17.8	0.9	-100.0
	Group 4	167.6	130.5	62.3	63.1	96.9
	All groups	112.9	74.1	33.9	33.5	27.4
Two-season Rice without Green Manure	Group 1	231.5	308.6	48.5	54.0	609.5
	Group 2	-29.3	-27.7	-22.2	-20.7	-16.3
	Group 3	-74.2	-45.9	-2.8	-0.1	142.9
	Group 4	-66.3	-55.4	-24.7	-24.0	153.8
	All groups	-48.2	-28.9	-13.5	-11.8	161.1
Two-season Rice with Green Manure*	Group 1	-57.3	-92.3	-10.4	-16.2	-100.0
	Group 3	-100.0	-100.0	-100.0	-91.5	-100.0
	Group 4	-100.0	-100.0	-82.9	-81.3	-55.0
	All groups	-91.0	-98.4	-72.1	-70.2	-76.3

Notes: Household group 1: no educated members; Household group 2: no draught power and more than 1 educated member; Household group 3: draught power and 1 and 2 educated members; Household group 4: draught power and more than 3 educated members; * Household group 2 has no two-season production with green manure.

The responses of household groups 3 and 4 differ from those of household groups 1 and 2 in the first four scenarios, but responses within these two groups also vary. The responses of household group 3 show that it tries to avoid labour-intensive production and to expand production that needs more external inputs. This group decreases its supply of oxen services to the village market (see Table 6.5). Household group 4 greatly increases its one-season rice production with green manure and substantially decreases its use of green manure in both one, but particularly two-season rice production, this to enable it to increase its supply of oxen services to the village market and avoid cash constraints (this is more pronounced under scenarios 1 and 2). Increases in cash availability for household group 4 mean that, the extent of change under scenarios 3 and 4 on one-season rice switching are less than under the other scenarios. It seems that, for this group, the marginal return of using own oxen is less than the prices of selling oxen services on the village market, and this group maintains a higher level of supply to the market (compared to the base level - see Table 6.5) in the first four scenarios.

It is interesting to see that, in the first four scenarios, household group 1 is the only group that increases both one and two-season rice production without green manure. This household group increases both its one and two-season rice production. The increase in two-season rice production of household group 1 is driven by the increase in livestock production and the need for more fodder. However, with the increase in labour scarcity in scenarios 2 and 4, household group 1 also shifts production to one-season rice. And while its production of two-season rice with green manure declines its production of two-season rice without green manure increases. This is because the production decisions of group 1 are affected not only by labour availability and cash constraints but also by the lower price for oxen services in the village market.

As before, the production responses in scenario 5 are different from the other scenarios. Due to the lower prices of purchased inputs, all households (except household group 4) stop growing one-season rice without green manure and two-season rice with green manure, shifting their production towards one-season rice with green manure and two-season rice without green manure. Large increases in incomes of household groups 1, 3 and 4 in this scenario (higher output and lower input prices for agricultural production; household group 2 differ here as they are less involved in agricultural production) cause an increase in leisure

consumption and therefore reduce labour availability and greatly push up the price of oxen services. When household groups 1, 3 and 4 have more cash for buying external inputs their best option is livestock production. Because this implies a need for extra fodder, two-season rice production without green manure, which needs higher demand for external inputs, increases. Household group 2, which is affected most by the increase in local off-farm employment and least by the output and input price changes, decreases all types of rice production except for one-season rice without green manure (increase 60.7 percent), because of the strong reduction of labour availability. Household group 4 switches its rice production patterns in a markedly different fashion to the other groups in this scenario, increasing one-season rice production with green manure (which needs less oxen use) and decreasing one-season rice without green manure. This is due to this group being the only supplier of oxen services to the village market and its increases supply more than two times of the base level in scenario 5.

Input use

Table 6.4 presents the changes in use of inputs: manure, fertilizer, and pesticide and herbicide that are used in rice and other annual crop production. Under the first four scenarios overall use of all three types of inputs decreases. This is due to an increase in one-season rice production increases and other annual crops and a decrease in two-season rice production (Table 6.2) in the first four scenarios. In all these scenarios the magnitude of fertilizer input decline is greater than that for manure use. The differences in changes between these two inputs are larger under scenarios 1 and 2. Two-season rice makes much more intensive use of fertilizer than one-season rice, and the intensity is least in other annual crop production. Increasing migration (scenarios 1 and 2) has a stronger influence on input use than increasing local non-farm activities (scenarios 3 and 4).

Although at the village level all inputs usage decreases in the first four scenarios, the responses of individual groups differ greatly between scenarios, due to the different changes in crop production made by individual household groups. Household groups 1 and 2 go against the trend and increase chemical fertilizer use in the first four scenarios because the increase in one-season rice production outweighs the decline in two-season rice production. For household group 1, manure use decreases

0.5 percent in scenario 2, due to an increase in the shadow price of manure (because of lower labour availability), and is compensated for by a 17.1 increase in chemical fertilizer use. Increases in income levels also encourage the use of more external inputs.

Table 6.4
Higher participation: simulation results for input use (% changes)

Inputs Use		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Group	Highly-educated migration	Poorly and highly-educated migration	Highly-educated local employment	Poorly and highly-educated local employment	Agric. prices and educated local employment
Manure Use	1	5.8	-0.5	2.3	0.1	18.8
	2	5.5	4.8	0.1	1.0	6.3
	3	-10.4	-9.6	-4.4	-3.8	-0.7
	4	-14.0	-14.3	-8.1	-8.3	-1.8
	All	-7.9	-9.0	-4.5	-4.8	2.9
Fertilizer Use	1	19.5	17.1	7.4	4.1	47.3
	2	20.3	20.0	6.2	8.4	26.0
	3	-13.6	-10.4	-3.4	-1.8	25.0
	4	-32.3	-31.3	-15.7	-15.6	9.5
	All	-14.0	-12.9	-6.4	-6.1	21.2
Pesticide & Herbicide Use	1	11.1	5.8	3.8	1.4	38.4
	2	14.2	13.8	4.3	5.7	19.3
	3	-11.7	-9.3	-3.7	-2.5	17.6
	4	-23.1	-22.4	-11.4	-11.4	6.6
	All	-11.6	-11.1	-5.6	-5.3	14.9

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.

Although manure use in farm production increases 2.9 percent in the fifth scenario, the increase in chemical fertilizer use is much greater at 21.2 percent. Table 6.2 showed that livestock production increased by 26.5 percent in scenario 5, meaning that a huge amount of additional manure is available for farm production. However, manure use by far less (2.9 percent) due to reduced labour availability. Moreover, increases in household incomes (relaxing cash constraints) result in a strong in-

crease in chemical fertilizer use. For household groups 3 and 4, manure use even decreases a little in the fifth scenario due to the increase in agricultural profitability and the reduction of available labour increasing the shadow price of manure[10]. The increase in agricultural profitability and the reduction of available labour also contribute to an increase in pesticide and herbicide use.

The simulation results for the hiring of agricultural labour and oxen are presented in Table 6.5. Household group 2 is the only group in the village that is a net hirer of labour (which has a fixed price in the village market as the hiring of agricultural labour is demand driven in the village model). Therefore, only the hiring out of agricultural labour is presented in the table. As the changes in hiring out are the same for all the other three household groups, they are only shown for household group 1.

Table 6.5
Higher participation: Simulation results for agricultural labour hiring and oxen renting

Factor Market Development Scenario		Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Agricultural labour hiring (% changes)			Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- & highly-educated local employment	Agricultural prices and educated local employment
	Group 1*	-	3.2	3.0	-0.1	0.3	2.2
Oxen Renting (% of base level)	Group 1	-5.9	-34.9	-28.0	-14.6	-10.6	-28.3
	Group 2	-94.1	-109.0	-108.1	-96.2	-97.6	-102.7
	Group 3	50.0	48.7	41.9	43.8	40.2	18.1
	Group 4	50.0	95.2	94.2	67.1	68.0	112.9
	Change	-	43.9	36.1	10.8	8.2	31.0

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.
Negative signs in oxen renting represent 'oxen renting in'.
* Results for hiring agricultural labour among groups 3 and 4 are the same as for group 1.

As explained before, household group 2 shifts its production towards one-season rice production and to other annual crop production in the first four scenarios. For this group, the increase in one-season rice production is much larger in scenarios 1 and 2 (increase in migration) than in scenarios 3 and 4 (increase in local off-farm employment). In scenarios 1 and 2, the other household groups supply 3.2 and 3.0 percent respectively of their agricultural labour to the village market. A large proportion of this hired agricultural labour is used by household group 2 in perennial crop production. In scenario 3, agricultural labour supply decreases by 0.1 percent because of the balance of changes that occurs in one-season rice production and perennial production. In the fifth scenario, the 15.0 percent increase in one-season rice production among household group 2 is the main reason for the increase in the hiring of agricultural labour in the village.

The figures for individual groups (second part of Table 6.5) in the column labelled 'Base' are the shares of oxen renting out (positive sign) or in (negative sign) by individual groups in the total marketing of oxen services (set at the level in the SAM model). The figures for individual groups within each scenario column are the rental oxen services as a percentage of the total base level. The last row in each scenario compares the change in marketing oxen services to that observed in the village SAM. As explained previously, oxen service production is modelled as a mark-up activity. Changes in the extent to which oxen services are marketed depend on prices for these services but the total production of oxen services does not change.

Overall the marketing of oxen services increases in all scenarios. The first scenario sees the highest increase, while the fourth scenario has the lowest increase. Reduced labour availability due to migration (in scenarios 1 and 2) has a stronger impact on oxen renting out than an increase in local non-farm activities. Increased agricultural profitability (scenario 5) and local non-farm activities have a strong impact on renting in oxen. This is due to migration having a greater impact on one-season rice production (which is the main crop requiring oxen services) than local off-farm employment does. With migration there is a greater decline in two-season rice production, especially among household groups 3 and 4. This will reduce their own use of oxen services and increase the supply available to the village market.

The impact of an increase in highly-educated migration on marketing of oxen service is stronger than the increase in mixed migration. This pattern also holds for increases in local off-farm employment. The differences are mainly due to the responses of household group 1 on the demand side and household group 3 on the supply side. Because household group 3 is less affected by scenarios 2 and 4 compared with scenarios 1 and 3, it further reduces its supply of oxen services to the market. Labour availability from household group 1 reduces in scenarios 2 and 4 and this decreases the demand for oxen services, even though the prices of oxen services decrease.

In comparison with the level observed in the village SAM, household group 1 (with no educated members) increases its renting in of oxen services in scenario 1 (34.9 percent of marketed oxen services in scenario 1 as against 5.9 percent at the base level). The increase in migration of educated people therefore has some strong indirect effects induced by the reduced availability of highly-educated labour within the other three household groups and the resulting fall in price for oxen services. In scenario 3, increased local off-farm employment of educated people results in a smaller increase in household group 1 renting in oxen (to 14.6 percent). In the fifth scenario, marketed oxen services increase strongly to 31.0 percent because of an increase in supply by household group 4 and demand by household groups 1 and 2.

Household income

Changes in the incomes of household groups are shown in Table 6.6. Of the first four scenarios, increased participation by highly-educated household members in local off-farm employment (scenario 3) shows the largest increase (3.2 percent) in total village household incomes. Participation of poorly and highly- educated in migration makes the lowest contribution (0.55 percent, scenario 1). The impact on average household income in the village of local off-farm employment (scenarios 3 and 4) is much stronger than that of migration (scenarios 1 and 2). Increased agricultural profitability (the fifth scenario) shows the strongest impact (4.6 percent) on household income[11].

Table 6.6
Higher participation: simulation results for household income (% changes)

Income	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agric. prices and educated local employment
Group 1	0.26	0.25	0.07	0.91	4.3
Group 2	-0.05	0.5	6.6	6.1	6.5
Group 3	3.7	3.4	1.2	1.1	2.4
Group 4	-1.6	-1.5	4.2	4.5	5.8
All Groups	0.55	0.6	3.2	3.3	4.6

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.

In scenario 1, household group 1 experiences 0.3 percent increase in income. This is a joint result of increasing the labour that it hires out on the village market and a decrease in input prices (oxen services). The income of household group 2 decreases slightly in scenario 1, despite a decrease in the price of oxen services. However this group fares best of all the groups in scenario 3 and 4 (increased participation in local non-farm activities) which give it income gains of 6.6 and 6.1 percent respectively, Household group 3, which is the group most involved in migration, gains most from increasing migration (scenarios 1 and 2). Household group 4, which is also heavily involved in migration (53 percent of their off-farm employment income comes from migration) experiences higher income increases in scenarios 3 and 4 and experiences an income decrease in scenarios 1 and 2. As migrants in household group 4 are relative young, remittances to household group 4 are lower than for other groups. The decline in incomes that this group experiences in the first two scenarios can be explained also by a fall in prices for providing oxen services. Household group 1, which is more involved in agricultural production gains most in the higher agricultural profitability scenario.

Increasing participation in migration has limited or even negative effects on the income of the two poorest household groups (1 and 4), with group 4 suffering a small decline in income and group 1 only mar-

ginally increasing its income. Increased participation in local off-farm activities gives better results for the income of household group 4, although not for household group 1. These two groups both gain most from higher agricultural profitability and increasing local non-farm employment. Higher agricultural profitability and raising local non-farm employment seem to show better results than others for equalizing income level in the village.

6.3.2 Simulation results for increasing wages in off-farm employment

The scenarios of increasing wages in off-farm employment examine the effects of increased profitability of off-farm employment, assuming that participation in off-farm labour does not change. An increase of household incomes leads to an increase of household consumption, including consumption of leisure by household members, and thus reduces the available labour within households for off-farm employment and farm production. Farm households adjust their production and consumption behaviour to adapt to the new situation. Higher off-farm wages from employment also reduce the cash constraints faced households, which may induce them to switch to production activities which require more external inputs.

Farm production

The simulation results for farm production, subdivided by major activities, are shown in Table 6.7. Total production of most crops, except one-season rice, decreases in the first four scenarios. Production of two-season rice and livestock (excluding oxen) decreases strongly, and production of other annual, and perennial, crops decreases slightly. In general, the impact of higher local off-farm employment wages on production activities is similar to that of higher migration wages. Higher wages from off-farm employment result in increases in households' leisure consumption and therefore decrease the labour available for farm production and off-farm employment. This leads, household groups to shift their production towards less-labour intensive activities and to buying more external inputs (using some of the additional income from off-farm employment). At the same time, the prices of oxen services remain unchanged or decrease slightly in the first four scenarios. In general, the responses to the first four scenarios are much smaller than in the previ-

ous simulations as the reduction in labour availability is much smaller in the second bundle of simulations.

Generally speaking, the production responses of the individual groups show similar trends, with only a few exceptions. Household group 1 increases its livestock production and two-season rice production in scenarios 1 and 3. It uses a high percentage of external inputs in livestock production so this becomes relatively less-labour intensive. It also increases two-season rice production to meet the higher demand for domestically produced fodder. The other household groups only increase one-season rice production. Household group 2 does not follow this general pattern, but instead (in scenario 3) increases other annual crop production for its own consumption (as this scenario gives the group its highest income increase). Household group 2 decreases all production activities a little in scenario 4 (Table 6.7).

An increase in profitability of farm production, combined with higher wages for both poorly and highly-educated household members working in local non-farm employment (scenario 5) leads to an increase in livestock and two-season rice production, which closely resembles the response of the fifth scenario in the previous simulation (higher participation rates in off-farm employment). Again, the response of household group 2 is quite different from that of the other three groups.

Green manure

Changes in the production of the four sub-types of rice (discussed earlier) are presented in Table 6.8. Higher incomes from off-farm employment cause a shift towards less labour intensive production, which explains the increase in one-season rice production and the decrease in two-season rice production (Table 6.7). Additional income from off-farm employment also allows production to become more intensive in its use of external inputs, and also affects oxen production and oxen service marketing decisions (to be explained in the discussion of Table 6.10 below). In general, in the five scenarios household groups increase one-season rice production with green manure, and decrease both forms of two-season rice (except for some minor increases in the production of two-season rice without green manure rise in scenarios 3 and 4). The overall village level trends are very much dominated by the responses of household group 4.

Table 6.7

Higher wages: Simulation results for farm production (% output changes)

Farm Production		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
One-season Rice	Group 1	0.9	-0.6	1.2	0.5	-0.2
	Group 2	1.3	1.5	-2.2	-1.3	**13.6**
	Group 3	2.4	2.5	2.2	2.3	1.4
	Group 4	2.1	2.3	2.9	3.0	**-21.1**
	All groups	2.0	1.9	2.0	2.1	-8.0
Two-season Rice	Group 1	0.5	-3.3	0.7	-1.1	**49.0**
	Group 2	-2.7	-3.1	-7.3	-6.8	-7.1
	Group 3	-6.8	-5.6	0.3	0.8	**40.7**
	Group 4	**-13.5**	**-12.8**	**-18.7**	**-19.3**	**70.5**
	All groups	-9.2	-9.0	**-10.1**	**-10.5**	**55.5**
Other Annual Crops	Group 1	-0.7	-0.8	-0.9	-1.0	-9.8
	Group 2	-0.2	-0.3	2.7	2.2	0.3
	Group 3	-0.6	-0.6	-0.8	-0.8	**-10.5**
	Group 4	-0.5	-0.6	-0.7	-0.7	-8.0
	All groups	-0.5	-0.6	-0.4	-0.4	-8.2

Continued

Perennial Crops	Group 1	-0.3	-1.1	-0.3	-0.7	**-16.8**
	Group 2	-0.8	-1.0	-2.1	-2.0	-1.6
	Group 3	-0.2	-0.2	-0.1	-0.1	-1.9
	Group 4	-0.2	-0.2	-0.3	-0.3	-9.8
	All groups	-0.3	-0.4	-0.5	-0.5	-6.1
Livestock (Excluding oxen)	Group 1	1.2	-6.4	1.7	-1.9	**118.7**
	Group 2	-2.4	-2.7	-5.6	-5.2	-5.3
	Group 3	-6.3	-6.2	-4.4	-4.4	**13.1**
	Group 4	-7.9	-7.7	**-10.8**	**-11.2**	**56.6**
	All groups	-5.8	-6.2	-7.1	-7.5	**36.3**

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.

Because of an increase in incomes and the supply of oxen services to the village market, household group 4 shifts towards production that it less intensive in its use of oxen services. Hence, the rice production of household group 4 shifts to one-season rice with green manure (which is less oxen service intensive) in all the scenarios. However, household group 3 (net renters out of oxen services) shifts production to one which is less intensive in its use of labour intensive and more intensive in its use of oxen services. This group shifts to one-season rice production without green manure in the first four scenarios, and to producing of one-season rice and two-season rice without green manure in the last scenario. In contrast to household group 4, it decreases its supply of oxen services to the market (Table 6.10) in all scenarios. Shifting to one-season rice production without green manure allows this group to meet its own increased requirement for oxen services caused by an expansion of one-season rice production in the first four scenarios while maintaining a smaller share of oxen service supply to the village market.

It is noticeable that the one-season rice production patterns of household group 2 differ between scenarios 1 and 2 (higher wages for migration) and scenarios 3 and 4 (higher wages for local off-farm employment. [12] Within the two clusters of scenarios, the responses of household group 2 are similar in direction, but different in magnitude. This group 2 has a smaller increase in incomes under scenarios 1 and 2 than scenarios 3 and 4, and as result it shifts its production to less labour-intensive production and less use of oxen services in the latter two scenarios. This explains the shift from one-season rice without green manure to one-season rice with green manure (which uses less oxen services) in scenarios 3 and 4. In the first two scenarios this group shifts to one-season rice production without green manure as this is more intensive in its use of oxen and less intensive in its use of labour.

The responses of household group 1 differ from those of the other household groups. In scenarios 1, 3 and 4 it shifts towards one-season and two-season rice production without green manure. This can be explained by the very small changes in income of for this group 1 in these scenarios and a lower price for oxen services in the village market.

Table 6.8

Higher wages: simulation results for rice production switching (% changes)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly-educated migration	Highly- educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
One-season Rice without Green Manure	Group 1	5.1	-6.0	7.1	1.9	20.2
	Group 2	5.7	6.3	-14.3	-9.5	58.9
	Group 3	4.9	5.9	8.7	9.4	18.9
	Group 4	-10.1	-7.6	-14.5	-14.6	-80.3
	All groups	-0.9	-1.0	-2.7	-2.8	-16.0
One-season Rice with Green Manure	Group 1	-19.9	25.8	-27.6	-6.3	-100.0
	Group 2	-9.7	-10.7	28.1	19.1	-100.0
	Group 3	-12.0	-17.4	-35.6	-38.8	-100.0
	Group 4	22.2	18.4	31.3	31.8	76.1
	All groups	9.8	9.7	14.7	15.2	13.9
Two-season Rice without Green Manure	Group 1	11.9	19.0	16.0	19.6	610.8
	Group 2	-2.7	-3.1	-7.3	-6.8	-7.1
	Group 3	4.5	7.0	15.6	17.1	164.5
	Group 4	-6.6	-5.7	-9.2	-9.4	171.8
	All groups	-1.7	-0.1	0.1	0.7	178.3
Two-season Rice with Green Manure	Group 1	-2.5	-9.2	-3.3	-6.5	-100.0
	Group 3	-19.7	-20.0	-17.1	-17.6	-100.0
	Group 4	-20.4	-19.8	-28.1	-29.1	-30.5
	All groups	-16.5	-17.7	-20.0	-21.3	-63.4

Notes: Household group 1: no educated members; Household group 2: no draught power and more than 1 educated member; Household group 3: draught power and 1 and 2 educated members; Household group 4: draught power and more than 3 educated members.

As discussed above, household group 2 has the lowest availability of labour in the fifth scenario. Hence this group shifts to one-season rice production without green manure. Household group 4 also increases its (agricultural) income in the fifth scenario (see Table 6.10 below), and increases its supply of oxen services to the village market (Table 6.10). Hence, under this scenario this group shifts to producing one-season rice with green manure and two-season rice without green manure as it able to use more external inputs and to reduce its own use of oxen services.

Input use

The simulation results for changes in input use are shown in Table 6.9. In general, the use of manure and chemical inputs decreases in the first four scenarios and increases in the fifth. However the magnitudes of changes in manure and chemical input use are very small in the first four scenarios, as increases in one-season rice production are counterbalanced by declines in two-season rice and other annual crops. Because two-season rice uses relatively more chemical fertilizer than pesticides and herbicides, chemical fertilizer use declines more strongly than that of chemical pesticide and herbicide.

Although, all inputs decrease at the village level in the first four scenarios, the responses of individual groups differ across scenarios. This is because of differences in changes in crop production by the individual groups. In some scenarios household groups 1, 2 and 3 increase chemical fertilizer or manure use. In most scenarios the changes in fertilizer use are more pronounced than those of manure use, as the shadow price of manure increases due to an increase in off-farm wages and lower labour availability. Household group 4 decreases its use of manure and chemical inputs in all four scenarios as this group substantially reduces two-season rice production and only slightly increases one-season rice production.

In the fifth scenario the strong increase of two-season rice production results in an increase of all inputs, although at very different rates: manure use increases by 4.4 percent, pesticides and herbicides by 17.8 percent and fertilizer by 25.0 percent. Household groups 1, 3 and 4, all substantially raise their two-season rice production (see Table 6.7) and show large increases in their use of inputs. But due to an increase in the shadow price of manure, the levels of increase in manure use are much smaller than those for chemical inputs use, especially fertilizer use.

Table 6.10 simulates the effects of the scenarios on agricultural labour and oxen renting. The effects of increased wages on the village's agricultural labour market are slightly lower compared to those of increased participation in off-farm employment (see Table 6.5). Household groups hiring out agricultural labour experience very small changes in the first two scenarios, and they are relatively large in scenarios 3 and 4. Agricultural labour hiring decreases by 2.4 and 2.1 percent for household groups 1, 3 and 4 due to the decrease in one-season rice production by household group 2, which has highest income increase in the scenarios 3 and 4. In the fifth scenario, agricultural labour hiring increases 1.7 percent due to a large increase in two-season rice production.

Oxen services production is modelled as a mark-up activity and the trading balance for this is achieved through price instead of quantity adjustments. As a result only marketed oxen services are presented in the table. Generally these increase under scenarios 1 and 5 and decrease slightly in the other three scenarios. Overall, the impact of higher wages is much smaller than that of increased participation in off-farm employment. The impact of increasing migration wages is stronger than that of increasing local off-farm wages, as household group 2 is affected less by migration.

In the fifth scenario the total marketed oxen services increases by 28.9 percent. Household group 1 contributes most to the increase in demand for this service, and household group 4 contributes most to the increase in supply. The great increase in two-season rice production by household group 1 (118.7 percent), means that this group has greater need for oxen services, even though price increases by 5 percent. Household group 4 has a 7.0 percent income increase in the fifth scenario. It increases its supply of oxen services to the market because it has less need to use oxen on its own land because of a large decrease in its one-season rice production. Household group 3 dramatically decreases its supply of oxen service, due to a sharp increase in two-season rice production and the resulting increased need of oxen service for its own production.

Table 6.9
Higher wages: simulation results for input use (% changes)

Inputs Use		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly-educated migration	Highly- educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Manure Use	Group 1	0.6	-1.9	0.8	-0.3	18.8
	Group 2	0.2	0.2	-2.6	-2.0	7.2
	Group 3	-0.5	-0.4	0.2	0.2	0.2
	Group 4	-2.7	-2.5	-3.7	-3.8	0.7
	All groups	-1.2	-1.6	-1.6	-1.8	4.4
Fertilizer Use	Group 1	1.9	-1.8	2.6	0.9	47.2
	Group 2	1.8	1.9	-5.4	-3.7	25.8
	Group 3	0.9	1.5	3.8	4.1	27.4
	Group 4	-4.9	-4.2	-6.9	-7.1	16.5
	All groups	-1.5	-1.4	-2.0	-2.0	25.0
Pesticide and Herbicide Use	Group 1	1.0	-1.7	1.3	0.1	38.4
	Group 2	1.2	1.3	-3.3	-2.2	19.3
	Group 3	0.4	0.8	2.5	2.7	19.4
	Group 4	-3.5	-3.0	-4.9	-5.0	11.5
	All groups	-1.3	-1.2	-1.7	-1.7	17.8

Notes: Household group 1: no educated members: Household group 2: no draught power and more than 1 educated member: Household group 3: draught power and 1 and 2 educated members: Household group 4: draught power and more than 3 educated members.

Household incomes

The simulation results for changes in household incomes are presented in Table 6.11. As could be expected, the total effect on household incomes in the village is positive in all five scenarios. In the first two scenarios, the income increase is larger when only the wages of highly-educated members increase. Again, the fifth scenario gives the largest income increase of all the scenarios.

For household group 1, the group with no educated members, the indirect effects of higher wages for educated labour (scenarios 1 and 3) are negligible (and in scenario three they are slightly negative). In scenarios 1 to 4, this group experiences smaller income changes than all the other groups. Household group 1 benefits the most from scenario 5 (a combination of higher agricultural productivity and higher off-farm wages) because it has a larger share of income from agricultural production. Household group 3, which is highly involved in migration, experiences the largest income increase in scenarios 1 and 2, while groups 2 and 4 benefit most from higher local off-farm wages (scenarios 3 and 4).

Income of household groups 1 and 4 (the poorer groups) changes in different ways. In all the scenarios household group 4 has the second largest increase in income. Household group 1 experiences larger increases when both poorly and highly educated individuals are involved in off-farm employment, but its the benefits it experiences are less than the other groups. Two better-off household groups always have an increase in income. Higher agricultural productivity and higher off-farm wages provide household groups 1 and 4 with the highest income increase.

6.4 Comparing the two bundles of simulations

This section compares the two bundles of simulations (increases in participation in off-farm employment and higher wages from off-farm employment) to examine any differences in their impact on farm production, input use, factor market development and incomes. Such comparisons allow for an analysis of different responses to improved off-farm employment opportunities created by increased labour participation and by higher off-farm wages.

Table 6.10

Higher wages: simulation results for agricultural labour hiring and oxen renting

Factor Market Development Scenario		Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Agricultural labour hiring (% changes)		-	Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
	Group 1*	-	-0.4	-0.5	-2.4	-2.1	1.7
Oxen Renting	Group 1	-5.9	-8.1	-3.7	-8.9	-6.9	-26.2
	Group 2	-94.1	-95.0	-95.1	-90.8	-91.8	-102.6
	Group 3	50.0	44.3	42.6	37.2	36.1	20.4
	Group 4	50.0	58.7	56.2	62.6	62.6	108.5
	Change	-	3.1	-1.2	-0.3	-1.3	28.9

Notes: Household group 1: no educated members:
Household group 2: no draught power and more than 1 educated member:
Household group 3: draught power and 1 and 2 educated members:
Household group 4: draught power and more than 3 educated members.
*Results for agricultural labour hiring for groups 3 and 4 are the same as for group 1.

Table 6.11

Higher wages: simulation results for household income (% changes)

Income	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Highly- educated migration	Poorly- and highly-educated migration	Highly- educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Group 1	0.012	2.5	-0.007	1.2	4.4
Group 2	3.3	3.7	8.5	7.9	7.9
Group 3	8.7	8.0	3.5	3.3	3.0
Group 4	4.3	4.1	6.0	6.2	7.0
All Groups	5.2	5.2	5.1	5.1	5.6

Notes: Household group 1: no educated members:
Household group 2: no draught power and more than 1 educated member:
Household group 3: draught power and 1 and 2 educated members:
Household group 4: draught power and more than 3 educated members.

The first bundle of simulations reduces the labour availability for farm production by households involved in off-farm employment, but does not directly affect incomes and profits. Changes in the incomes of household groups are due to re-allocation of labour within each household group over farm productions activities and changes in the village market (in factor prices). Household consumption and production decisions are modelled as non-separable, therefore these will include not only the reallocation of labour between production activities, but also include changes in leisure consumption. Changes in profits from off-farm employment for each household group will depend on changes in the shadow wages of labour among household groups.

The second bundle simulates the impact of increasing wages of off-farm employment. This stems from increased profitability of off-farm employment but does not directly decrease labour availability. However, additional income from off-farm employment induces households to increase their consumption level, including leisure, and relaxes cash constraints on farm production. Therefore, it reduces labour availability, but also increases the availability of cash for farm production activities. Hence, the income changes in this second bundle of simulations are due to increased profitability of off-farm employment (additional income effect), reduced labour availability in farm production (through additional leisure) and price changes in traded factors on village markets. Changes in profits from off-farm employment are due to increases in off-farm wages and changes in the shadow price of labour, and therefore are likely to differ substantially from profit changes in off-farm employment in the first bundle.

Both bundles include a simulation that involves increasing the profitability of farm production by increasing output prices and decreasing input prices (the fifth scenario). Both simulations make farm production much more attractive than it is in the other ones, and explains why there are less differences in the results of the fifth scenario between the two bundles.

Comparison of the results from the two bundles of simulations shows some important differences:

- In the first bundle of simulations, farm production activities shift towards less labour-intensive and more oxen-intensive production. In the second bundle it shifts towards less labour-intensive and more capital-intensive (using more external inputs) production.

- Switches between the four types of rice production activities are more pronounced in the first bundle, as changes in the availability of labour and cash and the price of oxen services play important roles in production switching.
- Relatively larger shifts in farm production in the first bundle of simulations, lead to larger changes in the use of farm inputs in this bundle.
- Differences in production changes between the two bundles mean that the impact on labour hiring is slightly smaller in the second bundle, while changes in renting oxen services are much larger in the first bundle.
- The effects on changes in income are much stronger in the second bundle than in the first one in the first four scenarios. The reasons here are complex because bundles involve two part changes. Changes in the income of household groups from labour reallocation (in the first bundle scenarios) are a combination of two types of change. The first relates to additional remittances or incomes from off-farm employment due to increased participation in off-farm employment. The second represents income changes from farm production due to 'lost-labour' and cash income (or remittances) from off-farm employment. Changes in income in scenarios of the second bundle also include two types of changes. The first includes additional income obtained from higher wages from off-farm employment. The additional income leads household groups to consume more leisure time with this income, leading to lower labour availability for farm production. The second change involves the income change from farm production. The decline in labour availability is much stronger in the first bundle than that in the second. Hence, the induced change in household farm income, through the loss of labour availability, is also much larger in the first bundle. Even though farm households could maintain farm production by using more external inputs, this depends on the extent to which 'lost-labour' effects can be compensated for by additional remittances or incomes. So, in general income changes for the first four scenarios in the first bundle will be smaller than in the second bundle.
- Finally, the fifth simulation for both bundles shows only small differences because the effects of changes in input and output prices are much stronger than the effects of changes in off-farm employment. The responses from the fifth simulations in both bundles differ from

the other four scenarios, as they greatly increase agricultural profitability and local off-farm employment (which are relatively small compared to that in other simulations).

6.5 Summary and Conclusions

This chapter has used a village equilibrium model to examine the impact of off-farm employment on farm production, input use, participation in village markets and household incomes. It started out by outlining a basic structure for the village CGE model, in which the oxen rental and agricultural labour markets are the two most important linkages among household groups. The price of oxen renting varies with changes in demand and supply in the village, while the wage rate for agricultural labour is assumed to be fixed and demand for labour determines supply. Two bundles of simulations are run with the model. They show that whether the increase in incomes from off-farm employment is due to increased participation in off-farm employment or wages received for off-farm employment, has important implications for its impact on the local rural economy and household responses. Simulation results for farm production, rice production, participation in village internal markets, use of inputs and the incomes of different household groups are presented.

Interactions among different household groups within the village are critical in determining aggregate responses. Changes in the price of oxen services, the volumes of oxen services marketed and of traded agricultural labour within the village explain the major production and consumption responses of households. Because labour availability is much more strongly reduced in the first bundle (changes in participation rates in off-farm employment), changes in production activities and the resulting responses through the village market, particularly the oxen services market, are much stronger in this bundle.

The first four simulations of the first bundle showed a decline in the production of two-season rice, other annual crops, perennial crops and livestock (excluding oxen), and an increase in one-season rice production . In a similar way in the first four simulations of the second bundle, household groups increased one-season rice production and decreased all other forms of agricultural production. Here however the magnitude of the changes was much smaller. Thus changes in the farm production structure induced by the two bundles are quite similar. Researchers with an interest in examining the impact of non-farm activities on farm pro-

duction have rarely paid attention to this switching of crops in farm production (Janvry et al. 2005, Taylor et al. 2003, Rozelle et al. 1999, Wu & Meng, 1996a & b).

The logic behind production switches is different in the two bundles. A general reduction in labour availability causes a shift towards less labour-intensive production for all households. It means that demand for oxen services also decreases. For instance, two-season rice production is not only labour-intensive, but also demands a high intensity of oxen service. In the first bundle decreases of both the prices of oxen services and the availability of labour push household groups to restructure their production. Reduced cash constraints also play an indirect role in the restructuring of farm production in the first four scenarios of this first bundle. Household groups 1 and 3 enjoy higher incomes in all five simulations in the first bundle.

In the second bundle, every household group benefits from the additional income and reduced cash constraints for increasing production. In this bundle of simulations, the impact of reduced labour availability for farm production, due to increased incomes from off-farm employment and associated increases in leisure, is modest. Therefore, the reduction in use of oxen services, bought about by decreases in two-season rice and other annual crop production, is smaller than in the first bundle and there is only a negligible decrease in the price for oxen services. As a result, production shifts towards less labour-intensive and more capital-intensive production. Because two-season rice production uses relatively more external inputs and labour, it decreases far less than in the second bundle than it does in the first, while the increase in one-season rice production is also smaller.

In the first bundle, on farm production activities are much more strongly affected by increased labour involvement in migration than by increased labour participation in local off-farm employment. In the second bundle, the impact of these two is quite similar. In the first bundle of simulations, there is a more pronounced reduction of labour availability and increases in incomes are smaller, especially for household groups 2 and 4. For household groups 3 and 4 these two effects lead to a reduction of their two-season rice production, while they offer more oxen services on the market. In the second bundle, the reductions of labour experienced by these two groups are smaller and their incomes increase more, and they respond by reducing their supply of oxen services to the

market in most scenarios (increase 3 percent in the first scenario). On the demand side of oxen services, household group 2 has a larger increase in incomes in the second bundle and a lower need for oxen services in the market (increase 0.9 percent in the first scenario). Different responses of two types of groups formulate the differences of impact of migration and local off-farm employment.

The simulation results for participation in oxen rental and agricultural labour markets indicate that the effects of increased participation in off-farm employment are much stronger than those of increased wages, particularly for the oxen rental market. This is one of the main reasons for the different responses of household groups in the two bundles of the simulations.

A summary of the impact of off-farm employment on LPC, EQ, household income and income distribution is presented in Table 6.12. The relationship between off-farm employment and LPC and EQ, is examined by using two proxy indicators; switches between sub-types of rice production and changes in input use. Rice production using manure and/or green manure improves soil structure and is better for long term production, by improving soil organic matter content. The simulation results indicate that increased off-farm employment (for both bundles of simulations) leads to a switch towards using green manure in one-season rice production under the first four scenarios. It leads to a general decline in two-season rice production in most cases, except for scenarios 3 and 4 in the second bundle, where it leads to a switch towards production without the use of green manure.. However, two-season rice production accounts for a very small share of rice production in *Shangzhu* village. Hence, the impact of increased off-farm employment on LPC and EQ through shifts in rice production activities is positive because increasing rice production with green manure will lead to less use of chemical fertilizer (as well as improving the soil organic matter and soil structure). A switch from two-season, to one-season, rice production also results in less inputs being used. In general it leads to a decrease in production intensity and it benefits long-term production capacity.

The trends in the use of manure and chemical fertilizers are similar in each of the first four simulations, although the magnitude of change differs considerably between the scenarios. In the first bundle the use of chemical fertilizers declines much more than that of manure. In the second bundle, the difference is smaller. This is because of the more

marked shifts in production activities in the first bundle, which are induced by lower levels of labour availability. Hence, in some simulations the impact of increased off-farm employment on the LPC and EQ is significant and positive. The relatively higher decrease in use of chemical fertilizers in farm production in the first four scenarios has a positive impact on LPC and EQ. The overall effect on LPC and EQ, also taking into account switching between rice production activities, is also very positive in the first four scenarios.

The impact of changing agricultural prices (scenario 5 in both bundles) on LPC and EQ is highly negative as it leads towards two-season rice production without green manure planting and a strong increase in the use of chemical fertilizer. Although one-season production with green manure also increases, the increase is relatively small.

Another important indicator is that of pesticide and herbicide use in farm production. This shows the same trends as for chemical fertilizer, although the magnitudes are slightly smaller. In the first four scenarios, pesticide and herbicide use declines, less than fertilizer use, but generally more than manure use. In the fifth scenario of both bundles, pesticide and herbicide use increases considerably. Hence, we can conclude that with an increase in off-farm employment, the EQ will benefit from a decrease in pesticide and herbicide use. But in the fifth scenario, the impact on the EQ is very negative.

In terms of incomes, increased rates of off-farm participation have a weaker effect than higher off-farm wages. Comparing the two bundles of simulations in terms of their socio-economic impact, shows that the fifth scenarios in each bundle produces higher increases in household incomes. Incomes of two poorest household groups (1 and 4) increase more in this scenario than under the other four. In the first four scenarios, increases in wages from off-farm employment (second bundle) always show better income results for all groups than increases in participation in off-farm employment. They also show larger income increases for household group 4 (poorer group), although neither bundle has much effect in increasing the incomes of household group 1 (the poorest group). In some scenarios, this group even suffers from an income loss. Household group 4 also suffers an income loss from increased participation in migration (scenarios 1 and 2 in the first bundle).

These findings about the impact of migration on household income are partly consistent with those of other researchers, such as Taylor et al.

(2003)[13] whose study showed migration to have no significant impact on household income. Thus, the aggregate income of rural households left behind in the rural area, is similar before and after migration. But Taylor et al. found that households experience an increase in per capita income of between 16 percent and 43 percent. Our results indicate that household incomes increase with an increase in migration, but only marginally (see Table 6.6). If the household income deducted the migrant members, the per capita income may also increase substantially in our results. Poorer households do not fare as well as richer households in this study as they do in the study of Taylor et al. (2003). In the first bundle of simulations, poor household group 1 seems to experience the least increase in income under the first four scenarios, and poor household group 4 only fares well with an increase in local off-farm employment.

Because this study used the same approach as Kuiper (2005), it is possible to compare not only the findings for the impact of migration on income and income distribution, but also for the impact of migration on households not involved in migration. Her research[14] showed that an extra 10 percent migration increased the income of groups involved in migration by 1.5 to 3.8 percent, with the changes in incomes of household groups not involved in migration being marginal. Thus increases in migration remittances reinforced existing income household differences. The findings presented here show that one household group suffers from income loss under some circumstances while another group raises its income by 3.7 or 3.4 percent. However, direct comparison of these two sets of findings is difficult because they use different simulations. Despite this, the findings of this report suggest that the changes in income of (some) households involved in migration are larger in *Shangzhu* village than in Kuiper's study area. This study appears to show more variations in the effects of migration, even within different groups of households with migrated members. This may be due to households in a remote village show more heterogeneity. In this study, household group 1 which has no highly-educated members also increases its income marginally. Hence, the findings for income distribution are similar in the two studies.

Table 6.12

Summary of the impact of off-farm employment on LPC, EQ and household income and income distributions

	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	Highly- educated migration		Poorly- and highly- educated migration		Highly- educated local employment		Poorly- and highly- educated local employment		Agricultural prices and educated local employment	
	P	W	P	W	P	W	P	W	P	W
LPC	++/++	+/+	++/++	+/+	++/++	+/+	++/++	+/+	- -/--	- -/- -
EQ	++	+	++	+	++	+	++	+	- -	- -
Income	+	+++	+	+++	++	+++	++	+++	+++	+++
Income distribution	- -	- -	- -	- -	+	+	+	+	+ +	+ +

Notes: 'P' stands for the simulation on increases in participation in off-farm employment and 'W' stands for higher wages from off-farm employment. In the row of the impact on LPC, the impact of rice production switching and changes in input use is included separately. '+ +' and '+ + +' indicate the strength of these effects.

If policy makers want to achieve substantial increases in incomes and welfare, the analysis in this chapter suggests that changing agricultural prices (scenario 5 in two bundles) is a more promising option than that simulating off-farm employment. However, the environmental consequences of such a policy are quite negative. If policy makers try to combine the objectives of raising incomes and maintaining environmental quality, then they can take inspiration from the first four scenarios in the second bundle, which show increases in incomes and a positive impact on LPC and EQ, although the income effects are not as strong as in the fifth scenario. Stimulating off-farm employment can contribute to achieving income increases as well as improving environmental quality and long-term production capacity. But the income effects of such a policy are smaller than a policy focusing on changing agricultural input and out prices, and the impact on reducing income inequality is less evident.

Notes

1. Explanations of these two items are in chapter 2.

2. A discussion of the project can be found in chapter 1.

3. Kuiper (2005) estimated the shadow wage of household labour by estimating the marginal product of labour from an agricultural production function. She found that the shadow wage of labour in agricultural production is substantially lower than the wage rate of off-farm employment.

4. Specification of which commodities are considered as household non-tradables and those considered as village non-tradables can be found in annex of this chapter.

5. In the applied model the balance of payments is left out of the model and used as a check for consistency. According to Walras' Law the N^{th} market should be in equilibrium if N-1 markets are in equilibrium. One can thus leave out one market (in this case the village balance of payments) and the model should still attain equilibrium in all markets. Computing the village balance of payments after solving the model allows for checking whether the model satisfies Walras' Law, or in other words if all markets in the model are in equilibrium.

6. Because the wage of agricultural labour is assumed to be fixed and is determined in the village market by adjustment from demand and supply sides, the increase of participation in and wages from agricultural labour employment are not simulated.

7. The 5 percent of the Shangzhu village GDP divided by the income or remittances of each type of off-farm employment will give the percentages of changes in off-farm employment. Because poorly -educated members are relatively less involved in off-farm employment, the percentage differences between the increases when looking at only the highly -educated workers and both members for off-farm employment and both poorly- and high-educated members are very small.

8. Oxen services prices decrease by 6, 5, 1 and 1 percent in the first four scenarios respectively and increase by 4 percent in the fifth scenario.

9. Rice and other crop production use oxen service.

10. The highest increase in shadow price of manure is 23% for household group 4, and the lowest is 6% for household group 1.

11. Because we cannot give exactly the same injection (5% of GDP) in the fifth scenario but inject 3% of GDP into local off-farm employment and increase output prices and decrease input prices.

12. Household group 2 does not produce two-season rice with green manure.

13. The household data used in their study are from a sample of 787 farm households from 31 villages in Hebei and Liaoning Provinces.

14. She used data from the same area in Jiangxi province, although the village she took data from has better access to the outside world.

6 Appendix: Basic village model: elements, model equations and GAMS code

(Largely based on Kuiper, 2005)

6A.1 List of variables, parameters and sets

Variables

Prices:

p^{*}_{hj}	Effective household price
p^{ht}_{hj}	Price of household tradables (perceived as exogenous)
p^{p}_{hj}	Price of purchased commodity (perceived as exogenous)
p^{s}_{hj}	Price of sold commodity (perceived as exogenous)
PA_{ha}	Cobb-Douglas activity price
PI_{hak}	Price Composite input in Cobb-Douglas activity

Quantities:

q^{c}_{hj}	Quantity consumed
q^{ht}_{hj}	Net marketed surplus of household tradables
q^{i}_{haj}	Inputs by activity
q^{o}_{haj}	Output by activity
q^{s}_{hj}	Quantity sold of price-band commodities
q^{p}_{hj}	Quantity purchased of price-band commodities
$\overline{q}^{\omega}_{hj}$	Endowments

Other variables

π_{ha}	Profits by activity
w_h	Household full income
$\overline{y}^{l}_{h}$	Exogenous income or payments

Parameters

δ_{ha}	Shift parameter Cobb-Douglas production function

α_{hak}	Cost shares Cobb-Douglas production function
ι_{hakj}	Leontief input coefficients of composite input of Cobb-Douglas production function
θ_{haj}	Leontief output coefficients of Cobb-Douglas activities
β_{haj}	Input coefficient of Leontief activities
γ_{haj}	Output coefficient of Leontief activities
ε_{haj}	Level of outside village employment
ξ_{haj}	Household share of village demand for agricultural labor
κ_{haj}	Household market share of village produced goods
τ_{hj}	Household market share of village traded tractor services

Sets

H	Households
P	Purchased price band commodities
S	Sold price band commodities
HT	Household tradables without price band
J	Commodities
I	Inputs
O	Outputs
A	Activities
C	Consumed commodities
VNT	Village nontradables
E	Commodities exported from the village
M	Commodities imported in the village
CA	Cobb-Douglas activities
CI	Composite inputs of Cobb-Douglas activities
LA	Leontief activities
VA	Village production activities
MA	Markup activities (cattle is the only element)
FI	Fixed inputs
FO	Fixed outputs

6A.2 Activities define

Table 6A.1
Activities in the village equilibrium model

	Cobb-Douglas	Leon tief	Mark up	Profit[1]	Bounds on supply
Farm production					
One-season rice without green manure	x			no	no
One-season rice with green manure	x			no	no
Two-season rice without green manure	x			no	no
Two-season rice with green manure	x			no	no
Other crops	x			no	no
Perennial crop	x			no	no
Other livestock	x			no	no
Fuel wood collection		x		no	no
Manure processing		x		no	no
Factor rental					
Oxen			x	no	(village) demand
Inside village employment					
Agricultural labor		x		yes	village market share
Outside village employment					
Non-agricultural labor		x		yes	fixed supply
Self-employment		x		yes	fixed supply
Migration		x		yes	fixed supply

Note: [1] Profits are introduced to bridge the gap between market and household shadow prices.

Table 6A.2
Commodities and set-membership in the basic village equilibrium model

	Type of use			Household tradability				Village tradability		
	I	*O*	*C*	*HT*	*S*	*P*	*HNT*	*VNT*	*E*	*M*
Output of agricultural production										
One-season rice		x	x		x				x	
Two-season rice		x	x		x				x	
Other crops		x	x		x				x	
Perennial crop		x			x				x	
Livestock (excluding oxen)		x	x		x				x	
Cattle		x			x				x	
Outside village employment										
Low educated labour local non-farm employment		x			x				x	
High educated labour local non-farm employment		x			x				x	
Low educated labour self-employment		x			x				x	
High educated labour self-employment		x			x				x	
Low educated labour migration		x			x				x	
High educated labour migration		x			x				x	
Farm produced inputs										
Manure	x	x					x	x		
Processed manure	x	x					x	x		
Straw	x	x					x	x		

Continued												
Feed	x	x					x		x			
Oxen services	x	x		x					x			
Agricultural labour	x	x		x					x			
External inputs												
Fertilizer	x				x					x		
Pesticide and herbicides	x				x					x		
Seed	x				x					x		
Purchased feed	x				x					x		
Other external inputs	x				x					x		
Consumption goods												
Food			x		x					x		
Nonfood			x		x					x		
Durables			x		x					x		
Factors												
Low educated labour	x		x				x		x			
High educated labour	x		x				x		x			
Irrigated land	x						x		x			
Dry land	x						x		x			
Forest land												
Oxen	x						x		x			

Notes: I = inputs; O = outputs; C = consumed; HT = household tradable; S = sold; P = purchased; HNT = household nontradable; VNT = village nontradable; E = exported; M = imported.

6A.3 Model equations

Price block:

$$\tilde{p}^{p}_{hj} \geq p^{*}_{hj};\quad q^{p}_{hj} \geq 0;\quad q^{p}_{hj}(\tilde{p}^{p}_{hj} - p^{*}_{hj}) = 0 \qquad \forall\ h \in H, j \in P, \tag{6.1}$$

$$p^{*}_{hj} \geq \tilde{p}^{s}_{hj};\quad q^{s}_{hj} \geq 0;\quad q^{s}_{hj}(p^{*}_{hj} - \tilde{p}^{s}_{hj}) = 0 \qquad \forall\ h \in H, j \in S, \tag{6.2}$$

$$\tilde{p}^{ht}_{hj} = p^{*}_{hj} \qquad \forall\ h \in H, j \in HT, \tag{6.3}$$

$$\tilde{p}^{p}_{hj} \geq \tilde{p}^{s}_{hj} \geq 0,\ \tilde{p}^{ht}_{hj} \geq 0 \qquad \forall\ h \in H, j \in J. \tag{6.4}$$

Production block:

$$q^{i}_{haj} = f_{a}(p^{*}_{hj}) \qquad \forall h \in H, a \in A, j \in J. \tag{6.5}$$

$$q^{o}_{haj} = g^{o}_{ha}(q^{i}_{haj}) \qquad \forall h \in H, j \in O, a \in A, j \in I, \tag{6.6}$$

Consumption block:

$$w_{h} = \sum_{j} p^{*}_{hj}\bar{q}^{\omega}_{hj} + \sum_{l} \bar{y}^{l}_{h} + \sum_{a} \pi_{ha} \qquad \forall\ h \in H \tag{6.7}$$

$$\pi_{ha} = \sum_{o} p^{*}_{hj} q^{o}_{haj} - \sum_{i} p^{*}_{hj} q^{i}_{haj} \qquad \forall\ h \in H,\ a \in A. \tag{6.8}$$

$$q^{c}_{hj} = f(p^{*}_{hj}, w_{h}), \qquad \forall\ h \in H, j \in C. \tag{6.9}$$

Commodity block:

$$q^{c}_{hj} + \sum_{a} q^{i}_{haj} + q^{s}_{hj} + q^{ht}_{hj} = \sum_{a} q^{o}_{haj} + \bar{q}^{\omega}_{hj} + q^{p}_{hj} \quad \forall\ h \in H, j \in J. \tag{6.10}$$

Village constraints:

$$\sum_{h} q^{ht}_{hj} = q^{vt}_{j} = 0, \qquad \forall j \in VNT, \tag{6.11}$$

$$q^{e}_{j} = \sum_{h} q^{s}_{hj} \qquad \forall j \in E, \tag{6.12}$$

$$\sum_{h} q^{p}_{hj} = q^{m}_{j}. \qquad \forall j \in M. \tag{6.13}$$

Cobb-Douglas production activities:

$$\min_{QI_{hak}} \sum_{k} PI_{hak} QI_{hak} \qquad \forall\, h \in H,\ a \in CA,\ k \in CI \qquad (6.14a)$$

subject to

$$QA_{ha} = 1, \qquad \forall\, h \in H,\ a \in CA \qquad (6.14b)$$

with

$$QA_{ha} = \delta_{ha} \prod_{k} QI_{hak}^{\alpha_{hak}}, \text{ and } \sum_{k} \alpha_{hak} = 1$$

$$\forall\, h \in H,\ a \in CA,\ k \in CI \qquad (6.14)$$

$$PI_{hak} QI_{hak} = \alpha_{hak} PA_{ha} QA_{ha} \qquad \forall\, h \in H,\ a \in CA,\ k \in CI. \qquad (6.15)$$

$$q^{i}_{haj} = \sum_{k \in ci} \iota_{hakj} QI_{hak} \quad \text{with} \quad \sum_{i} \iota_{hakj} = 1$$

$$\forall\, h \in H,\ a \in CA,\ j \in I \qquad (6.16)$$

$$q^{o}_{haj} = \theta_{haj} QA_{ha} \quad \text{with} \quad \sum_{j \in o} \theta_{haj} = 1 \qquad \forall\, h \in H,\ a \in CA,\ j \in O \qquad (6.17)$$

$$PI_{hak} QI_{hak} = \sum_{j \in i} p_{hj} q^{ia}_{hj} \qquad \forall\, h \in H,\ a \in CA,,\ k \in CI. \qquad (6.18a)$$

$$PI_{hak} = \sum_{j \in i} \iota_{hakj} p_{hj} \qquad \forall\, h \in H,\ a \in CA,\ k \in CI. \qquad (6.18)$$

$$PA_{ha} = \sum_{j \in o} \theta_{haj} p_{hj} \qquad \forall\, h \in H,\ a \in CA, \qquad (6.19)$$

Leontief Activities:

$$q^{i}_{haj} = \beta_{haj} QA_{ha} \quad \text{with} \quad \sum_{j \in i} \beta_{haj} = 1 \qquad \forall\, h \in H,\ a \in LA,\ j \in I \qquad (6.20)$$

$$q^{o}_{haj} = \gamma_{haj} QA_{ha} \quad \text{with} \quad \sum_{j \in o} \gamma_{haj} = 1 \qquad \forall\, h \in H,\ a \in LA,\ j \in O \qquad (6.21)$$

$$\pi_{ha} = \sum_{j \in o} p_{hj} q^{o}_{haj} - \sum_{j \in i} p_{hj} q^{i}_{haj} \qquad \forall\, h \in H,\ a \in LA. \qquad (6.22)$$

$$q^{o}_{haj} = \varepsilon_{haj} \qquad \forall\, h \in H,\ a \in OUT,\ j \in O. \qquad (6.23)$$

$$q^{o}_{haj} = \xi_{haj} \sum_{h} \sum_{a \in ca} q^{i}_{haj} \qquad \forall\, h \in H,\ a \in AL,\ j \in L, \qquad (6.24)$$

Oxen renting activities:

$$q^{i}_{haj} = \overline{q}^{i}_{haj} \qquad \forall\, h \in H,\ a \in MA,\ j \in FI \qquad (6.25)$$

$$q^{o}_{haj} = \overline{q}^{o}_{hoj} \qquad \forall\, h \in H,\ a \in MA,\ j \in FO, \qquad (6.26)$$

$$p_{hj} = \frac{\sum_{j \in i} p_{hj} q_{haj}^{ia}}{q_{haj}^{oa}} \qquad \forall\ h \in HD,\ a \in MA,\ j \in I. \qquad (6.27)$$

Consumption decisions and welfare measurement

$$\max_{q_{hj}^c} \prod_c q_{hj}^{c\ \mu_{hc}} \qquad \forall\ h \in H,\ j \in C \qquad (6.28a)$$

$$p_{hj}^* q_{hj}^c \le w_h \qquad \forall\ h \in H,\ j \in C, \qquad (6.28)$$

$$p_{hj}^* q_{hj}^c = \mu_{hc} w_h \qquad \forall\ h \in H,\ j \in C. \qquad (6.29)$$

$$EV_h = \left(\frac{u_h^d - u_h^b}{u_h^b} \right) w_h^b, \qquad \forall\ h \in H, \qquad (6.29)$$

6A.4 GAMS code (main structure)

(Largely based on Kuiper, 2005)

```
*=============================================================
$ONTEXT
VILLAGE EQUILIBRIUM MODELING July, 2005
- Model is solved as MCP (allows introduction of switches)
$OFFTEXT
*=============================================================
* Read sets
$include R_sets_1.inc
SETS
SAM   SAM accounts plus additional set elements and their de-
      scription
      /Arice1 activity one season rice without green manure
      Arice2  activity one season rice with green manure
      Arice3  activity two season rice without green manure
      Arice4  activity two season rice with green manure
      Aocrop  activity other crops
      Afore   activity perennial crops
      Acat    activity cattle
      Aoliv   activity other livestock
      Amanu   activity manure production
      Afuel   activity fuel wood collection
      Avag    activity agricultural employment inside village
      Aoag
      Aongl   activity non-farm employment outside village by
              low-educated members
      Abisl   activity self-employment by low educated members
      Aomol   activity migration outside province
```

```
      Aongh    activity non-farm employment outside village by
               high educated members
      Abish    activity self-employment by high educated members
      Aomoh    activity migration outside province by high edu-
               cated members
      hlb      pool hired agricultural labour
      pirlnd   pool irrigated land
      pox      pool oxen services
      rice1    one season rice
      rice2    two season rice
      strw     rice straw
      ocrop    other crops
      fore     perennial crops
      cat      cattle
      oliv     other livestock
      lman     livestock manure
      mman     processed manure
      feed     crop residues used as feed
      oox      own oxen services
      frt      fertilizer
      pst      pesticides
      seed     seed
      pfeed    purchased feed
      oinp     other inputs
      food     food
      nfood    non-food
      durab    durables
      fuel     fuel wood consumption
      lowlb    low educated labour
      highlb   high educated labour
      irlnd    irrigated land
      drlnd    dry non-irrigated land
      frlnd    forestland
      oxen     oxen stock
      h1       Households with no-one with more than 4 years
               education
      h2       Households with no oxen, at least 1 educated
               (more than 4 years) member;
      h3       Households with oxen, 1~2 educated (more than 4
               years) members;
      h4       Households with oxen, 3 or more educated (more
               than 4 years) members.
      h5       institution migrated household renting out
      gvt      institution government
      oinc     off-farm income earned above shadow wage
      row      rest of world outside village
* additional entries needed for model or reading data
      oxs      oxen services
      labor    composite labour input
      land     composite land input
      interm   intermediate inputs
```

```
      exter    external inputs
      oag      outside village agricultural labour
      ongl     outside village non-farm labour
      bisl     outside village self-employment labour
      omol     migration outside province
      ongh     outside village non-farm labour
      bish     outside village self-employment labour
      omoh     migration outside province
      tax      tax payments
      rem      remittances from outside the province
      rent     irrigated land rental payments
      nhs      extra entry to read entries that are not house-
               hold specific
         /
A(SAM)         Activities
         /Arice1,Arice2,Arice3,Arice4,Aocrop,Aoliv,Acat,Avag,Aoa
         g,Aongl,Abisl,Aomol,Aongh,Abish,Aomoh,Afore,Amanu,Afuel
         /
LA(A)    Leontief    activities
         /Avag,Aoag,Aongl,Abisl,Aomol,Aongh,Abish,Aomoh/
PLA(A)   pricing Leontief activities changed into Cobb-Douglas
         activities  /Amanu,Afuel/
MA(A)    Markup activities  /Acat/
CA(A)    Cobb-Douglasactivities
         /Arice1,Arice2,Arice3,Arice4,Aocrop,Afore,Aoliv/
J(SAM)   Commodities
         /labor,land,interm,exter,rice1,rice2,strw,fore,fuel,ocr
         op,feed,cat,oliv,lman,mman,oxs,hlb,oag,ongl,bisl,omol,o
         ngh,bish,omoh,lowlb,highlb,irlnd,drlnd,frlnd,oxen,frt,p
         st,seed,pfeed,oinp,food,nfood,durab/
SJ(J)    Subset of commodities for combal
         /labor,land,interm,exter,rice1,rice2,strw,fore,fuel,ocr
         op,feed,cat,oliv,lman,mman,oxs,hlb,oag,ongl,bisl,omol,o
         ngh,bish,omoh,lowlb,highlb,irlnd,drlnd,frlnd,oxen,frt,p
         st,seed,pfeed,oinp,food,nfood,durab/
O(J)     Outputs
         /rice1,rice2,strw,fore,ocrop,fuel,feed,cat,oliv,lman,mm
         an,oxs,hlb,oag,ongl,bisl,omol,ongh,bish,omoh/
LO(J)    Leontief outputs
         /hlb,oag,ongl,bisl,omol,ongh,bish,omoh/
PLO(J)   Pricing Leontief outputs                  /mman,fuel/
MO(J)    Variable markup outputs                   /oxs/
FO(J)    Fixed markup outputs                      /lman,cat/
I(J)     Inputs
         /lowlb,highlb,irlnd,drlnd,frlnd,oxen,frt,pst,seed,pfee
         d,oinp,hlb,oxs,feed,mman,lman,strw/
LI(J)    Leontief    inputs                     /lowlb,highlb/
PLI(J)   Pricing     Leontief inputs
         /lowlb,highlb,lman,strw,frlnd/
MI(J)    Markup Variable  inputs                   /oxen/
```

```
FI(J)    Markup fixed inputs
                    /lowlb,highlb,feed,oinp/
CI(J)    Composite inputs Cobb-Douglas activities
         /labor,land,oxs,interm,exter/
* household 4 consumed part of cattle output
C(J)     Consumption
         /rice1,rice2,ocrop,fore,fuel,cat,oliv,lowlb,highlb,
         food,nfood,durab/
F(J)     Factors      /lowlb,highlb,irlnd,drlnd,frlnd,oxen/
FF(F)    Fixed factors
        /lowlb,highlb,irlnd,drlnd,frlnd,oxen/
P(J)     Purchased    /frt,pst,seed,pfeed,oinp,food,nfood,durab/
S(J)     Sold
         /rice1,rice2,ocrop,fore,cat,oliv,oag,ongl,bisl,omol,ong
         h,bish,omoh/
HT(J)    Household tradable     /hlb,oxs/
SHT(J)   Subset household tradables for trade balance    /oxs/
E(J)     Exports
         /rice1,rice2,ocrop,fore,cat,oliv,oag,ongl,bisl,omol,ong
         h,bish,omoh/
M(J)     Imports
          /frt,pst,seed,pfeed,oinp,food,nfood,durab/
HR(SAM)  Households and not household specific account
         /h1,h2,h3,h4,h5,nhs/
H(HR)    Households  /h1,h2,h3,h4/
HP(H)    Household owning oxen power      /h1,h3,h4/
L(SAM)   Non-factor income and fixed expenditures
         /rem,rent/;
* Need an additional set to get home consumption from SAM
SET
AO(O)    Consumed agricultural output
         /rice1,rice2,ocrop,fore,fuel,cat,oliv/;
Alias (h,hh);
Alias (sam,samc);
Alias (hr,hrc);

*=============================================================
* Read data from SAM & compute value of consumption
$include R_SAM_1.inc (SAM can be sent upon request)
*=============================================================
* (Detail of equations can be sent upon request)
*Equations determining prices
$include E_prices_1.inc
* Leontief production activities in case of village model
$include E_leontief_1.inc
* Pricing Leontief production activities
$include E_P_leontief_1.inc
*  (manure and fuel wood collection activities) Cobb-douglas
production activities
$include E_PLA_CobbDouglas_1.inc
* Markup production activities
```

```
$include E_markup_1.inc
** Cobb-Douglas agricultural production
$include E_P_CobbDouglas_1.inc
$include E_IO_CobbDouglas_1.inc
** Consumption with Cobb-Douglas utility
$include E_U_CobbDouglas_1.inc
*=============================================================
* MODEL AND MATCH EQUATIONS WITH VARIABLES
* Matching of fixed model equations
$include M_match_1.inc
* SELECT A PRODUCTION FUNCTION
** Cobb-Douglas agricultural production
$include M_P_CobbDouglas_1.inc
* SELECT A UTILIY FUNCTION
** Cobb-Douglas utility function
$include M_U_CobbDouglas_1.inc
*=============================================================
* MODEL CLOSURE
* Closure for fixed parts of model
$include C_closure_1.inc
* Closure for Cobb-Douglas agricultural production
$include C_P_CobbDouglas_1.inc
$include G_shock_1.inc
*=====SOLVE MODEL============================
* Specify solver and options
$include S_solving_1.inc
** Equivalent variation with Cobb-Douglas utility
$include S_U_CobbDouglas_1.inc
*=====CONSISTENCY CHECKS ON MODEL ============================
* Check Walras' Law
$include S_Walras_1.inc
*=====GDX ouput ==============================================
$include G_output_1.inc
```

7 Comparison of the two village-wide models and a partial household model

7.1 Introduction

This chapter will compare the results of the village equilibrium model in chapter 6 with those of a household model (developed in this chapter) and the SAM multiplier approach in chapter 5. Household models have often been used in the literature to analyse household responses to policy shocks (Chen et al., 2006; Taylor et al., 2003; Benjamin and Brandt, 2002; Cook, 1999; Reardon, 1994). However, as explained in chapters 4 and 6, household interactions are very important in rural China, and may modify the household responses obtained from a partial household model analysis. Moreover, household interactions are not captured in a household model analysis. Hence, by comparing the results of a partial household model with those of the village equilibrium model a better understanding of such interactions between households and their relative importance can be obtained. The SAM multiplier "model" is also included in the comparison since SAM-based approaches to village development are still in use. The extent to which the results of the partial and general equilibrium models deviate from the outcomes of the SAM-based extrapolations, illustrate– at least partly– the benefits of using theoretically more appropriate modelling approaches.

As explained in previous chapters, opportunities for off-farm employment in rural areas are not equally distributed. Some households are not able to participate in off-farm employment or have only limited access to it. Changes in off-farm employment not only influence households that participate in it, but also households that are not directly involved. This influence occurs as a result of interactions between households, which affect household incomes, farm production, input

and factor use. Hence, it will be interesting to examine to the extent to which the household model results of the impact of off-farm employment differ from those results from a village equilibrium model.

Chapter 6 analysed the impact of off-farm employment on factor market development, input use and farm production by using a village CGE model. Some of the important insights obtained from the *Shangzhu* CGE model differ from the findings of the SAM multiplier approach for the same village, outlined in chapter 5. This is because the latter does not take into account the effect of price changes on village markets and household responses to such price changes. This chapter also examines the differences between these two types of models in order to assess the relative importance of household responses to price changes.

The overall objectives of this chapter then are to examine the differences between the three types of models in predicting the impact of off-farm employment on factor market development, input and factor use, household income, LPC and EQ, and to assess the importance of interactions among village households in determining household responses. This chapter has three specific goals. Firstly, it will compare the results of the village CGE model with those of a partial household model. Secondly, it will analyse differences between the results of the village CGE model and the village SAM multiplier approach. Finally, it will draw some general conclusions from these comparisons, with a particular focus on the importance of household linkages within a village and household responses to price changes.

The remaining part of the chapter is organized as follows. Section 2 explains the steps required to obtain a partial household model from the *Shangzhu* CGE model. In the third section, the results of policy simulations using the partial household model will be presented. These results are compared with those of the *Shangzhu* CGE model in the fourth section. Section five compares the results of the *Shangzhu* SAM multiplier approach with those of the *Shangzhu* CGE model. Section six draws some general conclusions from these two comparisons.

7.2 Adjustments to the *Shangzhu* CGE model for partial household model analysis

We wish to see the possible impacts of simulations of developments in village households' behaviour when these are studied in a general equilibrium context as opposed to a partial setting. However, thus far the study

has only developed a village CGE-model for one particular village, not a specific partial household model. However, a household model can be readily derived from the CGE model presented in chapter 6: if the household interactions in the village CGE model are frozen, then the resulting model can be used for a standard household level partial analysis. Freezing the household interactions, involves adjusting the price equations for household tradables (equation 6.3 in the annex of chapter 6) and the village constraints on household tradables (equation 6.11 in the annex of chapter 6). The other parts of the model remain the same. The village CGE model incorporates two main interactions: oxen rental activities and the hiring of agricultural labour. Land rental activities are fixed at the level observed in the *Shangzhu* SAM, so these do not need to be adjusted for the household model.

In the CGE model households are assumed to expand their agricultural labour hiring, in order to earn more 'profit'[1] from it, until there is 'zero profit'. However, institutional constraints in the village market for hiring labour mean that non-zero profits exist. Attempts are made to maintain these characteristics in the household model. The wage of hired agricultural labour is therefore fixed, and the quantity of hired labour determined by the level observed in the *Shangzhu* SAM.

For oxen service renting, equilibrium in the village CGE model is attained by allowing prices to adjust until supply meets demand in the village market. In this case the linkages between households are frozen by fixing the price of oxen services. Households in the partial household model can rent in an unlimited amount of oxen services, or rent out oxen services until they exhaust their oxen endowment.

7.3 Policy simulations using the partial *Shangzhu* household model

Policy simulations in the household model have the same structure as for the CGE model and include two bundles (an increase in participation in off-farm employment and an increase in wages from off-farm employment). Because household group 1 only has poorly educated labour, the simulations of increased participation of well-educated labour in off-farm employment (scenario 1) and increased off-farm wages well-educated labour (scenario 3) will have no impact on household group 1.

7.3.1 Scenarios on increased participation in off-farm employment

The simulation results for farm production, subdivided by major crops, are shown in Table 7.1. The trend in the first four scenarios is for farm production at the village level to shift to one-season rice production, because of reduced labour availability. The responses at the village level are quite similar for increases in the participation of only well-educated household members and both well- and poorly-educated household members. Scenario 5 shows that with more favourable agricultural prices, the production of two-season rice and livestock increases the most (38.6 and 16.9 percent, respectively), while other annual crops and perennial crops declined.

The responses of individual household groups are quite different for some production activities, especially for household group 2. This group, which is the one mostly strongly involved in local off-farm employment, does not increase one-season rice production as do household groups 3 and 4, but increases other annual crop production (and perennial crop production in scenarios 1 and 2), although only marginally. Because oxen service prices and the amount of marketed agricultural labour are fixed in the household model, household group 2 cannot shift production towards activities that use more hired agricultural labour. Therefore, it shifts towards production that makes less use of hired agricultural labour and external inputs. This group experiences a large increase in incomes in scenarios 3 and 4, and its production shifts even towards more other annual crops to meet its own consumption needs.

The responses of household groups 3 and 4, who are the two suppliers of oxen services in the village market, differ from those of household groups 2 and 1 in the first four scenarios. They dramatically increase their oxen services supply to the market (see Table 7.4 below) at the expense of two-season rice, perennial crops and other annual crop production. These two groups, are more affected by an increase in migration (scenarios 1 and 2) than they are by local off-farm employment because the increase in migration has a large impact on the labour availability within the households.

Table 7.1

Higher participation: simulation results for farm production (% output changes)

Farm Production		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
One-season Rice	Group 1	0.0	-5.9	0.0	-1.4	1.6
	Group 2	-2.0	-5.1	-6.2	-5.5	16.8
	Group 3	9.6	10.3	5.9	5.4	5.6
	Group 4	5.8	6.2	5.4	4.9	3.2
	All groups	5.6	5.0	3.8	3.3	5.1
Two-season Rice	Group 1	0.0	-12.3	0.0	-3.5	51.7
	Group 2	-27.0	-24.8	-19.5	-17.9	-15.3
	Group 3	-100.0	-100.0	-59.6	-55.0	28.3
	Group 4	-84.1	-84.3	-54.0	-52.8	45.4
	All groups	-74.7	-76.3	-46.7	-45.2	38.6
Other Annual Crops	Group 1	0.0	-2.6	0.0	0.0	-9.6
	Group 2	1.0	0.8	1.3	0.9	-0.5
	Group 3	-6.8	-4.9	0.008	0.008	-9.6
	Group 4	-7.0	-6.0	0.1	0.1	-12.8
	All groups	-5.3	-4.4	0.2	0.1	-9.8

Continued

Perennial Crops	Group 1	0.0	-1.0	0.0	-0.3	-18.6
	Group 2	0.2	0.05	-1.5	-1.4	-1.4
	Group 3	-1.3	-0.8	-0.03	-0.03	-2.2
	Group 4	-8.3	-6.7	-0.4	-0.3	-11.5
	All groups	-3.5	-2.9	-0.4	-0.3	-7.0
Livestock (Excluding oxen)	Group 1	0.0	-23.3	0.0	-6.9	123.9
	Group 2	-18.7	-17.4	-13.7	-12.6	-12.0
	Group 3	-45.5	-45.6	-23.8	-21.9	4.6
	Group 4	-46.0	-45.9	-28.3	-27.3	21.5
	All groups	-38.0	-39.2	-22.5	-21.7	16.9

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.

The results of the fifth scenario differ from the other four scenarios, and individual household groups also react differently. All the groups, except household group 2, shift towards two-season rice and livestock (excluding oxen) production. And all the groups increase one-season rice production, with household group 2 showing the largest increase (16.8 percent). Household groups 1, 3 and 4 increase agricultural production when the prices of inputs decrease and the prices of outputs increase. This leads them to expand livestock production. To meet the demand for fodder, production of two-season rice rises a lot, and one-season rice production increases less. The responses of household group 2 in the fifth scenario differ from those of the other groups due to the larger reduction of labour availability for this group in the fifth scenario (due to an increase in its participation in local off-farm employment).

The results for rice production are presented in Table 7.2. In the first four scenarios the production of one-season rice switches to using green manure, while both sub-types of two-season rice production (with and without green manure) decline. These changes are due to the labour use intensity being much higher in two-season rice production. One-season rice production with green manure is less demanding of manure and labour compared to production without green manure. Increases in labour scarcity and the shadow price of manure therefore contribute to this change. Migration has a stronger impact on these shifts in rice production patterns than local non-farm activities. These shifts are mainly caused by the reduced availability of labour and the lack of possibilities for hiring additional agricultural labour through the village market (as only the base level of hired labour reported in the *Shangzhu* SAM is available). In the fifth scenario, all farmers completely stop using green manure in both one and two-season rice production.

The degree of response by various household groups differ, but are generally consistent with their production responses. The only exception is the switch made by household group 1 towards two-season rice production without green manure, a shift that is mainly driven by reduced labour availability. The relatively strong responses made by household groups 3 and 4 are the main factors that determine the aggregate village level trends.

Table 7.2

Higher participation: simulation results for rice production switching (% changes)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
One-season Rice without Green Manure	Group 1	0.0	-44.1	0.0	-10.4	22.4
	Group 2	-20.4	-35.8	-39.3	-35.2	63.3
	Group 3	-23.6	-21.9	-17.0	-15.8	23.9
	Group 4	-100.0	-100.0	-63.2	-65.4	66.1
	All groups	-50.0	-56.8	-34.9	-36.3	43.9
One-season Rice with Green Manure	Group 1	0.0	181.6	0.0	42.8	-100.0
	Group 2	44.1	71.7	76.8	68.9	-100.0
	Group 3	201.8	196.4	138.4	128.0	-100.0
	Group 4	179.2	180.2	117.9	120.2	-100.0
	All groups	156.1	172.2	108.5	110.6	-100.0
Two-season Rice without Green Manure	Group 1	0.0	76.6	0.0	5.3	623.8
	Group 2	-27.0	-24.8	-19.5	-17.9	-15.3
	Group 3	-100.0	-100.0	-61.5	-56.8	141.2
	Group 4	-68.1	-68.5	-36.4	-35.9	191.3
	All groups	-70.3	-65.8	-40.5	-38.3	181.7
Two-season Rice with Green Manure	Group 1	0.0	-35.8	0.0	-5.8	-100.0
	Group 3	-100.0	-100.0	-57.5	-53.0	-100.0
	Group 4	-100.0	-100.0	-71.6	-69.7	-100.0
	All groups	-78.9	-86.5	-52.8	-51.8	-100.0

Notes: Household group 1: no educated members; Household group 2: no draught power and more than 1 educated member; Household group 3: draught power and 1 and 2 educated members; Household group 4: draught power and more than 3 educated members.

Percentage changes in inputs use are presented in Table 7.3. In the first four scenarios, the levels of input use in the village decrease, although by different magnitudes. There are much more pronounced decreases in the use of fertilizer, pesticides and herbicides use than of manure. Increased migration (scenarios 1 and 2) has a stronger effect than increased local off-farm employment (scenarios 3 and 4), and induces different production responses. The dramatic drop in two-season rice production (which requires a high intensity of external inputs) that occurs under the increased migration scenarios, accounts for much of the decline in the use of external inputs. Again, there is only a small difference between the responses that occur for well educated off-farm employment (scenarios 1 and 3) and a mixture of both poorly and well educated off-farm employment (scenarios 2 and 4). And, as before, the responses of household groups 3 and 4 are much stronger than those of the other two groups.

In the fifth scenario the use of chemical inputs (fertilizer, pesticides and herbicides) strongly rises, while manure use increases only slightly. The large growth in two-season rice production, an increase in the shadow price of manure (due to an increased labour scarcity) and increased cash availability are responsible for these differences. The responses of household groups 1 and 4, which are more focused on farm production, are much stronger than those of the other two household groups in this scenario.

The simulation results for oxen renting are presented in Table 7.4, the structure of which is similar to that of Table 6.5 in chapter 6. Changes in agricultural labour hiring, however, are not included in the table, because agricultural labour hiring is now fixed at the level observed in the *Shangzhu* SAM. One row has been added to the table to present the changes in renting in oxen by household groups 1 and 2[2], because these changes are the same as the changes in oxen renting out (shown in the last row) as in the village CGE model. In the first four scenarios, demand for oxen services from household groups 1 and 2 decreases because oxen service prices are fixed and total rice production decreases (due to a reduction of labour availability). Household groups 3 and 4 considerably increase the oxen services that they market in these scenarios as these two groups substantially reduce their farm production and therefore reduce the own use of oxen services. In the fifth scenario, all household groups increase their demand for oxen services (household groups 3 and 4 even turn to

Table 7.3

Higher participation: simulation results for input use (% changes)

Inputs Use		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
Manure Use	Group 1	0.0	-8.9	0.0	-2.3	20.2
	Group 2	-5.4	-7.7	-7.6	-6.9	7.3
	Group 3	-12.3	-11.6	-5.8	-5.3	0.0
	Group 4	-16.1	-16.5	-9.3	-9.5	3.4
	All groups	-11.2	-13.0	-6.4	-6.7	5.8
Fertilizer Use	Group 1	0.0	-11.9	0.0	-3.4	49.5
	Group 2	-8.8	-14.0	-14.9	-13.4	27.8
	Group 3	-28.1	-27.3	-17.2	-15.9	26.3
	Group 4	-41.5	-41.4	-25.1	-25.3	44.1
	All groups	-28.3	-30.1	-18.2	-18.1	37.3
Pesticide and Herbicide Use	Group 1	0.0	-8.9	0.0	-2.5	40.4
	Group 2	-5.9	-9.4	-9.9	-8.9	21.0
	Group 3	-22.2	-21.4	-13.1	-12.1	18.9
	Group 4	-29.2	-29.0	-17.2	-17.3	28.1
	All groups	-21.2	-22.2	-13.2	-13.1	25.8

Notes: Household group 1: no educated members. Household group 2: no draught power and more than 1 educated member. Household group 3: draught power and 1 and 2 educated members. Household group 4: draught power and more than 3 educated members.

renting in oxen instead of renting them out) due to the sharp in increase in agricultural production.

An increase in migration has a much stronger impact on the renting out of oxen because it has a larger impact on switching production, especially on rice production. Hence, household groups 3 and 4 reduce their use of their own oxen services even more and increase their supply of oxen services to the market. With the fixed price of oxen services, household group 1 even starts to rent out oxen services instead of renting them in from the market under scenario 2.

Changes in incomes are presented in Table 7.5. At the aggregate level all the household groups see their incomes increase and the fifth scenario gives the highest increase. The scenarios for local off-arm employment show much larger income increases than the migration scenarios. The results for only well-educated off-farm employment (scenarios 1 and 3) are similar to those for both poorly- and well-educated off-farm employment (scenarios 2 and 4). As discussed in chapter 6, previous studies (e. g. Taylor et al. 2003) found that migration gave negative 'lost-labour' effects and positive income effects through remittances,, and the combination of these two effects was close to zero. The impacts of migration on household incomes shown in Table 7.5 are in some ways consistent with Taylor et al. (2003) as they are just above zero and far less than the 5 percent of village GDP injection used in the model.

As expected, individual household groups experience quite different changes in incomes under the different scenarios. Household group 3, which is involved most in migration, gains most from the migration scenarios. The household groups most involved in local off-farm employment, groups 2 and 4, gain most from local off-farm employment. The group that depends most on agriculture, household group 1, gains little from the first four scenarios. In some cases, the lost-labour effect outweighs the remittances effect, resulting in income declines for some groups in the two migration scenarios.

Table 7.4
Higher participation: Simulation results for oxen renting

Factor Market Development Scenario		Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
			Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
Oxen Renting	Group 1	-5.9	-5.9	10.7	-5.9	-1.8	-39.0
	Group 2	-94.1	-86.5	-83.8	-83.9	-84.8	-108.2
	Change	-	-7.6	-21.3	-10.2	-13.4	47.2
	Group 3	50.0	115.4	110.7	86.6	83.8	-10.5
	Group 4	50.0	162.3	160.4	111.2	113.2	-56.6
	Change	-	177.6	171.1	97.8	97.0	-167.1

Notes: Household group 1: no educated members.
Household group 2: no draught power and more than 1 educated member.
Household group 3: draught power and 1 and 2 educated members.
Household group 4: draught power and more than 3 educated members.
Negative signs for oxen renting describe 'renting in oxen'.

Table 7.5
Higher participation: simulation results for household income (% changes)

Income	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Group 1	0.0	-0.02	0.0	0.84	4.4
Group 2	-0.2	0.3	6.5	6.0	6.6
Group 3	3.6	3.2	1.2	1.1	2.4
Group 4	-1.7	-1.6	4.2	4.4	5.9
All Groups	0.4	0.4	3.2	3.3	4.7

Notes: Household group 1: no educated members.
Household group 2: no draught power and more than 1 educated member.
Household group 3: draught power and 1 and 2 educated members.
Household group 4: draught power and more than 3 educated members.

7.3.2 Scenarios for increasing wages of off-farm employment

We turn now to the second bundle of scenarios, that of increasing wages from off-farm employment. The simulation results for farm production, subdivided by major crops, are shown in Table 7.6.

At the village level, the production of two-season rice and livestock activities decline substantially in the first four scenarios, while other production activities hardly change. In the fifth scenario, on the other hand, two-season rice and livestock production strongly increase, while the other production activities only show minor changes.

Household groups 1 and 2 decrease their one-season rice production, in contrast to household groups 3 and 4 which increase it. As was the case in the first bundle, this is the household model fixes oxen service prices and the amount of marketed agricultural labour in the village market. Thus household group 2 cannot shift its production activities so as to use more hired agricultural labour. Another reason is that the intensity of labour use by household groups 1 and 2 in one-season rice production is smaller than in two-season rice production, although these differences are quite small. The differences are larger for household groups 3 and 4 for whom the intensity of use of external inputs is higher in two-season rice. An increase in the incomes of household groups 1 and 2 reduces

their move towards one-season rice production. Hence, the overall effects result in decreases in both forms of rice production.

The response of household group 2 in the fifth scenario differs from that of the other groups. This group increases one-season rice production substantially and decreases two-season rice production. The other groups increase two-season rice and livestock production. The responses of household group 2 differ on the responses from others are due to it has highest labour less available compared to other groups.

The results for rice production switching are presented in Table 7.7. As with the first bundle of simulations, one-season rice production shifts towards using green manure in the first four simulations, although the shifts are much smaller. This is because the second bundle of simulations does not take the reduced availability of labour into account, but examines the impact of the additional income from off-farm employment on leisure consumption and on relaxing cash constraints. The results indicate that the net impact of these two effects is to increase green manure planting in one-season rice production. Compared to the previous simulations the decreases in two-season rice production are also relatively small. In this simulation migration leads to a smaller switch towards one-season rice production with green manure than local off-farm employment does. This is contrary to the finding from the previous bundle of simulations and is due to the reduction in labour availability from migration (in the first bundle) being relatively stronger. In the fifth scenario, rice production with green manure is completely abandoned due to the more favourable prices for agricultural produce, as in the first simulation bundle.

Household groups show different responses to the five scenarios, but they are all in a similar direction as responses in the first bundle. This indicates that the net impact of increased leisure consumption and relaxing cash constraints is similar to the impact of reduced labour availability for all household groups, but that the magnitude of the effect is smaller.

Table 7. 6

Higher wages: simulation results for farm production (% output changes)

Farm Production		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
One-season Rice	Group 1	0.0	-1.5	0.0	-0.7	1.6
	Group 2	-2.1	-2.3	-6.6	-5.9	15.9
	Group 3	1.1	1.0	0.4	0.4	4.1
	Group 4	0.7	0.6	1.0	1.0	-1.1
	All groups	0.5	0.2	-0.1	-0.08	2.5
Two-season Rice	Group 1	0.0	-3.9	0.0	-1.8	52.6
	Group 2	-2.0	-2.3	-6.3	-5.7	-5.8
	Group 3	-10.0	-9.2	-4.0	-3.7	39.6
	Group 4	-13.5	-12.7	-18.7	-19.3	67.4
	All groups	-10.1	-10.0	-11.4	-11.8	54.1
Other Annual Crops	Group 1	0.0	0.002	0.0	0.002	-9.5
	Group 2	-0.04	-0.04	2.7	2.2	0.5
	Group 3	0.007	0.006	0.002	0.002	-9.4
	Group 4	-0.04	-0.04	-0.06	-0.06	-12.5
	All groups	-0.017	-0.017	0.290	0.233	-9.4

Continued

Perennial Crops	Group 1	0.0	-0.8	0.0	-0.4	-18.6
	Group 2	-0.8	-0.9	-2.1	-1.9	-1.8
	Group 3	-0.2	-0.2	-0.1	-0.1	-2.2
	Group 4	-0.1	-0.1	-0.2	-0.2	-11.2
	All groups	-0.2	-0.3	-0.4	-0.4	-6.9
Livestock (Excluding oxen)	Group 1	0.0	-7.7	0.0	-3.6	126.0
	Group 2	-1.7	-1.9	-4.7	-4.3	-5.6
	Group 3	-4.2	-3.9	-1.6	-1.5	12.4
	Group 4	-6.4	-6.0	-8.8	-9.1	37.5
	All groups	-4.5	-4.7	-5.3	-5.6	27.8

Notes: Household group 1: no educated members;
Household group 2: no draught power and more than 1 educated member;
Household group 3: draught power and 1 and 2 educated members;
Household group 4: draught power and more than 3 educated members.

Table 7.7

Higher wages: simulation results for rice production switching (% changes)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
One-season Rice without Green Manure	Group 1	0.0	-11.6	0.0	-5.5	22.3
	Group 2	-11.5	-12.9	-36.2	-32.7	62.1
	Group 3	-2.4	-2.2	-1.1	-1.0	22.1
	Group 4	-21.8	-20.6	-30.0	-31.0	59.2
	All groups	-10.5	-11.7	-15.6	-16.3	40.4
One-season Rice with Green Manure	Group 1	0.0	47.9	0.0	22.5	-100.0
	Group 2	21.6	24.2	67.8	61.4	-100.0
	Group 3	21.0	19.4	9.1	8.4	-100.0
	Group 4	37.5	35.4	51.7	53.4	-100.0
	All groups	30.1	32.4	41.9	43.9	-100.0
Two-season Rice without Green Manure	Group 1	0.0	5.9	0.0	2.8	628.2
	Group 2	-2.0	-2.3	-6.3	-5.7	-5.8
	Group 3	-10.0	-9.2	-4.1	-3.8	162.5
	Group 4	-9.6	-9.1	-13.3	-13.7	235.3
	All groups	-8.5	-7.6	-9.1	-9.0	213.2
Two-season Rice with Green Manure	Group 1	0.0	-6.5	0.0	-3.1	-100.0
	Group 3	-10.0	-9.1	-3.9	-3.6	-100.0
	Group 4	-17.3	-16.4	-24.0	-24.8	-100.0
	All groups	-11.7	-12.4	-13.6	-14.6	-100.0

Notes: Household group 1: no educated members; Household group 2: no draught power and more than 1 educated member; Household group 3: draught power and 1 and 2 educated members; Household group 4: draught power and more than 3 educated members.

The results for input use are presented in Table 7.8. These are very similar to those for the first bundle of simulations, but once again the magnitudes of changes are smaller, due to the smaller changes in production activities. Once again the reductions in the use of fertilizer, pesticides and herbicides use are larger than those for manure in the first four scenarios. However, contrary to the first simulation bundle, increases in local off-farm wages have a stronger impact than increases in migration wages, due to the relatively large shift in production activities caused by higher local off-farm wages. In the fifth scenario, the use of fertilizer increases much more than that that of manure, as was the case the fifth scenario in the first bundle.

Table 7.8
Higher wages: simulation results for input use (% changes)

Inputs Use		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Manure use	Group 1	0.0	-2.5	0.0	-1.2	20.6
	Group 2	-2.0	-2.2	-5.4	-5.0	8.5
	Group 3	-0.9	-0.8	-0.4	-0.3	1.0
	Group 4	-3.0	-2.9	-4.2	-4.3	5.6
	All groups	-1.7	-2.1	-2.3	-2.6	7.2
Fertilizer use	Group 1	0.0	-3.8	0.0	-1.8	50.0
	Group 2	-4.1	-4.6	-12.8	-11.6	28.1
	Group 3	-2.7	-2.5	-1.1	-1.1	29.0
	Group 4	-7.5	-7.1	-10.4	-10.7	51.2
	All groups	-4.6	-4.9	-6.3	-6.5	41.4
Pesticide and Herbicide use	Group 1	0.0	-2.8	0.0	-1.3	40.9
	Group 2	-2.8	-3.1	-8.4	-7.6	21.3
	Group 3	-2.1	-1.9	-0.9	-0.8	21.0
	Group 4	-5.1	-4.8	-7.0	-7.3	33.0
	All groups	-3.3	-3.5	-4.5	-4.6	28.8

Notes: Household group 1: no educated members.

Household group 2: no draught power and more than 1 educated member.
Household group 3: draught power and 1 and 2 educated members.
Household group 4: draught power and more than 3 educated members.

The results for oxen renting are presented in Table 7.9. The supply of oxen services to the market by household groups 3 and 4 increases in the first four scenarios, and demand for oxen services from the other two household groups decrease, as was the case under the first simulations bundle. Here again the magnitudes of change are smaller. The impact of higher local off-farm wages is stronger than that of higher migration wages, which is consistent with the changes in farm production. In the fifth scenario, household groups 3 and 4 turn to renting in oxen instead of renting out to the market, while household groups 1 and 2 increase their renting in of oxen due to their expanding farm production. The magnitudes of the changes in the fifth scenario are comparable to those for the fifth scenario in the first bundle.

Changes in incomes are presented in Table 7.10. The incomes of all groups increase in all five scenarios (except for the incomes of household group 1 in scenarios 1 and 3, because this group has no well-educated members). At the aggregate village level, increases in incomes are quite similar for increased migration wages and higher local off-farm wages and the total income increases are just above 5 percent. As the total income injection amounts to 5 percent of the village GDP in all scenarios, this means that the net effect of higher off-farm wages on agricultural incomes, through increased leisure consumption and relaxing cash constraint is slightly positive. The fifth scenario gives the highest increase in incomes. Household group 1 has the largest income gain in the fifth scenario, as this it depends more on agriculture for its income.

Table 7.9

Higher wages: Simulation results for oxen renting

Factor Market Development Scenario		Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
			Highly-educated migration	Poorly- and highly-educated migration	Highly- educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Oxen Renting	Group 1	-5.9	-5.9	-1.3	-5.9	-3.7	-39.3
	Group 2	-94.1	-91.6	-91.2	-86.4	-87.1	-109.4
	Change	-	-2.5	-7.5	-7.7	-9.2	48.7
	Group 3	50.0	55.6	55.2	52.4	52.2	-14.7
	Group 4	50.0	70.8	69.6	78.6	79.5	-61.7
	Change	-	26.3	24.8	31.0	31.8	-176.5

Notes: Household group 1: no educated members.
Household group 2: no draught power and more than 1 educated member.
Household group 3: draught power and 1 and 2 educated members.
Household group 4: draught power and more than 3 educated members.
Negative signs in oxen renting signify 'renting in oxen'.

Table 7.10
Higher wages: simulation results for household income (% changes)

Income	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Group 1	0.0	2.5	0.0	1.2	4.6
Group 2	3.3	3.7	8.5	7.8	8.0
Group 3	8.7	8.0	3.5	3.3	3.0
Group 4	4.3	4.1	6.0	6.2	7.1
All Groups	5.2	5.1	5.1	5.0	5.7

Notes: Household group 1: no educated members.
Household group 2: no draught power and more than 1 educated member.
Household group 3: draught power and 1 and 2 educated members.
Household group 4: draught power and more than 3 educated members.

7.4 Comparing the results of the partial household model with the CGE model

The *Shangzhu* CGE model and the household model analysed the impact of off-farm employment on the rural economy, focusing on their impact on farm production, input use, factor market development and changes in income. This section compares the results from the two models in terms of changes in farm production, factor market development, incomes, and land use.

7.4.1 Changes in farm production pattern

In terms of farm production both the household and the CGE models generally showed an increase in one-season rice production and large declines in two-season rice and livestock production. In the GCE model one-season rice production increased by more than double the rate that it did in the household model. The two models gave broadly similar results for the decreases in other production activities.

The responses of some household groups differ from the general trends, in both the village model (Tables 6.2 and 6.7) and household

model (Tables 7.1 and 7.6). For example, increased participation in off-farm employment in the village CGE model induces household group 1 to increase the production of other crops and livestock as well as one-season rice in some scenarios, while household group 2 increases one-season rice production as well as that of other annual crops. However, in the household model analysis household group 1 decreases all types of production (in scenarios 2 and 4) or there is no significant change (in scenarios 1 and 3), and household group 2 only raises production of other annual crops and perennial crops (in scenarios 1 and 2).

As discussed in section 7.2, household group 2 cannot shift production towards activities that use more hired agricultural labour because the prices of oxen service and the amount of marketed agricultural labour are fixed in the village market in the household model,. Therefore, household group 2 shifts towards production which makes less use of hired agricultural labour and external inputs. Household group 2 has a large increase in income in scenarios 3 and 4, and in these scenarios its production shifts even towards more other annual crops to meet own consumption needs. Household groups 1 and 2 use labour less intensely in one-season rice production than in two-season rice production, although the far less than those for household groups 3 and 4. The intensity of external input use is generally higher in two-season rice than that in one-season rice. Increased additional incomes drives household groups 1 and 2 to shift towards two-season rice production, while reduced labour availability drives a shift towards one-season rice production. The overall effect is a decrease in both one and two-season rice production among these two groups.

In the village CGE model, lower oxen service prices and the possibility of hiring more agricultural labour enhance the shift towards one-season rice production. So, in the village CGE model the responses of all four household groups show the same trends in the first four scenarios, while in the household model the responses of household groups 1 and 2 are different from that of household groups 3 and 4. This explains why the responses of shifting towards one-season rice production in the village model are much stronger than that in the household model.

The fifth scenario is dominated by the effects of an increase in output prices and a decrease in inputs prices for farm production. In consequence, the results for the fifth scenario are quite similar in the two models. Changes in the production of two-season rice and livestock are

more pronounced in the village model than in the household model, but one-season rice production increases in the household model while it decreases in the village model. In the village model, the overall rice production increases by 5.7 and 7.4 percent in the first and second bundles of simulations, while in the household model it increases by 13.2 and 15.0 percent in the same two bundles. Decreases in production of other annual crops and perennial crops are somewhat larger in the household model than they are in the village model. Increased agricultural profitability results in an expansion of rice and livestock production in the household model with a fixed price for oxen services in the village market and an unlimited possibility for renting in oxen services. But in the village model, where the total supply of oxen services is fixed and the prices of oxen services rises by 4 to 5 percent (in the first two bundles), household groups shift to the more profitable two-season rice production and livestock production.

7.4.2 Impact on factor market development and incomes

Comparisons in oxen renting activities can only be made between the two models because the amount of labour hiring is fixed in the household model. Hence, here the only comparison made here is for differences in oxen renting in the two models.

The simulation results for the first four scenarios for oxen service renting under the CGE model (Tables 6.5 and 6.10) are quite modest compared with those obtained from the household model (Tables 7.4 and7.9). In the simulations of increasing participation in off-farm employment, household groups 3 and 4 increase their renting out of oxen by 8.2 - 43.9 percent in the village model and by 97.0 - 177.6 percent in the household model. In the second bundle of simulations (higher wages from off-farm employment), household groups 3 and 4 raise oxen services renting out by 3.1 percent in one scenario and slightly decrease oxen renting out in the other three scenarios. By comparison in the household model they increase oxen renting out by 24.8 - 31.8 percent. In the village model, household group 3, a supplier of oxen services to the village market, reduces its oxen services supply to the village market, while in the household model it increases its supply of oxen services, as does household group 4. In the fifth scenario, the changes in the household model are much stronger than those in the village model. As explained in section 7.2, by freezing the oxen services marketing in the

household model, it is assumed that households can rent in unlimited oxen services in the village market at a fixed price. Under this assumption we see that all the household groups use far more oxen services in the fifth scenario (an increase in agricultural profitability). This contrasts with scenario 5 in the village model in which the same total amount of oxen services are used as in other scenarios but with an increase in their price, which leads household groups 1 and 2 to use more oxen services at the expense of a decline of oxen service use by household groups 3 and 4.

The reason for this difference is because in a partial model the village demand for oxen services is not made to be equal to the supply, and the price has been artificially fixed. Hence, in the household model, household groups' decisions about how much of these services to rent in or out depends solely on the difference between the marginal product of oxen services and the fixed price for them in the market. In the village model, however, oxen service prices go down (up) when the supply to the village market is increased (decreased), thereby dampening the responses of households.

The household and CGE models give very similar, results for village income levels under all scenarios. Even for individual household groups, changes in income levels do not differ more than 0.3 percentage points between the two modelling approaches. Hence, although some groups gain and others lose in the village CGE model from price changes for oxen renting, the impacts on household incomes are small and tend to cancel each other out at the village level.

7.4.3 Impact on LPC and EQ

To examine the impact on LPC and EQ, the results for rice production switching (Tables 6.3, 6.8, 7.2 and 7.7) and input use (Tables 6.4, 6.9, 7.3 and 7.8) in the two models are compared, starting with the first four scenarios.

In general, switches of rice production between one and two-season rice and with / without green manure planting are in the same direction in both models and show a production shift towards one-season rice production with green manure. The switches in the village model are smaller than those in the household model. This is somewhat surprising since rice production responses in the village model are slightly stronger than those in the household model, as discussed above. The reason is

that all household groups switch towards production of one-season rice with green manure in the household model, due to reduced labour availability and increased cash availability. In the village model, however, household groups 1 and 2 switch towards producing more one-season rice without green manure, which uses relatively more oxen inputs, due to the lower price for oxen services on the village market. In other words, the aggregate shift towards one-season rice with green manure in the village model is the combined effect of a lower price for oxen services, an increase in cash availability and less labour availability. But in the household model, the combination of lower labour availability and higher cash availability pushes all the household groups towards one-season rice production using green manure. The availability of hired agricultural labour does not play a role in the shifts in both models, because one-season rice (with and without green manure) use hired agricultural labour.

In the village model, the rice production switches under the first bundle of the simulations are much stronger than that under the second bundle. This is mostly because the decreases in prices for oxen services are smaller in the second bundle than in the first. In addition, reductions of labour availability in the second bundle of simulations (caused by increased leisure consumption) are not as strong as in the first bundle in either model. Hence, in both models switches in rice production are smaller under the second bundle of simulations, than the first.

The simulation results for the fifth scenario in the household model show that both one and two-season rice production shift away from using green manure, due to the lower price for purchased inputs. In the CGE model, however, one-season rice production shifts towards using green manure (and two-season rice towards production without using green manure). The differences between the two models are due to the differences in production responses between different household groups. As explained before, in the household model, household groups increase both one and two-season rice production, but in the village model only two-season rice production rises. With more available cash, household groups shift towards rice production without green manure in the household model, with increases in both one and two-season production. With increased market prices for oxen services, household groups shift towards one-season rice production with green manure (which uses less oxen services) and decrease the total one-season rice production.

With respect to input use, responses in the two models are all in the same direction, although responses are much stronger in the household model for the first four scenarios. Declines in fertilizer, pesticide and herbicide use are two to three times larger in the household model than in the village model. Decreases in manure differ less between the two models. These changes are related to changes in farm production and switches in rice production. There are stronger reductions of two-season rice production in the household model than in the village model and smaller increases in one-season rice production in the household model. In the household model, there is a stronger shift towards one-season rice production with green manure, which needs less fertilizer, than in the village model.

In the fifth scenario, both the village and household models show increases in input use, with fertilizer, pesticide and herbicide use increasing more than the manure use. The responses in the village model are less than in the household model in this scenario, due to stronger rice production switching in the household model.

What implications do these changes have for LPC and EQ? Given the rice production switching in the two models, the impact on LPC is positive in the first four scenarios and is stronger in the household model, because the increase in one-season rice production with green manure is larger in this model. In the first four scenarios the impact on EQ is also more positive in the household model because the use of fertilizer, pesticides and herbicides decreases twice as much as in the village model, while the decrease in manure is only around fifty percent larger.

In the fifth scenario, the impact on LPC is negative in the household model, due to households abandoning rice production with green manure and greatly increasing rice production without green manure. In the village model, the impact on LPC is unclear because production of one-season rice with green manure and two-season rice without green manure both increase.

The impact on EQ in the fifth scenario is strongly negative in both models, as this scenario causes large increases in chemical input use which are larger than the increases in manure use. These effects are stronger in the household model than in the village model.

In summary, although many responses simulated with the household model are similar to those simulated by the CGE model, the differences in outcomes between the two models reveal that household linkages

through village markets play an important role in shaping household responses:

- Firstly, changes in the prices of oxen service have an important impact on the responses of household groups in the village model, while agricultural labour hiring plays a less important role.
- Secondly, differences in the direction of responses of household groups in the village model are mainly due to different positions of these groups within the village market. In the household model, there are more similarities in the responses of the different household groups.
- Thirdly, although household groups in the household model show slightly smaller changes in production activities, they show much stronger responses in rice production switching, input use and market participation than they do in the village model. This is caused by the dampening effect of household linkages, particularly oxen renting activities.

7.5 Comparing the *Shangzhu* CGE model with the *Shangzhu* SAM multiplier model

To make the *Shangzhu* CGE model comparable with the *Shangzhu* SAM multiplier model, we have kept the scenarios in the *Shangzhu* CGE model identical to those used in the SAM multiplier model in terms of the total amount being injected in the simulations. However, there are a few differences in the simulations that were run between the two models.

Remittances or incomes obtained from off-farm employment (from outside the village) in the *Shangzhu* SAM multiplier model are treated as exogenous. Simulations of changes in off-farm employment in the SAM multiplier model are done by injecting given amounts of income into the exogenous account of off-farm employment and then examining changes in endogenous accounts and the total. Increases in remittances or income from off-farm employment can either be the result of increased labour input or higher wages earned in off-farm employment. Because factor constraints were not imposed on the *Shangzhu* SAM multiplier model, it is not possible to distinguish whether the additional incomes (remittances) are due to increases in off-farm wages or from increases in labour input in off-farm employment.

Simulations with the SAM multiplier model were also done to examine the impact of increasing export demand. This was done by injections in the export accounts, to reflect exported products (e.g. rice or handicrafts) out of the village. The price of exported products in a SAM is assumed to be fixed and it is not possible to simulate the effects of price changes for exported products outside the village in such a model.

In the *Shangzhu* CGE model it is possible to distinguish between increases in labour inputs for off-farm employment and increases in wages from off-farm employment. These factors are fixed and it is possible to simulate them separately. However, increases in products exported from the village cannot be simulated, as they are endogenous to the model. Hence, in both village and household models a scenario of a 2 percent increase in output prices and a 2 percent decrease in input prices instead was used as a substitute for an increase in exports.

This section compares the results for the *Shangzhu* SAM multiplier model with those of the CGE model. The results of the first will be taken as the benchmark for comparison. Deviation from that benchmark shows the potential significance of applying a theoretically more satisfying approach, that of a village general equilibrium model.

7.5.1 Changes in farm production pattern

The results for the village-level changes in farm production are compared in Table 7.11, which uses data taken from tables in chapters 5 and 6. The results from the SAM multiplier model are in the rows labelled 'SAM', and those from the first and the second bundles of simulations with the CGE model are in the rows labelled 'CGE1' and 'CGE2', respectively. In the SAM multiplier approach, rice production increases by 5 – 6 percent, other annual crops production by 6 – 7 percent, livestock production by around 4 percent, and perennial crop production by less than one percent in the first four scenarios. All production activities increase by 6 – 7 percent in the fifth scenario (an increase in incomes from off-farm employment and exports). In the CGE model, farm production shifts towards one-season rice production and other farm production activities decrease in the first four scenarios, due to lower labour availability and a lower price for oxen services in the village. In the fifth scenario, the combined effect of higher profitability from agriculture and higher prices for oxen services is to shift production towards two-season rice and livestock production.

In the *Shangzhu* SAM multiplier model there are no factor constraints (or other constraints) on expanding production, and prices, including the price of oxen services and leisure, do not change. Hence, we do not see production shifts in the SAM multiplier model. This explains the large differences in production results between the two models.

The SAM multiplier approach shows the increase in different production activities driven by an income-induced increase in consumption. Hence, the highest increase in production is for those products that are mainly consumed by households within the village. Production activities that produce goods that are mainly sold outside the village increase less. In the simulation of the fifth scenario, production of such 'export' goods increases relatively more because a larger increase in exports is injected into that scenario.

There are greater differences in the responses of individual household groups in the CGE model than in the SAM multiplier approach in all the scenarios (Tables 6.2, 6.7 and 5.12). All the household groups' production activities increase at more or less the same level in the SAM multiplier model, even in the fifth scenario. This last scenario consists of a combination of additional off-farm income and an increase in demand for exports, which result in an increase in production for consumption and for export. The fifth simulation in the CGE model consists of an increase in output prices and a decrease in input prices, combined with an increase in participation in off-farm employment (the first bundle) or in wages of off-farm employment (the second bundle). In response to these changes three household groups shift their production towards the agricultural production which is now the most profitable activity. However, household group 2 shifts towards less labour-intensive production activities, as this group is the one that is most influenced by an increase in off-farm employment.

Table 7.11

Comparison of simulation results for farm production in SAM multiplier and CGE models (% output changes)

Farm Production		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employ-ment	Poorly- and highly- educated local employ-ment	Agricultural prices and edu-cated local em-ployment
One-season Rice	SAM	5.24	5.50	5.16	5.25	6.60
	CGE 1	10.0	11.4	9.5	9.1	-5.3
	CGE 2	2.0	1.9	2.0	2.1	-8.0
Two-season Rice	SAM	5.54	5.82	5.51	5.59	6.59
	CGE 1	-69.9	-64.2	-43.3	-41.5	40.5
	CGE 2	-9.2	-9.0	-10.1	-10.5	55.5
Other Annual Crops	SAM	6.29	6.79	6.22	6.32	6.8
	CGE 1	-6.7	-7.3	-1.7	-1.8	-8.4
	CGE 2	-0.5	-0.6	-0.4	-0.4	-8.2
Perennial Crop	SAM	0.76	0.77	0.61	0.61	7.07
	CGE 1	-4.8	-4.3	-0.7	-0.7	-6.3
	CGE 2	-0.3	-0.4	-0.5	-0.5	-6.1
Livestock (excluding oxen)	SAM	3.91	4.25	3.81	3.94	6.85
	CGE 1	-37.5	-39.1	-27.3	-26.7	26.5
	CGE 2	-5.8	-6.2	-7.1	-7.5	36.3

7.5.2 Impact on factor market development and incomes

Because land renting in the CGE model has been fixed (at the amount observed in the SAM) it is only possible to compare two factor markets, those for renting oxen renting and hiring agricultural labour. These comparisons are presented in Table 7.12. In the SAM multiplier model there were only marginal differences between the results for hiring in and hiring out agricultural labour, so only figures for hiring out are shown in the table.

Table 7.12
Comparison of simulation results for factor market participation in the SAM multiplier and CGE models (% changes with respect to the base situation)

Factor market participation		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Agricultural labour hiring	SAM	3.47	3.28	3.77	3.75	6.48
	CGE 1	3.2	3.0	-0.1	0.3	2.2
	CGE 2	-0.4	-0.5	-2.4	-2.1	1.7
Oxen renting	SAM	4.23	4.92	8.36	7.89	8.89
	CGE 1	43.9	36.1	10.8	8.2	31.0
	CGE 2	3.1	-1.2	-0.3	-1.3	28.9

An increase in farm production, leads to increases in hiring agricultural labour and renting oxen in all scenarios in the SAM multiplier approach. The level of increase in agricultural labour hiring is quite similar between the SAM model and the first two scenarios in the first bundle of the CGE model. But all there are considerable differences between the two models in all the other results, due to differences in farm production responses and the fact that the CGE model allows substitution between inputs and factors. In some of the simulations in the CGE model, hiring agricultural labour and/or oxen actually decreases. In the fifth scenario of the SAM multiplier model, oxen renting is somewhat higher than in

the other four scenarios as all production activities increase most in this scenario. The increase in oxen renting under the fifth scenario is much stronger in the CGE model, because two-season rice and livestock production increase more strongly in this model.

Table 7.13 compares changes in household incomes resulting from the simulations with the two models. The SAM multiplier approach shows higher increases in household incomes than in the CGE model. This is because there are no constraints on labour and oxen services in the SAM multiplier model, so all farm production activities can expand. The corresponding direct income effects lead to additional demand for goods produced within the village. These indirect income effects are considerable (see for example the response of household group 1 in scenarios 1 and 3 in Table 5.12). In the CGE model, these multiplier effects are restricted by the constraints on labour availability and hiring oxen services. Some household groups even suffer an income loss in some scenarios (see Table 6.6).

Table 7.13
Comparison of simulation results for household incomes in the SAM multiplier and the CGE models (% changes)

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly-educated migration	Poorly- and highly-educated migration	Highly-educated local employment	Poorly- and highly-educated local employment	Agricultural prices and educated local employment
Income	SAM	7.03	7.49	6.93	7.12	6.78
	CGE 1	0.55	0.6	3.2	3.3	4.6
	CGE 2	5.2	5.2	5.1	5.1	5.6

In both the models, the household group most involved in migration (group 3) gains relatively more in the first two scenarios, while household groups that are involved more in local off-farm employment (groups 2 and 4) gain most from scenarios 2 and 4. The results of the fifth scenario, however, differ between the two models. In the SAM multiplier approach, household group 2 experiences the highest increase in income (see in Table 5.15), because it not only obtains income from off-farm employment, but also from an increased demand for exported

products. In the CGE model, household group 2 has the lowest increase in income (see Tables 6.6 and 6.11), because it has the highest share of labour working in local off-farm employment and it cannot expand agricultural activities that become more profitable in the fifth scenario.

7.5.3 Impact on LPC and EQ

The SAM multiplier approach did not distinguish between rice production with and without green manure. However, it can be expected that both activities will increase in proportion to the overall expansion of rice production in this model. The CGE model, on the other hand, implied huge shifts between the sub-types of rice. In the first four scenarios this involved a shift towards growing one-season rice with green manure (see Tables 6.3 and 6.8). In the fifth scenario of the model, rice production shifts towards two-season rice without green manure and one-season rice with green manure. These production switches are mainly driven by labour scarcity and changes in the price of oxen services in this CGE model.

Table 7.14 compares results for input use at the village level between the two models. The use of both manure and chemical inputs (fertilizer, pesticides and herbicides) increase at similar rates, in relation to production increases, in the SAM multiplier approach (in all five scenarios). In the CGE model, however, input use only increases in the fifth scenario, when two-season rice production expands substantially. In this scenario the increase in input use is much higher than that simulated by the SAM multiplier approach. The absolute changes in the use of fertilizer, pesticides and herbicides are much larger than the absolute changes in the use of manure use in the CGE model. In the SAM multiplier approach the magnitude of changes for both types of inputs is similar, because they correspond directly to the expansion of production. In the CGE model, input use changes reflect not only changes in production but also changes in the prices of inputs (and the shadow price of manure).

The simulation results of the SAM multiplier approach suggest only marginal changes in LPC and EQ, because the increases in the use of fertilizer, pesticides and herbicides and manure and in rice production (with and without green manure) are at more or less similar levels. But in the first four scenarios of the CGE model, decreases in the use of fertilizer, pesticides and herbicides are much greater than the decline in the use of manure, thus giving a positive .impact on LPC and EQ. In the

fifth scenario, increases in fertilizer, pesticide and herbicide use greatly exceed the increase in manure use, resulting in a negative impact on LPC and EQ.

In summary, comparisons of the simulation results from the CGE model and the SAM multiplier approach show some major and crucial differences:

- Firstly, the changes in production activities in the SAM multiplier-based predictions are relatively small as they are driven by an increase in demand (income) and not by profitability. In the CGE models, changes in different production activities are driven not only by demand increases but also by profit maximization under prevailing factor market constraints and therefore they are more substantial.
- Secondly, because there are no factor constraints operative in the SAM multiplier approach, the approach predicts that all household groups will expand all their production activities, whereas in the CGE model they only expand one-season rice production in the first four scenarios and two-season rice and livestock production in the fifth scenario.
- Thirdly, the indirect effects of all scenarios on income and production are stronger in the SAM multiplier approach than in the CGE model because expansion of production is assumed to be unconstrained by factor availability.
- Fourthly, the SAM multiplier approach shows only small effects on LPC and EQ for all scenarios because increases in the use of fertilizer, pesticides and herbicides and manure and in rice production with/without green manure are at more or less similar levels. But in the CGE model, decreases in the use of fertilizer, pesticides and herbicides are much larger than the decline in the use of manure in the first four scenarios. Hence the impact on the LPC and EQ is positive. In the fifth scenario, increases in fertilizer, pesticide and herbicide use greatly exceed the increase in manure use, resulting in a negative impact on LPC and EQ.

Table 7.14

Comparison of simulation results for input use in the SAM multiplier and CGE models (% changes)

Input use		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Highly- educated migration	Poorly- and highly- educated migration	Highly- educated local employment	Poorly- and highly- educated local employment	Agricultural prices and educated local employment
Manure use	SAM	5.78	6.07	5.68	5.76	6.67
	CGE 1	-7.9	-9.0	-4.5	-4.8	2.9
	CGE 2	-1.2	-1.6	-1.6	-1.8	4.4
Fertilizer use	SAM	5.43	5.61	5.29	5.38	6.60
	CGE 1	-14.0	-12.9	-6.4	-6.1	21.2
	CGE 2	-1.5	-1.4	-2.0	-2.0	25.0
Pesticide and herbicide use	SAM	5.50	5.62	5.50	5.56	6.72
	CGE 1	-11.6	-11.1	-5.6	-5.3	14.9
	CGE 2	-1.3	-1.2	-1.7	-1.7	17.8

- Finally, and more generally, the results from a SAM multiplier approach present an initial 'snapshot' view of the impact of additional income/demand on household production and income, taking a given (and fixed) structure of the village economy. However it has shortcomings that limit its role in analyzing and predicting household responses when economic mechanisms such as changing village prices and household shadow prices play an important mediating role.

7.6 Summary and Conclusions

This chapter has compared the results of the village equilibrium model in chapter 6 with those of a household model (developed in this chapter) and the SAM multiplier model from chapter 5. To this end, the household model was first developed from the village CGE model, but without including interactions between the households in the village. As explained in chapter 6, the markets for oxen rental and agricultural labour are the two important linkages among household groups in the CGE model. To freeze the linkages among households, the wage rate of agricultural labour (as in the CGE model) and the price of oxen services have been assumed as being fixed, with agricultural labour hiring being fixed at the level observed in the SAM. Households can rent in as much oxen services as needed, and can rent out these services until they run out of their resources in the household model.

Two bundles of simulations are run with the household model. They are the same as the simulations run with the CGE model. The simulations show that, when migration and off-farm employment increase, household groups shift towards one-season rice production at the expense of other production activities. At the village level, the responses of household groups in the first bundle (increase in participation in off-farm employment) are stronger than the responses in the second bundle (increase in wages of off-farm employment). Income gains, however, are much larger in the second bundle. The responses of individual household groups are all in the same direction, although the magnitudes of the responses differ between different groups. When agricultural prices increase and input prices decrease (fifth scenario), households intensify rice production and shift towards livestock production. Changes in production, input use and oxen renting and income are largest in this scenario.

Although there are many similarities in the responses simulated by the household model and by the CGE model, the differences that do exist reveal that household linkages through village markets play an important role in shaping household responses. The responses in the household model in the first four scenarios are smaller than that in the village CGE model. For instance, aggregate increases in one-season rice production in the first bundle of the village model are almost twice the level than they are in the household model. By contrast the responses to the fifth scenario are much stronger in the household model than in the CGE model. The responses of individual household groups are more diversified in the village model, whereas in the household model there are only differences in magnitudes. In the second bundle, the differences between the two models are smaller.

In the household model the fixed price of oxen services and of available agricultural labour in the village market greatly constrain the possibility for production switches in response to scarcity of labour and additional incomes from migration and/or local off-farm employment. However, the household model also exaggerates the production response of household groups with higher agricultural profitability scenario, and so the production responses are stronger in this model than in the village CGE model. Differences in the direction of responses of household groups in the village model are mainly due to different positions of these groups in the village market. There are far fewer differences between household groups' responses in the household model. For example, household groups in the household model consistently show much stronger responses in rice production switching, input use and market participation than they do in the village model where these responses are dampened by household linkages, particularly in renting oxen.

This chapter also compared results based on the SAM multiplier approach with those from the CGE model, and this exercise showed some major differences. The differences in changes in production activities are relatively small in the SAM multiplier model because they are driven by a demand (income) increase, not by profitability. In the CGE models, changes in different production activities are driven not only by demand increases but also by profit maximization under prevailing factor market constraints. Because a SAM multiplier approach assumes an absence of factor constraints, the household groups expand all their production activities. In the CGE model they only expand one-season rice production

in response to increased participation or wages of migration and local off-farm employment and expand two-season rice and livestock production with higher agricultural profitability and increased local off-farm employment. The indirect effects of all scenarios on income and production are stronger in the SAM multiplier approach than in the CGE model again because of the assumption about expansions in production not being constrained by factor availability.

The SAM multiplier approach shows only small effects on LPC and EQ for all scenarios because increases in the use of fertilizer, pesticides and herbicides and manure in rice production with / without green manure are at more or less similar levels. In the CGE model, decreases in fertilizer, pesticide and herbicide use are much larger than the decline in the use of manure in the first four scenarios and the impact on LPC and EQ is positive. With higher agricultural profitability and increased local off-farm employment, increases in fertilizer, pesticide and herbicide use greatly exceed the increase in manure use, resulting in a negative impact on LPC and EQ.

Although the results from the SAM multiplier approach may be useful in presenting an initial view of the impacts of additional income/demand on household production and income *given* the structure of the village economy, there are shortcomings in its ability in analysing household responses when economic mechanisms such as changing village prices and household shadow prices, which play important roles. This is clearly visible in the differences in results obtained with the aid of the two approaches. If the difficulties in building village equilibrium models, can be overcome, they have a much greater potential to provide insightful scenario analyses than the mechanically running of extrapolations within the confines of a SAM-based snapshot of a village economy.

We found the results of the impact on LPC and EQ from the three models compared here to be quite different. They thus provide different understandings of the impact of off-farm employment on sustainable land use; therefore the policy implications of the three models are different. Therefore, research has to be very careful when trying to draw conclusions from a SAM multiplier model and the household model without considerations of economic interactions between households, when these may be expected to play a significant role.

Notes

1. Because wages of agricultural hiring labour in the village are higher than the shadow wages of household labour, 'profit' is introduced in the modelling of agricultural hiring activities. It is equal to the agricultural wage rate minus the shadow wage of household agricultural labour. See the more detailed explanation in chapter 6.

2. The base level is set at groups 1 and 2 renting in 5.9 and 94.1 percent of oxen services in the market, respectively. The row 'change' under group 2 in the table indicates increase or decrease in oxen rented in compared to the base level.

8 Discussion and Conclusions

8.1 Introduction

China, with over 20 percent of world population, has only 10 percent of the world's arable land and one quarter of the average water resources per person (OECD 2005). Increasing the intensity of production, especially through increased chemical input use, has become one of the main characteristics of Chinese agriculture in order to meet the need for food and other agricultural products. However, environmental problems such as the pollution of water resources from intensified use of chemical fertilizers and pesticides, and land degradation are becoming more severe. With the increasing importance of migration and other off-farm activities, rural labour is increasingly moving away from the countryside while sending remittances back home. What will the members of the households that remain active in farming do on their farms, and what is done with off-farm income?

Farm households have dramatically expanded their participation in off-farm employment since the implementation of policy reforms in China in the 1980s, and this is expected to continue in the future. Researchers have paid much attention to rural dwellers who migrate as it is seen as a way of reducing surplus rural labour in China and raising farm household incomes. There has been little research, however, on the impact of farm household participation in off-farm employment on their families and home villages, and especially on the resources used for agricultural production, and on the environment they live in. Some studies have focused on the impact on the villages of origin of the migrants, but these studies focus mainly on the impact on agricultural production and household incomes.

This thesis tries to examine the extent to which farm household participation in different types of off-farm employment affects farm production, input use, factor market development and incomes, and draws some inferences for the resulting effects on land production capacity and environmental quality. Sustainable use of land resources is of crucial importance for meeting China's food demand and sustaining economic growth in the future, especially given the huge population and limited resource base. Insights into the impact of off-farm employment on resource use will also assist Chinese policy makers in developing and implementing appropriate policies. This concluding chapter first reviews the modelling approaches used in this study, reviews the main findings, and finally discusses the insights gained, together with their possible policy implications.

8.2 Modelling approaches

8.2.1 Models and simulation scenarios

Two village models (a village SAM multiplier and a CGE model) are used in this study as instruments to analyse village economies. Within these models four household groups are distinguished, depending on the number of educated household members (as a major resource for earning off-farm incomes) and oxen ownership (a major resource for earning agricultural incomes). This distinction gives four groups: household group 1 '*Households with no educated persons*', household group 2, '*Households with no oxen and at least one educated person*', household group 3, '*Household with oxen, one or two educated persons*' and household group 4 '*Households with oxen, at least three educated persons*'.

The CGE model is used to make two bundles of simulations, all of which operate under an assumption of injecting an additional five percent of GDP village into the village economy. The five scenarios in the first bundle are:

1. increase in migration by highly-educated labourers (scenario 1),
2. increase in migration by both poorly- and highly-educated labourers (scenario 2),
3. increase in participation in local off-farm employment by highly-educated labourers (scenario 3),
4. increase in participation in local off-farm employment both

poorly- and highly-educated labourers (scenario 4), and,

5. increase of 2 percent in output prices and decrease of 2 percent in input prices combined with an increase in participation in local non-farm employment of both poorly- and highly educated labourers (scenario 5).

The scenarios in the second bundle have the same structure as the first bundle but simulate higher wages from off-farm employment instead of higher participation rates. Unfortunately it is not possible to make a similar distinction for the SAM multiplier model, because the income injections are exactly the same for both bundles. The simulations made with the SAM multiplier model therefore consist of income injections, but do not differentiate between their source (whether increased participation in off-farm employment or from higher off-farm wages). The first four simulations that are made with the SAM multiplier model are similar to scenarios 1 - 4 described above. The fifth scenario consists of the combined effects of an increase in agricultural exports from the village (as export prices are assumed to be fixed in SAM multiplier models) and an increase in participation in local non-farm employment by both poorly- and highly-educated labourers.

The impact of village linkages is examined by comparing the results of the CGE model with those from a household model which is similar to the CGE model but does not include any linkages between the four household groups.

8.2.2 Expected model outcomes

The comparison between the SAM multiplier model, village CGE model, and household model is intended to analyse how different models shape the different responses resulting from the same policy simulations and what causes these differences in responses. Because the prices of all commodities in the SAM multiplier approach are fixed, all commodities can be considered as tradable in this approach. In the village CGE model, some commodities are village tradable and therefore have exogenous prices. Other commodities are household non-tradable with shadow prices determined by household demand and supply, while agricultural labour and oxen services are village non-tradable (household tradable). An overview of the characteristics of these commodities within the village CGE model is provided in Table 6A.2. The household model is derived from the village CGE model by changing oxen rental activities into

a (household and village) tradable, while the volume of agricultural labour hiring activities is fixed and can therefore be considered a household non-tradable.

Responses to external shocks will be usually larger for tradable than for non-tradable goods and services, as price changes dampen the effects on those that are non-tradable. For example, changes in the use of non-tradable inputs (for example manure) resulting from exogenous shocks are expected to be smaller than changes in tradable inputs (for example fertilizer).

Because prices are fixed in the SAM multiplier model, exogenous shocks do not lead to price changes and hence have a very limited impact on the structure of production and input use. In the village SAM and household model, however, exogenous shocks will generally cause price changes in non-tradable commodities and hence in the price ratios of non-tradable to tradable commodities. Households in such models adjust their production, consumption and labour supply behaviour in response to relative price changes. So, in the village CGE and household models, relatively large changes can be expected in the choices of production activities and input use, but not in the SAM multiplier model.

Simple partial equilibrium analysis shows that when a commodity changes from a non-tradable into a tradable commodity, total welfare (measured as the sum of the producer and consumer surplus) increases. In the village SAM multiplier approach, all commodities can be considered as tradable, so changes in income levels resulting from exogenous shocks are expected to be larger than the income changes resulting from the village CGE and household models, in which some commodities are (village) non-tradable. The household model is derived from the village CGE model by changing one commodity from a village non-tradable commodity into a tradable one and changing another village non-tradable commodity into a household non-tradable commodity. |Hence, it is unclear whether exogenous shocks will have stronger income effects in the village CGE model or in the household model.

In the village CGE and household models, two simulation bundles are compared to reveal the differences between the 'lost-labour' effect and the 'income' effect of increased off-farm employment. The first bundle (an increase in participation in off-farm employment combined with an increase in income) simulates the joint impact of the 'lost-labour' and 'income' effects. The second bundle (an increase in income at a

given rate of off-farm participation) simulates the impact of the income effect only. Comparing the results of the two bundles will give us insights into the size of the 'lost-labour' effect from increased off-farm employment.

8.3 Main findings

The main findings of the study are presented in the following sequence. Firstly, the findings from analyzing the relative importance of different types of off-farm employment and the driving forces behind this phenomenon using the data from three villages in Jiangxi province are discussed. Then, household participation in different markets within these three villages is examined. The impact of off-farm employment on village market development is analysed for *Shangzhu* village, which was primarily chosen for its remoteness, and hence the grater likelihood of the existence of (stronger) internal village markets, using the three types of models. Thirdly, the same three models are used to examine the impact of off-farm employment on farm production. The same is then done for the impact of off-farm employment on household incomes. The impact of off-farm employment on land production capacity (LPC) and environmental quality (EQ) is investigated by analyzing switches between one season and two season rice production, the use of green manure and changes in the use of chemical inputs and manure in farm production for the three models. Finally, a comparison of the results obtained by using the three different model approaches is presented.

8.3.1 Participation in sub-categories of off-farm employment

The first part of the thesis analyses the relative importance of four subcategories of off-farm employment, and the factors driving the participation of individuals in these activities. The four types of off-farm activities distinguished in the analysis are; agricultural employment, local non-farm employment, self-employment and migration. In analyzing the importance of these different types of off-farm employment, data collected from a household survey in Jiangxi province covering the year 1998 (for 24 villages and 1001 households; only distinguishing between agricultural and non-agricultural off-farm employment) and from a household survey in Northeast Jiangxi province covering the year 2000 (for 340 households in 3 villages) are used.

In two of the villages covered in the later survey, those of *Banqiao* and *Shangzhu*, the participation rate of households in off-farm activities in 2000 was close to the average level that found in the survey for 1998 (just over 70 percent). In *Gangyan* village, however, the participation rate in 2000 was considerably higher (93 percent) than the average for 1998. Non-agricultural activities were the main types of off-farm activities in both surveys. Agricultural employment is less important both in terms of the percentage of participating households and (as found in the 2000 survey) of income obtained. Review studies for Latin American and Africa (Reardon 1997, Reardon et al. 2001) have also found agricultural wage employment to be a relatively minor off-farm activity. But they also found local non-agricultural employment to be much more important than migration, which is clearly not the case in this research area.

If 'absent households', defined as households that have a *Hukou* in the village but were absent at the time of the survey, would also be included in the surveys, migration would of course become even more important. A recent study for China found that migration has become the dominant form of off-farm activity in 2000, with almost half the individuals working off-farm being migrants (de Brauw et al. 2002). In the three villages in the research area, migration was even more dominant in 2000 (see Table 3.4). Moreover, more than 80 percent of the migrants lived and worked outside the province as compared to almost 40 percent of the migrants in the sample of de Brauw et al. (2002).

In the 1998 survey, more than 70 percent of the households that had experienced welfare increases[1] since 1992 contributed these welfare increases to non-agricultural activities. In the 2000 survey, around 38 percent of farm household income came from off-farm activities. If total migration income were to be taken into account instead of only remittances, income obtained from off-farm employment would contribute even more to the total incomes. These off-farm shares are comparable to the shares found in synthesis studies by Reardon et al. (1998) and Reardon et al. (2001) for East Asia (35%) and other parts of the world (South Asia: 29%, Africa: 42%, Latin America: 40%)[2].

The results of a multinomial probit analysis explaining off-farm participation decisions show that the presence of young children in a household restrains participation in migration, while the presence of elderly persons and a higher level of education stimulate migration. Local wage employment and self-employment are not affected by these factors.

The gender bias in access to off-farm employment is largest for agricultural employment and local non-agricultural employment. Land scarcity stimulates participation in migration and local non-agricultural employment, while the possibilities to rent out land out to other farmers only stimulates migration.

Migration is the most important off-farm activity in rural Jiangxi Province in terms of the percentage of households involved in it and the time that they spend on it. Young and educated household members are more likely to be involved in migration. Rural migrants working in urban areas tend to have long working days and have to pay higher school fees at public schools than urban residents. Married migrants therefore often come alone to the cities and leave their wives and young children at home, or tend to prefer work closer to their homes. The presence of older persons at home relaxes this constraint, as they can take over the responsibility of taking care of the children. Land scarcity is an important factor driving migration, as it reduces the possibilities for making an income from agriculture. Renting out land facilities migration, because farm households might otherwise lose their land use rights over contracted land that they are not cultivating. The study further suggests that social connections (outside the village) do not play a role in the decision to migrate, but this result, which is counter-intuitive result, may be due to measurement problems.

Comparison of aggregate regression results for off-farm employment and more differentiated ones, show that the former do not reveal some critical aspects about different types of off-farm employment. The results confirm that empirical analyses of the factors that drive participation in off-farm employment should distinguish between sub-categories of off-farm employment.

8.3.2 Impact of off-farm employment on household village market participation

Data collected from the three villages (*Banqiao*, *Shangzhu* and *Gangyan*) for the year 2000 were used to examine household involvement in different factor, variable input and output markets. It was found that the irrigated land market is much more important than the other types of land markets (dry land and forest land) in all three villages. Almost 46 percent of households rent irrigated land from other households (Table 4.2). The dry land market is also important in *Banqiao* village. Land is only traded

within a village, but a big gap was found in the sample between the amount of rented-in and rented-out irrigated land. Adjustments were made to the calculations to allow for absent households in these villages (who could not be interviewed), and this narrowed the differences, but a substantial gap still remained unexplained (Table 4.3). Renting land from the village collective is a possible explanation for the remaining gap between renting in and renting out land, and it was (also) people not wanting to say to outsiders that they rented out land.

There are also very active agricultural labour markets within the three villages. Twenty-nine per cent of households in *Banqiao* exchange agricultural labour. In *Shangzhu* the figure is 37 percent and in *Gangyan* village, the village with the highest participation in migration, the figure is 50 per cent. Exchange labour accounts for between 6 - 8 percent of the total labour input in agricultural production in these villages. The share of households using hired labour in agricultural production ranges from 15 percent (in *Shangzhu*) to 28 percent (in *Gangyan*) and on average accounts for 5 percent of the total agricultural labour input.

Oxen renting is another typical village market, although participation in this is lower. Some 5 percent of the households that plant late rice, and 4 percent of the households that plant one-season rice, rent oxen from other households within the village. The survey questionnaire unfortunately did not contain questions on the sharing of oxen between different households. Follow-up visits in the research area indicated that this is quite common in the surveyed villages.

Some 56 per cent of households in the three villages borrow money. Around one third of them obtain credit from inside the village, the other two-thirds borrow money from outside the village. Friends and relatives are the most important credit providers; banks and rural cooperatives play only a marginal role.

Rice is marketed outside the villages as well as peanuts from *Banqiao*. Other agricultural products are mainly produced for self consumption. There are no village markets for agricultural inputs. Seeds, fertilizer, herbicides and pesticides are imported from outside the village, while manure is normally produced on-farm.

Linkages between households in these three villages therefore mainly consist of the land market, the agricultural labour market and the oxen rental market. *Shangzhu* village was chosen as a case study to empirically examine the impact of off-farm employment, using a village level CGE

model. The agricultural labour market is characterised by seasonality and surplus labour and the agricultural labour wage was therefore assumed to be fixed, with supply assumed to adjust to demand. In the market for oxen renting, equilibrium between supply and demand is achieved through price adjustments. Due to data limitations, irrigated land renting in and renting out is assumed to be fixed in the village CGE model.

The household model assumes agricultural labour to be fixed. The only village market for which a comparison between the village CGE model and the household model is meaningful therefore is the oxen rental market. In both models, oxen renting activities increase considerably as a result of increased participation in off-farm employment. This increase is much stronger in the household model (ranging from 97 to 178 percent in the five scenarios) than in the CGE model (ranging from 8 to 44 percent), because oxen services are tradable in the household model but are village non-tradable in the village CGE model. Changes in the village market price for oxen services therefore dampen the effect of the off-farm participation in the village CGE model. The results for the second bundle of simulations, i.e. increases in off-farm employment wages, are much more modest. Oxen rental activities change between 25 and 32 percent in the household model and between -1 and +3 percent in the village CGE model. [3] It can therefore be concluded that the development of the oxen rental market is mainly caused by the lost-labour effect of off-farm employment.

In the SAM multiplier approach, oxen renting activities increase between 3 and 9 percent in the five scenarios. As relative prices do not change in this multiplier approach, the shifts in production structure and input use were negligible. The modest increase in oxen rental activities was mainly caused by an increase in the total agricultural production level.

The analysis permitted a comparison of changes in agricultural labour hiring between the village CGE model and the SAM multiplier model. Increased participation in off-farm employment (first simulation bundle) caused a -0.1 to +3.2 percent change in agricultural labour hiring in the village CGE model, while increased off-farm wages (second simulation bundle) reduce the hiring of agricultural labour by 0.4 to 2.4 percent. The latter result can be explained by the increased demand for leisure associated with the income effect of off-farm employment. Comparing the results for the two bundles shows that the lost-labour effect stimulates agricultural labour hiring by 2.3 – 3.6 percent.

In the SAM multiplier approach, the increase in labour hiring due to increased off-farm employment ranges from 2.6 to 3.8 percent. In the fifth scenario (increased exports of agricultural products and local off-farm wage employment) agricultural hiring labour increases much more (by around 6 percent), because relatively more hired labour is used in the production of export crops (rice and perennials).

It can be concluded that there are village markets for irrigated land, agricultural labour and oxen renting in the research area. Increased participation in off-farm employment has a major impact on the development of oxen rental markets but a relatively small impact on the agricultural labour market. The 'lost-labour' effect of off-farm employment is the major driving force for these developments. Data limitations unfortunately make it impossible to analyse the impact of off-farm employment on the market for irrigated land. Comparing the simulation results of the village CGE model, the household model and the SAM multiplier model clearly shows the importance of taking village market equilibrium mechanisms into account when analysing the development of factor markets. Simulation results for the oxen rental market obtained with the village CGE model, in which oxen renting is a village non-tradable, differ significantly from those obtained with the household and the SAM multiplier models, in which oxen renting is specified as a tradable commodity.

8.3.3 Impact of off-farm employment on farm production

There are also major differences between the three model approaches in terms of the results for the impact of off-farm employment on production activities. In the SAM multiplier model all types of farm production increase when households receive more income from off-farm employment. Production of rice and other annual crops increases by 5 – 7 percent, while perennial crop and livestock production increase by only 0.6 - 0.7 and 3.8 – 4.3 percent respectively in the first four scenarios. These differences in growth rates are caused by the degree to which households consume or export the product in question. Relative prices do not change (including the price of oxen services) and therefore do not affect the choice of production activities.

Because relative prices can change in the CGE model, responses of individual household groups are much stronger than in the SAM multiplier model for all scenarios. The first bundle of simulations (increased

participation in off-farm employment) shows that households increase their production of one season rice by 9 – 11 percent and reduce other production activities. This is because one season rice uses relatively little labour and relatively more oxen services (which decline in price) compared to the other production activities. The second bundle of simulations (higher wages for off-farm employment) shows a similar shift in production activities, but the increase in one season rice production is only 2 – 3 percent. So, again the 'lost-labour' effect of off-farm employment is found to have much more impact than the 'income' effect.

The results of the household model show a similar shift towards one season rice production. But the increases in one season rice production (3 – 6 percent in the first bundle; -0.1 – 0.5 percent in the second bundle) are less than one half of those in the village CGE model. The decrease in other types of production is quite similar in the two models. The main difference between the two models is in the household model the quantity of input of agricultural labour is fixed and the price of oxen renting is fixed. Hence, in this model, households have fewer possibilities for increasing one season rice production, because they cannot hire additional agricultural labour and they do not benefit from a lower price for oxen renting (as they can in the CGE model).

The findings concerning the impact of off-farm employment on farm production show that households shift their production activities towards less labour-intensive and more oxen service intensive activities in response to increases in off-farm employment. The income effect and the lost-labour effect of off-farm employment are found to cause similar shifts in production activities, with the 'lost-labour' effect having a stronger impact than the 'income' effect. These findings differ from previous studies that mainly focused on changes of farm income and yields, but not on changes in production activities (De Janvry et al. 2005, Taylor et al. 2003, Rozelle et al. 1999, Wu & Meng 1996a & b). These studies find that the income effect on agricultural production is opposite to the 'lost-labour' effect, and that the 'income' effect partially compensates for the 'lost-labour' effect. In contrast to this study, these studies did not consider household consumption (including leisure) or village markets in their approaches.

8.3.4 Impact of off-farm employment on household income

The choice of model also has important implications for analysing the impact of off-farm employment on income levels. Increases in household incomes in the SAM multiplier approach are around 7 percent in all the simulations. As the original income injection is 5 percent, this means that the value of the multiplier is around 1.4. As expected, the income effects are smaller in the village CGE and household models because some commodities are (household or village) non-tradable in these models while in the SAM multiplier model all commodities are tradable (in other words, there are no factor constraints in the SAM multiplier approach).

The impact of increased participation in off-farm employment (in the first bundle of simulations) on the average household income level ranges from 0.6 to 3.3 percent in the village CGE model. When the rise in off-farm wages (second bundle) is analysed, average household incomes are found to increase by 5.1 – 5.2 percent. In other words, the 'income effect' of off-farm employment on the household income level in the village is slightly larger than the original 5 percent injection. The 'lost-labour' effect causes substantial declines in household income levels, because farm households need to adjust their production structure to deal with the labour loss. These negative income effects of the loss of labour are strongest (-4.6%) for the migration scenarios (scenarios 1 and 2). As can be seen from Table 6.2, the shifts in production activities are also largest in the two migration scenarios, probably because it is possible to combine local off-farm employment with work on the own farm, whereas this is not possible for migration.

The income results for the household model are very similar to those for the village CGE model. A rise in off-farm wages (second bundle) causes an increase of 5.0 – 5.2 percent in average household incomes, while higher participation in off-farm employment (first bundle) causes average income increases ranging from 0.4 percent (for the two migration scenarios) to 3.3 percent. Hence, the 'lost-labour' effect of migration is slightly larger in the household model than in the village CGE model.

The findings of the effects of increased participation in migration are consistent with other studies (e. g. Taylor et al. 2003) which find negative 'lost-labour' effects and positive 'remittances effects', with the resulting total income effects being close to zero. However, Taylor et al. (2003) find that households experience an increase in per capita income of be-

tween 16 and 43 percent. If we deduct the migrants from the total number of the household members, the per capita income would also increase substantially in the results of this study.

In contrast to the findings of Taylor et al. (2003), poorer households do not fare as well as richer households in this study. The reason is that poor households (groups 1 and 4 in this analysis) earn relatively low incomes from migration, and therefore need to make larger labour adjustments to increase their migration income by 5 percent in the first bundle of simulations. In the case of household group 4, increased participation in migration even leads to an income decline of 1.5 – 1.7 percent in the village CGE and household models.

8.3.5 Impact of off-farm employment on LPC and EQ

To examine the impact of off-farm employment on LPC and EQ, switches between sub-types of rice production and changes in input use were used as proxies of changes in LPC and EQ, respectively. The findings from the CGE model are discussed first:

- The simulation results for both bundles indicate that increased off-farm employment leads towards using green manure in one season rice production , whereas the decline in two season rice production is mainly in two-season rice with green manure. Because one season rice is much more widely grown than two season rice in *Shangzhu* village, the impact of increased off-farm employment on LPC through shifts in rice production activities is positive. These results indicate that land production capacity (LPC) can be maintained or even improved when farm household members become more engaged in off-farm employment. This is because the prices for oxen service decline as a result of increased off-farm employment, which makes it more profitable for farmers to use oxen for ploughing the land after planting of green manure.
- As discussed above, an increase in off-farm employment causes a switch in production from two season rice to one season rice. The result is a strong decrease in the use of chemical inputs. This decrease is much greater than the decrease in manure use in all the simulations. Manure is a household non-tradable, while chemical inputs are tradable. The responses of tradable commodities to external shocks, such as increased off-farm employment, are generally much larger than responses of non-tradable commodities, because changes

in the (shadow) prices of the non-tradables dampen the effects of such shocks. The responses to simulations of higher wages of off-farm employment are smaller, but in the same direction. Overall, the impact of increased off-farm employment on environmental quality through changes in input use is positive, and EQ will improve. The overall effects on LPC and EQ, also taking into account switching of rice production activities, are very positive in the scenarios of increased participation in off-farm employment. These lead to a decrease in production intensity and benefit the long-term production capacity of the land.

- The fifth scenario, that simulates the impact of changing agricultural prices combined with increasing local off-farm employment, shows a shift in rice production towards two season rice production without green manure planting, and a strong increase in the use of chemical fertilizer. Hence, the impact of this scenario on LPC and EQ is negative. Contributory factors include a strong increase in agricultural profits and an increase in the village market price of oxen services.
- Pesticide and herbicide use show similar trends as chemical fertilizer, but the magnitudes are slightly smaller. Hence, with an increase in off-farm employment, the EQ will also benefit from a decrease in pesticide and herbicide use. However, a rise in agricultural profitability combined with an increase in local off-farm employment results in a strongly negative impact on the EQ.

Comparison of the results of the household and CGE models gives the following findings:

- Rice production in the household model also shifts towards one season rice production with green manure when off-farm employment increases. The switch towards production with green manure in the household model is larger than in the CGE model even though the actual increase in one season rice production is much smaller. This is because oxen services are tradable in the household model, whereas it is a village non-tradable in the CGE model. As a consequence, households rent in far more oxen services for ploughing the green manure into the soil. Hence, the positive impact of off-farm employment on LPC is more pronounced in the household model.
- Chemical inputs and manure use also decline in the household model. The decline in the use of chemical inputs is much more pronounced in the household model (around twice) than in the CGE model,

while the decreases in manure use are about half as much as in the CGE model. This is because two season rice production declines much more in the household model than in the CGE model, combined with manure being a non-tradable commodity (which means that the shadow price of manure dampens part of the shock). Hence, the positive impact on EQ is stronger in the household model than in the CGE model.

- In the scenario that simulates the impact of changing agricultural prices combined with increasing local off-farm employment, the planting of one and two season rice without green manure strongly increase because the fertilizer price is assumed to be lower in this scenario and the price for oxen services does not increase. Hence, the negative impact on LPC is stronger in the household model than in the CGE model. Likewise, the increase in chemical input use is even higher in the household model than in the CGE model, while the increase in (non-tradable) manure use is only slightly higher. Hence, the impact on EQ in the household model is even more negative than in the CGE model.

In the SAM multiplier model, relative prices of chemical inputs, manure and oxen services do not change. Hence the planting of rice crops with and without green manure increases in proportion to the expansion of the rice production, and an increase in off-farm employment does not affect LPC. Likewise, the use of both manure and chemical inputs (fertilizer, pesticides and herbicides) increases at more or less similar rates because they are treated as tradable in the model. Hence an increase in off-farm employment also does not affect EQ in this model.

Other studies (Janvry et al. 2005, Taylor et al. 2003, Rozelle et al. 1999, Wu & Meng 1996a and b) find that additional income from migration (remittances) or other non-farm activities are important in lessening the cash constraints faced by households in rural China. Although these studies do not explicitly examine input use, they argue that farm households partly compensate the 'lost-labour' effect of off-farm employment by buying more external inputs (e. g. fertilizer) from these additional income sources. These studies therefore suggest that off-farm employment has a negative impact on EQ. Our study, however, shows that increased off-farm employment causes a large shift in production activities and that this results in a strong reduction of chemical input use and a rela-

tively small reduction in manure use. In general it is concluded that off-farm employment has a positive impact on EQ.

8.3.6 Findings from comparing the three types of models

The responses of the household model are in the same direction as those from the CGE model, but there are significant differences between the two models in many aspects. The household linkages that are part of the village CGE model turn out to have an important impact on the different responses of all household groups to off-farm employment. Comparisons of the CGE model and the SAM multiplier approach also show large differences. In the SAM multiplier approach, household linkages are taken into account, but relative prices do not change (all commodities are tradable) and behavioural responses of households are absent. The main findings from comparing the three model types are:

- Changes in the prices of oxen services have an important impact on responses of household groups in the village CGE model, while agricultural labour hiring is less important. In the village CGE model, differences in the direction of responses of household groups are mainly due to their different positions in the village market. In the household model, the responses of household groups rarely differed.
- Although household groups in the household model show slightly smaller changes in production activities than in the CGE model, they show much stronger responses in rice production switching (with or without green manure), input use and market participation than in the village CGE model. This is caused by the dampening effect of household linkages within the village, particularly towards oxen renting activities.
- Changes in production activities in the SAM multiplier model are relatively small, because they are driven by a demand (income) increase but omit household responses to price changes. In the CGE model, changes in production activities are driven not only by demand increases but also by household responses to relative price changes, assuming profit maximization by households and the presence of factor market constraints. The changes in production activities are therefore substantial. Because there are no factor constraints in the SAM multiplier approach (all commodities and factors are tradable), household groups expand all their production activities. In the CGE model, households expand only one season rice production in re-

sponse to an increase in off-farm employment, and expand two season rice and livestock production in the scenario for agricultural price changes and increased local off-farm employment. The total effects on income and production are stronger in the SAM multiplier approach than in the CGE model under all scenarios, because all commodities are tradable in the SAM multiplier model.

- The results from the SAM multiplier approach present a useful snapshot view of the impact of additional income/demand on household production and income given the prevailing structure of the village economy. However it has shortcomings as it is unable to analyse household responses to changes in village prices, including household shadow prices which play an important role in shaping these responses. The results of the SAM multiplier approach can be seen as indicative of what the responses would be in the extreme case of the complete absence of market imperfections in all markets (including the market of oxen service, for example).
- Under the SAM multiplier approach off-farm employment has negligible effects on LPC and EQ, because the use of fertilizer, pesticides and herbicides and manure and the planting of rice with and without green manure all grow at similar rates. In the CGE model, the decreases in the use of fertilizer, pesticide and herbicide (all tradable commodities) associated with increased off-farm employment are much larger than the decline in the use of manure (a non-tradable commodity). Hence the impact on the EQ is positive. Moreover, the prices of oxen service decline as a result of increased off-farm employment in the CGE model, which makes it more profitable for farmers to use oxen for ploughing the land after green manure has been planted. Farmers therefore plant relatively more rice with green manure. Hence, the impact of off-farm employment on LPC is also positive in the village CGE model.

8.4 Policy implications

Given the huge population that still remains in rural areas and the small pieces of land available to households, participation in off-farm employment by rural households will continue to play an important role in rural China in the coming decades. This study analyses the consequences of increased involvement in off-farm employment by rural households on agricultural production, rural household incomes and land and envi-

ronmental quality. The findings summarized above suggest some important policy implications:

- Migration is a dominant choice of households in the research area, as it is in many other less developed areas in China. Given that population levels in Shanghai, Beijing, Guangzhou and other mega-cities in China are approaching their limits, future off-farm income-earning opportunities for rural households should wherever possible be created within their own region or province. In other words, local wage employment and self-employment should be stimulated. Policies for creating new employment opportunities should not only focus on regions where out-migration is dominant, but should also take individual preferences for different types of off-farm employment into account. The results of this study indicate that policies for promoting rural off-farm employment in relatively poor regions should give consideration to focusing on creating more employment opportunities for women and educated persons in order to reduce incentives for migration to other provinces.
- A land distribution policy takes into account households' comparative advantage in agricultural production or off-farm income earning opportunities may be more efficient than the current land distribution policy and would also better contribute to equity. Further development of land rental markets, which are still absent or incomplete in many regions, may also play a similar positive role.
- The analysis in this thesis suggests that raising agricultural profitability through offering farmers more favourable prices [4] is a more promising option for raising household incomes and welfare than stimulating off-farm employment. However, the environmental consequences of such a policy can be quite negative, whereas the environmental consequences of stimulating off-farm employment are positive.
- To achieve the dual objective of raising incomes and maintaining environmental quality, an appropriate policy option would be to increase the wages paid for off-farm employment. The simulation results for this policy show that it results in both increases in income and an improvement of land production capacity (LPC) and environmental quality (EQ). The income effect of such a policy is only slightly smaller than the income effect of a policy focusing on raising agricultural profitability.

With more and more households or members of households becoming involved in off-farm employment, policy makers may increase their concerns on resource and environmental degradation issues. Maintaining agricultural production capacity and achieving sustainable land use have recently emerged as important focal points for rural policy in China. This analysis indicates that the impact of increased off-farm employment on resource and environmental quality is positive, because the intensity of agricultural production (switch from two season to one season rice) and the use of chemical inputs decline. However, more involvement in off-farm employment also causes a decline in non-rice agricultural production activities. To maintain agricultural production levels, complementary policies, for example investment in rural roads, irrigation works, and agricultural research and development, are needed. It is promising to note that these policies play an important role in the recently adopted focus on "Promoting the building of a new socialist countryside" by the Chinese Government (Wen, 2006).

Notes

1. In the 1999 survey respondents were asked about the changes in welfare between 1992 and 1998.

2. All the data are generalized from different sources from the 1970s to the 1990s from countries to countries by Reardon et al. (1998).

3. The results for scenario 5 are not considered here and in most of the remainder of this chapter, because in both bundles the result for this scenario are dominated by the increase in agricultural profits resulting from price changes.

4. Directly raising agricultural prices does not seem feasible. But this can be achieved through policies aimed at reducing transaction costs in rural areas though for instance public investment on rural infrastructure.

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