Sustainable livelihood development: A case study measuring social capital and its role in sustainable livelihood development in Zoucheng, China

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ABSTRACT

This thesis is to discover whether the strength of social capital can alter household livelihoods and their sustainability. The intention of this thesis is to answer two questions: (1) Can different types of social ties [1] (kin and non-kin ties) lead to differential access to social capital in a small community in China? (2) Does the strength of social capital alter local livelihood patterns by diversifying household livelihoods, or producing new livelihoods in an industry that has potential for development?

This thesis, using a quantitative methodology, focuses on social capital measures. It begins with data collection on the social capital status and livelihoods of mining households. The household survey used a random recruitment for sample selection, which involved 228 participants in mines and related working departments (e.g. electricity, and the corporate headquarters of the local biggest mining company) in Zoucheng city, Shandong Province, China. OLS regression models used the household survey to generate associations of variables, such as human capital resources for respondents, length and location of residency, access to social networks, etc. with the composite measure of access to social capital. With these analyses and background information about Zoucheng, I use a simulation model to project the alternative livelihoods for local rural households based on local resources (e.g. farmland, tourism, and mineral resources). The aim of the simulation model was to better understand the role that social capital might play in possible transitions to alternative livelihoods (namely, tourism and farming).

The research results argue that both kin ties and weak ties (such as friendships) are important factors associated with social capital for mining sector residents in Zoucheng (Chapter Six). The advantages of strengthened social capital are presented in the simulation model (Chapter Eight). As social capital was enhanced, both incomes and number of rural tourism operators increased. These results have implications for governmental policy regarding livelihood strategy diversification and poverty alleviation. An understanding of these concepts may play a role in assisting emerging economies to be resilient at local levels and better equipped to withstand exogenous shocks in certain cultural contexts (e.g. Confucian society).

[1] In general, social capital refers to resources embedded in networks of relationships, trust, and social norms that will bring reciprocal benefits to those involved (Sobel, 2002; Lin, 1999; Coleman, 1990; Bourdieu, 1986; Putnam, 2000). Social ties are individual actors' relationships in hierarchical structures and other networks, which provide potential access to other actors in the social networks (Lin, 2001:2004). These network resources embedded in individual actors potentially become people's social capital (Lin, 2001:2004).

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CHAPTER ONE: INTRODUCTION

1.1 **Introduction**

In general, social capital refers to resources embedded in people's connections or group memberships that will bring reciprocal benefits to those involved (Sobel, 2002; Lin, 1999; Coleman, 1990; Bourdieu 1986). Although the concept of social capital was originally constructed in the context of western societies, it has recently drawn the interest of researchers from different cultural backgrounds, particularly as it relates to Chinese culture. Traditional Chinese culture emphasizes the importance of interpersonal relationships and personal networks. Influenced by these traditional cultural values, Chinese society is normally recognized as an exchange-based economy that possesses high social capital, characterized by '*guanxi*'. 'Guanxi' is defined as "a dyadic, particular and sentimental tie that has the potential of facilitating favor exchanges between the parties connected by the tie" (Bian, 2006, p.312), which has played an extremely important role in social and economic life in Chinese society (Lu et al., 2013). Therefore, social capital that constitutes *guanxi* is pervasive in economic and non-economic life in Chinese society. These features are a concrete manifestation of social capital in China. With the rapid development of the economy and improvements in living standards, it is particularly useful to analyze the role of social capital in Chinese society.

Over the years, social capital has been shown to act as an important bridge between academic disciplines in the development of economic theory (Woolcock & Naryan, 2000, Cordes et al, 2003, Yen, Barnes, & Wang, 2011). Furthermore, social capital has an important role to play in government, regarding the investment of resources into poverty alleviation or income generation. With a clearer sense of livelihood assets such as social capital, policy-makers can identify the most useful sorts of public investment for different people in different places (Bebbington, 1999). The focus of this thesis is on the role of social capital during the transition to sustainable livelihoods in a small

city (i.e., a county-level city[2]) in China. It may be generalizable to at least some other counties that have similar features to Zoucheng, China.

1.2 Statement of the problem

Natural resources are normally considered the bedrock for most developing economies (Sovacool, 2015; Conceicao et al., 2011). However, serious resource depletion can lead to environmental contamination and degradation. The main problem is that there are regions that are heavily natural resource-dependent. This is a problem for future development if those regions fail to develop some alternative sources of economic growth. This issue involves the sustainability of natural resources. One important criterion for sustainability of natural resources emphasizes that the rate of consumption is equal to or less than the rate of recovery, which could be applied to both renewable and non-renewable resources (Asafu-Adjaye, 2005; Richards, 2006). Non-sustainable development of natural resources can generate environmental degradation, resource depletion, increasing income disparity, poverty, and marginalization (Raskin, 2000). Examples of natural resource-dependent and relevant issues can be found in many literature sources (e.g. Li et al., 2015; Ferrol-Schulte et al., 2015; Habibah et al., 2010; Nguyen, 2015; Ruffini, 2006; Bury, 2004; Amijaya & Littke, 2005; Pegg, 2006). Therefore, heavy natural resource-dependency is an issue of concern to the internationally.

This thesis uses Zoucheng County as a case study, because this city is heavily reliant on mining. Although mining companies contribute positively to the social and economical components of Zoucheng's development by generating employment and

[2] In this thesis, the concept of a small city is only in terms of its administrative system (i.e. county-level city). The formal administrative hierarchies in mainland China are: 1. Central government; 2. Provincial-level units such as Province, Autonomous Region, and Cities under Central Administration; 3. Prefectural-level units such as Prefecture, Autonomous Prefecture, and City; 4. County-level units such as Small City, County, and Urban District (Chan & Hu, 2003). A county-level city is often considered as an alternative word for 'small city', and the lowest level that central government reaches. In the strictest sense of the word, county-level cities are not "cities" since they contain rural areas (e.g. villages and farmland) many times the size of their urban, built-up areas.

wealth, they still contribute negatively to the local environment and create mining-associated risks for the community. Thus, this section focuses on mining issues in China so as to understand the general background related to mineral resource dependence.

China is one of the world's largest consumers of energy and the largest producer of CO_2 emissions (Li, 2010; Hu & Lee, 2008). Because of the resource characteristics of China, coal has made a great contribution to economic development so that the coal-based energy consumption structure is not likely to change in a short period of time (Ju et al., 2010; Shi & Liao, 2012; Shi, 2015). China consumes about 40% of the world's total coal production and its coal production accounts for about 39% of the worldwide total (Bian, Inyang, Daniels, Otto, & Struthers, 2010). Some experts and institutions estimate that coal is one of the most plentiful energy resources underpinning the economic and social development of the world (World Coal Institute, 2002; The World Bank Group, 1999).

In general, the coal energy production system includes coal mining, preparation or processing and energy generation. Every stage of the coal energy system may have environmental impacts (Bian, et al., 2010). In many European countries, coal is recognized as a dirty source of energy and has been rendered obsolete. For instance, the French government closed all coal mines in 2004 (Bian, et al., 2010), in contrast to the growing coal production and consumption in China. The impact of mining on the environment is becoming an increasingly prominent problem.

Coal mining is also a major source of atmospheric pollution in China. In general, fugitive dust and gases including sulfur dioxide, oxides of nitrogen and methane from coal mining operations cause air pollution (Bian, et al., 2010; Xu, et al., 2000). Wind erosion from coal stockpiles is another source of fugitive dust (Ghose & Majee, 2000).

Spontaneous heating of coal in waste dumps, mine fires, and methane leaking from the coal strata and coal seams release substantial amounts of CO, CO_2, NO_x, and SO_x (Ghose & Majee, 2000; Bian, et al., 2010; Xu et al., 2000). As particulate matter and

gases are released into the mine air to be eventually discharged into the atmosphere, the environment can be damaged. For example, in China, around 87% of SO_2 and 60% of dusts in the air are from coal combustion (Xu et al., 2000). The huge emissions of SO_2 can affect the pH of rainwater (e.g. acid rain), which has created much economic and social damage (Xu et al., 2000). Ye et al., (2001) indicated that burnt coal residues can increase the pH of the soil. Excessive coal fly ash (a coal combustion residue) incorporation results in heavy metal pollution, high soil pH, lack of microbial activity and high soluble salts, which all degrade the quality of the land and reduce agricultural productivity (Pandey & Singh, 2010; Gupta, et al., 2002; Haynes, 2009; Lyer & Scott, 2001). In terms of human health, long-term living in a poor environment can increase lung cancer mortality (Xu, et al., 2000; Hendryx et al., 2008).

Mining has possibly precipitated more disputes over land use than any other industries (Hilson 2002). Chen (2007) found that construction accounted for 21% of China's total arable land loss in the period from 1986 to 1995 and 20.8% from 1997 to 2003. Construction was defined as "conversion of arable land to urban and rural settlements, industrial and mining sites, communications and agricultural facilities" (Cheng, 2007 p.4). Deng et al. (2006) and Chen (2006) found that farmland loss has accelerated after 2000.

In China, approximately 95% of coal production was from underground mines in 2007 (Bian et al., 2010). However, one important adverse impact of mining on the environment is land subsidence over underground mines. Li et al. (2009) pointed out that the process of mining coal resources gradually breaks the original stress equilibrium in strata, which causes arable land decline in mining areas. In China, the cumulative total of collapsed coal mining areas is more than 700,000 ha, and about 1.86 ha per capita (based on the population in mining areas) in mined-out regions (as cited in Li, Liu, Du, & Chen 2009). On average, mining about 10,000 tons of raw coal will cause around 0.2 hectares of land to subside (Bian et al., 2010).

In addition, mining activity also affects farmland quality and reduces agricultural productivity, which can subsequently influence rural households' incomes. Long et al. (2007) indicated a strong negative relationship between crop yield and industrialization by analysing a city in China. Coal exploitation on arable land can cause land collapse or degradation, and reductions in crop production (He & Su 2002; Bian et al., 2010).

When local economic development is heavily natural resource-dependent (e.g. mining), economic activities can impact adversely on the environment and other sectors. In recent years, the Chinese government has had to consider the development of measures to meet the requirements for sustainable development (Xu, Yao, & Mo, 2011). For instance, the Chinese government announced that China aims to reduce the intensity of carbon per unit of GDP by 40-45% by 2020, based on 2005 levels (Xu, Yao, & Mo, 2011). In addition, the Chinese government is placing greater emphasis on advancing economic restructuring, economic development modes, and encouraging consumption and production methods that help conserve resources (NCNA, 2008). Other countries and regions have also developed ways to deal with natural resource dependence, which are discussed in the next section.

1.3 Review of the literature

In dealing with the depletion of natural resources and environmental degradation, sustainability and economic transition solutions are important. There is a vast academic literature dealing with natural resource dependence. Some studies (e.g. Wang et al., 2013; Ferrol-Schulte et al., 2015) support governmental and institutional approaches in mitigating the underlying causes of vulnerability of communities and in facilitating sustainable livelihood strategies. Some other studies (Li et al., 2015; "Technologies, preferences", 2011; Hentschel et al., 2002) emphasize the role of technology and innovation in energy efficiency improvements to enable the sustainable transition of resource-dependent cities or industries. Some natural resource-dependent activities (e.g. shrimp aquaculture) are highly vulnerable to natural disasters such as floods and cyclones. Paul et al. (2013) suggested increasing the capacity of community

participation to cope with uncertain phenomena in ways that make livelihoods sustainable. In general, the efficient use of natural resources and wider livelihood options are approaches to dealing with natural resource-dependence (Ahmed et al., 2010; Ursache, 2014). Erzurumlu & Erzurumlu (2015) investigated involving diverse stakeholders and local communities to develop more sustainable livelihood strategies.

The effects of natural resource-dependence on households cannot be ignored. Such dependence can generate over-reliance on one particular economic activity and reduce the diversity of livelihoods available to households (Soriano, 2007). Bury (2004) and Allison & Horemans (2006) evaluated how current livelihoods (e.g. mining operations, fishing) altered household access to resources (e.g. human capital, financial capital, social capital). Asset, activity and income diversification are important attributes of rural livelihoods in developing countries, which might reduce the risk of livelihood failure (Barrett, et al., 2001; Allison & Ellis, 2001). Other studies (Horsley et al., 2015; Ferrary, 2003; and Mayoux, 2001) focus on capital assets and their interrelationships in households.

As one of the important capital assets[3] (i.e., natural, human, social, financial, and physical capitals) in households, social capital has often attracted the interest of researchers at the community level (Dagupta, 2000; Knack & Keefer, 1997). The economics literature has concentrated on modelling social capital in areas such as economic growth and development (Putman et al. 1993; Rupasingha et al, 2000; Whiteley, 2002), health and well-being (Zhang et al, 2006; Yip et al 2007), labour markets (Rebick 2000; Knight & Yueh 2008), and inter-firm relationships (Batijargal 2007; Peng & Quan, 2009; Gao, Xu, & Yang 2008).

In the household livelihood development area, Nguyen et al. (2015) studied the role of social capital in environmental resource dependence. They suggested that higher levels of social networks affect the choice of livelihood strategies and reduce income

[3] Further explanations are presented in Chapter Three.

dependence on the extraction of environmental resources. Habibah et al. (2010) found that social capital supported the sustainability of local ecotourism and produced better livelihoods. Some social network scholars (Lin 2001a & 1999; Lu, et al., 2013; Bian, 1997; Bian & Huang, 2009) echo a call for research attention to be given to the role of social networks in metropolises such as Beijing. Social capital, which is interpreted as the social resources that people draw in pursuit of their livelihood objectives, has received much attention in Chinese society. However, most studies have been conducted in provincial level cities in the Chinese administrative system, which have populations of at least 10 million. Very few studies have specifically examined the relative importance of social capital with respect to household livelihoods in county-level cities in China.

1.4 Literature gaps

This thesis identifies the important role of kin and non-kin ties in terms of their relationship to social capital in a county level city.

As with many Confucian societies in East Asia, the importance of family or kin ties is an historical aspect of Chinese society. Trust is often encouraged in a relatively narrow circle of family and close friends in Confucian tradition (Dalton, et al., 2001). However, China's changing socio-economic conditions and increased interaction with foreign communities and culture may affect these orientations. With respect to population size, different development status and being exposed to foreign cultures, different city sizes may experience different effects on these traditions relating to social capital. In some large metropolitan cities in China, kin ties (i.e., with relatives) limit the growth of social capital (Lin, 2001; 2004), while in county-level cities in China, the effect of different types of social ties (kin and non-kin ties) on social capital has received less attention. Thus, this study aims to fill gaps in academic knowledge about whether different types of social ties (kin and non-kin ties) can lead to differential access to social capital in small communities in China.

As a research target, this study is conducted in the context of small cities in China, which have been under-studied. In 2011, Mainland China had around 2,859 counties and county-level cities (Meng et al., 2012; Fung et al., 2013). The total geographic area of China's counties accounts for about 90% of the total national area (Mi & Ji 1999), while the population of these counties is more than 70% of the total population. Because of this, counties and county-level cities are crucial to the country's economic viability, social cohesion and effective leveraging of social capital. However, in contrast to the situation in large cities, economic development, related education, academic research institutions and the inadequacy of statistical departments in small cities in China have limited researchers' ability to undertake relevant investigations.

1.5 Research objectives and questions

The objectives of this study are to investigate the role of social capital during the transition to alternative livelihoods in a county-level city in China and present a dynamic simulation model of the livelihood outcome changes based on case studies. The intention of this thesis is to answer two questions:

1) Do different types of social ties (kin and non-kin ties) lead to differential access to social capital in a small community in China?

2) Does the strength of social capital alter local livelihood patterns by diversifying household livelihoods and providing new livelihoods in industries with potential for development?

Investigating the role of social capital in sustainable livelihood development is an important purpose for this thesis. Therefore, understanding local social capital is very important. This motivation generated the first research question. This thesis examines the social capital status of a mining community (the group most involved with the improvement of the local economy) in Zoucheng. The study provides social capital measurements, assesses the strength of relationships (kin and non-kin ties), and provides econometric evidence of factors associated with access to social capital. In doing so it draws out some of the links between social capital growth and relevant

factors such as demographic characteristics. As discussed previously (see Section 1.4), it pays special attention to the strength of relationships (i.e., kin and non-kin ties). The study uses the research results from the first question to adjust the strength of social capital, which is important in the next research step.

The second question is the key question in the whole research process. It includes the issues of current livelihoods, social capital, household strategies, and livelihood outcomes. Without these components, the simulated results would not reflect or achieve the research aim.

This study involves many issues common in China and worldwide, such as a resource-dependent economy and its associated negative effects on the environment and the local community, and investigates sustainable livelihood options. The risks associated with mining activity may become serious problems for future development. Thus, the shocks and risks of mining activity on the local environment and livelihoods provide background information for the simulation model.

The second question also considers the possibilities of alternative livelihoods in different industries. As discussed in Sections 1.2 and 1.3, a transition to an alternative industry is one of the ways to deal with natural resource dependence. Therefore, it is necessary to understand the current development status of alternative industries and their relationships with mining (including the adverse impacts from mining).

This study concentrates on improving the sustainability of household livelihoods, not those of individuals. If mining is the primary employment, diversifying household livelihoods may be achieved for other mining household members who currently receive low rates of pay. It might reduce the vulnerabilities of current household livelihoods, especially with the lack of livelihood choices for miners.

This study uses the sustainable livelihood framework (DFID, 1999), together with social capital investigations and assessment along with local households' and the city's economic background information to develop a theoretical and empirical sustainable

livelihoods simulation model. The data come from quantitative studies. Household survey data were used to analyze social capital status. Secondary data were also gathered to provide insight into local historical contexts that affected household livelihoods. Thus, this thesis provides a useful and innovative approach for studies on the applications of social capital in the process of moving to an alternative livelihood by combining appropriate econometric models and a simulation model. All of the collected data permit the construction of a simulation model to estimate possible outcomes on livelihoods with appropriate consideration given to relevant shocks.

The findings from this study may have implications for government policy regarding social capital implementation, revenue generation, and economic development as well as the personal career development of individuals. Considering the large number of county-level cities in China, this could have significant practical applications. The study also contributes new perspectives on social capital applications in the process of transition from a resource-dependent economy to a sustainable economy in a county-level city in China. The findings may be valuable to other small cities, and rural areas with similar socio-economic characteristics and cultural values (e.g. social networks, family values) in China, and even to other developing countries with similar characteristics in their social networks.

1.6 Outline of the thesis

Research Question (1) demonstrates the framework of empirical relationships between social capital and associated factors. Research Question (2) demonstrates a general research perspective for this thesis. Research Question (1) will be tested in Chapter Six. Research Question (2) will be tested in Chapters Seven and Eight. All of the relevant background information such as general issues and links between different industries are discussed in Chapter Two and Chapter Five.

The remainder of the thesis is organized as follows:

Chapter Two describes the case study area of this thesis (Zoucheng city). It notes some important resources (e.g. mineral resources and tourism) in the city, three industries (mining, tourism, and agriculture), and relevant livelihood alternatives. The aim is to help the reader to understand the background to the analyses and simulation model presented in the following chapters.

Chapter Three builds up the theoretical framework of this thesis. It firstly introduces the sustainable livelihood framework. Social capital is discussed in terms of the purpose of this thesis. The last section introduces the role of social capital in a sustainable livelihood framework, and the applications of social networks. All of these are important theoretical guidelines in establishing the regression model and simulation model.

Chapter Four describes the research methods used to investigate social capital and other questions listed in Section 1.5.

Chapter Five discusses possible issues, influences, shocks and risks in the local community with the growth of mining activities in Zoucheng city. The main livelihood issue is over-reliance on mining activities. Residents of Zoucheng city will have to use local resources to find an alternative livelihood in the future.

Chapter Six presents the strength of social ties in the local city. It also provides the econometric results exploring the factors associated with social capital scores.

Chapters Seven and Eight build up a model with similar characteristics to the current livelihood system, which mainly involves the influences of mining activities on two industries – tourism and agriculture – so as to simulate the current issues in the local community. Then, social capital as applied to livelihood development is included, to indicate the role of social capital in the development of alternative livelihoods (i.e., rural tourism).

Chapter Nine concludes the thesis, discusses relevant policy implications and study limitations, and makes some recommendations on the basis of this research.

In general, Chapters Two and Five are based on background information and issues related to mining activities. Chapters Three and Four provide the theoretical framework and methods for research. Chapter Six analyses the social capital survey results. Chapters Seven and Eight focus on model establishment and analysis.

CHAPTER TWO: Research Context

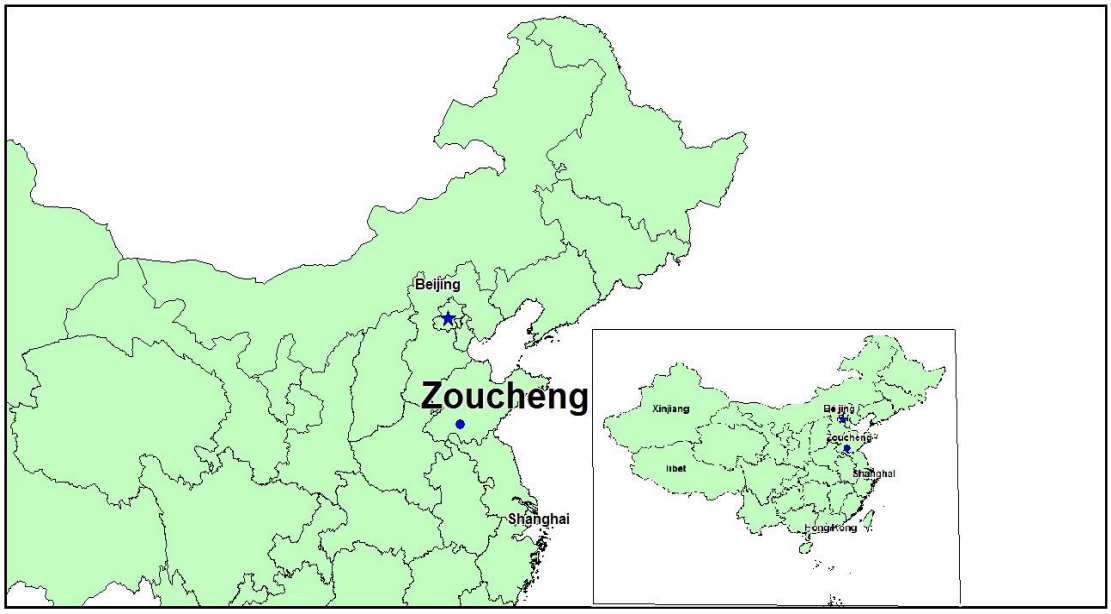
2.1 Description of the study area

The case study area refers to the whole of Zoucheng city, located in the south-west of Shandong province in China (Figure 2.1). It covers 1,613 square kilometers with a population of about one million, and includes about 350,000 households. About 64 percent (746,395 of 1.16 million) of the total population is registered as agricultural households (Zoucheng Statistical Yearbook, 2013).

In October 1992, Zoucheng became a county-level city. For the national top one hundred counties' ranking, Zoucheng ranked 25th in the 2012 order of economies and its highest place was 16th in 2006 (SURPDI, 2012). In 2013, the output of the county was 73.16 billion yuan (about 20.6 billion US$[4]), of which about 58% was contributed by secondary industry. The average per capita annual income was 27,605 Yuan (about US$ 7,776) in urban areas and 12,576 Yuan (about US$ 3,543) in rural areas (Zoucheng Statistical Yearbook, 2013).

[4] According to the World Bank, the PPP (Purchasing Power Parity) conversion factor for GDP is 3.55 by following the number of units of China's currency required to buy the same amounts of goods and services in the domestic market as a U.S. dollar would buy in the United States.

Figure 2.1: *The location of Zoucheng County in Shandong Province, China*



At present, coal mining, water, electricity and gas supply, equipment manufacturing, agricultural processing industries, textile industries, drink manufacturing, non-metal mineral product industries, and raw chemical materials and chemical products production represent about 88.6% of the local secondary industry (Zoucheng Statistical Yearbook, 2013). Coal mining in Zoucheng has experienced rapid growth since the early 1980s and has dominated the local economy in recent years. In the local employment market, the mining industry directly or indirectly provides more than 100,000 job opportunities (Zoucheng Statistical Yearbook, 2013). Local mining industries and connected local companies such as commercial institutions and hospitals, etc., employ more than 70% of the working population in Zoucheng (SURPDI, 2012). Thus, miners' networks (e.g. miners' friends, household members etc.) have significant influences and connections in local society. For this reason, people working in mining or related industries were chosen as the research group in Zoucheng city.

In contrast, tourism occupies a disadvantaged position in the local economy. In 2013, the total tourism revenue was about 3.3 billion yuan, which was lower than that of most other local industries (Zoucheng Statistical Yearbook, 2013). Although the rich tourism resources present potential growth capacity, local tourism development has been slow.

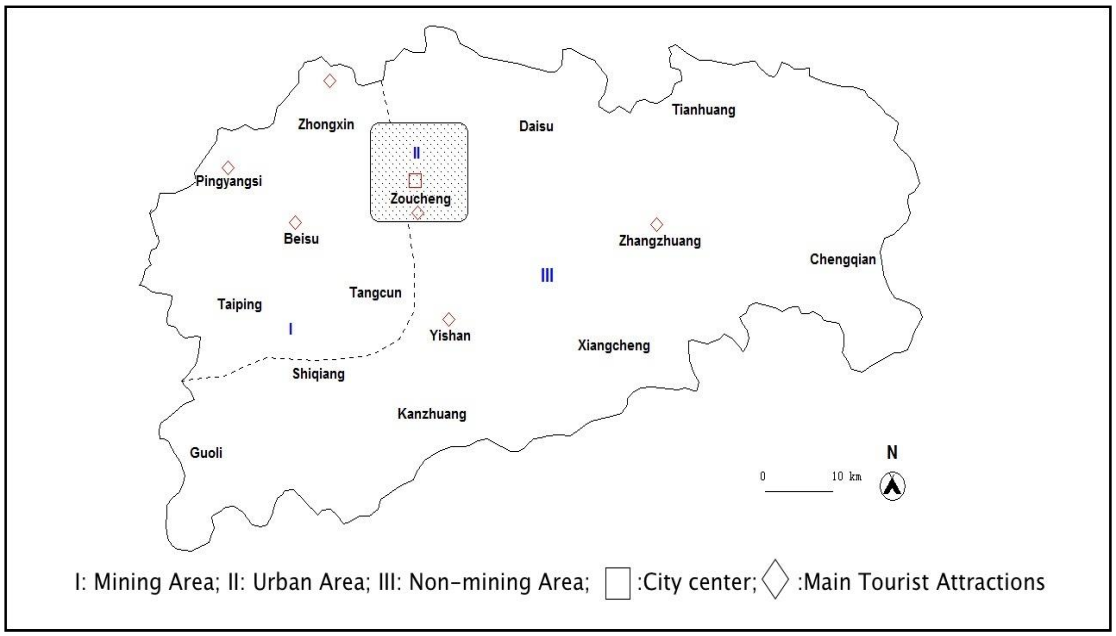
On average, the annual proportion of direct income from local tourism was less than 6% of tertiary industry added value from 2000-2013 (Zoucheng Statistical Yearbook, 2000-2013).

Mineral resources, agriculture and tourism are three important industries, which could support the local economy. However, the focus here is on tourism as a potential resource to support sustainable local economic development.

2.2 Distribution of livelihood alternatives: mining, tourism, and agriculture

Zoucheng city is separated administratively into 17 districts as shown in Figure 2.2 (in which three village towns are recognized as urban areas). The shaded area is urban area and the rest is rural. Figure 2.2 illustrates the distribution of the main mineral resources and main tourist attractions. The local mineral resources have a narrow distribution in the western area, while tourism resources are widely dispersed compared to mining in Zoucheng city.

Figure 2.2: *Mining and tourism distribution in Zoucheng city*



The following information describes the basic background, the process of local economic development in Zoucheng, the living status of residents and tourism development.

2.2.1 Mining

In Zoucheng city, mineral resources include coal, granite, limestone, marble and kaoline, and industries related to these resources have been the pillars of the local economy. Geologically, Zoucheng is part of the Yanzhou Coalfield. In China, Yanzhou Coalfield is one of the eight major regions for coal resources (Hu, et al., 2012).

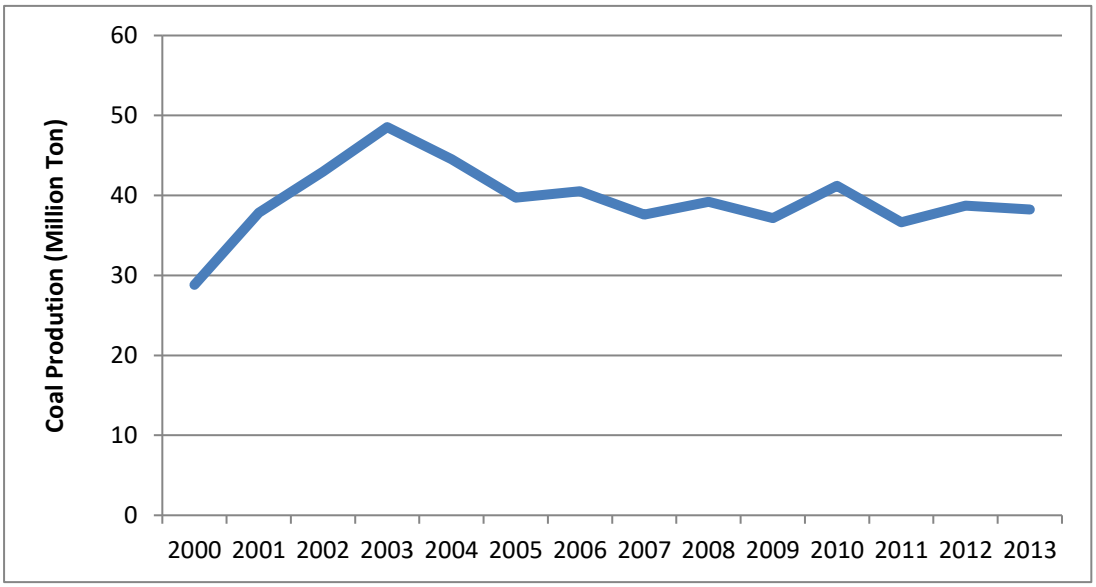
Zoucheng is a national energy industrial base and the coal deposit had total reserves of more than 3.014 billion tons at the end of 2007 (Xu, et al., 2014). In Zoucheng, coal is found over 357 square km, representing about 22.13% of the local land area (Yang et al., 2007). In recent years, the stock of minerals has been reduced with local economic development and the outputs are currently at a stable volume.

Zoucheng city has nine coal mines: BaoDian, DongTan, NanTun, BeiSu, LiYian, TaiPing, HengHe, TangCun, and LuoLing. Regarding the length of service remaining for these coal mines, two mines (TangCun & LuoLing) are already closed (The conciliation commission of regional economies, 2006, Dec). The productive lifespan for the rest of the local mines was estimated at more than 25 years on average at the end of 2006 (The conciliation commission of regional economies, 2006, Dec).

However, the excessive exploitation of mineral resources has decreased the local mines' life span in recent years. Taking four local mines as an example, the total coal deposits for NanTun, BeiSu, BaoDian, and DongTan are about 0.3 billion tons (Li, 2012). The life spans for these four mines have reduced from more than 25 years to only 15 years, if the actual annual extraction continues at 20 million tons instead of the designed annual capacity of about 12 million tons (Li, 2012).

A Chinese proverb says: “be prepared for danger in times of safety” and local economic development is no exception. First, for years coal exploitation has brought serious pollution to the natural environment (as noted in Chapter One), which is likely to increase environmental costs and challenge economic growth. Second, it is undeniable that coal is a non-renewable resource. The stock of local mine resources will be depleted in future, especially considering the life spans of the local mines discussed above. The question is how mining households can adapt to this before most of the mines close. It is important to develop alternative industries before mineral resource depletion is complete. Otherwise, the local economy will suffer serious problems such as increasing unemployment and decreasing local financial income, affecting the administrative resources for county development. For instance, Doncuan City in China was wealthy in copper ore. The product value from local copper ore made up more than two thirds of the local GDP. In 1958, Doncuan City became a prefecture-level city. However, when all four mines were closed, Dongcuan was downgraded to a county-level region (The conciliation commission of regional economies, 2006 Dec). When a prefecture-level city is downgraded to a county-level region, allocations of central finance and the city’s attractiveness to investors is affected. This, in turn, reduces local economic development and residents’ livelihoods. In my fieldwork, I have seen people adapting to mine closures by changing their livelihoods; for example, planting vegetables and fruits. Therefore, the local government should have some awareness of shocks to the economy. For example, current miners may start to expand their livelihood choices by undertaking activities such as developing agricultural enterprises and ecological tourism.

Figure 2.3: *Annual Coal production in Zoucheng (Million Tons)*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

Figure 2.3 shows coal production in Zoucheng over the period 2000-2013. As can be seen from the graph, there is an obvious steady increase in coal production in the first four years (from about 29 million tons in 2000 to about 49 million tons in 2003). After that, coal production, with minor fluctuations (e.g. in 2006, 2008, 2010, and 2012) has gradually decreased to about 38 million tons in 2013.

With a wealth of coal and other minerals, Zoucheng has enjoyed remarkable levels of long-term economic growth. The average GDP growth rate was more than 14% per year from 2003 to 2013 (Zoucheng Statistical Yearbook, 2013). Hilson (2001), investigating the impacts of mines on community groups, showed that mines can create a positive socioeconomic impact in local communities.

However, recent changes in the macroeconomic environment may potentially change the benefits obtained from local coal enterprises. There has been a slowdown in China's economy; the GDP growth rate was 6.9% but coal consumption reduced by 3.7% in 2015, while the revenue from domestic tourism increased by 13.1% (NBSC, 2016). In my field work, people working in the local mining industry presented similar views on the coal market following the downturn – sales in the local coal market showed sluggish growth in recent years, as did the levels of coal production (see Figure 2.3). Therefore,

developing alternative enterprises (e.g. tourism) is an important step in removing dependence on a resource-based economy.

2.2.1.1 Resource dependence

The local economy depends upon mining industries. As a resource-based area, local industries are heavily dependent on coal mining, the coal chemical industry, electric power and other coal-related industries (Guo & Liu, 2012). In addition, employment shows similar trends: total employees numbered 230,000, of whom 46% (about 105,000) were working in the local mining industry (Guo & Liu, 2012). On average, employment in local mining was stable at around 100,000 from 2000 to 2013 (Zoucheng Statistical Yearbook, 2000-2013).

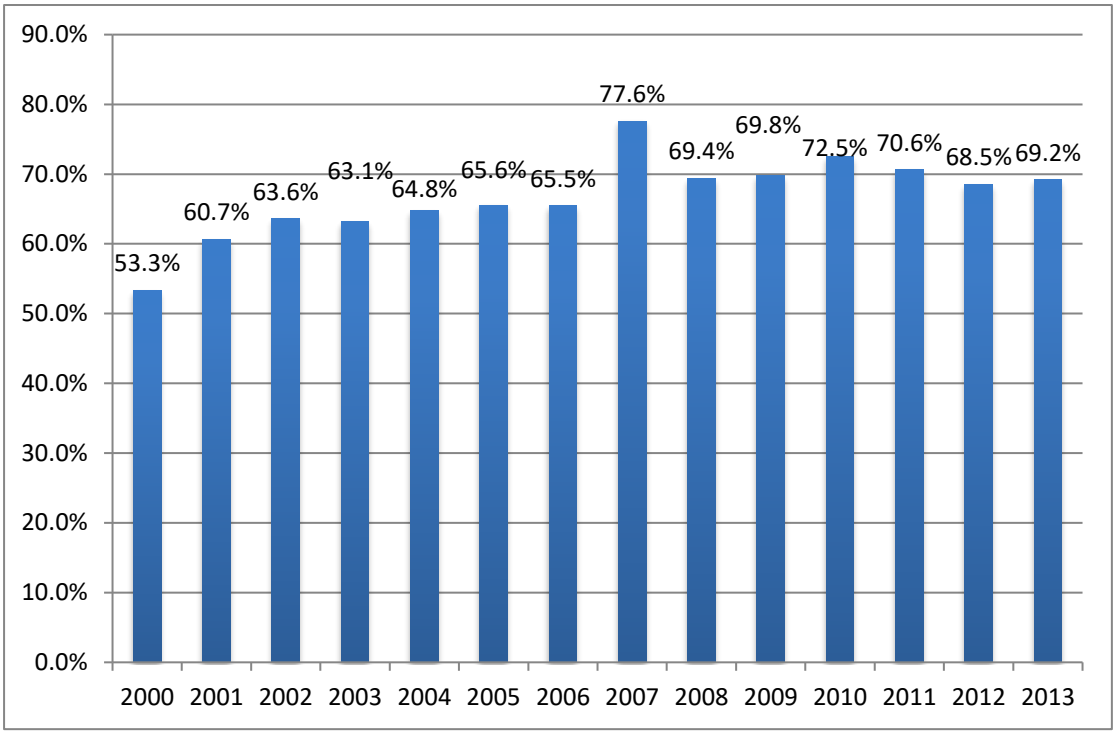
2.2.1.2 Economic growth

A case in point is Yanzhou Coal Mining Company Limited. It was the first big national enterprise that chose Zoucheng City as an operating site. In 1973, Yanzhou Coal Mining Company Limited (the largest mining company in Zoucheng city) was established in Zoucheng City. Thereafter, other foreign enterprises such as the Zouxian coal-fired power plant and Lineng Enterprises were also attracted by the availability of local mineral resources. Therefore, it is generally agreed that Zoucheng City's economic development started in that year. For instance, the average local GDP growth rate was only about 7.5% from 1949 to 1975; then the growth rate increased to about 11% from 1976 to 1989, and to about 21% in the 1990s (Liu & Liu, 2000). It must be emphasized that economic development is a very complicated process. It is not simply claimed that the boost to the local economy was completely caused by a mining company. However, it is apparent that the company had or potentially had significant positive impacts on the local economy.

2.2.1.3 Contribution of mining to industrial output value

In Zoucheng city, total industrial output values have been primarily calculated from the eight biggest industries: coal mining; electric power, gas and water supply; manufacture of general purpose machinery; agricultural and subsidiary product processing industries; textile industries; beverage manufacturing; manufacture of non-metallic mineral products; and manufacture of chemical raw materials and chemical products. In Zoucheng city, most of the local manufacturing is related to local mineral resources, and coal mining makes a large contribution to the total value of secondary industry (SURPDI, 2012). Local mineral resources and their related products have advantages in terms of scale and geography over other local products in terms of profitability because Zoucheng has abundant and potentially profitable mineral resources. For "quick financial gains", local industrial output values are mainly driven by the mining industry. For instance, the mining industry represented the majority of total industrial output from 2000-2013. Figure 2.4 shows that the local mining industry contributed more than half of the total industrial output value from 2000-2013, notably 77.6% in 2007 and an average of 66.7% over the total period.

Figure 2.4: *The contribution of local mining industries to total industrial output value, 2000-2013 (Unit: %)*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

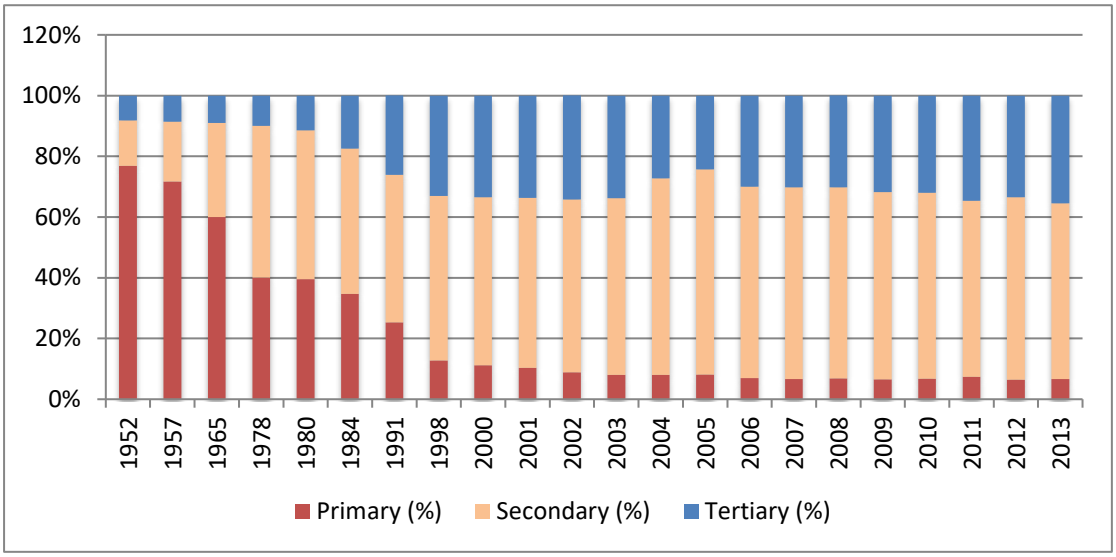
2.2.1.4 Industry structure

In Zoucheng city, mining not only supplies financial income, but also changes the local industrial structure. With more financial support, local manufacturers, the chemical industry, textile industry and other industries have been boosted in recent decades.

Figure 2.5 shows the local industrial structure distribution from the 1950s to 2013. The bar chart illustrates the proportion contributed by each industry sector to the local economy. The local industrial structure distribution shows sharp contrasts between primary and secondary industries. For tertiary industry, there has been a substantial increase compared with the other two sectors. At the beginning of the establishment of the People's Republic of China, Zoucheng's economy was heavily dependent on agriculture and was largely self-sufficient. It can be seen that primary industry earned about 77% of total GDP in 1952. Primary industry employed more than 97% (about

186,500) of the local labour force in 1952, with only about 3% in the secondary and tertiary industries (Liu & Liu, 2000). However, primary industry has decreased over the years. Mining became a component of the local economy in the 1970s and has provided an ongoing boost to local economic development. Secondary industry has held the leading position in the state economy since the 1990s. Figures for tertiary industry have fluctuated slightly and increased over the same period. Overall, the local economy experienced a transition from an agricultural to an industrial base. Figure 2.5 indicates that the industrial structure is not static and can change with different industrial contributions to the local economy. Therefore, the local industrial structure could be moved to a higher reliance on tertiary industries as an alternative livelihood strategy for local community and economic development.

Figure 2.5: *The industrial structure distribution of local GDP in Zoucheng (% of GDP)*



Source: Author's compilation from Liu & Liu, May 2000; Zoucheng Statistical Yearbook, 2000-2013

The distribution of mineral and tourism resources (see Figure 2.2) influences the development of the relevant industries in Zoucheng. Industry in the west and agriculture in the east or "rich west and poor east" are general development features of Zoucheng in recent decades. In recent years, the outputs from western villages/towns provided more than 80% of the total output in Zoucheng (SURPDI, 2012). In consequence, the west developed areas of serious land subsidence due to the intensive operation of mineral resource-based industries in this area, while the ecological advantages of the

east played no role due to the underdeveloped transportation system and other relevant public infrastructures (SURPDI, 2012). Zoucheng seems to have had a passive division of the territory in terms of regional industry, but this division did not fully use all of the local resources (such as tourism). In Zoucheng, primary industry is distributed primarily in the eastern and southern areas; secondary industry is highly concentrated in the central and western areas; and tertiary industry is confined to the central city (SURPDI, 2012). However, tertiary industry could potentially develop in many other areas due to a wide distribution of local tourism resources (see Figure 2.2).

2.2.1.5 Residents

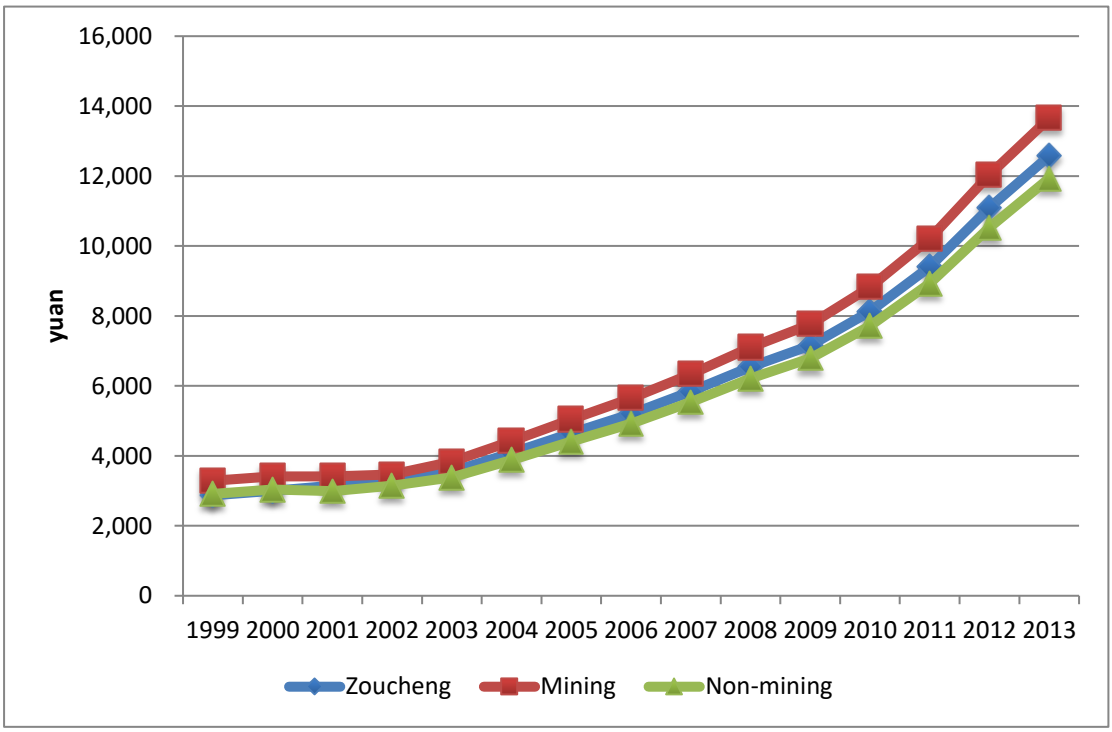
Mineral resources have brought benefits for local residents. For instance, householders use natural gas in place of firewood, coal, and electricity in cooking.

In March 1983, the Ministry of National Coal Resources ratified a gas-engineering project in Zou County (the original name for Zoucheng city). This project was a joint operation between Yanzhou Coal Mining Company Limited and the Zoucheng government. In 1989, the Zouxian Gas Company was established. Initially, only around 400 households benefited from this local facility. In 1998, the total length of gas pipes grew to 162 kilometers, which could provide services for about 32,000 households and about 117,500 people (about 59.1% of the total urban population) in the urban area (Liu & Liu 2000, May). In 2005, the gas pipes were increased to 368 kilometers and about 85% of urban citizens had access to the gas facility (The conciliation commission of regional economies, 2006, Dec). With more gas facilities provided, dwellers could conveniently use clean, cheap energy for cooking.

The most direct benefit for dwellers was net income growth. Figure 2.6 presents annual cash income per capita for rural dwellers from 1999-2013. It also divides the region into two categories: mining areas and non-mining areas. If at least one mine exists in a village town, it is defined as a mining area. Of 17 village towns, six are located in the mining area. As shown in Figure 2.6, annual cash income per capita increased in both

mining and non-mining village towns from 1999-2013. For instance, the cash income was about 13,652 yuan in mining areas in 2013, which was more than quadruple that in 1999. The income gap between mining and non-mining areas also expanded. In 1999, the annual cash income per capita for residents in mining areas was about 377 yuan more than non-mining residents on average. In 2013, the average gap increased to about 1,700 yuan. Residents in mining areas are thus likely to earn higher incomes than those in the non-mining areas of Zoucheng city.

Figure 2.6: *Net incomes per capita for mining and non-mining areas, 1999-2013*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

2.2.2 Tourism

This section will introduce the characteristics of tourism development in Zoucheng.

2.2.2.1 Tourism resources

The following paragraphs include the structure of local tourism resources (i.e., category diversification) and discuss cultural areas and scenic spots, the area's excellent geographical position, the status of traditional culture in local society, and market trends.

a) Diverse categories

Zoucheng is a vast county, rich in tourism resources. In Zoucheng, there are hundreds of unmovable cultural relics, more than 15,000 pieces in local museums, and more than 60 local relic protection units (DPZ, 2015).

Numerous historical sites and scenic spots provide great potential for developing tourism. The local government and the Tourism Planning and Design Institute of Beijing conducted joint research on local tourism development (March, 2008). They collected relevant information about local tourism resources and divided these resources into eight categories. Table 2.1 shows the structure of local tourism resources, including natural and historical resources. Landscape architecture takes first place in the total number of tourism resources. Following that, geological landscape (about 19%) and water scenery (about 19%) take second place. Historic ruins and sites (10%) follow. Taking local tourism resources and the prospect of tourism marketing into account, local government and the Tourism Planning and Design Institute of Beijing (March, 2008) divided 131 local tourist attractions into three classifications: A-grade resources that are rare, typical, specially protected by the state, and well-known both at home and abroad; B-grade resources under provincial protection; and C-grade resources under protection at city or county level. These resources play a supplementary role on the local tourist track. In the Zoucheng area, there are 15 A-grade, 46 B-grade and 70 C-grade resources (Zoucheng municipal government, March, 2008).

Table 2.1: *The structure of local tourism resources in Zoucheng*

Resource Type	N	Proportion
Landscape architecture	48	22%
Geological landscape	41	19%
Water scenery	41	19%
Human activities	27	13%
Historic ruins and sites	22	10%
Biodiversity	20	9%
Tourist commodities	11	5%
Others	5	2%
Total	215	100%

Source: Author's compilation from Zoucheng government, March, 2008

In recent years, the local government formulated regional plans to strengthen tourism resource management. The national key cultural relics protection units were increased from four to seven and 28 provincial levels were established in Zoucheng by the end of 2015 (DPZ, 2015). According to the master plans in Zoucheng (Bureau of City Planning of Zoucheng city, 2014), local government is undertaking further programming on natural scenic places and cultural monuments, with the intention of creating about 13 potential tourist resorts in the next few years. These tourist resorts will combine ecological and modern tourism concepts. These scenic areas will include forests, mountains, ecological environments in subsidence areas, and some cultural heritage assets.

b) Potential tourist attractions

Zoucheng is rich in natural landscape and cultural tourism resources. The east of the city is surrounded by mountains (there are about 190 mountains in Zoucheng), and there are more hill areas in the west (SURODI, 2012). The elevation ranges between about 35m and 645 m (SURODI, 2012). There are three nature reserves (Shibapan, Fushan, and Yishan) in the local area (SURODI, 2012). The area of Shibapan is about 3,000 ha; it is a reserve that protects primarily plants such as spruce, and other rare tree species. Fushan (about 3,000 ha) preserves forest ecology. Yishan is about 5,000 ha, and focuses

on historical sites and scenic areas in Zoucheng (SURODI, 2012). Zoucheng also has two wetland parks (Beisu & Xiangcheng). Beisu Wetland Park is about 1,500 ha and is located in a subsidence area.

In addition, Zoucheng city has a long history and a flourishing culture. In the Qin Dynasty (221 B.C-207 B.C), Zou was named as one of the counties by the government. Confucius and Mencius, both of whom were great philosophers and educationalists in Chinese history, were born in Zoucheng city. Therefore, Zoucheng is considered the home of the Confucian system. In 1995, the State Department listed Zoucheng city in the third group of National Famous History and Culture Cities (Zoucheng government, March 2008). Local places of historic interest include the "Three Mengs," which include Meng Mansion, Meng Temple (the place where people feted Mencius) and Meng Forest. In addition, Zoucheng has beautiful scenery such as Yi Mountain, Gang Mountain and the Fenghuangshan Buddha. These cultural and natural resources represent potential tourist attractions for Zoucheng city:

The Three Mengs:

The "Three Mengs" are the most famous and typical historical sites in the city. They include the Meng Temple, the Meng Family Mansion, and the Meng Forest. The Mencius Temple is also called the Second Saint Temple in China. It is located in the southern part of the urban area and is now a key cultural relic under state protection.

Yi Mountain:

Yi Mountain, a beautiful scenic spot, sits in the southeastern part of the city, about 10 kilometers away from the city centre. Mencius said: "Confucius ascended the eastern hill, and Lu[5] appeared to him small. He ascended the Tai mountain[6], and all beneath the

[5] The State of Lu was one of the kingdoms in China during the Spring and Autumn Period (770 B. C-476B. C).

[6] It is the most famous mountain in China.

heavens appeared to him small." It symbolizes high aspirations in people's lives. Many scholars believe that the "eastern hill" is Yi Mountain.

Fenghuangshan Buddha:

This is located in the east part of Zoucheng city and was carved in the Tang Dynasty (618 A.D.-907 A.D.). The Buddha is set into a cliff on Fenghuangshan Mountain. It is about 4.2 metres tall.

Chongxing Tower:

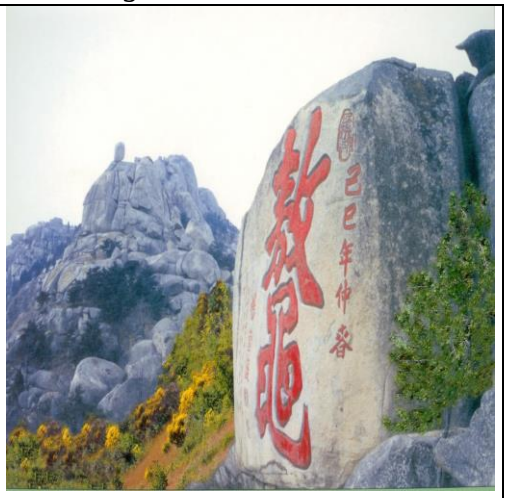
Located in the central part of the city, Chongxing Tower is an octagonal building, 9 stories (33 metres) high, with 10 eaves on the roof. It was built in the Song Dynasty (960 A.C.-1279 A.C.), about 1,000 years ago.

Double Saints Stones:

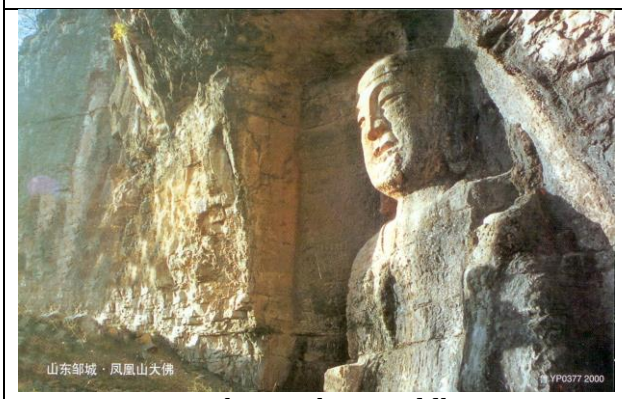
These are two important stones that indicate the city is the birth place of both Confucius and Mencius. Confucius (551-479 B.C.) was one of the world's greatest philosophers and ancient thinkers. Confucius' theories emphasized the importance of societal ethics and bonds, which profoundly influenced Chinese society and culture. Mencius (372-289 B.C.) inherited and passed on Confucius' theories. He stressed the idea of benevolent government and developed Confucianism as the core of Chinese culture. The Double Saints Stones are in the Railway Station Square of Zoucheng city.

Figure 2.7: *The main cultural and scenic areas in Zoucheng*

Mencius Temple



Yi Mountain



Fenghuangshan Buddha

Chongxing Tower

Double Saints Stones

Source: Authors' compilation from Liu, 2000

c) Geographical position

Transportation, public transport and infrastructure can directly impact the growth of tourism (Wen, 1997). Due to its superior geographic location, Zoucheng has made great

achievements in the modernization of its transportation networks in the past 20 years. The completed road system in the city reached 3545.14 km by the end of 2013 (The Bureau of Statistics of Zoucheng City, 2014). Many railways, highways, and other traffic routes run across the urban centre, including the Beijing-Shanghai railway, Beijing-Fuzhou highway, Beijing-Shanghai highway, 104 National Highway, Beijing-Hangzhou Canal, and the Beijing-Shanghai high-speed railway. According to the Zoucheng municipal government (March, 2008), the distance from the city centre to Jinan international airport is about 180 km. It is about 60 km to Jining[7] domestic airport; about 210 km to Rizhao ocean port, and about 400 km to Tsingtao ocean port. In Shandong Province, Jining, Jinan, Rizhao, and Tsingtao are common entry points for tourists. These convenient traffic routes provide the means and capacity to attract more tourists and develop local tourism, if distinctive products are developed and marketed.

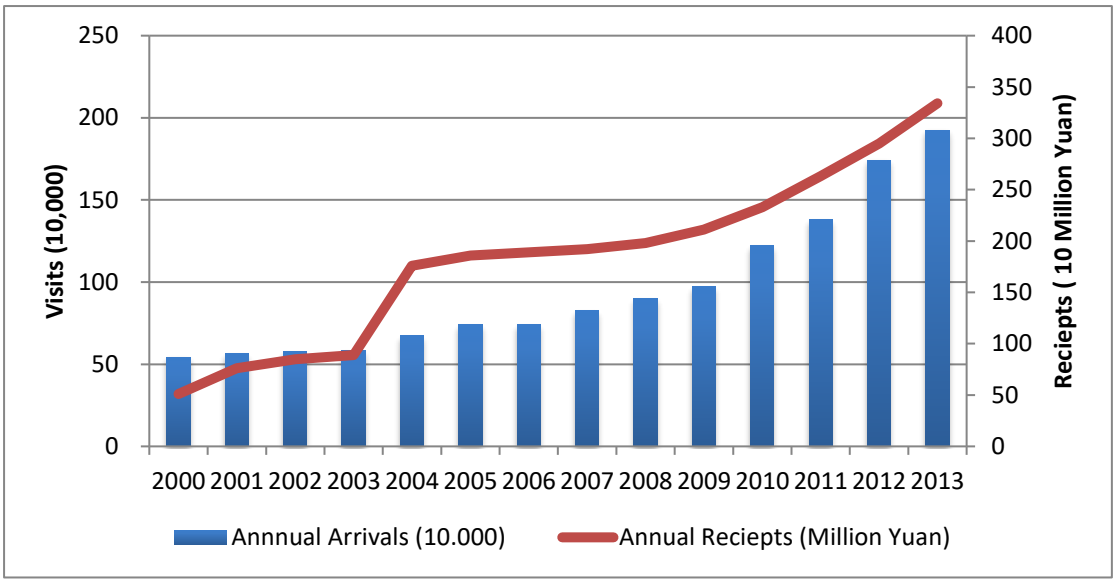
d) Market demand

In the local tourism market, annual tourism receipts are increasing steadily with increased annual arrivals. It indicates the positive relationship between number of tourist arrivals and tourism benefits, which provides some hints for building up the tourism simulation model in Chapter Seven.

Figure 2.8 shows tourism development in Zoucheng from 2000-2013 (Zoucheng Statistical Yearbook, 2000-2013). The bar chart and line graph represent annual arrivals and annual tourism receipts in the period 2000-2013 respectively. As can be seen from the graph, there is a steady increase in both of these tourism indicators. In 2000, there were about 543,000 tourists and 0.51 billion yuan in tourism receipts. In 2013, arrivals increased to about 1,925,000 and tourism receipts were approximately 6 times more (3.3 billion yuan) than in 2000. The growth rate in annual receipts has been greater than that of annual arrivals, particularly from 2003-2004, due to the ticket price rise for local tourist attractions in this period.

[7] Zoucheng's higher level administrative city

Figure 2.8: *Tourism development in Zoucheng, 2000-2013*



Source:Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

2.2.2.2 Characteristics of tourism operations

The following paragraphs introduce the characteristics of local tourism operations that may influence tourism development.

a) Government role and private business

In the case of Zoucheng city, government structure and market mechanisms both influence local tourism resources and enterprises. Private business operation and the ownership of tourist attractions are clearly distinguished.

In the city, almost all of the tourist attractions are owned by the state or local government. Table 2.2 below gives a brief review of the nature of ownership of the main tourist attractions in the city. Of the 17 local tourist attractions, 16 belong to the state. Most of these tourist attractions are affiliated public institutions of the Zoucheng Cultural Relics and Travel Bureau (World Bank, 2010). Because of the government role in ownership of the main tourist attractions, the financial support and preservation of local cultural relics, and salary payments for relevant employees are still dependent on state and local government (World Bank, 2010; Zoucheng government, March 2008).

Table 2.2: *Nature of ownership (Publicly owned) of the main tourist attractions*

Tourist attractions	Higher Authority
Mencius Temple & Mencius Family Mansion	Zoucheng Cultural Relics and Travel Bureau (ZCRTB)
Meng Forest	ZCRTB
Zoucheng Museum	ZCRTB
Tieshan, Gangshan Carved Stone Calligraphy	ZCRTB
Yi Mountain	ZCRTB
Fushan tourist district*	None
LuHuangWang Mausoleum	ZCRTB
Mencius Forest	ZCRTB
Former residence of Mencius in Fu village	Fu Village of Qufu city
Scenic spot of Shibapan	Zoucheng Forestry Bureau
Zouxi Subsidence area	Beisu, Pingyangsi Village Town
Mencius's Mother Forest	Qufu Cultural Relics Bureau
Tiexi public park	YanZhou Coal Mine Bureau
Sports park	Zoucheng Administration of Sports
Wubaoan Mountain	Zoucheng Forestry Bureau
Mencius Lake	Bureau of Water Resources of Zoucheng city
Tieshan Park	Zoucheng Landscape Department

*:None ownership

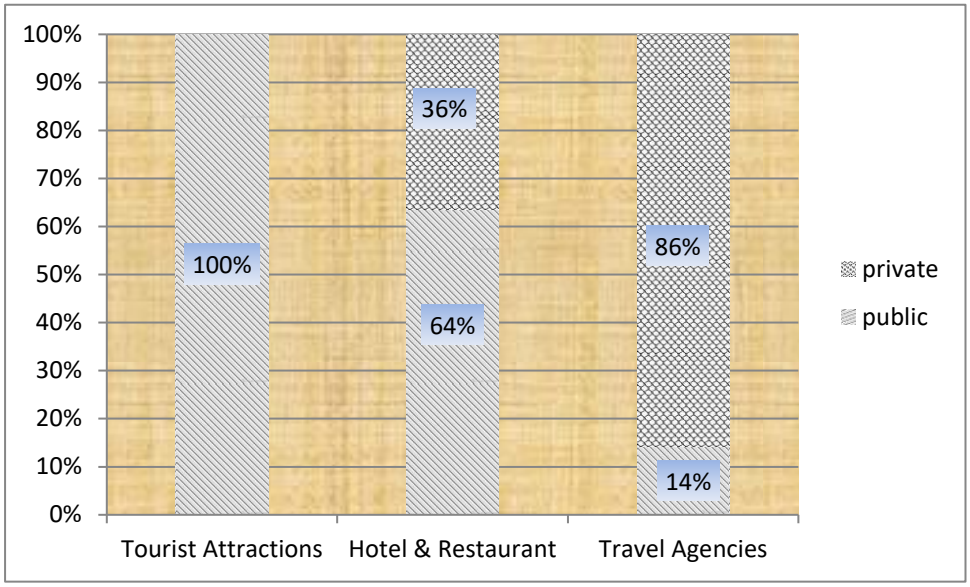
Source: Author's compilation from Zoucheng government, March 2008; World Bank, 2010

On the other hand, business operations are moving toward a market economy. Based on local government studies (2013), the proportion of privatization in 11 local hotels or restaurants and in 14 travel agencies[8] was higher than that of local tourist attractions. The proportion of private and public distribution of local tourist attractions, hotels or restaurants and travel agencies is illustrated in Figure 2.9. For local tourist attractions, ownership is dominated by the state or large national companies. This compares to less than 65% state ownership of hotels and restaurants. For local travel agencies, the rate

[8] These hotels, restaurants, and travel agencies are relatively large in terms of their business operations and are well known in the local area.

of private ownership is above 85%. Therefore, local government plays an essential role in local tourism activities. Local government can implement relevant policies on tourism development. With government support, residents might gain benefits such as tourism employment and income from tourist arrivals.

Figure 2.9: *The distribution of private and public ownership in local tourism*



Source: Author's compilation from Zoucheng Tourist Administration, 2013

As previously discussed, the Zoucheng government plays an important role in the nature of ownership of the local tourist attractions. The operations of these local tourist attractions rely primarily on state or local government financial support (Zoucheng government, 2008). The entrance fees provide only about 20% of the required budget to maintain and repair the cultural heritage assets in Zoucheng (World Bank, 2010). Lack of required financial resources might result in failure to manage and protect local cultural heritage assets and reduce the satisfaction of tourists in Zoucheng (World Bank, 2010). Furthermore, local mining activity generates pollution issues, which may impact on the quality of the local environment and consequently reduce tourist arrivals. On the other hand, mining contributes greatly to the local economy. Restricting mining activities may have an impact on financial assistance at county level, which in turn would affect financial investment in the operation of local tourist attractions. In other words, local mining activities can indirectly support the operation of local tourist

attractions. Tourism development relies on mining income, which is not necessarily self-sustaining. Thus, the development of local tourism must not be conditional upon the willful neglect of mining activities.

Given the substantial involvement of government, understanding what type of role the government plays in tourism development is very important. Zhang, Chong, and Ap (1999) stated that "without identifying the nature of the government's role, neither past tourism development in China can be systematically analyzed, nor can future trends be forecasted." (p. 472). They also summarized six roles that the Chinese government should play in the development of tourism:

- Operator: concerning relevant ownership in tourism resources, relevant tourism business activities and providing infrastructure for tourism development;
- Coordinator: Coordinating relevant activities of different government branches to develop tourism;
- Promoter: promotion and marketing activities for tourism;
- Regulator: making, regulating, formulating and implementing relevant policies to manage tourism activities;
- Investment stimulator: attracting more tourism investment or public investment programmes for tourism development through the provision of financial incentives;
- Educator: stimulating tourism development by establishing tourism education institutions and training programmes.

In the Zoucheng area, the local government is expected to play these roles to stimulate tourism and economy development. For instance, local government might invest in public infrastructure improvements, transport planning and road building between tourist attractions and rural households. Furthermore, local government can coordinate, organize, and train farmers to help them pursue an alternative livelihood, including rural-tourism business operation based on families or villages, and the design and operation of broad activities and interests so as to attract more tourists. Local government can also carry out market promotion for tourism such as the design and distribution of posters, the placing of newspaper advertisements, maintenance of web site content, development of smart phone apps, and the posting of billboards.

b) Lack of destination identity

According to tourism studies in Zoucheng (Zoucheng government, 2008), more than 70% of total tourist arrivals selected the "Three Mengs" and Yi Mountain as their main travel destinations in Zoucheng. About 38.5% of visitors were day-trippers and most of the tourists stayed at relatives' or friends' homes rather than hotels. In Zoucheng, tourists' average stay was only 0.3 days (World Bank, 2010). The factors most in need of improvement for local tourism purposes were found to be traffic conditions and entertainment facilities (Zoucheng government, 2008). Furthermore, a lack of available information, incentive or opportunity also prevents visitors from spending more time and money in Zoucheng (World Bank, 2010). Therefore, despite the large numbers of tourists (see Figure 2.8) in Zoucheng, residents derive limited benefits (e.g. improved local standards of living) from tourism (World Bank, 2010). A large number of tourists with short stay times and low consumption may be a serious issue for tourism development in the Zoucheng area (Guo & Liu, 2012).

In addition, Zoucheng's tourism resources have similar characteristics to those in other surrounding cities and the area lacks a distinctive destination identity. More unfavourably, local tourism resources are overshadowed in architectural scale, area, and history by other cities' resources. For instance, the architecture of the Mencius temple and mansion are very similar to those of Confucius, so most tourists do not extend their visit to Zoucheng (World Bank, 2010).

Table 2.3 selects four main tourist attractions (the Mencius Temple, Mencius Family Mansion, Mencius Forest, and Yi Mountain) to compare with similar resources in other surrounding cities (i.e., Qufu and Taian). The main tourist attractions in Qufu city comprise the Confucian Temple, Confucian Family Mansion, and Confucian Forest, each of which has a longer history than the Three Mengs. The Confucian Temple was established in 478 BC, while by contrast, the Mencius Temple was established about 1,400 years later (i.e., 1037 A.D.).

A further potential problem is that Zoucheng's tourist attractions are smaller in terms of size and reach. For instance, the Mencius Family Mansion is about 21,000 square metres, which is approximately one quarter the size of the Confucian Family Mansion, at about 75,000 square metres.

In quality ratings, most of the Zoucheng tourist attractions are national cultural relics. However, local tourism development is limited by its small regional or county-level environment, even though some tourism resources are evaluated as state-level.

Of course, area, history, and the quality ratings of tourism sites are not enough to measure the competitiveness of local tourism resources. However, lack of distinctive features could reduce the city's ability to cope with regional competition and risks. Geographic closeness and very similar characteristics enhance the potential to develop regional competitiveness for tourism development in Zoucheng. For instance, the farthest tourist attraction is Tai Mountain, which is less than 100 kilometres from Zoucheng. Outside visitors might prefer to travel to Tai Mountain instead of Yi Mountain because of the history and reputation. Thus, tourism in Zoucheng needs to develop a different emphasis (e.g. rural tourism) in order to be more distinctive, more competitive and attract visitors. The emphasis in further developing the local tourism market should be on providing a more diverse range of goods and services to satisfy the needs of a broader range of visitors (World Bank, 2010). With a more diverse range of goods and services, local tourism can present its own destination identity, which encourages visitors to venture across the boundaries of local cultural heritage assets. Furthermore, local residents may gain more work opportunities related to the tourism industry and become engaged in the care and maintenance of cultural heritage assets as well.

Table 2.3: *Comparison between Zoucheng tourism resources and tourism resources in nearby cities*

	History	Tourism Area or Distance	Renown and honours	Distance from Zoucheng
Confucian Temple	478 BC	96,000 square meters	World cultural heritage & State cultural relics protection unit	23 km
Mencius Temple	1037 A.D.	23,250 square meters	State cultural relics protection unit	urban city centre
Confucian Family Mansion	1038 A.D.	75,000 square meters	World cultural heritage & State cultural relics protection unit	23 km
Mencius Family Mansion	Song Dynasty; about 800 years	20,812.5 square meters	State cultural relics protection unit	urban city centre
Confucian Forest	about 2,400 years	2 km^2	World cultural heritage & State cultural relics protection unit	23 km
Mencius Forest	1037 A.D.	0.61km^2	State cultural relics & protection unit	urban city centre
Tai Mountain		426 km^2	World natural & cultural heritage	Less than 100 km
Yi Mountain		8,000 meters	Provincial-level scenic spot	Southeast of urban city

Source: Author's compilation from Zoucheng government, March 2008

2.2.3 Agriculture

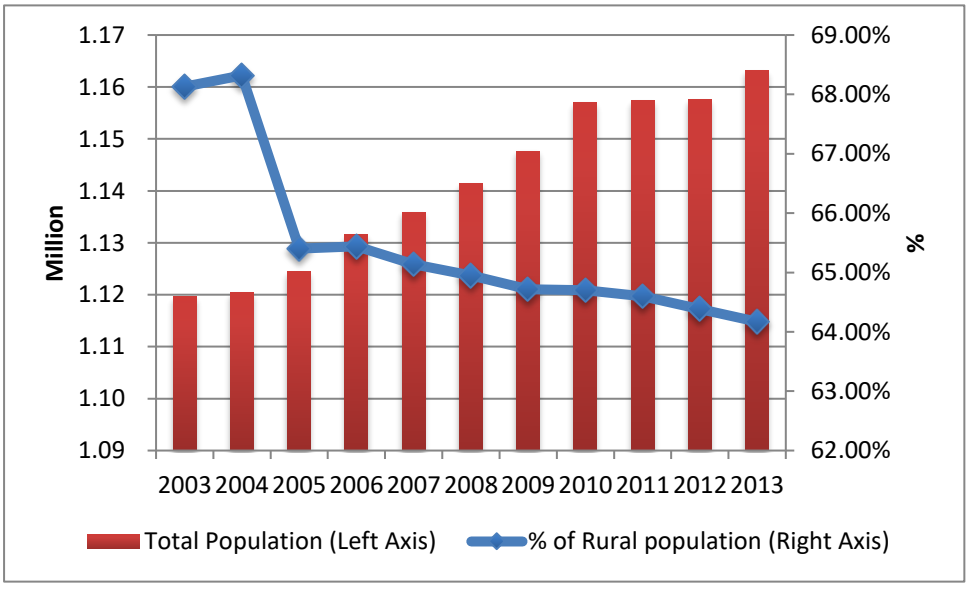
a) Rural population & labourers' demand for work

Traditionally, China was and still is the biggest agrarian country in the world. Even with the past several decades of reform, the rural population still accounts for a considerable proportion of the total population. In Zoucheng city, rural residents account for nearly 65 percent of the total population. Figure 2.10 shows the proportion of the Zoucheng population classified as rural from 2003-2013.

It is clear that in recent years, the rural population has declined, but it still accounts for a majority of the population. Due to administrative redesign, some rural areas were re-designated as urban in 2002. About 75% of the population was classified as rural prior to the administrative re-design in 2000-2002. Thus, Figure 2.10 only involves the period from 2003-2013. As shown in Figure 2.10, the rural population fluctuated slightly and then fell to about 64% of the total in 2013. The biggest decline was in 2005, possibly because of reforms of the household registration system by the Chinese government in 2005. By following new policies, some of the rural migrant workers who met certain eligibility requirements became urban residents.

It is worth noting that the rural population stabilized at around 64% of the total population after 2007 in Zoucheng. Surplus labourers may exist in the local rural area, which is a general scenario in the Chinese labour market (Fan et al., 2003; Wang & Cheng, 2001). Fan, et al., (2003) and Wang & Cheng (2001) suggested that the marginal labour productivity in the agricultural sector remained at a very low level in China. The main reason is the continuing large surplus of rural labourers. In other words, the issues of rural development need more attention as Zoucheng undergoes the process of urbanization and industrialization.

Figure 2.10: *Rural population percentage in Zoucheng city, 2003-2013.*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2003-2013

Mining cannot satisfy the demand for employment from the rural labour market. According to local Yearbooks (2003-2013), each village town (17 village towns in total) on average has about 14,287 labourers in agriculture. The annual net income per capita for rural dwellers increased from 1999 to 2013. For instance, the net income per capita was less than 3,000 yuan in 1999, and increased to around 12,500 yuan in 2013 (Zoucheng Statistical Yearbook, 1999 & 2013). Although the net income per capita in rural areas increased more than fourfold from 1999 to 2013, the growth rate and income are still low compared to other industries. For instance, the monthly wages for miners increased from 1,213 yuan in 2000 to nearly 3,593 yuan in 2013 (Zoucheng Statistical Yearbooks, 2000; YanZhou Mining Group 2014). Although net income per capita and monthly income are two different standards, the income gap is still obvious. Thus, rural labourers may prefer working in local mining to get higher levels of pay. However, mining and relevant industries have stably provided about 100,000 jobs in the local labour market in recent years, including rural and urban labourers (Zoucheng Statistical Yearbook, 2000-2013). Local mining cannot satisfy the job demands of the total number of rural labourers (14,287×17 = 242,879). Rural households need alternative livelihood choices such as rural tourism.

b) Owning & using farmland

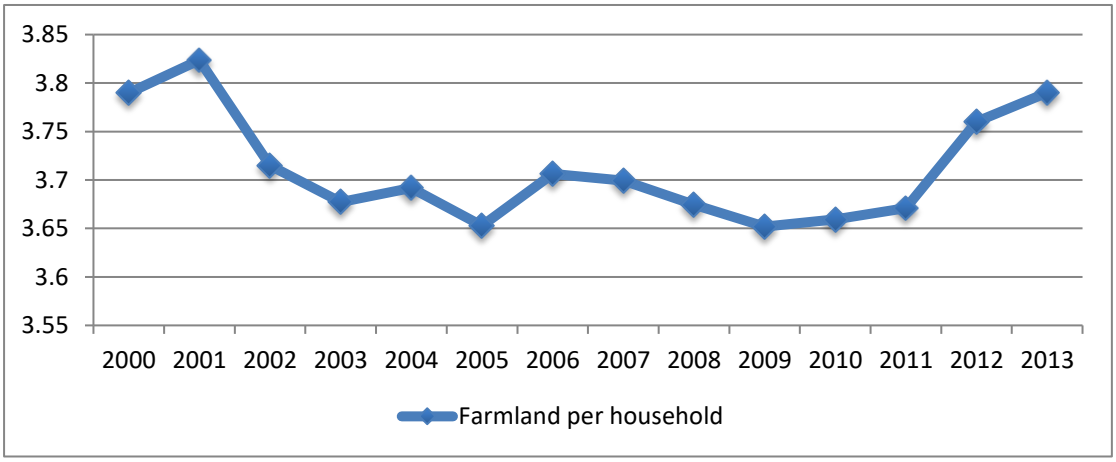
Rural households have difficulty transferring farmland to provide financial capital and engage in any alternative livelihoods in China. The ownership of farmland is one of the remarkable differences between rural and urban households, which could allow residents to gain financial capital by selling or transferring farmland in the business market. However, farmland property and living places are difficult to convert to financial capital in rural China. According to The Law of Land Management of the People's Republic of China, "the land of the countryside and suburb of towns, except those legally stated as the property of the country, belongs to the collective" (as cited in Luo & Fu, p 445-p446, 2009). However, the Village Committee normally fulfills the legal position of farmland owner. Peasants' private land property rights are weakened

through the use of policies to constrain peasants' ability to dispose of land, such as prohibiting leases, loans involving land mortgages, or transfer, sale, or lease for non-agricultural construction purposes (Cai, 2003; Luo & Fu, 2009). Due to the difficulties of land transfer, making good use of farmland and increasing the value of farm products would be a key link in alternative livelihood development for rural households.

Even for rural households with distributed farmlands, the profit motive or opportunity cost might change rural labourers' incentives to cultivate farmland. For instance, rural labourers might choose mining or other well-paid jobs instead of farming as their main activities. Each rural household might have a similar or limited farmland area, but they might have a different arable land size each year. Different rural households with different alternative livelihood choices might change their intentions to cultivate their land. In other words, rural households cannot fully take advantage of the natural capital (i.e., farmland) in their hands. Some alternative livelihood choices in rural areas might be necessary to make full use of available farmland resources. Figure 2.11 illustrates the arable land per household in Zoucheng city from 2000 to 2013. From 2000 to 2009, while the average arable land size per household increased slightly in 2001, 2004, and 2006, in general the arable land per household decreased gradually from about 3.8 mu[9] per household in 2000 to about 3.65 mu/household in 2009. After 2009, the arable land size per household gradually increased again to about 3.79 mu per household in 2013. Coincidentally, many local government policies to regulate agricultural structure, develop agricultural industrial production, ameliorate resource distribution, develop agriculture and boost market competence so as to increase rural households incomes, were begun around 2010 (e.g. Zhang, 2010; Ma & Duan, 2010; Du, 2010; Sun et al., 2010; Zoucheng government, 2012). Therefore, carrying out relevant land operation policies may be a useful way to raise enthusiasm for farming and allow households to develop more livelihood choices for themselves.

[9] A traditional unit of measurement for arable land in China. 1 Ha=15 Mu and 1 Mu ≈666.7 square meters

Figure 2.11 *Arable land per household in Zoucheng city 2000-2013 (mu/household)*



Notes: 1. Mining area: at least one mine in a village town 2. Mu: A traditional unit of measurement for arable land in China. 1 Ha=15 Mu and 1 Mu ≈666.7 square meters.
Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

c) Market demand

In Zoucheng city, farmers have two harvest seasons (summer and autumn). According to Zoucheng Statistical Yearbooks (2000-2013), the main crops that local farmers grow are corn and wheat and typical livestock includes pigs, goats, and cows. Furthermore, local farmers also plant some cash crops such as grapes, apples, kiwifruit, and cotton. This represents a potential way to enable diversification of local agricultural products to satisfy different demands in the market. However, farm products have lacked sales, because they rely on local government to find a market.

In the early 1980s, the socialist reformation of agriculture (Household Responsibility System) was implemented in China and Chinese rural households were free to choose the crops they grew. However, farmers' planting choices in terms of diversification may still depend on local villages' strategies (Demurger, Fournier, and Yang, 2010). Local farmers will increase agricultural outputs and higher-value farm products when they find a lucrative market.

In Zoucheng village towns, the government encourages outside investors and corporates, along with local peasant associations, to plan, manage, and readjust the

types of food crops grown or livestock raised, even finding relevant outlets for local farmers' products. For instance, Taiping village town, together with the Langu Gardening Company, established in total a 3,000 mu area of pear plantings distributed among about 1,000 local farmers, using contracted management of rural land in Zoucheng (Sun & Shao, 2010). The government in Zhongxin village town in Zoucheng developed 5,000 mu for cherry production and 1,500 mu for peach cultivation, which benefited about 3,800 rural households (Wang & Tang, 2013). Both of these village towns implemented relevant policies about cash subsidies, longer land-use rights, favourable terms, and training to encourage rural activity restructuring. The Zoucheng government also helps local farmers to find marketing channels for farm products. For instance, the government in Kanzhuang village town helped rural households to sell potatoes by contacting potential customers, promoting crops on the internet, and signing sales contracts (Wang, 2013). The government in Kanzhuan village town established specialist cherry farming cooperatives to attract wholesalers to purchase about 20,000 kg of cherries (Sun, 2014).

Activity diversification depends heavily on policies implemented at local level to promote economic restructuring and ignores disparities at the "individual level" (households). For instance, disparities in livelihood capitals might affect rural households' ability to create income opportunities out of traditional cropping. Local rural households may need an alternative livelihood with scope for initiative rather than being passive order takers.

d) Eating habits

Because of Zoucheng's location in North China, the average local family uses little rice; the staples are primarily wheat or corn. Local farmers also prefer to use corn to feed animals. These two uses are the primary reason for planting wheat and corn in Zoucheng. Wheat and corn provide the main raw materials for food, which affects the characteristics of local food. A characteristic food in Zoucheng is "Sichuan Noodles", which are made from flour and have a spicy, hot flavour. More than 30 years ago,

migrant workers in local mining companies used local food materials together with the characteristics of "Sichuan cuisine[10]" to invent "Sichuan Noodles". "Sichuan Noodles" are viewed as a major component of the cultural mix in Zoucheng, and could become one of the characteristics for local tourism development.

2.2.4 Comparing livelihood alternatives

For the two important resources (mining and tourism) in Zoucheng city, the number of jobs created and the monthly wages from these two industries are used as the basis for comparison.

In 2010, the monthly per capita average income in mining was about 3,100 yuan, compared to around 1,070 yuan in tourism. In 2013, the monthly per capita average income in mining had increased to about 3,600, while the tourism monthly income had increased to about 1,350 yuan (Zoucheng Yearbooks 2010-2013， Yanzhou Ming Group 2014 & Fang, et al., 2012). Mining has shown its advantages in local employment recruitment.

On average, the number of local labourers working in mining reliably fluctuated between 90,000 and 100,000 between 2010 and 2013, while formal tourism jobs were between 29,000 and 34,000 (Author's compilation from Zoucheng Yearbooks 2010-2013， Yanzhou Ming Group 2014 & Fang, et al., 2012).

In the local labour market, mining industries recruit their employees with the attraction of high pay, while many tourism jobs (e.g. restaurants) cannot hire workers (see Figure 2.12). Therefore, mining plays a dominant role in the local labour market due to its high rates of pay.

[10] China's four major styles of cooking are: Sichuan, Guangdong, Shandong, and Huaiyang.

Figure 2.12: *Recruitment advertisements in a local restaurant*

The recruitment advertisement says: (1) five administrative office receptionists wanted; negotiable salary (2) ten waitresses wanted; 1,000-1,500 yuan/month (3) ten kitchen stewards wanted; 800 yuan/month (3) two cleaners wanted; 600 yuan/month. Food provided. Tele: 5*57716.
Photograph taken by author in July 2010

a) Opportunities for rural tourism in Zoucheng city

In the last 20 years, the Chinese government has adopted tourism as one of the most important rural development strategies (Hu, 2008; Zheng&Zhong, 2004) and has given great support to the 'Speed up the Development of Tourism Industry' programme (Xu et al, 2009). Furthermore, tourism-based farm diversification and relevant rural tourism development have increasingly been considered a significant driving force for rural development, poverty elimination, sustainable development, and environmental protection (Sharpley & Vass, 2006; Ryan, Gu, & Zhang, 2009a & 2009b). Section 2.2.3 discussed rural population size, local farm products and relevant lifestyle (i.e., food), and some barriers to local agricultural development in Zoucheng, which may be important background information to provide a development basis for rural tourism.

b) Rural tourism operators

In local agriculture, the surplus rural labour force, the difficulty of transferring farmland to financial capital, and the influence of local government strategies on growing food crops or raising livestock can impact on farmers' livelihood choices. In tourism, financial dependence and lack of tourism products can limit local tourism development. In other words, local agricultural products need a market and tourism needs product diversification. Therefore, there is a possibility for cooperation between agriculture and tourism. Agriculture provides a premise for developing rural tourism, which may encompass diverse products such as "green" food and rural entertainment areas. Rural traditional customs, settlement culture, folk customs, and characteristic buildings provide rural tourism products of cultural value and can improve the tourist experience (He & Qi, 2012). These various rural assets could be "packaged" to encourage outside visitors and create tourism business opportunities (Yang, Cai, & Sliuzas, 2010). With respect to the tourist market, increasing numbers of tourists may consume the local cuisine, experiencing meals with different local flavors and local traditional customs, which creates more employment opportunities for rural tourism operators. In addition, tourists may prefer local and natural "green food", which will affect the prices and outputs of agricultural products in the whole supply chain and consequently improve farmers' incomes.

In Zoucheng, the government began to stress rural tourism development several years ago. At present, local rural tourism development is in its infancy and has not yet occurred on a large scale. However, it may give local farmers more livelihood choices and a chance for a better life.

Zhongxin is located in a coal mining area, and is also one of the local village towns that has promoted rural tourism development. Although mining still has a clear advantage in the local job market, local authorities are in support of the development of rural tourism products to diversify livelihood choices for residents. For instance, there are more than 2,000 greenhouses growing vegetables and fruits, which are used for tourism

(including “pick your own” experiences) and ecological tourism (Pan, 2014). The local government has also set up special funds to strengthen support for characteristic plantings (e.g. strawberries), processing and eco-tourism. In Longshan village in Zhongxin, eight rural households have built greenhouses employing a total of 300 people. Each greenhouse received 5,000 yuan in funds (Zhang, 2013). In addition, they can hire more than ten temporary workers during the busiest seasons. The maximum visitors to Zhongxin are 3,000 daily (Zhang, 2013). Tianhuang village town is another case of developing local rural tourism. In the 2015 Spring Festival, Tianhuang promoted its “Happy farmer in Spring Festival” to provide local rural cultural experiences (e.g. experiencing the local life style), catering and accommodation for urban tourists (2015, STAI). With a contract operating system for rural tourism and relevant planting industries (e.g. fruit, vegetables and sweet corn), the monthly net profit is about 1,080 yuan on average (Sun, 2013; Pan, 2014;). This monthly income from rural tourism is very close to the formal tourism wage in the local city.

Figure 2.13 below illustrates most of the rural tourism activities run by self-employed tourism operators in Zoucheng.

Figure 2.13: *Rural tourism activities in Zoucheng*

(1). Nong Jia Le -"enjoying farm home stay"

(2). Picking fruits and vegetables

(3). Picnic

(4). Rural cultural entertainment

(5). Rural natural environment entertainment

(6). Experiencing rural lifestyles

All photos were taken by Zoucheng Government Propaganda and Zoucheng Tourism Administration and permission was given for their use in this thesis.

2.2.5 Concluding summary

Chapter Two provided the background information for this research. In Zoucheng, farmland, mineral and tourist resources support three industries (agriculture, mining,

and tourism) and constitute the main “engine” of the region’s economic development. However, based on vast mineral resources and profitability, the mining industry has been the backbone of local economic development. The local mining industry provides higher pay, more job opportunities, and makes a higher contribution to local industrial outputs, which consequently influences the characteristics of local economic growth such as industry structure and the development of a mineral resource-dependent economy.

Because of the significant benefits for the local community, the idea arose that local economic development’s first consideration should be mining, which disregards the long-term sustainability of local economic and livelihood development. Under the constraint conditions of limited and non-renewable mineral resources such as limited length of service remaining for local coal mines, resource depletion and industrial decline after large-scale exploitation, there will be problems facing local economies and livelihood development. Therefore, industrial transformation should be studied in advance, particularly focusing on diversity and sustainability. The industry structure must be adjusted; the key is to build potential alternative industries such as rural tourism to replace the mineral resources industry before the resources become exhausted. Zoucheng has rich tourism resources (e.g. tourist attractions) and agricultural resources (e.g. rural labourers and diverse agricultural products). Therefore, the obvious choice is to use these two resources (tourism and agricultural resources) to develop the local economy and seek new economic growth before mineral resource depletion becomes severe. Examining these three resources (agricultural, tourist and mining resources) and related industries, the following chapters will focus on shifting the local economy and livelihoods towards sustainability.

CHAPTER THREE: CONCEPTUAL AND THEORETICAL FRAMEWORK

This chapter reviews the literature on sustainable livelihood and social capital. Sustainable livelihoods development is the basis of the conceptual framework to establish the simulation model in this thesis. By following the sustainable livelihoods framework, some issues related to natural resource dependency (vulnerability context), social capital (household livelihood assets), government policies on developing alternative livelihoods (policies, institutions & process), livelihood strategies and livelihood outcomes can be integrated in a model. It is important in answering the second research question in Chapter One (i.e., Does the strength of social capital alter local livelihood patterns by diversifying household livelihoods and providing new livelihoods in industries with potential for development?). In addition, the discussion focuses on social capital concepts, because both research questions in Chapter One are related to social capital. In theoretical discussions of social capital, the reasons of using possessed social capital, the definitions, strength of social ties, economics of social capital, and the role of social capital in livleihoods are proposed as important research components in this study. All of these provide the practical guidelines for analyzing social capital status and the development of the simulation model. In the following chapters, the risks of natural resource dependency, social capital measures, and establishing and analyzing the simulation model are the concrete implementations of the research.

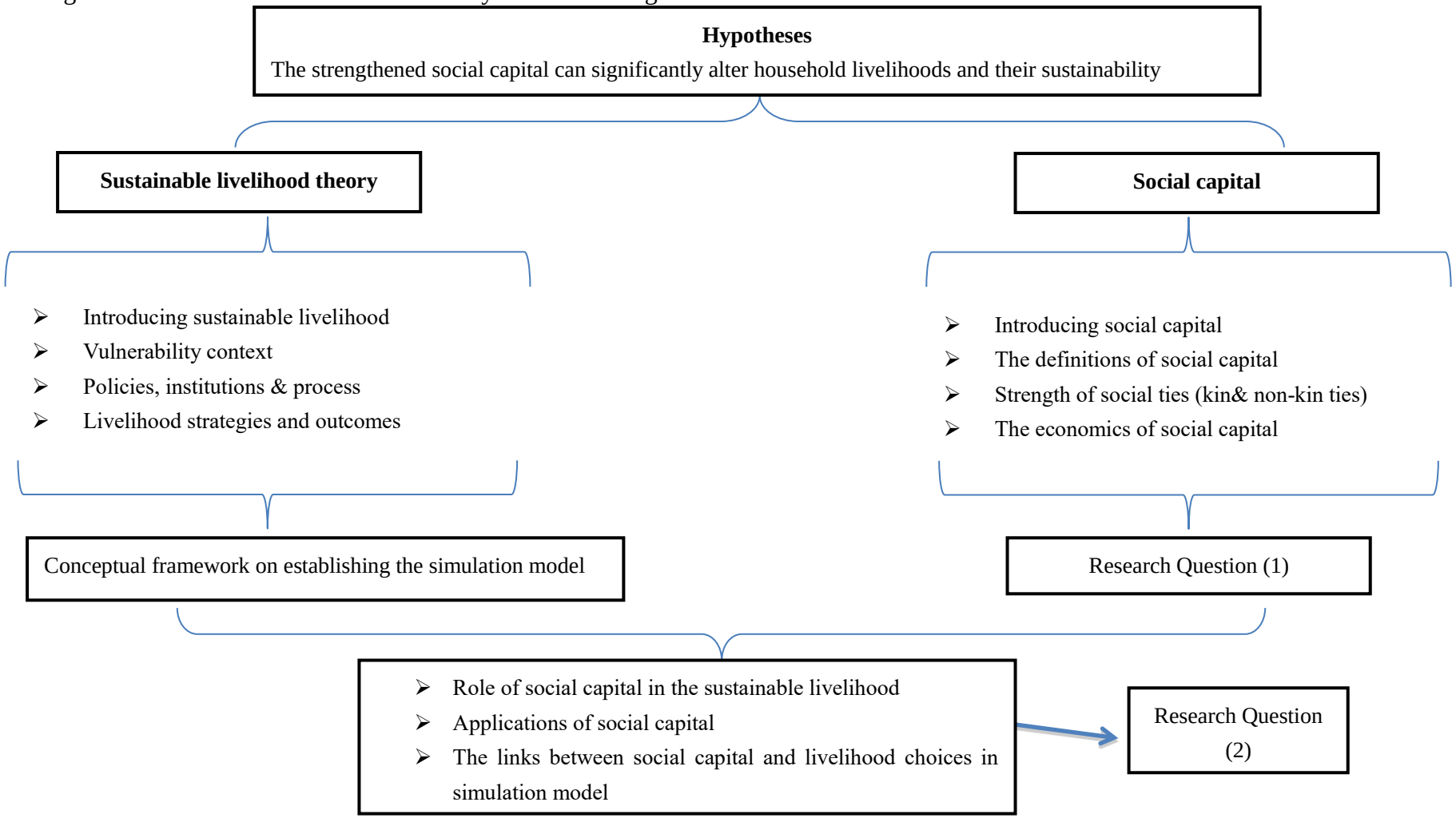
3.1 Introduction

As discussed in Chapter Two, the base of problem in Zoucheng is government overemphasis on mining to achieve economic growth targets and less emphasis on helping people to realise alternative livelihoods. So, this thesis focuses on social capital as way to open doors to new livelihoods. By following the main objective of this study (i.e., to investigate the role of social capital during the transition to alternative

livelihoods, also see Chapter One), a hypothesis is that strengthed social capital can significantly alter household livelihoods and their sustainability. Thus, livelihood theory and social capital are two important compnnents to guide the studies on social capital and livelihood development in this thesis.

By following hypotheses, the essential components of the conceptual framework for this thesis include two important theories: sustainable livelihood and social capital (see Figure 3.1). Sustainable livelihoods provide a practical and operational framework to establish the simulation model for this study (see Chapter Seven). This chapter will particularly discuss the framework of sustainable livleihoods, its main compnents (e.g., vulnerability context, policies, institutions & process, livelihood strategies and outcomes, etc.) integrating with local features (e.g., the issues of natural resource dependency, alternative livelihood strategies for local households) in Zoucheng city. This chapter then moves to social capital, including background information on social capital, definitions, the strength of social capital (kin & non-kin ties), and the economics of social capital. This section provides the practical guidelines for measuring and analyzing the social capital so as to answer the first research question (i.e., Do different types of social ties lead to differential access to social capital in a small community in China?) in this study. Finally, this chapter will review the literature on the role of social capital in the sustainable livleihood and its applications, which may provide some logical and theoretical supports to establish the causal relationship between social capital and livelihood choices in simulation model. This part also provides some basic theries to answer the second research question.

Figure 3.1: Theoretical framework for analysis of Zoucheng household livelihoods



3.2 Sustainable development theory as related to livelihood

A sustainable livelihood theory can recognize shocks (e.g. mining pollution) and offer a way to investigate transformations of people's livelihoods. More importantly, this approach can investigate livelihood activity choices and the factors determining these choices (Lambini & Nguyen, 2014; Nguyen et al., 2010; Wunder et al., 2014). Many previous studies (Allison & Ellis, 2001; Bebbington, 1999; Rakodi, 1999; Ellis, 2003; Barrett, et al., 2001) employed a sustainable livelihood approach to evaluate household livelihoods. With respect to the issues of natural resource dependence (shocks), current livelihoods (mining) and alternative livelihoods (rural-tourism) in Zoucheng, the sustainable development approach is an appropriate one with which capture the complexity of the situation in Zoucheng and to establish the simulation model.

The livelihood framework presents the main factors that can impact on people's livelihoods and the relationships between these components. It attempts to explain and assess important outcomes of the project in terms of impacts on stakeholders. It can be used in reducing poverty, improving the quality of life and strengthening the sustainability of poor people's livelihoods. The IDS (Institute of Development Study) defines sustainable livelihoods as follows:

> A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets, while not undermining the natural resource base (Scoones, 1998, p.5).

As people's livelihoods are highly dynamic, the livelihoods approach is a way to monitor and capture these changes and increase the scope of livelihood analysis (DFID, 1999). It also attempts to involve the relationship between micro- and macro-level contexts in the process of households seeking their livelihoods (Stokes, 2002).

The most prominent framework of sustainable livelihoods as developed by the UK Department for International Development (DFID). The essential components of the

framework include: five sets of livelihood assets upon which individuals draw to build their livelihoods – financial capital (savings, credit), natural capital (mineral resources, farmland owned, crops cultivated), human capital (people's 'capabilities' in terms of their education, health, labour), physical capital (agricultural machinery, bicycle, other vehicles.) and social capital[11] (social networks, social resourcese); vulnerability context - the shocks, trends or other influences which affect livelihoods; policies, institutions, and processes - organizations, in both private and government sectors; processes (laws, rules, policies, incentives), which define people's livelihood strategies; and livelihood outcomes that indicate the outputs of the livelihood strategies.

A livelihood asset portfolio consists of natural, financial, human, physical, and social assets, which can complement and substitute for each other (Scoones, 1998). These assets impact policy implementations, access to organisations and regimes and how these organisations and regimes work (Allison & Horemans, 2006). On the other hand, policies, institutions and processes can either enable or hinder people's access to assets and activities. Access to livelihood assets can also be affected by some factors, referred to as the vulnerability context. In Zoucheng, these trends or shocks in vulnerability context may include issues of natural resource dependency, (air pollution, subsidence area of farmland), and reduced livelihood choices. At a household level, these factors could be shocks that impact well-being in terms of sustainable development. Understanding the "vulnerability context" is also important in the design of policies and interventions to help people's existing coping and adaptive strategies. For instance, they may include developing and supporting rural tourism activities to reduce the issues of over-reliance on mining activity. The government might implement relevant policies on cash subsidies and other favourable terms to encourage rural activity restructuring, which might further benefit the development of sustainable livelihoods. A household's livelihood choice to pursue alternative activities (e.g. tourism) is influenced by its

[11] By following a sustainable livelihood framework (DFID, 1999), social capital is seen as the social resources that people draw on in pursuit of their livelihood objectives. In my thesis, the definition of social capital will be broader than DFID's definition and will be discussed in social capital sections.

livelihood assets access, difficulties with specific livelihoods and relevant policies. Finally, the livelihood framework points to livelihood outcomes. As Allison & Horemans (2006) pointed out people's ability to maintain or improve their standard of living related to income and well-being and reduce their vulnerability to shocks and issues could be the result of sustainable livelihoods. Many studies (e.g. Coomer et al., 2004; Jansen et al., 2006; Ellis & Freeman, 2004; Babulo et al., 2008) have pursued similar causality paths in both empirical and conceptual studies on income diversification and livelihood choices.

3.2.1 Vulnerability context

Trends, shocks and seasonality may directly impact upon people's livelihoods and their asset status. Trends are classified under the headings of population (e.g. population density, migration), resource (e.g. loss of resources, resource stocks), economic (e.g. price trends of produced goods), technological (e.g. technologies in use in the local area), and governance (e.g. politics, voting figures) (DFID, 1999; Carney, 1998). Shocks include human health shocks, natural shocks, economic shocks, and crop/livestock health shocks (DFID, 1999). In addition, Carney (1998) includes climate (e.g. annual rainfall, climatic disasters) and conflict (e.g. legal cases pending, accounts of conflict) as shocks. Seasonality, prices, production, health, and employment opportunities are all potential influences (DFID, 1999). Carney (1998) stressed the importance of culture (e.g. unexplained differences between two areas) instead of seasonality. All of these factors contribute to the Vulnerability Context. Furthermore, Scoones (1998) arranged these components into groups (e.g. history, terms of trade, social differentiation), which applied a different viewpoint to the Vulnerability Context.

3.2.1.1 Natural resource dependency-issues for mining activities

Regarding the sustainable livelihoods approach as the conceptual framework for the thesis, thinking through issues related to activities or industries (e.g. mining) is the first step in applying a 'livelihoods approach' (Allison & Horemans, 2006). All of these

issues are related to the current situation of the natural resource-dependent economy (i.e., mining activity) in Zoucheng.

Although mining can bring many rewards for mining communities, such as industrial profits and individual income, intensive mining activity can cause environmental problems and render land unsuitable for other industrial applications such as farming and forestry. First, coal mining inevitably causes negative environmental effects. Coal is a dirty energy source because of the air pollution that occurs during mining (e.g. drilling, blasting, transportation). Many serious environmental problems such as air pollution, noise pollution, ground fissure, and water pollution arise in the coal mining areas (Shi & He, 2012).

Air pollution and land subsidence are two major environmental challenges from coal mining (Bial, et al., 2010). Mining operations include surface mining operations (drilling, blasting, movement of heavy earth-moving machinery on haul roads, transportation, collection and handling of coal and the operation of screening, sizing and segregation units) and underground mining (uncovered waste dumps and coal piles). Both of these operations can emit dust (Ghose & Majee, 2000; Bian, et al., 2010). For instance, there is normally 4-6 inches or more accumulated dust on the surface of haul roads (Ghose & Majee, 2000; Nair & Singh, 1990), which can easily become airborne during adverse conditions. In agricultural areas, the excess dust on crops may affect respiration, photosynthesis, transpiration, and allow the penetration of phytotoxic gaseous pollutants. As a result, there is decreased productivity (Farmer, 1993).

Land subsidence is another important adverse impact of mining on the environment. As Li et al., (2009) pointed out coal exploitation causes an increase in direct surface subsidence and a decline in arable land in mining areas. The issue of land subsidence can also cause environmental problems, such as plant death, surface fractures and soil loss, utility failures, damage to buildings, and drainage system failures (Bian et al., 2010). For instance, mine subsidence can directly impact on the water environment due to the connection of underground water bodies to the mined space through fractured

overburden (Bian et al., 2010). Mine drainage and the disposal of mining wastes can affect water quality, including the surrounding surface or ground water, which further impact on aquatic habitats and the growth of agricultural products (Bian et al., 2010).

In recent years, enjoying a higher standard of living and requiring a good environment must be taken into account when studying tourists' behaviour (Vargas, et.al 2009). Huang, Zhou and Ali (2011) used correlation analyses to measure the relationship between tourism visits and mining activities. They found that tourism income is negatively affected by mining when they exist in the same area. In Zoucheng city, mining activity has negatively affected on the local environment (discussed in section one of Chapter Five), which demonstrates another conflict between tourism development and mining activity.

3.2.2 Institutional influences, transforming structures and processes

The analysis of institutional and organizational influences on livelihood resources and strategies is also important. Kong (2007) pointed out that government failure often leads to economic backwardness. Scoones (1998) gave three reasons to explain the importance of institutions in the policy and practice of development of sustainable livelihoods:

1. Understanding institutional processes can facilitate the design of interventions to improve livelihoods outcomes.

2. For social processes, an institutional approach can support sustainable livelihoods.

3. With regard to the combination of different livelihood strategies resulting in sustainable livelihood outcomes, both formal and informal institutions and underlying rules and norms can operate at different levels (e.g. household or national level) to mediate the processes of livelihood change.

Within the livelihoods framework, the transformation of structures and processes shape people's livelihood options. In the framework, structures can be thought of as hardware,

and processes can be thought of as software. Structures include the organizations (private and public) that set and implement policy, legislation, and deliver other services linked to livelihoods in the framework. Processes such as policies, laws, and 'rules of the game' determine operations and interactions among structures and individuals (DFID, 1999).

These structures and processes affect livelihoods in two major ways. First, they play a critical role in determining who can gain access to which types of capital and the effective value of that capital. Second, they help define the livelihood strategies, the decision-making bodies and the terms of exchange between different types of assets with regard to people's asset status (Carney, 1998). So, policies, institutions and processes might affect the options available to people. With these options, people can resist shocks and improve their livelihoods. Thus policy and institutional analysis have an important place in the livelihoods framework.

3.2.3 Livelihood strategies and outcomes

Livelihood strategies are the range and combination of activities and choices that people pursue in order to achieve their livelihood objectives (DFID, 1999). Livelihood strategies show enormous diversity at every level (e.g. within households and over time), across sectors and within geographic areas. The links between urban and rural centres possibly impact on people's decision-making and asset usage as well. Thus, there is a dynamic process in which people undertake a combination of activities to meet their goals at different times. A common example is migration (e.g. seasonal migration).

There are many ways to categorise livelihoods. For instance, livelihood strategies can be divided into three clusters in the sustainable livelihoods framework: agricultural intensification (productivity is increased by capital investment or labour inputs)/extensification (more land fit to be cultivated); livelihood diversification such as developing a wide income-earning portfolio; and migration (Scoones, 1998).

In many areas in developing countries, rural households normally choose nonfarm activities to diversify their livelihoods and income-earning portfolio. In developing countries, nonfarm activities make up about 35-50% of rural residents' total income (Haggblade, Hazell, & Reardon, Feb 2009; Knight & Song, 2003). For instance, total nonfarm earnings accounted for 51% of rural income in Asia (Haggblade, et al., Feb, 2009). In China, non-agricultural income also plays an important role for rural households. According to Zhao and Barry's rural household survey in China, about two-thirds of farm households obtained their income from at least two sources such as agricultural crops and nonagricultural activities (Zhao and Barry, 2014). On average, nonfarm income has comprised more than 50% of rural incomes in rural households (Zhao and Barry, 2014). Davis et al. (2007) analyzed rural income-generating activities by using a constructed cross-country database. They selected the rural samples and analyzed the income-generating activities of rural households. In all of the selected countries, the ranges of non-agricultural income were from 20 to 75% of total rural income, and 47% on average. Yang (2009) showed that the labour shift from cropping to non-agricultural activities has significantly contributed to income increase and income stability in rural China. Off-farm income is by far the most remunerative for rural households, allowing them to increase both the level and the stability of household income (Demurger et al., 2010; Yang, 2009; Ellis, 2000; Hoogeveen, 2001). Thus, there is an increasing tendency for rural households to generate more livelihood choices (i.e., non-farm activities).

The combination of activities and strategies also depends on health conditions, changes in dependency ratios and other factors over different time-scales. The resource endowments available and the level of risk relating to alternative options may influence the degree of diversification. Therefore, in the process of livelihood strategy analysis, a key step is to identify what livelihood resources are required for different strategies. The different types of 'capital' such as basic materials and social assets can influence livelihood strategies.

Livelihood outcomes are required to be a component of the framework as they are considered to be the achievements or outputs of livelihood strategies (DFID, 1999). Considering the livelihoods and the sustainability dimensions, Scoones (1998) defines five key elements to assess sustainable livelihood outcomes:

1) Creation of working days – a particular combination of livelihood strategies and the proportion of the population available for gainful employment.

2) Poverty reduction – an absolute poverty line.

3) Capabilities and well-being - sustenance and intrinsic elements such as happiness, stress and security.

4) Vulnerability, livelihood adaptation and resilience – this plays a key role in the concept of sustainable livelihoods. The required analysis factor is the history of responses to different types of shock, such as tolerance or avoidance.

5) Natural resource base sustainability – the ability of the natural resource-based system to maintain productivity to yield benefits for livelihoods. However, it is very hard to measure the sustainability of natural resources.

When assessing sustainable livelihood outcomes, the critical issue is whether the livelihood portfolios (the combination of activities that are pursued) produce positive or negative effects on the range of sustainable livelihood outcome indicators. This study is especially interested in natural resource base sustainability (e.g. agricultural and tourism resources), vulnerability (e.g. over-reliance on non-renewable resources such as mineral resources), and creation of jobs (e.g. more employment opportunities by increasing the competitive advantage[12] of alternative livelihoods) to assess sustainable livelihood outcomes in Zoucheng.

[12] The term competitive advantage is the ability to gain resources and attributes or make intensive use of factors to perform at a superior level to others in the same industry, area, or market (Deardorff, 2004). In general, superiority in production resources and superior performance outcomes reflect competitive advantage (as cited in Lau 2002).

3.2.3.1 Over-reliance one particular economic activity versus diverse livelihood strategies

Over-reliance on mining revenue for household income may limit the development of other potential alternatives (such as tourism). The lack of diversity in livelihoods may increase households' vulnerability to shocks and risks (Soriano, 2007). For instance, most mine labourers are categorized as farmers in China. However, they work most of their time and derive most of their income from mining (Gunson & Jian, 2001). A problem is that when mining operations are shut down, these miners are seen as being able to 'just return to their farms' (Gunson & Jian, 2001).

Furthermore, there is an ongoing large surplus of labour in rural areas in China (Knight, et al., 2011; Golley & Meng, 2011). Some scholars (Kwan 2009; Guo 2007) have estimated the total amount of surplus labour at between 110 million and 180 million, equivalent to between one-third and two-thirds of the total rural labour force in 2000. It is a big challenge for the Chinese government to shift this labour pool to the nonagricultural sector or urban areas, particularly in view of the large number of unemployed workers already in urban areas (China Daily 2006; Yang & Wang, 2006). Surplus labour together with an unsustainable industry may potentially increase the vulnerability of rural household livelihoods in mining areas.

Some non-agricultural activities such as service sectors and manufacturing could absorb rural workers and reduce the rural labour surplus in China (Wang, et al., 2011; Mai & Peng, 2012), which might diversify livelihood choices for rural labourers, particularly with regard to the role of rural tourism in China. Rural tourism has the potential to alleviate poverty and facilitate employment in rural regions in China (Zou, et al., 2014). According to the Centre for Agriculture Research in the Ministry of Agriculture of China (as cited in Zou, et al., 2014 and He & Qi, 2012), each direct employment position in rural tourism could lead to five indirect job opportunities. Developing rural tourism will broaden rural industrial development and promote rural economic diversification such as extending tourism into traditional agriculture, the

restaurant industry, commerce, service industries, rural transportation and other relevant industries (He & Qi, 2012).

In many developing countries, some rural households diversify their livelihood strategies, while others pursue one or few activities. For rural livelihoods, the reduction of poverty hinges on the capability of the poor to diversify and combine different livelihood strategies and sources (Soriano, 2007). Rural households have incentives to find alternative income sources to secure their livelihoods (Demurger, et al., 2010). In addition, a household's reliance on a particular economic activity in general, and on the level of environmental resource use in particular, may result in different livelihood outcomes (wellbeing, income, etc.) by considering the household's demographic and economic characteristics (Babulo et.al, 2008). Diverse livelihood systems are related to resilience, flexibility and stability, which allow rural livelihoods to become less vulnerable to shocks and risks (Ellis, 2000; 1999; Soriano, 2007). In this regard, it is important to understand the influences on livelihood outcomes of a household's activity choice so as to either develop or change the targeted policies.

3.2.3.2 Alternative livelihood strategy

Rural tourism normally occurs in non-urban areas where rural residents mainly engage in agricultural activities attached to rural resources such as land (Demoi, 1991). With a big rural population and rich tourism resources, rural tourism could be a new development for Zoucheng city. The rural tourism concept involves many interpretations. It is a multi-faceted activity rather than farm-based tourism only, and includes activities in nature, adventure, farms, health, arts, sports, education, and heritage, all taking place in the countryside (as cited in MacDonald & Jolliffe, 2003, Keyim, et al., 2005; Bramwell & Lane, 1994; Reichel et al., 2000; He & Li, 2003).

Chinese people traditionally enjoy sitting calmly and chatting or playing games with friends or relatives (He & Chen, 2012), which potentially increases the rural tourism market such as walking around tourism sites, enjoying the beauty of nature, and eating

rural home-made meals with friends. By the end of 2010, there were about 18,000 large-scale leisure agriculture parks and more than 1.5 million agritainment households in China (Wang, et al., 2013). According to Su (2011), rural tourism attractions entertain more than 300 million tourists and create more than 40 billion RMB[13] in revenue per year in China. In addition, about 70% of urban residents prefer rural tourism when planning trips, which could create about 60 million tourists for each long holiday such as National Day and Chinese New Year (Shao, 2007).

In many rural regions, researchers have been concerned at the trade-off between tourism and agriculture and debates over the allocation of resources between the two sectors. Agriculture provides the natural resources for tourism development; meanwhile tourism encourages the agricultural production of high value crops. There are lots of beneficial effects from tourism on agriculture, such as providing higher wages and resource values for farmers, infrastructure improvements in rural areas, introducing high-value agricultural products into the market system, stimulating other services in agriculture, and increased commercialization of agriculture (Cox, Fox and Bowen, 1995; Zhang, 2012).

As previously stated, rural dwellers constitute nearly 65% of Zoucheng city's population and there are rich tourism resources in the area. Thus, a series of rural tourism activities could be created by the local government so as to generate income to address the problems of poverty in rural areas and create sustainable development for local communities. According to MacDonald & Jolliffe (2003) and Ying & Zhou (2007), cultural and historic heritage elements and rural tourism could be integrated as a new concept 'cultural rural tourism.' This new form could also be owned and operated by individual farmers or rural households, and could constitute a kind of privately-owned small enterprise for millions of Chinese farm families (Zou, 2005; MacDonald & Jolliffe, 2003).

[13] RMB (renminbi) is an abbreviation of the official currency of the People's Republic of China.

In rural China, about 1.3 million farming families operated rural tourism enterprises by 2009 (as cited in Su, 2011). Normally, this features having rustic meals, experiencing rural lifestyles (e.g. doing hard farming work, participating in home-made meals with accommodation services such as farmhouse provided), and other amusements such as special adventure opportunities and cultural attractions provided by farming families (Ying & Zhou, 2007).

One typical type of rural tourism in China is known as "Nong Jia Le", which means, "enjoying farm home stay." Rural people normally use their own houses to cater for and accommodate tourists and provide rural cultural and natural environments for them (Fu, 2009; Su, 2011; Zeng, 2008). All of these services and amusements particularly suit tourists coming from urban areas for weekends and holidays, even if only for a few hours (MacDonald & Jolliffe, 2003).

For the operation of rural tourism in China, Zheng & Zhong (2004), He (2005) and Wang & Fang (2008) introduced six inter-related models for rural tourism development. All the models are based on levels of off-farm employment opportunities, operational scale and scope, tourism corporations specializing in the development and management of rural tourism, rural tourism associations representing the local community authority, and the role of government in rural tourism development.

1. Household-run small businesses are represented by the individual farming family. For instance, the family's work in meal cooking and bed making are basic and important for the business to survive. It is normally the first step in establishing rural tourism.
2. Individual farmsteads involve individuals specializing in rural tourism. The operation of this model is responsible for running and transforming tourism products and facilities into a tourist-designated spot. It can be developed as an autonomous business entity and encourage unemployed labour forces nearby to join in the business of rural tourism.
3. Farmer family plus farmer family may help to adjust and improve the

agricultural economy of rural communities via rural tourism development in China.

4. Corporation plus farmers involves setting up a tourism corporation specializing in the development and management of a village's rural tourism, in which the investors are outside the villages. The corporation can lease land and other resources from the farmer and provide technical guidance and the necessary training.
5. Corporation plus community plus farmers further develops the model "corporation plus farmers." In this model, all the owners of family-run businesses take part in a rural tourism association (e.g. village committee in most cases) and make the association function as the board of directors of the corporation. The corporation is trusted by the association to run and operate the village's tourism business. The farmers are employed and trained by the corporation.
6. Government plus corporation plus farmers involves large-scale tourism projects. The government, local community authority, and outside investors can form a collectively-owned rural enterprise to employ and pay salaries and bonuses to farmers.

Regarding local rural tourism development, models 1, 2 and 3 are all possible as main business operation models for rural tourism in Zoucheng.

Localization is essential to the sustainable development of rural tourism in China (Sharpley, 2003). It is important to coordinate the local people involved in rural tourism planning and development processes (Li, 2000). The local community can share the benefit from rural tourism development. Zou, et al., (2014) illustrates using the example of three villages in Beijing, where a community-driven development method is the proposed model. This approach can ensure the community's high level of participation and manage the costs under an effective supervision and evaluation system. On the other hand, government involvement also plays an important role in rural tourism

development in China by providing funds and developing local tourism products (Zou, et al., 2014). This study focuses on models involving a high level of community participation and government support. With more local participants involved, social networks might be an efficient option for further developing rural tourism.

With local mineral and tourism resources, planning in regional development policies is designed to encourage local endogenous economic growth, to reduce socioeconomic inequalities, and to ensure natural resource stability in local areas. Sharpley (2003) also claims that developing rural tourism should address five concerns: encouraging production of local crafts; establishing a supply chain of local products or services; satisfying the needs of the local community; ensuring maximum retention of profits locally; and ensuring that development is within the capacity of the local society and environment. Based on McIntosh's comments (1977) and Sharpley (2003) concerning a community framework with goals for tourism development, local tourism planning should be based on the following goals:

1. To create more job opportunities for rural households. For instance, policies may create more jobs in related transport, processing and marketing of agricultural produce and relevant services by cooperation between local tourism and agriculture industries.
2. To reduce negative effects on the local environment with economic development.
3. To reduce the development gap between advantageous industries and disadvantageous industries.
4. To encourage coordination between public and private efforts.
5. To maintain and protect cultural heritage, and the traditional pattern of human activities.
6. To promote tourism in a small resource-based community with the greatest local benefit.

The simulation model presented in Chapters Seven and Eight will concentrate on the first three points as important planning policies to diversify livelihoods and provide sustainable economic development for the local community.

3.3 Social capital

This section focus on providing some background information, definitions of social capital, the strength of social ties (kin & non-kin ties), and some economics of social capital because of the significance of social capital in this study.

3.3.1 Introducing social capital

Individuals can access relevant resources through the use of personal networks and connections (possessed social capital) or memberships in groups (structural social capital) to secure benefits (Sobel, March 2002). Possessed social capital specifically aims at embedding network resources in personal networks (Zhao, 2002). Structural social capital involves the behavioural manifestations of social capital, which is generally subsumed as memberships in formal associations (Harpham, Grant, & Thomas, 2002; Yip et al., 2007).

Social networks consist of family, friendships, formal (e.g. work-based) and informal community relationships (Gilchrist & Kyprianou, 2011). Many studies (e.g. Adler & Kwon, 2002; Wu & Choi, 2004; Xiao & Tsui, 2007; and Hitt et al., 2002) indicate the special relationships between relevant resources (e.g. access to financial resources, information etc) and social networks. Appropriate information combined with assets can help to motivate rural households to use and improve their livelihoods and expand their asset base (Soriano, 2007). The types of social relations, the quality of relationships, and the configuration of ties in a network can influence a firm's ability to obtain loans as well as the cost of borrowing (Uzzi, Aug 1999; 1997; Portes & Sensenbrener, 1993; Romo & Schwartz 1995; Uzzi 1997).

Membership of a group or organization is viewed as a form of *guanxi*, which might benefit individuals' careers or livelihoods by increasing their own structural social capital (Bian, Shu, & Logan, 2001; Knight & Yueh, 2008). For example, some formal groups not only have complete control of organs of State, but also provide contacts, information and influence for their members (Bian et al., 2001; Knight & Yueh, 2008). Putman (2000) emphasized that participation in multiple groups creates the rich network of ties, which may increase monitoring, information flows, and mutual respect.

Much of the literature relevant to China (e.g. Yueh & Knight, 2008; Liu, 2003; Lam, 2003; Yip et al., 2007) has used membership of the Communist Party or other formal associations as a measure of individual social capital in China. However, formal associations or networks may only be a small factor in the production of social capital (Lyon, 2000). First, party membership is not simply a matter of personal choice; members are selected and vetted by the Party secretary or Party organization (Bian, Shu, & Logan, 2001; Yueh & Knight, 2008). Therefore, the recruitment requirements may limit studies to use memberships of the Communist Party to represent individual or household's social capital in China. Second, some formal organisations have different degrees of power in the administrative system in China. For instance, the grassroots organizations of the Labor Union remain incapable of representing workers in China (Chen, 2009). The reason is the union bureaucracy's operation and the reliance of its power upon its formal government status (Chen, 2009). The All-China Federation of Trade Unions or its regional branches can play an active role in labour dispute settlements compared to grassroots organizations in China (Chen, 2009).

Because of the limitations of group memberships, the social capital in this study has focused on broader concepts in personal connections and networks. In this thesis, all of the definitions and measurements of social capital are based on personal connections and networks. Personal connections and networks are more common and easier to access in Chinese communities, compared to the recruitment requirements in formal organisations.

3.3.2 The definitions of social capital

As one of the important livelihood assets, social capital is easily overlooked as an influencing factor, since it cannot be directly observed compared to other assets (Bebbington, 1999). Social capital is probably the least tangible of the five capital assets, and is notoriously difficult to understand, identify and assess (Bebbington, 1999). In Section 1.3, each research article may define social capital differently. For instance, Nguyen et al., (2015) used the number of mobile phones in each household to represent social networks; Ferrary (2003) & Mayoux (2001) used financial credits; and Habibah et al., (2010) defined social capital based on local involvement in conservation. Lin (2001) paid attention to social networks. Given the difficulties of defining social capital and the different ways it is used in the literature, caution must be used before attributing too much weight to empirical results linking social capital and livelihoods (Bebbington, 1999). In other words, it is necessary to indicate the definition and measurement method on which indicators of social capital are based.

Over the last thirty years, many scholars have contributed to the definition of social capital (Coleman, 1990, Burt, 1992; Portes, 1998; Bourdieu, 1983/1986; Putnam, 1993b, 1995 among others). Although many of these definitions were constructed from different data and focused on either individual or collective levels of social capital, the general definition is consistent: “Investment in social relations with expected returns in the marketplace.” (Lin, 2001, p. 19). Other similar definitions from Coleman (1990) and Putnam (1993b) portray social capital as a web of cooperative relationships or connections to facilitate resolution of some confronting collective action problems among citizens. Lin (2001) also pointed out that social capital is the resources embedded in one’s social networks, which can be accessed or mobilized through ties in the networks. In other words, social capital is about networks plus resources. Paldam (2000), Dasgupta (2005), Stiglitz (1999), and Sobel (2002) express similar views in which social capital can be recognized as a collection of social networks.

Research on social networks has thus produced two conceptualisations to understand social capital. Coleman (1998) and Putnam (1993) proposed social capital as the emergent properties of social networks (e.g. trust and reciprocity). These "social networks" provide the social control and solidarity to faciliate "coordinated actions," pursue "shared objectives," and enhance collective well-being. Lin (1982, 2001a) conceptualises another view of social capital. Social capital is the resource instrument for social actions, which are accessed through interpersonal ties and distributed in a hierarchical structure. As Franke (2005) pointed out social networks are recognized as an important element of social capital and provide the resources accessed for social capital (Portes, 1998; Burt, 1997; and Lin 1999b). Dufhues, Buchenrieder, and Fischer (2006) defined useful social capital in terms of its relevant network sources (not in terms of outcomes such as trust).

In terms of social ties (Lin 2001a), people in high-ranking positions are likely to access better resources for instrumental social actions than those in the lower ranks. Furthermore, social network extensity (e.g. social connections in diverse places) increases the variety of available resources. For instance, miners' social networks in Zoucheng might exist among various objective strata within local society. Among these social resources, miners might use different kinds of relations with different ranking positions to pursue their benefits. With regard to this research on the hierarchical structure of social ties, I adopt Lin's conceptualisation. The social capital definition in this thesis is derived from Lin (2001) to investigate social resources in a small community in China.

3.3.3 Strength of social ties

As important sources of social capital, role relations have been widely used to measure the strength of social ties (non-kin ties and kin ties). Lin et al. (1981), Lin and Dumin (1986), Marsden and Hurlbert (1988), and Bian (1997), have similar views regarding the nature of Chinese tie-strengths. That is, social ties between relatives are strong, while social ties between acquaintances, neighbours and peer workers are weaker.

Furthermore, the strength of the relationships leads to different values of social resources. Strong (intimate, usually kin) ties imply obligation and trust to provide reliable information in one's own interest (Granovetter, 2005; Bian, 1997). On the other hand, weak ties (usually non-kin ties) may serve as bridges that link individuals to diverse social milieu and provide other valued information and resources not present in their own immediate social circle (Granovetter, 1995; Lin 2001a; Burt, 2001).

Globally different types of social ties can lead to differential access to social capital. Strong (intimate, usually kin) ties can be important for realizing these opportunities, by providing relevant information to preserve one's interests and ensuring collective action (Granovetter, 2005). For example, kinship serves to facilitate access to information where formal institutions, channels and processes limit legitimate access to resources (Boxman, Graaf and Flap, 1991). However, strong ties may be critical under institutional uncertainties or constraints to the availability of other resources (Rus, 1995; Bian 1997). For instance, strong ties (kin ties) have negative effects on general social capital in some large metropolitan cities in China (Lin, 2001; 2004). It may be that in these contexts the more homogeneous networks (e.g. kin ties) reduce the effect of networking as a way of accessing better social capital (Lin, 2004). On the other hand, weak ties (usually non-kin ties) may extend and strengthen general social capital by bridging social boundaries, providing diverse information and gaining access to opportunities and resources (Granovetter, 1973, 1974), which also applies in Chinese society (Lin, 2001; Ruan, 1998).

The literature discussed above indicate some causalities between social ties and social capital, which might provide theoretical support to answer the first research question (i.e., do different types of social ties lead to differential access to social capital in a small community in China?). However, they didn't concern themselves with the small cities in China. So, it is necessary to use a regression model to analyse the factors associated with access to social capital in a county-level city (see Chapter Six).

3.3.4 Some economics of social capital

There is a debate on the classification of social capital as either public goods (non-rival and non-excludable) or private goods (rival and excludable) (Leana & Van Buren, 1999; Adhikari & Goldey, 2009; Putnan, 1998; Cheng & Luo, 2011). From a macro-view, social capital is more likely to be a public good. Social network resources are embedded among society and wouldn't be reduced as one actor accesses more. Thus, public-good social capital brings resources to the whole society or group (Keana & Van Buren, 1999). From a micro-view, social capital becomes a private good. Individual social resources have a strong excludable characteristic. Private-good social capital benefits the interests of the individual (Keana & Van Buren, 1999). My study focuses on private goods only.

Establishing a relationship and joining a social network are typical and common forms of social capital investment (Glaeser et al., 2002). If social capital is a private good, social networks and different social ties (kin & non-kin) may provide excludable and rival relations to help individual to expand personal social resources. These relationships might be regarded as a kind of investment in a person's social capital.

Social capital has both a positive and negative side. For the positive side, social capital has the functions of ensuring collaboration among communities to improve the efficiency of social operations and lower their cos (Dowla, 2006; Portes & Landolt, 1996; DFID, 1999; Kah et al., 2005). People can receive assistance from social resources to support their livleihoods (DFID, 1999). In the simulation model of this thesis (see Chapter Seven), people might use social networks to access information to operate rural tourism business and increase their expected tourism income. This is the productive side of social capital. The negative sides of social capital (e.g., drawbacks of personal social ties) may reinforce inequality, reject outsiders (i.e., protectionism), and break community trust (Field, 2003; Gargiulo & Benassi, 1999; Putzel, 1997). For instance, people with social capital can collude and increase the price of products in a

market[14]. This is counterproductive. Thus, supporting institutions, processes (e.g., relevant policies and laws), supervision from below and transparency are all possible methods to reduce these drawbacks. This is also one of the important reasons for the simulation model in this thesis that involved institutions and processes to support people accessing social networks and relevant resources.

3.4 Role of social capital

The next two sections introduce relevant social capital information related to the second research question presented in Chapter One, which may provide some basic theories to establish the causal links between social capital and livelihood choices for the simulation model.

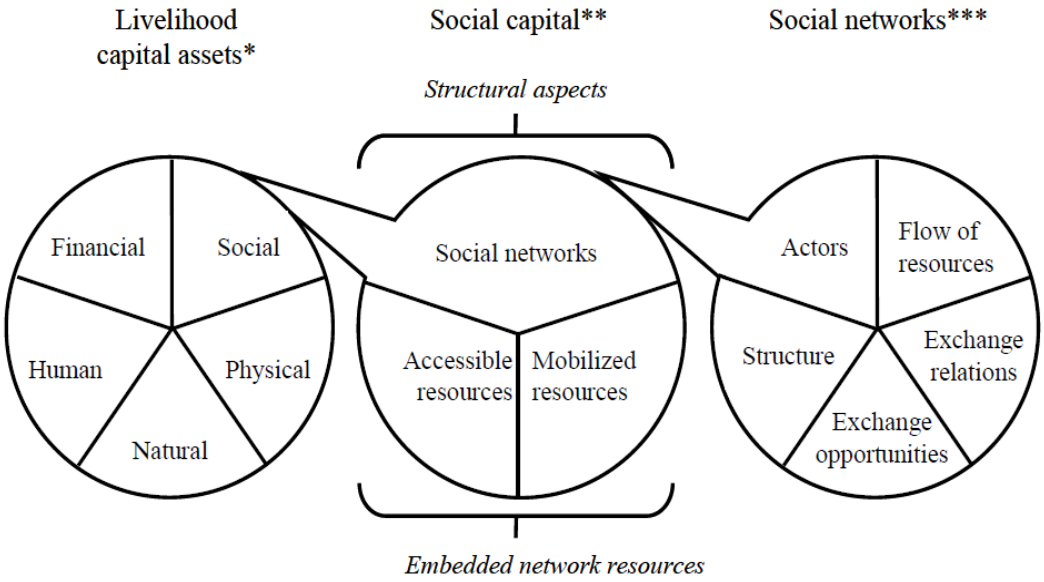
3.4.1 Role of social capital in the sustainable livelihood framework

Social capital in the form of social networks has gained much attention in terms of livelihood frameworks. Figure 3.2 shows the inter-linkage among livelihood capital assets for household, social capital and networks. The different types of household asset portfolios (natural, financial, human, physical, and social) can complement and substitute each other (Robison et al., 2002; Scoones, 1998). Bebbington (1999) and Moser (1998) state that social capital plays an important role in asset portfolios. Social capital can especially help households to solve the issue of deficiencies of other forms of capital (Fafchamps & Minten, 2002; Annen, 2001). On the other hand, social capital, made up of structural and embedded network resources (accessible and mobilised), plays a pivotal role in the capacity of households to access material resources and thus, livelihood strategies (Foley & Edwards, 1999; Moser 1998). However, since social capital is rooted in social networks, comprised of actors, resource flow, exchange relations, exchange opportunities and structured association (Cook et al., 1983), other

[14] It wouldn't be a problem in the simulation model of this thesis. Due to lots of business operators in simulation model, tourism business can compete each other. So, social capital is still postivie because negative sides are small.

factors such as income, poverty, or education level may influence the formation and stability of networks (De Weerdt, 2002; Narayan & Pritchett, 1999).

Figure 3.2. *Assets, social capital, and networks*



Note: * Based on Scoones (1998); ** based on Foley & Edwards (1999) and Lin (1999a); *** based on Cook et al. (1983)
Source: Dufhues, Buchenrieder, & Fischer, 2006, p.11.

In the access of households to material resources, social capital plays a special role in determining different livelihood strategies. For instance, access to productive resources or scarce resources depends not only on material wealth but also on engaging in relationships with other actors, or on special social networks in social institutions, or with cadres in some developing countries (Bebbington, 1999; Dalton & Ong, 2005; Winkels & Adger, 2002; and Berry, 1989). Some forms of social capital and social structures may facilitate group-based approaches to lending (DFID, 1999), which may become the financial supports in alternative livelihood development. In addition, access to livelihood assets such as social capital is an important factor in determining the choice of a household's livelihood strategy. As a feature of social structure in Chinese society, social capital generally can increase the achievement of certain economic and social ends (Coleman, 1988; Lin & Si, 2010). In the context of the social network theory, people with better interpersonal connections tend to have better careers, get more frequent promotions, and earn more income (Burt, 1997; Granovetter, 1985). The

livelihood approach states that households' available assets can affect the type of activity undertaken and the amount of income earned (Barrett et al., 2005; Brown et al., 2006). For instance, research on social networks has demonstrated the important role of social capital in the labour market (Lu, et al., 2013; Amuedo-Dorantes & Mundra, 2007; Aguilera & Massey, 2003; Sanders et al, 2002; Fong & Ooka, 2002). Therefore, knowing the "social game" is crucial to understanding the functioning of politics, business and other important areas in developing countries (Berry, 1989).

3.4.2 Applications of social capital: social networks and social resources

Understanding social networks and relationships with the broader concept of social capital is very important in understanding the ability to access key resources such as information and financial capital (Lyon, 2000). Social networks provide patterns of social interaction, social cues, and social identities, which are mechanisms to connect the individual to society (Inglehart & Baker 2000; Inkeles & Smith 1974; Inkeles 1983). Blair and Carroll (2008) noted that social capital contributes to economic development strategies. In China, it is important to maintain and cultivate the social networks, which function as the 'operational code' to get things done (Kipnis, 1997; Yan, 1996; Yang, 1994; Oi 1999). Social capital can be a source of skills, information, technologies, loan collateral, and contacts among neighbourhood dwellers (Reinke 1998 & Blair and Carroll 2008). With social contacts improving, inside information and connections can increase promotions and earnings (Knight & Yueh 2008; Lee 1998), although more effort is required to support the growing social network. With regard to the benefits generated from social relationships, many studies (Adler & Kwon, 2002; Wu & Choi, 2004; Xiao & Tsui, 2007 and Hitt et al., 2002) have used access to information and relevant resources to indicate the web of social relations.

A social network is considered as an information channel, which provides powerful, efficient means of access to information and resources (Coleman, 1988; Lin & Si 2010; Burt, 1992; Christakis & Flowler, 2010). There is a broad area in which social networks can increase information access. For instance, the information transfer between

recruiting firms and work-seekers could be improved through the use of contacts in an imperfect labour market (Knight & Song 2005; Zhao 2002). In the business area, an effective way of helping to find clients, suppliers, and investors is through personal networks of relationships to get relevant resources and information (Batijargal 2006 & 2007).

Social capital is expected to pay off in many ways by enhancing the efficiency of the labour and capital markets, improving information access, simplifying application procedures to meet people's credit needs, improving borrowers' access to formal credit, slashing administrative costs (e.g. lowering the costs of monitoring and enforcing existing rules and norms), and motivating repayment (e.g. introducing the relevant financial discipline by using peer pressure) etc. (Dowla, 2006； Kah et al., 2005; Rankin, 2002; Ostrom, 1992). Some social networks, communities, or groups are considered as support mechanism which help in developing social relations, improving information access in the market, making more rigorous business efforts, getting advice from successful group members, and trainings (Dowla, 2006).

Social capital can play an important role in tourism as well. In rural tourism communities, the participation of community residents plays a determining role in the process of community-driven rural tourism development (Zou et al., 2014). Many prior studies (Sharpley, 2003; Taylor, 1995; Tang, 1998; Liu, 2000; Zou, et al, 2014; Zhou & Liu, 2008; Su & Wall, 2014) claim that localization or community participation is essential to the healthy and sustainable development of rural tourism. The cooperation, support and participation of residents cannot ignore social capital in the process of establishing a sustainable tourism industry. Some studies (Nunkoo & Ramkisson, 2012; Mbaiwa & Stronza, 2010; Choi & Murray, 2010; Gursoy et al., 2010) suggest that social capital is likely to influence residents' attitudes and collective actions with regard to tourism development. Social capital is a necessary condition for sustainable tourism development (Park et al., 2012; Macbeth et al., 2004). Investigations in different contexts and diverse countries clearly show that high levels of social capital in

communities act collectively to produce superior development results over multiple sectors and diverse activities (Krishna, 2001; Grootaert, 1998; & Putnam, 1993a). Community tourism approaches cannot avoid the influence of guanxi in China (Li et al., 2007), especially in the early stages of tourism development (Jamal & Getz, 1995).

For theories and frameworks about sustainable livelihood development and the applications of social capital in livleihoods (e.g., information access, community participantion in rural tourism, etc.) discussed earlier, an analytical framework and causal linkages between social capital and livelihood strategies in terms of households' sustainable livelihoods in Zoucheng city can be generated as a theoritical basis for simulation model in Chapter Seven. The general process of developing a sustainable alternative livelihood for local residents is supported by social capital. Given the natural landscape and tourist resources in Zoucheng city, rural tourism is expected to be an alternative livelihood choice for city dwellers. Rural households could take advantage of more tourists in the local city by selling more agricultural products, which may be one of their income sources. By using their social capital networks, residents may have more opportunities to access relevant information to operate their own rural tourism business. The activities chosen by mining household members generate livelihood outcomes such as income diversification, and environmental and economic sustainability. This framework provides a conceptual depiction of the dynamics and endogenous interdependence for a simulation model (see Chapters Seven and Eight).

CHAPTER FOUR: RESEARCH METHODS

This chapter will firstly introduce the research design and data collection process for the whole study. Then, it discusses the analytical research framework design. After that, data entry, calculation and summary of collected data are introduced. Finally, two research methods (the regression model and the system dynamics model) are discussed with respect to answering the two research questions in Chapter One. This chapter pays particular attention to social capital, because social capital cannot be directly measured. The research methods mainly include the survey data collection, descriptive data, and the specific mathematical models that are used for regression analysis in Chapter Six, along with the system dynamics model that is used in Chapters Seven and Eight.

4.1 Research Design

The background data and information were directly collected from the Zoucheng government, Zoucheng Tourist Administration, the Bureau of Statistics of Zoucheng City, the Bureau of Agriculture of Zoucheng City, the relevant mining companies, and local official sites.

The household survey in this study focuses on the micro level (i.e., individuals and households). It collected data about social relationships and social resources in the communities most affected by local mining activities. In addition, relevant household characteristics such as location (rural or urban), participants' gender, and livelihood assets such as educational level and household expenditure were also included in this survey. This survey design was used to establish a composite variable for social capital, and a deeper analysis of the impacts and the associated factors with social capital. The questionnaire was completed in 2010 and obtained ethics approval from the Ethics Committees of the Management School of The University of Waikato in same year.

The following sections will provide more detail about this household survey.

4.2 Data collection for household survey

All of the data were collected in Zoucheng city, Shandong Province, China. The survey was a household survey, which was conducted among employees in local mining and relevant industries from April 2010 to July 2010. Participants were identified and recruited using a modified snowball method. The collection method for the household survey is described in the following paragraphs.

4.2.1 Sampling frame

There are over 100,000 people employed in local mining or related companies in Zoucheng city. This survey involved 228 participants in local mines and related departments (e.g. electricity, and the corporate headquarters of the largest local mining company Yanzhou Coal Mining Group).

Although the literature does not provide a consistent answer to the minimum sample size in a multiple regression analysis, a combination of methods is likely to be most valuable in many situations. According to the Rules of Thumb[15] for minimum smaple size and methods for calculating effect sizes in multiple regression (Knofcznski & Mundfrom, 2007; Algina & Olejnik, 2003), about 200 samples and the nine predictor variables used in regression model in Chapter Six of this thesis are technically acceptable and provide a good prediction level in multiple regression analysis.

The local mines involved included Baodian, DongTan, Nantuan, Beisu, Liyan, Taiping, and Henghe. The survey included other relevant employees in the total sample since mining-related employees work in multiple fields in the mining industry such as coal

[15] As Harris (1985) and Wampold and Freund (1987) have pointed out, historically the most common rule seems to have been that the ratio of subjects to predictors be at least 10:1. Green (1991) recommended that a reasonable rule of thumb for minimum sample size is 104+number of predictors. Tabachnick and Fidell (1989) suggested that the shample size should be at least $5 \times$ number of predictors. Comb (2010) noted that a "one-size fits all" formula of having a sample of at least 100 subjects is a widespread assumption in the applied sciences, irrespective of the value of the predictor variables in a regression model.

digging, transportation, marketing, and expansions of the industrial chain (e.g. electricity, chemical industries).

Table 4.1 summarizes the relevant mines or departments that were involved in this survey. For instance, Electricity and Headquarters are considered as employment expansions of the local mining industrial chain. For each targeted mine or department the numbers of participants who completed the survey are listed.

Table 4.1: *Participant distribution among local relevant mining companies*

Targeted	Number of participants
BaoDian	31
DongTan	22
NanTun	39
BeiSu	24
LiYan	21
TaiPing	26
HengHe	27
Electricity	21
Headquarters	17

4.2.2 Sample selection and collection methods for household surveys

The household survey conducted in this study firstly used a form of snowball recruitment to help the author to access leaders in local mining groups. The snowball sampling approach is also called link-tracing or chain-referral (Illenberger & Flotterod, 2012). It is initialized by sampling a set of respondents (referred to as seeds) who report relevant alters (members of a person's networks or social contacts) or other subjects without replacement (Illenberger & Flotterod, 2012; Goodman, 1961).

These local leaders can help the author to access their networks or social contacts that can provide a list of miners for research survey of this thesis. The main issue from the snowball sampling approach is a homogeneous cluster may exist among the participants in the sample (Illenberger & Flotterod, 2012; Atkinson & Flint, 2001; Goodman, 1961; Thompson & Frank, 2000; Thompson, 2006; Chow & Thompson, 2003). However, this study didn't use the collected data from leaders (considered as pretesting data) due to

they may have close individual connection. The participants used in this thesis were selected randomly from the list of miners provided by leaders in local mining groups.

Data were collected either through face-to-face interviews or a self-administered survey. The household survey was started by contacting group leaders or middle-level leadership who were working for the local mining company. Then, these people were interviewed by the author to pretest the survey questions as research assistants. Thus, there was at least one research assistant in each company. After that, the author randomly selected the participants from the list of miners provided by local leaderships. The most common approach was to spread the survey in a meeting room or in a place at a time arranged by the author, group leader and middle-level leadership. In the survey process, if participants could not understand the questions, they could ask the author or the research assistant. However, there were some participants who took the questionnaires home and returned them the next day as they could not attend the organised survey at that time. Some other individuals were interviewed by the author, as they finished work.

4.2.3 Questionnaire design

The household survey[16] was designed to include questions relevant to social capital and general background information.

4.2.3.1 Social capital

a) Measurement of individual social capital

To investigate the social capital concept, many researchers (Van der Gaag & Snijders, 2005; Lin, 2001; McCallister & Fischer, 1978) have used access-type social capital data to measure potential social resources in social networks. However, this type of measurement is in its formative stages and there is a lack of consensus on the meaning

[16] See Appendix D.

of the term (i.e., the connection between measurements of social capital and the theoretical definition of social capital) (Dufhues, Buchenrieder, & Fischer, 2006). Adam and Roncevic (2003) noted that it is important to be cautious about its use in parametric measurement. Nevertheless, according to the definition used in this thesis, social capital is the resources embedded in one's social networks and social relationships. In other words, social capital is rooted in social relations and social networks (Lin, 2001b).

Most studies tend to examine formal or semiformal social networks (e.g. membership of clubs, organizations or associations). Bourdieu and Wacquant (1992) believed that the sum of the resources attainable through institutionalized relations would be best operationalized for social capital. But this kind of social resource does not represent the entire strength of social capital if this information is not accompanied by what people do as members and does not consider informal networks (friends, workmates, school class networks) (Schuller et al., 2000). In other words, social capital cannot be simply measured by counting the number of registered groups in a community, if the group nature and quality are not considered during the process (Lyon, 2000； DFID, 1999). Sobel (2002) stated that the extent of an individual's social resources depends on three factors: (1) a person's connections through individual or common group membership; (2) the strength of these connections; (3) available resources within their connections. Social networks accessed, and the resources embedded in them, both constitute social capital.

Measurement can focus on two important dimensions at the individual level of social capital: social resources; and ways in which these can be made available to individuals (Lin, 2001; Flap, 2002). The range of social resources, their variety, the best possible resources, and the composition of resources among social ties or networks can be used to measure social networks (Dufhues, Buchenrieder, & Fischer, 2006).

Three important measurement instruments are available to collect data about social resources possessed by network members. There are the Name Generator (McCallister

& Fischer, 1978), Resources Generator (Snijders, 1999; Van der Gaag & Snijders, 2003), and Position Generator (Lin, Fu, and Hsung, 2001, Lin, 1982; 2001). Each of these social capital measurement instruments emphasizes a different dimension of social capital.

McCallister & Fischer (1978) designed the Name Generator. It emphasises on both relationships and resources. It starts with individual-centered social networks or social contexts and collects a social resource inventory. Typically, questions are posed, such as "Do you know anyone who helped you get your current job/helped you get this house" etc., and the respondent is asked to provide a list of names of those who did help. The results of this type of research can provide very detailed social capital descriptions (Burt, 1984; Snijders, 1999). Furthermore, the relevant ties between individuals, locations, and network resources can be computed (Lin 2001b). However, the data from Name Generator consist only of the direct ties of an individual (thus there is a bias towards stronger ties), and is impractical to list all of the members in a network (e.g. if the individual's network is very big, it can be relatively time consuming and costly) (McCarty et al., 1997; Fu, 2005). The Resource Generator and the Position Generators can partly overcome those shortcomings.

The Resource Generator puts more emphasis on resource-oriented social capital. With a fixed list of specific social resources, this instrument asks about access status. For instance, "Do you know anyone who can repair a car or bike/can loan you a large sum of money/is active in a political party." The Resource Generator has been developed in the context of certain developed countries but without major preparatory work, it should not be used in different cultural contexts (Van der Gaag & Snijders, 2005).

The Position Generator focuses more on social resources than relationships in social networks by mapping a set of occupations in a hierarchically modelled society in terms of job prestige for individuals. Lin (2005) commented that "Social capital is seen as contingent on network features… but not identical to these features." (p. 19). The Position Generator methodology allows measurement of both capacity (accessed

resources) and actual uses for particular actions (mobilized resources) (Lin, 2005). Typical questions are "Do you know anyone who is a farmer/lawyer… etc." The Position Generator enhances the Name Generator, but the prerequisite for the Position Generator is that most of the national occupational job-prestige ratings are known (Dufhues, Buchenrieder, & Fischer, 2006). However, the Position Generator is more suitable in this case than the Resource Generator, because Lin (2001) has already applied it in several cities in China, which is the focus of this study.

b) Selected measures of social capital

The first and most important purpose in building up a questionnaire is to create a composite social capital value. Regarding the case study area in this thesis, Zoucheng is a county-level city; membership of some grassroots organizations might not be enough to represent individual social capitals. Thus, the social capital section was based on Lin's study (2001) in order to create social capital scores. Lin has studied social capital in China for many years and has listed the relevant prestige scores for "job positions" in terms of the Chinese situation. The Prestige Rating scores were ranked and calculated from the contact status, social reputation, and census listing of occupations (Lin, 2001). A sample of structural positions that are salient in a society that Lin (2001) used for his research, is based on occupations, authorities, work units, class, or sector. With these sampled positions, respondents need to indicate contacts in each of the positions (e.g. those known on a first-name basis). Considering the sampling content or role areas, this collection method (i.e., the Position Generator) samples hierarchical position, and is role/location neutral (Lin 2004).

In the process, each respondent was asked if he knew anyone in each of the sampled positions. If the respondent indicated more than one contact, the respondent was asked to focus on the most familiar one. Then, Lin constructed three social resource access measures: the position accessed with the highest prestige score, the difference between the highest and lowest accessed statuses, and number of job positions accessed. Finally,

Lin (2001; 2004) used a factor analysis method to generate a single value for social capital scores.

Regarding details of the questionnaires of the social capital, participants were asked the question "Of your relatives, friends, and acquaintances… (If respondents knew more than one occupant of any position, they were asked to think of the first occupant who came to mind.) Do you know people in the position?" The respondent was then asked whether any of his or her kin ties (i.e., relatives), non-kin ties (i.e., friends, acquaintances) or others held such a position.

The sampled job positions were distributed in general social capital levels. Uphoff (1999) pointed out that investment of time, prestige, money, and information can yield a benefit flow in employment, other payoffs, income, and knowledge for networks. Thus, each sampled job position has its own prestige score (see Table 4.3). The survey followed the prestige ratings constructed by Lin (2001), Bian (1994) and Lin et al. (1997) for Chinese occupations to overcome potential differentials between countries for prestige scores on job positions.

Table 4.2: *Prestige rating for job positions in China*

General social capital	
Accessed positions	**Prestige score**
University Professor	91
Mayor	83
Head of Bureau	76
Lawyer	72
Journalist	68
Head of an Enterprise	67
Chief of a Section	60
Elementary School Teacher	58
Worker	45
Administrative Personnel	45
Electrician	44
Farmer	30
Housemaid	11

Source: Author's compilation from Lin (2001), Bian (1994) and Lin & Ye (1997)

4.2.3.2 Other information

Other information including demographic questions, and other relevant questions such as monthly income and expenditure were based on the Living Standards Survey in China (World Bank, 1995; 1997), the Vietnamese Household Living Standards Survey (General Statistics Office, 2006), and a manual for planning and implementing a the living standards measurement study survey (World Bank, 2003).

Household surveys also collected information about farm products that households had planted last year, which were based on local Yearbook listings. The survey also used car ownership as a measure of wealth. Along with the increase in private wealth, many Chinese have come to aspire to car ownership, thus this is used as an indicator of family income and status. In the auto market in China, although the prices of domestic brands have fallen rapidly in recent years, many households still choose foreign-brand cars because they are recognized as one of the important indicators of household wealth and status.

4.2.4 Sample size and basic information

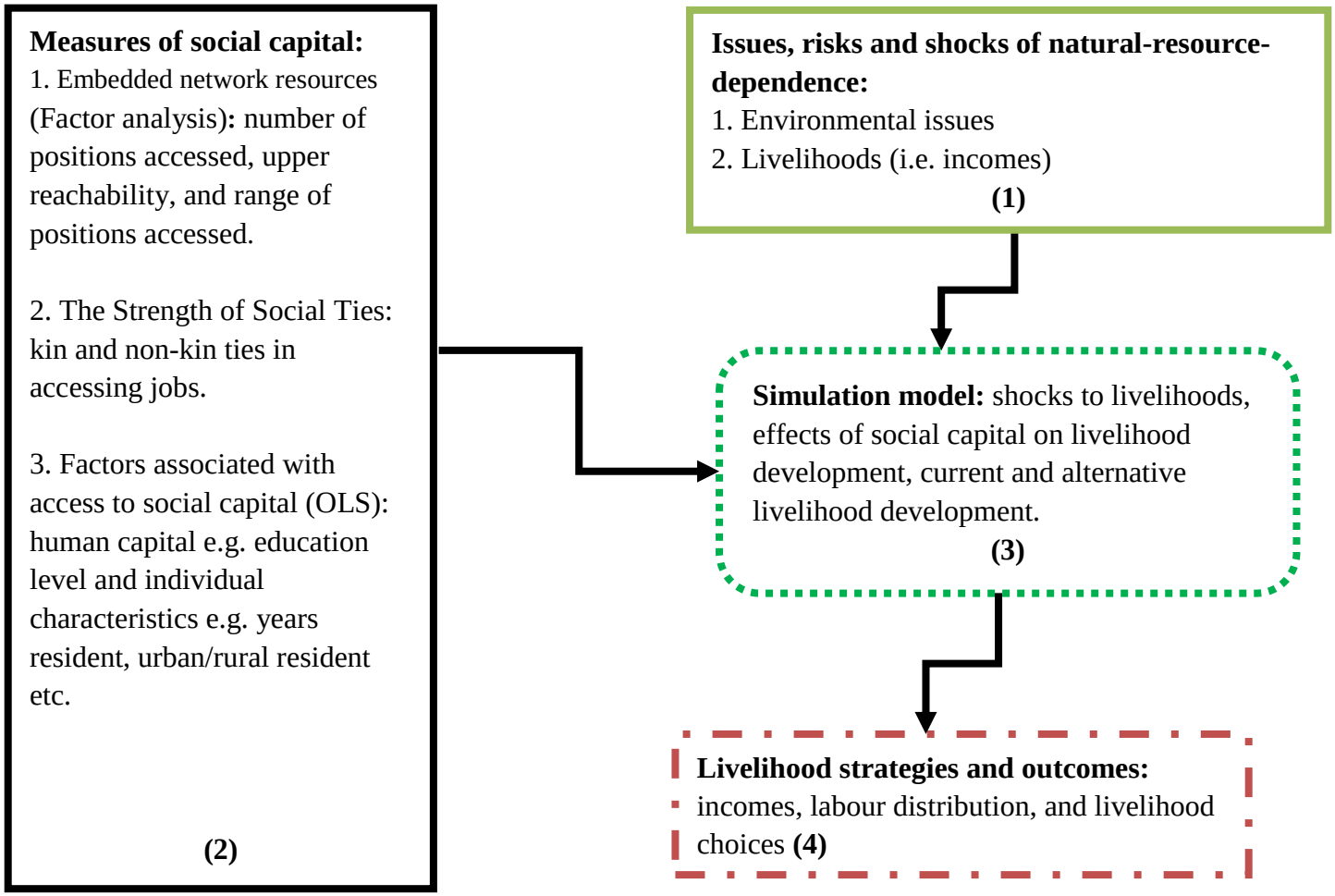
A total of 228 respondents completed the survey. Respondent characteristics are summarized in Table 4.4. More than 60% of survey participants were household heads. There were more men (88%) than women which reflects the fact that mining is more restricted to males. The sample consisted of nearly equal numbers of respondents living in either the rural or urban neighborhoods of a county city, Zoucheng. The mean age of interviewees was about 35 years. More than three-quarters (78%) of the respondents were married. On average there were nearly four household members and one child in a family. In terms of local living and working experiences, participants had on average 26 resident years and 14 working years respectively. The collected data were expected to measure local social capital (e.g. social ties, social relationships, social resources etc.) in a local city since most of the participants lived or worked in the local area.

4.3 Analytical framework design

The general framework for the research process for this thesis is based on the sustainable livelihood framework. In Figure 4.1, different boxes focus on different components of the sustainable livelihood (discussed in Chapter Three), such as shocks and risks of natural resources-dependence (vulnerability context), social capital measurement (household livelihood assets), and analysis in a simulation mode (relevant policy implementation, livelihood strategies and outcomes). The livelihood framework is based on the theory discussed in previous chapters. Relevant issues, risks, and shocks to the local community are very important factors in building up the background relationships among three local industries (mining, farming, and tourism). Ordinary least squares (OLS) regression was used to establish associations with the composite measure of access to social capital. Using the relevant coefficients and variables from regression analysis and background information on Zoucheng, the relevant livelihood strategies and outcomes were generated using a simulation model. This simulation model was used to simulate the socio-economic status for the local community, household behaviours in response to different livelihood type, and relevant policy implementations. The relevant issues, influences and risks relating to mining activities are explored in Chapter Five. Social capital measurements and analyses are discussed in Chapter Six. The simulation model is introduced in Chapters Seven and Chapter Eight.

Figure 4.1 illustrates the four sections (represented in the four boxes) of this research. The bold and highlighted arrows and frames indicate the main flow of the research process.

Figure 4.1: *Research framework*



4.3.1 Issues, risks and shocks relevant to the local community

Box (1) in Figure 4.1 explores the relevant shocks, risks, and issues relating to natural resource-dependent activities (mining). It involves collecting secondary data from local documents and literature. Although Box (1) cannot directly answer any of the research questions mentioned in Chapter One, it is indispensable. It provides the general relationships between the three important industries (mining, farming, and tourism) in Zoucheng, which are important links in building up the background scenario for the simulation model. Without these risks analyses, the whole research purpose could be out of focus.

The relevant risks, issues, and potential shocks of mining are measured in two areas: environmental issues and livelihoods. Environmental pollution focuses on local farmland quality such as subsidence areas and atmospheric pollution, which may affect both agricultural output and number of tourist arrivals. Issues related to livelihoods were examined in terms of the amount of income resources produced by different household members. With the dominance of mining activities in household incomes, developing alternative livelihoods for other mining household members might be more feasible than focusing on miners themselves, which provides an important guideline to in diversifying livelihood choices for mining households in the simulation model.

4.3.2 Measures of social capital

Measuring social capital is one of the main purposes of this study. There are three research areas in social capital measurement: collecting and calculating social capital scores, discussion of the strength of social ties (e.g. kin and non-kin ties) in accessing work, and regression analysis of factors associated with social capital (see Box (2)).

As discussed earlier (see Section 4.2.3.1), three variables (i.e., number of sampled job positions accessed, upper reachability, and range of positions accessed) were used to generate a composite value for social capital scores. Role relations (e.g. kin & non-kin

ties) are also important sources of social capital, which have been widely used to measure the strength of social ties (see Section 3.3.1). This section summarizes and discusses the frequency of accessing different sampled job positions in terms of the strength of ties (kin & non-kin ties). With this summary, the characteristics of local role relationships on accessing jobs or other useful information can be understood, and can then be applied in the livelihood development policies and simulation model analysis in following Chapters. It is particularly useful to analyse the role of social capital in Chinese society, including the role of family relationships in accessing social resources.

The third section in Box (2) uses regression analysis. The dependent variable is social capital, which is calculated from variables that measure the range, variety and composition of social resource. The aim is to examine the empirical relationships between the strength of social ties (e.g. kin and non-kin ties) and social capital to address question (1) in Chapter One. Research Question (1) from Chapter One is: do different types of social ties (kin and non-kin ties) lead to differential access to social capital in a small community in China? Some other independent variables are also expected to positively associate with social capital, such as higher education and length of local residence. On the other hand, some negative linkage is expected as well (e.g. rural residents may have fewer opportunities to access social resources).

4.3.3 Simulation model and analysis

Boxes (3) and (4) relate to the process of establishing and analysing the simulation models. With all of the above analysis (e.g. risks and social capital), the simulation model (Box (3)) deals with the complex and multiple interactions among the variables that were described above, in order to simulate the background livelihood status for a local community. This simulation analysis draws out the role of social capital in a sustainable livelihood development model and the possibility of an alternative livelihood choice (tourism) for rural households. With different policies applied in the simulation model, the simulation can investigate different livelihood strategies and outcomes to determine possible alternative livelihoods for rural households. The

simulation model is discussed in Chapters Seven and Eight. The results of the regression and simulation models will evaluate the validity of Research Question (2) in Chapter One.

4.4 Translation, data entry and consistency checks

The data collected from household surveys were recorded in the Chinese language. Since the targeted city is the hometown of the author, the questionnaires were translated into the local language to help participants to thoroughly understand the meaning of each question. The format of the questionnaire was very similar to the English version for ease of data entry.

The raw data were firstly entered into Excel and double-checked. Some handwriting was hard to understand, and some extreme or inconsistent data such as improbably high income or expenditure were removed.

4.5 Calculation of composite social capital value

Following Lin (2001; 2004), three indicators of social capital were then constructed from the data, using the Position Generator items: (1) the total number of positions accessed; (2) the prestige score of the highest position accessed (upper reachability); and (3) the difference between the highest and lowest positions accessed (range of positions accessed). Numbers of positions accessed were the total number of job positions that participants could access; the highest position accessed was the highest prestige score that participants could access; and the range of prestige was the difference between the highest and lowest prestige scores that participants could access. To assess whether the three variables for each type of social capital could be considered as indicators of a single dimension, factor analysis was performed on these three indicators of "access to social capital". Using principal components analysis, the coefficients of these three variables were used to generate a composite value for general social capital.

Next, factor structures for access to social capital were constructed. Following Lin (2001b), factor analysis was used to determine whether one value could be generated to represent a composite of each individual's access to social capital, called a *Social Capital Score*. If so, then the score could be used in subsequent analysis as a quantitative measure representing access to social capital. The three position generator variables (number, prestige, and range) were included in the analysis (using principal component and varimax rotation). The general mathematical model is shown below:

$$X_i = a_{i1}F_1 + a_{i2}F_2 + a_{i3}F_3 \ldots + a_{ij}F_j + + a_{im}F_m + \varepsilon_i$$

i=1,2,…,p; m<p

where:

F values are measures of social position
a values are factor loadings
Xi is the score for the ith subject

ε_i are independently distributed error terms, E (ε)=0

Table 4.3 presents the results of a three-factor solution for access to social capital. The first factor has an eigenvalue of 2.63 and explains 88% of the covariance structure. The second and third factors have very small eigenvalues (the second factor had an eigenvalue of 0.27, and explain 9% of the covariance structure.). All factor loadings have the expected (positive) sign. Thus, these three measures of position data are highly correlated and produce a single factor. A constraint condition (i.e., factors having eigenvalues greater than 1 to generate factor loadings of the three variables imposed on the single factor) produce very high factor loadings; see Table 4.3 (0.922 on numbers of positions accessed, 0.966 on range, and 0.92 on highest position accessed).

A Kaiser-Meyer-Olkin test (KMO, overall 0.707) was used to assess the appropriateness of using factor analysis, in which the measure of sampling adequacy provides an index (between 0 and 1) of the proportion of variance among the variables

that might be common variance. If the KMO index[17] is near 1.0, the factor analysis is applicable; if KMO is near 0, the factor analysis is not relevant. Table 4.3 shows the KMO index is 0.707, which is an acceptable level. The squared multiple correlations (SMCs) of variables with all other variables (in this case, between 0.735 and 0.843) were also used to test the strength of the relationships among the measured variables. According to Bagozzi & Yi (1988) and Hair et al. (2006), the recommended value for SMC is greater than 0.5. Thus, the SMC test results in Table 4.3 are acceptable.

Table 4.3: *Factor Structures of Access to Social Capital*

Variable	Sample
General social capital	
Factor eigenvalues	
Factor 1	2.631
Factor 2	0.265
Factor 3	0.104
Cumulative	
Factor 1	0.877
Factor 2	0.965
Factor 3	1
Factor loading on Factor 1	
Number of positions accessed	0.922
Range of prestige of positions accessed	0.966
Prestige of highest accessed position	0.92
LR test: Prob>chi2	<0.000
KMO test:	
number of positions accessed	0.750
Prestige of highest accessed position	0.757
Range of prestige of positions accessed	0.638
Overall	0.707
SMC test:	
number of positions accessed	0.735
Prestige of highest accessed position	0.727
Range of prestige of positions accessed	0.843

[17] Kaiser (1974, citied in Dziuban and Shirkey, 1974) refined the index further and suggested that anything in the .90s was 'marvelous', in the .80s 'meritorious', in the .70s 'middling', in the .60s 'mediocre', in the .50s 'miserable' and below .5 'unacceptable'.

Therefore, we can be confident that the factor loadings from the factor analysis can be used to construct a plausible index representing social capital with a single score. The distribution of predictive scores on social capital ranged from -2.397 to 2.136.

4.6 Definitions and summary of variables

All of the variables from the household survey that were used in the regression analysis in this thesis were summaried in Table 4.4.

Table 4.4: *Definitions and summary of variables for social capital models (n=228)*

Variables	Description	Percent or Mean	Std. Dev	Min	Max
Individual characteristics					
Resident place-rural or urban	Rural area=1 Urban area=0	55% 45%			
Marital status:					
Married	1 if married, 0 single	77.63%			
Divorced or widowed		1.79%			
Never married		19%			
Gender	1 if male, 0 if female	87.50%			
Size of family	Including yourself, how many people live in your household	3.6	0.974	2	8
Number of children	How many children in your household	1	0.670	0	4
Duration in local city area	Years resident in the area	26	12.68	1	68
Working experiences	How many years worked since graduation	14	9.00	1	37
Age		35.2	8.84	20	68
Education level					
Education level (participants):	The highest education level attained for participants				
Less than high school		31.53%			
High school or similar		32.89%			
College or more		35.59%			
Expenditure					
Phone	Monthly expenditure on phone/Internet	127.44	88.14	0	600
Wealth and wealth indicator					
Car	Ownership of a foreign car	10%			

Source: Household Survey data

4.7 Applications to research questions

There are two main questions in this study (see Chapter One). The first question is addressed by the regression model. The second question is explored in the simulation model.

4.7.1 Regression model

1) Do different types of social ties (kin and non-kin ties) lead to differential access to social capital in a small community in China?

In accordance with the livelihood frameworks, the first step is to analyze the livelihood assets and their interrelationships. Thus, the first question is how to evaluate the social capital.

A). What is social capital and how is it generated?

The relevant concepts and calculation for social capital have been discussed in Chapter Three and Section 4.5 of this chapter respectively.

B). How are other factors are associated with access to social capital?

Ordinary least squares (OLS) regression was used to establish associations with the composite measure of access to social capital. A number of variables were posited to be related to social capital; these included human capital, length and location of residency, household size, access to social networks, and wealth. Greater human capital (education level of the respondent) and wealth (ownership of a foreign car) open up more opportunities for interactions, particularly with people in higher prestige positions. Human capital is measured in terms of numbers of respondents who graduated either from middle school, high school or higher educational levels. People naturally accumulate more social capital the longer they live in a given location; thus the length of residency was included. Similarly, people who live in urban areas and those with larger families might have more access to different positions, so rural location and household size was also included. The respondents' monthly expenditure on the

Internet and telephone was taken as a proxy for access to communication, which can be used to develop social capital. Finally, the percentages of kin ties and non-kin ties involved in accessing job positions were included to investigate their relative importance to accessing social capital.

The parameters for the equation were estimated using ordinary least squares (OLS).

Regression Model:

$$SK_i = \partial + \beta_0 H_i + \beta_1 RS_i + \beta_2 R_i + \beta_3 NM_i + \beta_4 TEL_i + \beta_5 CA_i + \beta_6 K_i + \beta_7 NK_i + \varepsilon_i$$

where:

SK: The estimated scores for general social capital performances

H: Human capital resources for respondents. The human capital part includes two dummy variables for respondents (1) Junior middle school (compulsory studying in China), (2) higher educational level (diploma or more)

RS: Number of years that respondent has lived in the local city

R: The living place (rural area=1) for each respondent

NM: Number of household members

TEL: Respondents' monthly spend on internet and phones

CA: Ownership of a foreign car

K: The percentages of kin ties accessing job positions

NK: The percentages of non-kin ties accessing job positions

4.7.2 Simulation model: system dynamics methodology and Vensim

After the regression analysis of the factors associated with social capital, the relevant linkages and parameters on social capital can be applied to livelihood development to explore Research Question (2):

> Does the strength of social capital alter local livelihood patterns, such as diversifying household livelihoods and finding new livelihoods in an industry with potential for development?

This is the main question in this study. The social capital information is collected from this chapter and Chapter Six. Using results from multiple regression is a coomon method for inferring values for unknown parameters in System Dynamics models (Houghton, et al., 2014; Higuichi et al., 1996; Mayerthaler, et al., 2009). The risks of mining activities and most of the background information are from Chapter Two and Chapter Five. With all of the relevant information, this study will establish a simulation model to analyse different livelihood choices and outcomes. The following paragraphs introduce the theory and software that the study will use in establishing and analyzing the simulation model in Chapters Seven and Eight.

There are complex economic and environmental considerations in the real world. Thus, the question of how natural capitals or environmental issues should be managed in the context of local cities' rapid development led to the idea of building a sustainable development model. The system dynamics model is a simple and powerful method for analysing the dynamic relationships between interrelated systems (Guan, Gao, & Fukahori, 2010), which simplifies complex real-world phenomena and can represent a good understanding of the problems and interdependence within the real-world system (Wiranatha & Smith, 2000). In the development planning process, system dynamics models can simulate different policy scenarios and contribute to improvements in the decision-making process (Saeed, 1994; Bergh, 1991).

System dynamics methodology was initially developed by Jay Forrester and others at the Massachusetts Institute of Technology (Maani & Cavana, 2007). The system dynamics approach creates operational maps and simulation models to capture the interrelationships of physical and behavioural processes, information feedback, policies, and time delays and test the holistic outcomes of alternative plans and ideas (Wolstenholme, 1997). It also provides an experimental tool to integrate these issues (i.e., economy and environment) with suitable government structures and sector

policies to evaluate alternative long-term capacity planning policies (Vlachos, Georgiadis, & Iakovou, 2007). Policy makers can use models to test different policy options via learning-by-doing, particularly since some experiments are costly or even impossible to conduct in real-world conditions (Holling et al., 1998; Bontkes & Keulen, 2003). It is a well-established method to develop understanding of the complex interactions between the environment and human actions (Costanza & Ruth, 1998; Hannon & Ruth, 1994). In addition, the system dynamics model can efficiently obtain a general indication of changing behaviour over time in different scenarios (Sterman, 2000 & Ford, 1999). These feedbacks can be considered as a platform to facilitate the most relevant interactions among the several agents involved in the region (Stave, 2003; Vennix, 2001).

Vensim is one of the available softwares (others include Stella, Powersim, and Simile) used to develop System Dynamics models diagrammatically by drawing stock-and-flow diagrams. The simulation model in this study uses Vensim Ple Plus software (Ventana Systems, 2010) to analyze relevant components of local issues involved during the development.

Vensim is one of the "visual modeling systems" approaches to constructing a simulation model. The programs on Vensim can link and assemble various components to construct visual modeling systems, conceptualize dynamic relationships, and optimise models of dynamic systems (Venstems Systems, 2010; Muetzelfeld & Massheder, 2003; Smith, Holzworth, & Robertson, 2005; Costanza & Voinov, 2001). It provides a highly visual representation of the structure of the system and the existing relationships between variables so as to facilitate understanding of the behaviour of the system (Chaves, et al., 2013).

Vensim is used for a wide range of economic and environmental applications. Fraser, et al., (2010) used Vensim to evaluate the vulnerability in food systems. Chen, et al., (2005) developed a simulation model to assist government in obtaining alternatives for sustainable land use management. Other areas of application include the labour market

(Kara & Zaim, 2012); hydrology (Fleury, et al., 2007); environmental pollution (Chaves, et al., 2013); poverty and livelihoods (Tshimpanga, 2012); municipal waste management (Karavezyris, et al., 2002); public finance (Mantel, et al., 1994); and an urban transportation system and its application (Wang, et al., 2008).

Parsons, et al. (2011) concentrated on the agricultural area. They used Vensim to simulate farming systems (crop-livestock) to assess the effects on crop-livestock production for smallholders. For environmental management, Crooks, et al. (2013) concluded that it is feasible to use systems dynamic modeling (viaVensim) for economic evaluation of ecological restoration activities. Pedercini (2004) simulated the socio-economic-environmental system of Papua and identified a developmental path for local residents. Development methods, relationships among variables, and results in the literature provided a general framework and some insights for the development of the simulation model in this thesis. However, the simulation model in this thesis has its own characteristics. This is the first known application that couples social capital with system dynamics and livelihood choices in terms of the sustainable livelihood development framework.

There are several advantages in using Vensim to construct a simulation model: (1). It is easy and quick to learn and use; (2). It has a broad range of predefined functions and tools to build, operate and test the models; (3). It is easy to generate graphs and tables, which can be viewed as dynamic outputs (Smith et al., 2005). On the other hand, the major weakness of this approach is its limited flexibility (Smith et al., 2005). For instance, the user generally has less capacity to modify the system with respect to advanced modeling tasks or particular objectives (Costanza & Voinov, 2001).

CHAPTER FIVE:

ISSUES, RISKS AND SHOCKS TO THE LOCAL COMMUNITY

Chapter Two discussed the background of Zoucheng city. The economic activities indicate a mineral resource-dependent lifestyle in the local community. However, coal mining activity is normally accompanied by serious threats to the environment such as land subsidence, seasonal or perennial waterlogging and soil erosion, which can cause losses in agricultural production (Hu et al., 2013). In addition, poor atmospheric quality caused by mining may decrease the number of potential tourists. Finally, over-reliance on mining activity may also limit households' livelihood choices. This chapter explores the risks, issues and potential shocks of mining activities in the local community (i.e., in Zoucheng).

5.1 The impact on agriculture: Farmland quality

Zoucheng belongs to an area where there is heavy production of both coal and grain. In Zoucheng city, the increase in mining activities has resulted in the loss of farmland and negative impacts on water quality and areas, which further impact farmland quality and crop yields.

Large areas of farmland and construction land were eroded by land subsidence in the Jining mining area (Guo & Liu, 2012). The total subsidence area was about 66,000 mu (more than 4,200 ha) (Yang et al., 2007) and these areas were predicted to increase by 2,500-3,000 mu per year in Zoucheng city (The conciliation commission of regional economies, 2006, Dec).

Although these subsidence areas are a relatively small proportion of the total land area in Zoucheng, they have a direct effect on the life of residents, especially with regard to agricultural livelihoods. Coal mining activities lead to serious damage to nearby

cultivated fields (Hu et al., 2012). In Yanzhou Coalfield, a large number of local farmers have lost their lands, which in turn intensifies the conflict of interests between the extraction companies and the need for cultivated land (Hu & Zhao 2007; Xu et al., 2014). In Zoucheng, the subsidence areas increased to around 80,300 mu (about 5,353 ha), of which about 43,000 mu (about 2,867 ha) were agricultural land in 2010 (Li, 2012). Table 5.1 summarises the subsidence areas in Zoucheng city in 1998, 2000, 2002, 2004, and 2010. The subsidence areas showed a gradual increase during this period, directly affecting five village towns (Zhongxin, Beisu, Taiping, Pingyangsi, and Tangcun) and more than 20 villages (Yang et al 2007). By 2006, seven schools, 17 factories and 23 villages had to be removed and relocated as a result of the increase in subsidence areas (The conciliation commission of regional economies, 2006, Dec). In the most affected areas, the farmland per capita was reduced to less than 0.2 mu in more than ten villages in 2009. With the current growth rate, the total subsidence areas in Zoucheng will have increased to 150,000 mu, about 67 villages will have to be relocated and about 200,000 people will lose their land by 2050 (The conciliation commission of regional economies, 2006, Dec).

Table 5.1: *Subsidence areas in Zoucheng city*

Year	1998	2000	2002	2004	2010
Subsidence areas (ha)	2,600	3,182.34	3,515.6	4,266.67	5,353.3

Source: Author's compilation from Yang et al. 2007; Li, 2012.

Table 5.2 shows the changed rate of land use in six village towns in the local mining area from 1990 to 2005. Farmland size clearly declined, while urban and industrial areas significantly increased (except Pingyangsi). The changes in Pingyangsi village town may be due to labour migration from farming to mining in other village towns as a result of the reduced service life for the local mines. In addition, Pingyangsi is one of the village towns most affected by land subsidence in Zoucheng (The conciliation commission of regional economies, 2006, Dec).

Table 5.2: *Changes in rate of land use in village towns from 1990 to 2005 (%)*

Village town	Farmland	Water area	Urban and industrial area
Pingyangsi	-16.29	122.56	-7.01
Beisu	-10.4	43.07	13.84
Taiping	-73.47	-2.3	293.94
Tangcun	-1.18	27.72	1.82
Guoli	-1.41	11.8	3.48
Shiqiang	-0.91	-0.45	17.96

Source: Author's compilation from Yang et al 2007

Furthermore, mining activities led to profound modifications of water quality and area. In the Yanzhou Coalfield, underground coal mining affects the main water-rock interactions that lead to altered chemical characteristics, such as alkalinity of the groundwater (Han et al., 2013).

In addition, some water reservoirs were created with the increase in subsidence, due to the collapse of the areas above underground coal excavations (as cited in Sierka et.al, 2009; Jankowski & Molenda, 2007). Water reservoirs in subsidence area are treated as mining damages (as cited in Sierka et.al, 2009). In the Yanzhou Coalfield, the depth of subsidence is up to 3-10 m below the surface, while the water table is high, at about 3-4 m (Hu et al., 2012). As a result, water collects in the middle of the sinking basins, destroying nearby arable land (Hu et al., 2012). In 2007, there were 15 water bodies and a total water area of 18 km^2 in the mining area that were the result of subsidence in the Yanzhou Coalfield (Hu et al., 2012). In the Zoucheng mining area, Table 5.2 shows that water area increased as farmland shrank, except in Taiping and Shiqiang village towns, where both slightly decreased.

In the Jining area, there is a potential causal relationship between subsidence areas and water areas or wetland systems in the mining area (Guo & Liu, 2012). Because of the degree of subsidence and the rising of the water table, the effective moisture of the soil changes. The increased soil moisture content may lead to fewer crop roots and problems with root establishment (Loheide, 2011). High moisture in the soil also affects

salinization (accumulation of salt in the soil profile) and waterlogging in the rainy season (Loheide, 2011). All of these can cause degradation of land quality, soil erosion, and crop yield reduction in mining areas (Xu et al., 2014).

As a result of the influences of subsidence and water area or wetland systems in mining areas, damaged cultivated land is categorized into three grades: mild yield reduction areas; moderate yield reduction areas; and out of yield areas (Bi & Ding 2003; Hu et al., 2007; Kong, 2007). Mild yield reduction areas suffer from a reduction in soil moisture and fertility which influences crop yields to a certain extent. Moderate yield reduction areas have more serious damages because of the subsidence, seasonal waterlogging, and land salinization, leading to crop yield reduction and potentially an eventual total loss of the crop yields. In loss of the crop yield areas the ground surface falls below the groundwater level as a result of mining subsidence. Consequently, crop yield is totally lost in these areas because they are under water (Xu et al., 2014). According to Xu et al. (2014), land subsidence and groundwater level influence the farmland quality and crop yields in the Zoucheng mining area.

For water areas and subsidence areas, land reclamation consists of either gravitational drainage or producing different, value-added products such as developing aquaculture in Zoucheng. For instance, Xigu village in Beisu village town established an aquaculture base using this kind of water area (The conciliation commission of regional economies, 2006 Dec). However, Bury (2004) and Molenda (2006) pointed out that the deposition of post-coal mine wastes significantly changed the water quality in reclamation reservoirs.

In terms of soil quality in the Zoucheng area, mining subsidence can lead to soil desertification, pollution, and soil erosion (Wang et al., 2009; Meng et al., 2009). Mining subsidence together with declining regional underground water levels changes the slope of the ground surface, which aggravates soil erosion (Meng et al., 2009). Subsidence changes the slope of the cultivated land and in some cases, increased surface runoff leads to more serious soil erosion (Xu et al., 2014). In the Yanzhou coal

mining area, the pH, sulfate levels, total hardness and solid content in subsidence areas are extremely high, which poses potential risks to the quality of groundwater, public health, and soil quality (Meng et al., 2009). Yang, et al. (2007) used statistical data in Zoucheng city to analyze coal mining effects on local ecosystems and land use change. The results indicated that the land use structure changes rapidly and soil quality gradually decreases with the growth of coal mining, which negatively impacts on agricultural production in the area.

5.2 The impact on tourism: Air pollution

One of the negative effects of coal production is air pollution (see Chapter One and Chapter Three), which may affect the attractiveness of Zoucheng and reduce the number of tourist arrivals.

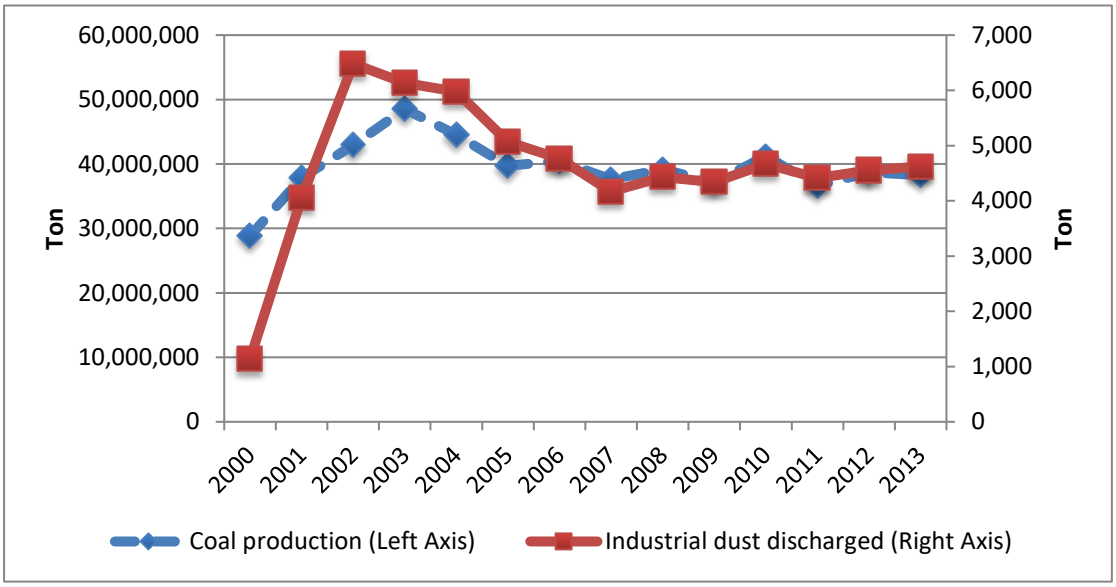
As discussed in Chapter Two, Zoucheng and other surrounding cities lie within the Yanzhou Coalfield. Given spillover effects, pollution within Zoucheng, particularly air pollution, is not only caused by mining activities in Zoucheng, but also by activities outside the county. More broadly, there may be various causes of local air pollution. However, the actual development characteristics of Zoucheng, such as the dominant role of mining in the local economy, cause the authorities to engage in introspection rather than take responsibility. I have lived in Zoucheng for more than 20 years. The widely recognized and accepted belief in the local community is that local mining is the direct and most important cause of worsening air quality, with the altered distribution and dispersion of airborne dust in the local urban area being due to increased mining activities in the west of the city.

In Zoucheng city, tourism is relatively small and undeveloped, so it contributes less than mining in the economic area. As with coal mining's effects on agriculture, there is little research about the relationship between mining and tourism in Zoucheng. However, poor air quality may impair environmental tourism products and reduce the

numbers of potential tourists. It is important to analyse the effect of coal mining on local air quality.

In Zoucheng city, coal mining operations in local mines and coal consumption by the local coal-fired power plant (Zouxian power plant) may degrade the local atmospheric environment. In addition, mining subsidence leads to soil desertification and erosion, which increase dust in the atmosphere, and consequently increases air pollution (Wang et al., 2009). Figure 5.1 illustrates the growth trend for coal production and industrial dust discharge in Zoucheng city from 2000 to 2013. The left axis represents coal production and the right axis is the volume of industrial dust discharged. One thing that must be noted is that coal production is not the only source of industrial dust discharged in the city. However, with the high level of local GDP growth and the dominant role of mining in local industries, coal production is largely to blame for this pollution issue. As shown in Figure 5.1, coal production and industrial dust discharge showed very similar movements in the period 2000-2005 (for example coal production increased from about 29 million tons in 2000 to more than 39 million tons in 2005, which was associated with industrial dust discharged increasing from about 1,140 tons in 2000 to about 5,067 tons in 2005), and there were similar results for the period 2006-2012. Only two periods (i.e., 2005-2006 and 2012-2013) indicated an opposite movement.

Figure 5.1: *Coal production and industrial dust discharged in Zoucheng from 2000 to 2013*

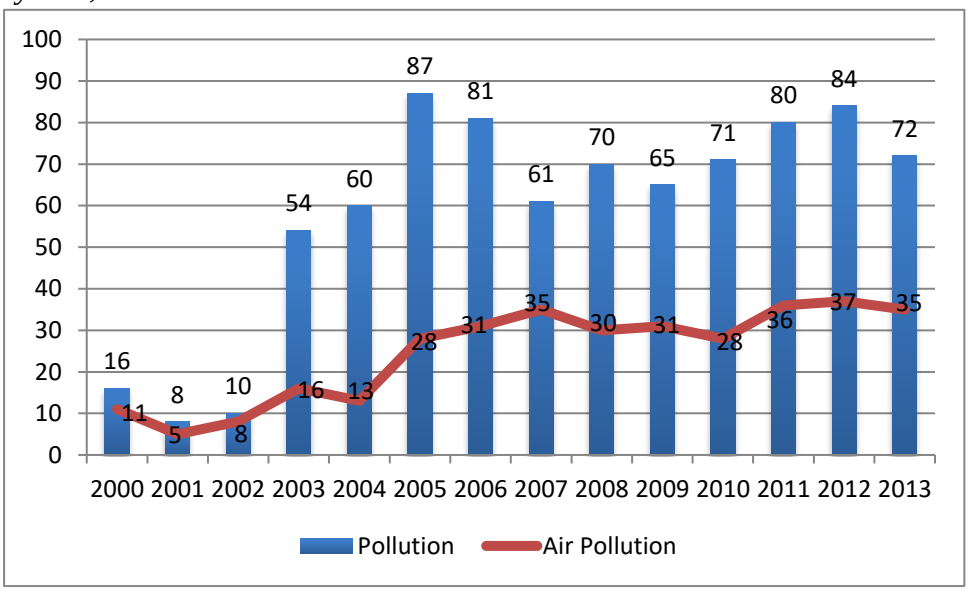


Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013

Although the local economy has grown rapidly, rising incomes tend to be correlated with a greater demand for environmental quality (Anderson & Locker, 2002). In the coal mining areas, the typical political issues are the problems that arise between local people and coal mine-induced environmental problems (Shi, 2015). In Zoucheng city, there is growing awareness among residents that environmental issues have caused health risks, even when total coal production was generally decreasing after 2003. Figure 5.2 shows the number of pollution issues petitioned by residents to the local Administrative Petition System from 2000 to 2013. This can be considered the residents' feedback on local environment quality. The bar chart represents the total number of pollution issues including water, air, noise, air and others each year. The environmental issue most directly related to the operation of the mines is air pollution (Ghose & Majee, 2000). Therefore, the line graph presents the number of exhaust emission petitions each year. On both graphs, the general trends are upward. In the first three years, pollution issues were kept at a low level. Then, complaints about general pollution climbed rapidly to 54 and air pollution was down at 16. In 2005, the total pollution complaints increased to a peak of 87 and air pollution rose to 28. In the next two years, the number of general pollution cases dropped slowly to 81 in 2006 and sharply to 61 in 2007, while air pollution issues continued to rise, increasing to 35 in 2007. The following year,

general pollution petitions rose slightly to 70 then dropped to 65 in 2009, before gradually rising again to 84 in 2012. In 2013, the number of general pollution cases decreased to 72. Meanwhile from 2008 to 2013, the number of air pollution issues fluctuated around 33, peaking at 37 in 2012. These graphs therefore indicate that: 1. Local residents have gradually paid more attention to local environmental issues; and 2. More sustainable policies are needed to coordinate economic development and environmental protection.

Figure 5.2: *Number of pollution issues in the Zoucheng local administrative petition system, 2000-2013.*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2013.

In addition to being an industry, rural tourism is a multi-faceted activity rooted in environment and social resources (Yang et al., 2010). The local community can take advantage of various environmental and social resources to develop a variety of environmental and cultural tourism products (Cawley & Gillmor, 2008; Garrod et al., 2006). However, lack of cleanliness can make cities unattractive (World Bank, 2010).

In Zoucheng, most of the tourism resources are scenic spots (see Section 2.2.2.1), which are often sensitive to environmental damage. Poor air quality may also damage historical sites in the long term. Furthermore, a high quality environment is a decisive element of tourism development, in terms of attracting more visitors (Yang et al., 2010).

Thus, coal production, the industrial dust discharged, and related pollution issues may potentially threaten local tourism resources and the attractiveness of Zoucheng, which in turn decreases local tourism development.

5.3 Over-reliance on mining activity

Working in mining is a livelihood strategy for many households in Zoucheng. The sustainable livelihoods approach seeks to understand the factors that lie behind people's choice of livelihood strategy. Then, it develops and reinforces the positive sides and mitigates the constraints or negative effects of current livelihood activities (DFID, 1999). Examining the amount of income resources provided by different household members is important when thinking about livelihood strategies (DFID, 1999). Thus, this section discusses the distribution of income resources between miners and their partners (married or lived together).

Because of privacy issues about people's incomes and the difficulty of gathering information about "underground economic activities", this study collected information on base payments and bonuses as part of monthly income. Total family income is based on that of the survey respondent and their partner. In this household survey the average mining wage was about 2,943 yuan per month, with the partner's wage being about 1,689 yuan per month. The miners' proportion of the household income (64%) was almost double their partners' (36%).

When the responses were divided into urban and rural households, the effect of occupation on total income structure as divided between participants and partners produced different results. In urban households, the average mining wage was around 3,192 yuan per month, which made up about 57% of total household income. In rural households, the situation is more significant. On average, the participants' incomes decreased to about 2,736 yuan, which made up about 73% of the total household income. In general, miners received significantly better levels of pay than their partners in households in both urban and rural areas.

Of the total 194 participants of the household survey who completed the mining income section, about 84% of households had a mining income as their family's main source of income, and 85% considered that the income of the current job could cope with daily household expenses. For income sources in rural households (105 participants), only about 1% of households had farm activity (i.e., total income from crop production) as the main source of their households income, and about 32% of rural households considered their agricultural production income could deal with their routine household expenses.

Comparing the significance of mining incomes in rural and urban households, mine work plays a more important role in rural households than in urban ones. This income source dependence potentially increases the vulnerability of rural household, which might further reduce the range of options and the ability to switch between multiple strategies to secure their livelihoods. Because mining is dependent on a non-renewable resource, it is not a sustainable industry for the local community in the long term. Thus, coal miners and other related-industry workers may lose their jobs when local mineral resources have been consumed or mines are unexpectedly closed by government command. Rural mining households are likely to suffer more pressures since they derive more of their income from mining. As discussed in Chapter Three, rural mine labourers are normally categorized as farmers in China. They have to return to their farms once mining operations are shut down. This is one of the important reasons for this study focusing on rural households in the simulation model (see Chapters Seven and Eight) to help them to deal with these potential shocks to their livelihoods. The preceding discussion shows that rural dwellers in Zoucheng city have to be encouraged to access more livelihood assets and local resources to find an alternative sustainable livelihoods with the help of relevant policy implementations.

However, because mining is highly paid in the local labour market, this may slow down the process of transition to alternative livelihoods. For instance, a highly paid miner is very unlikely to leave his current job and operate an alternative industry (e.g., rural

tourism) with relatively low rates of pay. As discussed in Chapter Two, local mining cannot satisfy the level of job demand from rural households. It is not possible to provide enough mining jobs to accommodate all members of rural households. However, because of the low rates of pay for partners in mining households, these household members are a more likely target group for alternative livelihoods. Although miners' own self-interests are not changed, the interests of their households are enhanced. In this case, the purpose of encouraging other household members to work in alternative livelihoods is to diversify household livelihood choices and reduce potential shocks and risks of over-reliance on mining activity. With the development of alternative industries (e.g., rural tourism), mining households always have the ability to deal with mining job losses.

CHAPTER SIX: SOCIAL CAPITAL

6.1 Introduction

This chapter presents the empirical study results on social capital in Zoucheng. It firstly measures the strength of social ties (non-kin and kin ties) in current social resources. After that, regression analysis is used to examine Research Question (1). Research Question (1) involves associations with the composite measure of access to social capital, which was outlined in Sections 4.3.2 and 4.7.1. More specifically, it investigates whether there is a significant relationship between social capital and other livelihood assets such as human capital (e.g., graduated from middle school or higher educational levels) and resident characteristics (e.g. years resident in local city). The main purpose of this regression model is to examine the empirical relationships between the strength of social ties (e.g. kin and non-kin ties) and social capital (also see Research Question (1) in Chapter One).

These research results have implications for government policy regarding revenue generation, increasing competitive advantages in alternatives such as tourism, and economic development. The applications are used in a simulation model (Chapter Seven), which tests the Research Question (2) in Chapter One.

By following the research methods in Chapter Four, the following sections provides the general distribution of the role relations (non-kin and kin ties) among research participants and the regression results of factors associated with access to social capital.

6.2 The strength of social ties

Table 6.1 summarizes the frequency with which each position was accessed in the sample, by the strength of ties. Due to missing data, these data are only available for 218 of the 228 respondents.

Three indicators of social capital (number of positions accessed, upper reachability, and range of positions accessed) indicate the overall measures of social capital. The mean number of positions accessed was 4.32; the mean prestige of the highest accessed position was 69.3 (about the position of Journalist) and the mean range between the lowest and highest prestige scores was 41.8. All three indicators were lower than Lin's (2001; 2004) study in several large metropolitan cities in China (number of positions, 6.80; highest accessed position, 73.90; range, 44.4). Urban respondents were more likely to have advantages in prestige of highest accessed position and range of prestige of positions accessed than rural respondents. However, the number of positions accessed is not statistically significantly different between rural and urban residents.

In general, the respondents tended to use more non-kin ties (e.g. friends, acquaintances) than kin ties to access most of the social positions (10 of the 13 positions are statistically significant). The exception to this was the 'Farmer' position, which was accessed more using kin (56%), than non-kin ties (26.9%). These kin ties for the 'Farmer' position may be spouses or other relatives living in the adjacent Zoucheng city. This special relationship between miner and farmer may have some implications for government policies on developing alternative economic activities such as rural tourism for rural households. With regard to access to high-ranking positions enabling the availability of better resources for social actions (discussed in Chapter Three), miners could help their relatives (farmers) to access more information to diversify their livelihood choices.

Table 6.1 also compares the use of kin and non-kin ties in accessing each position, separately for respondents living in rural or urban areas. Urban respondents were more likely to use kin ties for 3 of the 13 positions (Mayor, Head of Bureau, and Farmer), which might indicate a special and close relationship between rural and urban residents in a small city. Urban respondents were also more likely to access job positions using non-kin ties (9 of the 13 positions are statistically significant). Furthermore, both urban and rural respondents used more non-kin ties than kin ties to access the positions (8 of the 13 positions are statistically significant).

In summary, both kin ties and weak ties are important factors associated with social capital for the mining sector residents in Zoucheng County and adjacent rural areas. Urban respondents use weak ties more often than kin ties to access job positions.

Table 6.1 Comparison of Access to Social Capital by kin and non-kin ties between rural and urban areas (N=218)

Variable	**Mean**			P-value for sig difference between urban and rural	Percent Using (Kin & Non-Kin)										
					Percentage Using (Kin)				Percentage Using (Non-Kin)				P-value for sig difference between Kin & Non-Kin (Rural)	P-value for sig difference between Kin & Non-Kin (Urban)	P-value for sig difference between Kin & Non-Kin (Whole sample)
General social capital (Position score)	Whole sample	Rural	Urban												
Number of positions accessed	4.32	4.11	4.52	0.20											
Prestige of highest accessed position	69.27	65.97	71.79	0.01											
Range of prestige of positions accessed	41.84	35.33	45.79	0.00											
Accessed positions (prestige score)	Percent			P-value for sig difference between urban and rural	Whole sample	Rural	Urban	P-value for sig difference between urban and rural	Whole sample	Rural	Urban	P-value for sig difference between urban and rural			
	Whole sample	Rural	Urban												
University professor (91)	30.8%	29%	32.9%	0.07	2.9%	3.5%	2.4%	0.65	12.8%	9.2%	16.5%	0.06	0.10	0.02	0.00
Mayor (83)	18.7%	16%	21.4%	0.47	2.9%	1.2%	4.8%	0.04	4.7%	3.5%	6%	0.30	0.05	0.52	0.1
Head of Bureau (76)	35.7%	26%	45.7%	0.00	9.9%	6.8%	13.3%	0.00	14%	6.8%	21.7%	0.00	0.69	0.14	0.31
Lawyer (72)	32.4%	23%	42.1%	0.02	2.9%	2.2%	3.6%	0.49	17.2%	10%	26.5%	0.00	0.02	0.00	0.00
Journalist (68)	24.7%	23%	26.7%	0.15	2.9%	3.4%	2.3%	0.34	10.9%	8%	14%	0.09	0.01	0.00	0.00
Head of Enterprise (67)	40.7%	39%	42.9%	0.14	6.4%	9.1%	3.6%	0.28	23.8%	19.3%	28.6%	0.05	0.29	0.00	0.00
Chief of a Section (60)	62.9%	58%	67.8%	0.00	11.2%	14.29%	8.1%	0.79	45.5%	38.5%	52.9%	0.01	0.02	0.00	0.00
Elementary School Teacher (58)	91.6%	92%	90.8%	0.64	23.2%	26.2%	19.5%	0.80	61.1%	57.3%	65.5%	0.16	0.49	0.29	0.22
Worker (45)	88.7%	87%	90%	0.11	35.1%	37.9%	32.2%	0.59	48.7%	44.2%	53.3%	0.03	0.9	0.15	0.4
Administrative Personnel (45)	52.5%	50%	55.3%	0.01	12.2%	11.5%	12.9%	0.83	30.9%	29.2%	32.9%	0.35	0.05	0.06	0.01
Electrician (44)	78.7%	80%	77.3%	0.80	16%	21%	10.2%	0.35	56.9%	53%	61.4%	0.09	0.05	0.00	0.00
Farmer (30)	85.7%	83%	88.5%	0.09	56%	52.6%	59.8%	0.04	26.9%	29.5%	24.1%	0.78	0.00	0.00	0.00
Housemaid (11)	26%	15%	37.8%	0.00	2.4%	1.2%	3.7%	0.22	13%	2.3%	24.4%	0.00	0.13	0.35	0.06

6.2 Factors associated with access to social capital

Table 6.3 describes the results of the regression analysis on factors associated with access to social capital. The survey dataset contains data on more than 190 households from 17 village towns in Zoucheng. It is very possible that the residents in each town may not be independent, and this could lead to residuals that are not independent within each village town. In other words, people in the same social network are likely to have similar characteristics and similar relationships to social capital. Thus, the regression also corrected for clustering at the village level.

The equation used the social capital score as the dependent variable. The results demonstrate that access to social capital increases with most of the explanatory variables, except for expenditure on phone and the Internet, low education level, and family size and rural area, which decreases social capital. The nature of the variables being used on this regression model such as household wealth (own a car) and expenditure may have a multi-collinearity effect on the findings. Thus, the study firstly looked for multi-collinearity in the regressors. This study does not encounter the problem of multi-collinearity (see Table 6.2).

Table 6.2: Collinearity Diagnostics for Variables used in the Social Capital Model (OLS)

Variable	VIF	1/VIF
Years resident in Zoucheng city area	1.27	0.79
Own a car (Foreign)	1.1	0.91
Expenditure on phone and internet	1.02	0.98
Higher education (e.g. diploma, bachelor or higher)	1.33	0.75
Middle School	1.43	0.7
Job accessed through kin ties (%)	1.06	0.94
Job accessed through non-kin ties (%)	1.05	0.96
Family size	1.05	0.95
Resident area (rural=1)	1.08	0.93
Mean VIF	1.15	

Note: High multi-collinearity exists if VIF values are larger than 10 (Gujarati & Porter, 2009, p. 362). All the variance inflation factors (VIF) values are less than 10, which confirms that this study does not encounter the problem of multi-collinearity.

Living in rural areas had a negative association with access to social capital, which contrasts with the higher numbers and range of positions that could be accessed in big cities (Lin, 2001; 2004).

The number of years that a person had lived in the Zoucheng city area had a pronounced, positive association with access to social capital. For instance, people who grew up together tend to have interacted frequently and built up long-term relationships in the community (Gertler, et al., 2006; Onyx & Bullen, 2000). The longer respondents have lived in the local city area, the more opportunities they have to access a greater number of people, acquire information through friend and expand their social circles.

Table 6.3: Factors associated with Access to Social Capital (Partial Regression Coefficients, N=191)

Explanatory variable	OLS with Cluster Option	
	Coefficient estimate	Standard error
Years resident in Zoucheng City area	0.018**	0.008
Own a car (foreign)	0.604***	0.121
Expenditure on phone and internet	0.001	0.001
Higher education (e.g. diploma, bachelor or higher)	0.394**	0.185
Middle School	-0.09	0.095
Job accessed through kin ties (proportion)	1.395***	0.357
Job accessed through non-kin ties (proportion)	0.975***	0.327
Family size	-0.076	0.078
Resident area (rural=1)	-0.409**	0.15
Constant	-0.769**	0.3
R-squared	0.337	
Adjusted R-squared	-	
F Test	58.85	
Probability>F	0	

Statistically significant at 10 %(*), at 5% (**) and at 1% (***)

The results show that people who graduated from school with at least a college education (e.g. diploma or above) have greater access to social capital. This may be because these people have more opportunities to access higher positions in social hierarchies. In addition, people with higher education normally have better employment, and can use these positions to access a greater number of occupational and political positions, or higher positions within the industry. By contrast, respondents with a lower-level nine-year compulsory education experience some disadvantages when trying to access social capital.

Furthermore, the percentages of kin ties and weak ties possessed by individuals have a positive relationship with access to social capital. Both kin and non-kin ties are equally likely to be able to access social capital since the two coefficients are not statistically different from each other (Prob>F=0.359).

The results confirm firstly the importance of kin ties in China for access to social capital. In China, many villages are named after the family that makes up the largest proportion of the population, emphasising the characteristic of kinship. Kinship networks play a very important role in rural Chinese life. For instance, relatives help each other in events such as death, birth, and marriage. (Chu, June 2001). These findings are consistent with Lin's (2001; 2004; 2001a) point that vulnerable groups tend to gain benefit through kin ties. In addition, the coefficient of weak ties is also significant. Bian & Ang (1997) suggests that weak ties are also important means to access resources in the Confucianist Chinese society in rural areas and small county cities.

Regression analysis showed that ownership of a foreign car had a positive association with social capital, possibly meaning that higher income or financial support is associated with greater access to social capital.

Some modern tools (cyber networks and mobile phones) have become popular means of communication within kin and friendship networks (Lin, 2001; 2004; 1999a; Gilchrist & Kyprianou, 2011). However, in this study, the results showed that monthly expenditure on phone and the Internet was not significantly related to access to social capital. Nor does family size appear to have a significant association.

6.3 Conclusions

The results of studies on social capital summarized the strength of social ties and social network resources in social capital in a small city in China. Drawing on the work of Lin (2001; 2004), this chapter discussed kin and non-kin social ties and how these different types of ties lead to differential access to social capital. The results of

this chapter indicate that kin and non-kin ties are equally effective ways to access social capital in a small community.

CHAPTER SEVEN: SIMULATION MODELING

7.1 Introduction

From the previous discussions on local economic background and social capital analysis, several results can be applied in this chapter. First, Zoucheng is rich in mineral and tourism resources. Coal mining brings higher incomes and more job opportunities for local residents, while tourism shows a slow development. Second, the danger is that coal mining pollutes the local environment, particularly affecting air quality, and degrades farmland quality. However, mining is still a preferred job in the local community because of the high pay rates in mining and the lack of alternative livelihood choices for local coal miners. However, mining household members (i.e., partners) with lower income levels may be a target group for the development of some alternative livelihood choices. Third, rural tourism has potential for development in this region. These results have implications for government policy regarding livelihood choices. The objective of the work in this chapter and the next is to identify and examine potential livelihood paths that might be more sustainable for related households that suffer the issues of mining activities in Zoucheng.

This chapter develops an economic model based on the system dynamics framework to simulate the impacts of alternative policy implementation so as to diversify livelihoods. It develops and simulates a conceptual and empirical basis for the role of social capital in facilitating people's access to an alternative livelihood. Compared to mining development, the competitive advantage of tourism is expected to increase through social capital application and the development of tourist resources in the local city, which may provide more livelihood choices for rural labourers.

The system dynamics approach synthesizes relevant information that is based on previous studies and data collected in this study to analyze their dynamics over time. The simulation results are important to help local decision makers to better address the issues, tradeoffs and conflicts associated with sustainable management of residents' livelihoods and resources.

There are three stages in complete the process of system design, model development, and behavioural analysis. These stages include development of the model concept, development of the simulation model, and simulation of system behaviour in response to policy analysis design (Tshimpanga, 2012). Chapter Seven and Chapter Eight undertake these stages. Chapter Seven first outlines the analytical framework. Then, it introduces the process of simulation model development. Chapter Eight presents the results of the model based on different policy implementations.

7.2 The Analytical Framework

The framework broadly treats natural resources, livelihood choices, labour distributions, livelihood assets (e.g. social capital and natural capital), industries (e.g. mining, agriculture and tourism) and products, and individual incomes as endogenous and interrelated to simulate the general economic and livelihood scenarios.

A wide variety of models are based on systems theory to develop approaches to understanding the dynamic behaviour of complex systems (e.g. Garcia-Barrios, Speelman, & Pimm, 2008; Jogo & Hassan, 2010; Walker et al., 2005; Hao, et al., 2007). All of these complex systems include multiple elements that are tightly interwoven into one system. The adapted framework used in this study consists of five subsystems: mining, agricultural production, social capital, tourism, and livelihood outcome. All of these subsystems are defined as different components of local economic and household livelihood development. Moreover, a set of causal relationships are designed to investigate interconnections among subsystems to determine how changes in one subsystem affect others, and the influences of the resulting feedback. Finally, following DFID (1999), Lin (2004) and the household survey analysis conducted in this study, this chapter develops indicators to measure relevant types of assets such as social and human capital and their interrelationships for local mining households. Social capital is as defined by Lin (2001), natural capital consists of the quality of farmland and the coal deposits, and human capital is represented by numbers of workers. All of these components and their interrelationships are illustrated in Figure 7.1.

Figure 7.1: *Analytical framework showing the interactions between components of the system*

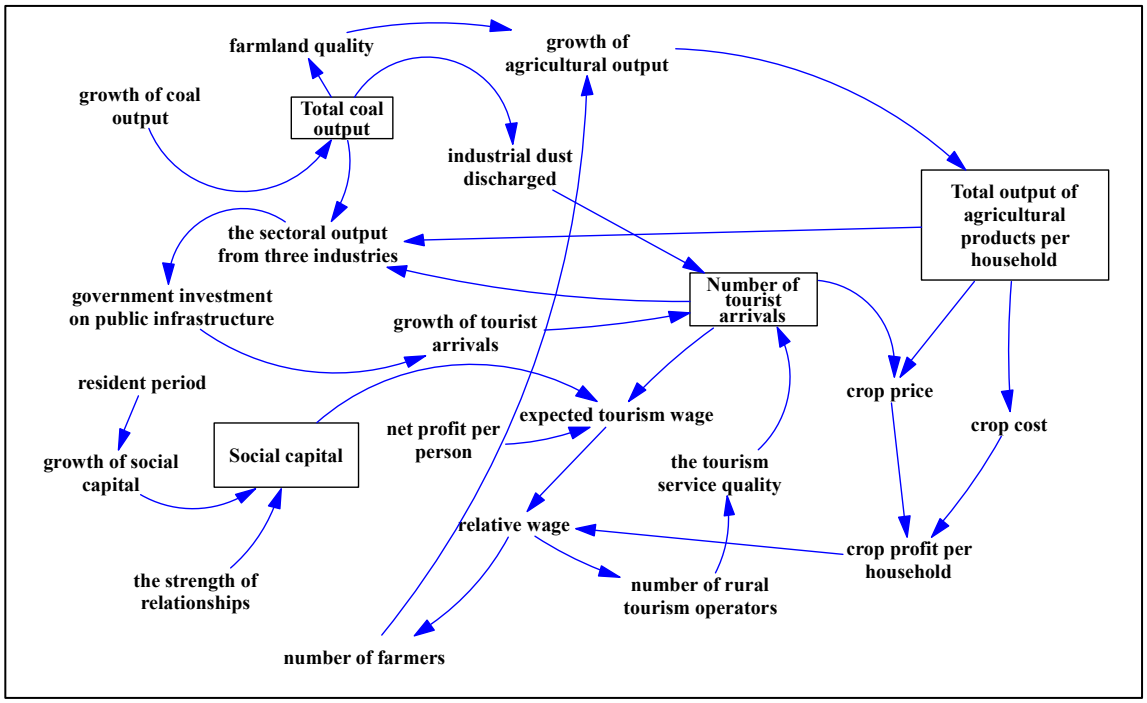


Figure 7.1 illustrates the main sectors of the model and how they connect with each other. The modelling design and process are based on data and information from Zoucheng. The model built here will first simulate the environmental issues resulting from coal production. Coal production degrades farmland quality and pollutes the local environment, which in turn affects the growth of agricultural outputs and the number of tourist arrivals.

The traditional livelihood of Chinese farmers is agriculture (He & Chen, 2012). Thus, agriculture is an important subsystem in the simulation model. The agricultural production subsystem includes crop production and farmland quality at a household level. The growth of agricultural output depends on the growth of agricultural inputs, for example, natural growth (such as natural generation of fruit crops in orchards or re-seeding of land) and labour input. Farmland quality is negatively linked to coal mining activity, as discussed in Chapter Three and Chapter Five. The influence of total labour input (i.e., number of farmers) on the growth of agricultural output is assumed to be very low in the simulation

model. This is because of the issue of surplus agricultural labourers and the very low marginal productivity in the agricultural sector, which is almost zero for some crops in China (Fan et al., 2003; Wan & Cheng, 2001). Rural workers are simulated as having more livelihood choices (e.g. tourism) and moving between farming and tourism activities. Finally, total net profits (seasonally) from farming activities are generated from the difference between crop cost and price. In the simulation model, crop price and the total cost are influenced by agricultural outputs. Tourism also brings benefits for farm products. More tourists may drive the price of agricultural products up, which may change the crop profits in the simulation model.

The negative correlation between tourist numbers and coal production is simulated in the tourism subsystem. Tourists prefer a good environment, particularly in terms of air quality (Vargas, et al., 2009). In the tourism subsystem, air pollution resulting from the mining industry will reduce the number of tourists. On the other hand, government investment in public infrastructure may attract more tourists as more facilities become available for on tourism services. In the simulation model, government investment in public infrastructure alters with the growth of total sectoral output values (mining, agriculture and tourism). The quality of tourist services is affected by the number of rural tourism operators; more of them will attract more tourists. An increase in the number of tourist arrivals in Zoucheng is likely to mean an increase in expected tourism incomes and in the number of workers required in the tourism industry.

The social capital component is influenced by the length of residence in the area because of the increased opportunities and time available to maintain and increase social networks and relationships. According to some studies (Aguilera & Massey, 2003; Lin, 2001a; Bian, 1997; Granovetter, 1995), through social connections, individuals obtain valuable information and overcome structural barriers in the labour market, which may improve the effectiveness of the job search process and subsequent earnings. In the simulation model, the expected tourism income not only follows the net profit from each tourist and the number of tourist arrivals in Zoucheng, but is also limited by the absence of social capital. Low social capital levels mean fewer channels to access information and consult about operating rural tourism.

The livelihood outcome of the system is influenced by benefits derived from two areas: farming (agriculture) and non-farming activities (rural tourism, mining). Due to the dominant role of local mining, income from exploiting mineral resources is obviously higher than from agriculture and tourism. Therefore, income and employment in mining are assumed to be constant so as to simulate the possible alternative livelihoods (in agriculture and tourism) for other mining household members (excluding miners themselves). In the simulation model, there are two livelihood choices for mining households' members, including farming activities and rural tourism operation. The labour distribution is determined by the different expected incomes in agriculture and rural tourism. The model allows the identification of social capital effects on the development of an alternative livelihood (rural tourism).

7.3 The Empirical Model Components and Assumptions

Farming, coal mining, and tourism business are the most important activities supporting the well-being of the local community. The empirical model concentrates on these three livelihoods, their interrelationships, social capital applications, and simulated results (livelihood outcomes). The model integrates five subsystems, which are discussed in detail below. The key equations are given in each section. Furthermore, all key variables are defined as follows:

Coal Mining Module:

$\mathbf{C}$	Total coal output	$\dot{\mathbf{C}}$	Growth rate of coal output
$\bar{\mathbf{C}}$	Potential or maximum coal output	$\mathbf{RG_C}$	Intrinsic growth rate of coal output

Agricultural Production Module:

$\mathbf{A}$	Agricultural output per household	$\dot{\mathbf{A}}$	Growth rate of agricultural output per household
$\bar{\mathbf{A}}$	Potential or maximum agricultural output	$\mathbf{P_A}$	Price of agricultural output per kilo
$\mathbf{Q_F}$	Farmland quality per household	$\mathbf{PL_A}$	Mining effects on farmland quality
$\mathbf{S_{PLA}}$	Scaling constant of coal mining effect on farmland quality	$\mathbf{RG_A}$	Intrinsic growth rate of agricultural output
$\mathbf{N_A}$	Number of labourers in farming	$\mathbf{S_{NA}}$	Scaling constant of labourers in farming on growth rate of agricultural output

Tourism Module:

$\mathbf{T}$	Number of tourists	$\bar{\mathbf{T}}$	Carrying capacity of tourist arrivals
$\dot{\mathbf{T}}$	Growth rate of tourist arrivals	$\mathbf{RG_T}$	Intrinsic growth rate of tourist arrivals
$\mathbf{INV}$	Government investment in public infrastructure or relevant tourism facilities	$\mathbf{Y}$	Sectoral output value from Y_C (coal mining), Y_A (agriculture), and Y_T (tourism)
$\mathbf{S_{LT}}$	Scaling constant of tourism quality on growth rate of tourist arrivals	$\mathbf{N_T}$	Number of rural tourism operators
$\mathbf{S_{PLT}}$	Scaling constant of pollution effect on tourist arrivals	$\mathbf{PL_T}$	Mining pollution on local atmosphere
S_{INVT}	Scaling constant of government investment effect on the intrinsic growth rate of tourist arrivals		

Social Capital Module:

$\mathbf{RS}$	Residence period	$\mathbf{SK}$	Social capital

Livelihood Outcome Module:

$\pi_{\mathbf{A}}$	Crop profit	$\mathbf{PC_A}$	Cost of agricultural output per kilo
$\pi_{\mathbf{T}}$	Net profit per person in tourism	$\mathbf{D_I}$	Relative expected income difference between farming and tourism
$\mathbf{I}$	Total expected incomes of I_A (agriculture) and I_T (tourism)	$\mathbf{L}$	Total workers

$\mathbf{S_{SKI}}$	Scaling constant of social capital effect on tourism incomes	$\mathbf{S_{TIRT}}$	Scaling constant of tourist effect on expected income in agriculture.
$\mathbf{P_A}$	Price of agricultural output per kilo	TIR	Tourism intensity rate

7.3.1 Coal Mining Module

The coal mining subsystem mainly comprises two linked variables: overall growth rate per unit time of coal output ($\dot{C}$) and total coal output (C). The growth of coal output is defined here inclusively to present the dynamic process of coal production, which further impacts on farmland quality and air pollution in other subsystems.

The length of service remaining for the nine coal mines in Zoucheng city is more than 15 years (See Chapter Two). The time span is 10 years, which is within the length of service remaining for local mines because mineral resources are finite. There is also a five-year term for central and local officials, who are normally selected for two successive terms in China's administrative system. It is plausible to make the ten-year institutional arrangements, policies, and interventions based on local resources for local government, which can help the rural households achieve more secure and diversified livelihoods.

Growth factors such as labourers, technical investment, machinery and equipment influence coal output. In the simulation model, coal output is changed by a general growth rate (intrinsic growth rate) that combines these effects on the growth of coal production. The intrinsic growth rate (RG_C) is based on the collected historical annual time series data of Zoucheng city. On the other hand, coal output should be subject to an upper limit ($\bar{C}$). For instance, available technology and fixed amount of coal in a mine may limit the mining capacity.

Coal mining yields a great variety of products of varying quality, including coking coal, steam coal, and washed coal; all of these coal products have different prices. As with the farm product sector, the model uses one representative product for mining.

The growth function of coal output in this subsystem is based on logistic growth. American geophysicist M. King Hubbert first introduced a logistic equation to estimate the peak and lifetime production for oil (Hubbert, 1956). Based on Hubbert's study, many subsequent studies (Lin & Liu, 2010； Tao & Li, 2007; Hook, et al., 2010) have used logistic growth curves to simulate the historical data of coal production and predict coal production in the future. However, this production model neglects the impact of economic cycles and other factors (Lin & Liu, 2010). Focusing on the main purposes of this thesis (see Chapter One), this simulation model concentrates only on social capital application in livelihood development and assumes other macroeconomic environmental factors such as the effects of economic cycles and inflation remain constant.

The coal mining subsystem in this simulation will use logistic equations to simulate the coal output. The production of coal fields is assumed to generally resemble logistic growth. With the input of equipment, labourers, and technical investment in coal mining, the initial stage of growth is approximately exponential; then, as some limitations arise such as technological issues and the fixed amount of coal, growth slows, and at maturity, growth stops. The coal mining module is represented in the simulation by the two-equation system given in Eq. (1) and Eq. (2) determining coal in the local mining industry.

The key simulation equations for Coal Mining Subsystem are given below.

(1) Overall growth rate of coal output per unit time (tons/unit time):

$$\dot{\mathrm{C}} = \mathrm{RG_C}(1 - \frac{\mathrm{C}}{\bar{\mathrm{C}}})\mathrm{C}$$

(2) Total coal output over time (tons):

$$\mathrm{C} = \int \dot{\mathrm{C}} dt$$

7.3.2 Agricultural Production Module

Many previous studies (e.g. Gradiz et al., 2007; Van Ittersum et al., 2008; Herrero et al., 2007; Castelan-Ortega et al., 2003; Keating et al., 2003; Moore et al., 2007; Van Wijk et al., 2009; Tittonell et al., 2007, 2008; Rufino et al., 2007) have developed and evaluated farming simulation models to assess the effects and characteristics of smallholders' diverse agricultural production. These models simulated a range of systems for farming such as the dynamic linkages among crops, livestock, and common land for cropping and grazing and relevant socioeconomic components. All of these simulation models were based on specific scenarios (e.g. Gradiz et al, 2007) or geographic region (e.g. van Lttersum et al., 2008). These previous simulation models show that it is important to integrate scientific and practical knowledge as well as background data and information for the target region and livelihood strategies for local inhabitatns.

In this study, the agricultural production subsystem tightly couples agricultural output per household (A) with intrinsic growth rate (RG_A) and the effect of mining on farmland quality (PL_A). It captures the dynamics of changes in total agricultural outputs per household. The development of coal resources and the intensity of coal resource exploitation may increase the number of collapsed areas on farmland, the pH of soil, and the effect of dust wastes on farmland quality. Thus, two issues are simulated in this subsystem: (1) The growth of agricultural output per unit time; and (2) The relationship between the quality of agricultural land and the increase in local mining production.

In many developing countries, crop cultivation and animal husbandry are integrated components of a crop-livestock system (Parsons et al., 2011). For instance, more than 66% of the rural farmers worldwide rely on crop-livestock systems for their livelihoods (ILRI, 2000). The interactions between crops, livestock, and natural resources are complex in this kind of farming system (Parsons et al., 2011). However, crop and livestock activities are driven by the same resources, including land, labour,

skill and capital (Lead, 2007; Parsons et al., 2011). Thus, several assumptions are possible and necessary in order to simplify the agricultural subsystem in the simulation model.

The time step is controlled by the "harvest seasons" of crop-livestock integration. Farmers in North China generally have two harvest seasons together with another one resulting from feeding poultry and livestock. The three-stage income is consistent with the time steps of the model, which are set to be four-monthly. Therefore, the time step (t) of the model is based on farming activities. It is postulated that the agriculture sector is following a four-monthly cycle.

As discussed in Chapter Two, there are many farm products in Zoucheng. However, a diverse crop-livestock system or diverse farm products potentially limit the ability to dynamically simulate scenarios. The variety of farm products in Zoucheng in terms of crops planted or types of livestock raised increases the complexity of the model in comparison to simulating one specific agricultural product. For instance, different crops have different growth rates and yields. Looking at the popularity rate and preference for corn and wheat in Zoucheng (Zoucheng Statistical Yearbook, 2000-2013), planting corn and wheat can be assumed to be a basic income source for local farmers. Finally, most of the respondents prefer to also plant some other crops such as fruits and vegetables, and breed livestock such as chickens, pigs, and goats in order to diversify their agricultural outputs, which may consequently increase their incomes from farm activities.

The different prices, demands, supplies in the market, growing periods, and investments in diverse farm products, all enable the model to make assumptions and create a representative farm product. The yield of the representative farm product in the model is based on the average yield of wheat and corn in this area. The reason is that these two crops are the preferred choices in North China and Zoucheng. Farmers in North China generally use a large area of farmland to plant corn and wheat. In general, farmers in North China, including Zoucheng, also use corn to feed poultry

and other livestock. Therefore, any effects on these two agricultural products (corn and wheat) should influence the total agricultural outputs and incomes for rural households.

In the simulation model, the price of the representative farm product will influence the expected income from agriculture. However, there are lots of agricultural products excluding corn and wheat, which are normally considered as economically viable crops in China. These crops can bring extra income or benefits to rural households. Therefore, I took account of these planting preferences in the Zoucheng area (e.g. by obtaining total planting areas for relevant agricultural products in Zoucheng from the local Yearbooks 2000-2013) to create a price for an assumed, representative farm product. First, the representative farm product in the simulation model takes the market price of corn and the price of wheat as the basic reference price due to the widespread planting of these two crops locally. Based on the prices of corn and wheat, the simulation model also takes account of market prices for other crops such as strawberries, apples, peanuts, cabbages, spinach, and livestock such as chicken to increase the price of farm products in the simulation model until the crop profits are similar to actual levels in Zoucheng. Therefore, it is assumed that all farmers in the model prefer to sell their agricultural products at this "mixed price" as the initial price in the market simulation.

The growth rate of agricultural output is the most important part of the agricultural subsystem. Guan, Gao, & Fukahori (2010) considered the value of farming production, animal husbandry, forestry, and fisheries as original data for renewable resources in their renewable resource subsystem. In this study, the agricultural production module will follow Guan et al.'s (2010) general structure, i.e., logistic growth. The growth of agricultural production has been estimated using an intrinsic growth rate (Li et al., 1994). The intrinsic growth rate describes the natural growth in farm output. As farm products mature and reproduce themselves, the amount of land

and physical capital are assumed constant. Of the other variables, only labour input and pollution factors can change the growth rate of agricultural output.

The model in this study did not consider the effects of natural shocks (e.g., natural disasters) on farm production, in order to avoid the effects of uncertainties on simulation results. Ellis (2000) and Chambers & Conway (1992) define shocks as unpredictable, traumatic and sudden events in on people's lives. These events can directly destroy livelihood assets or other relevant capitals. Any natural disasters or shocks may create vulnerabilities for rural dwellers. Thus, one of the assumptions is that there are no natural shocks to any products during the simulation period.

By simulating agriculture in line with the constraints discussed above, the growth rate of agricultural output per household ($\dot{A}$, see Eq. (3)) is based on the intrinsic growth rate for agricultural crops (RG_A), agricultural output per household (A), potential or maximum agricultural output ($\overline{A}$), labour input (N_A), and coal mining pollution effects on farmland quality (PL_A). The dynamic process of agricultural production over time is that more growth will lead to more seeds and other inputs. More seeds or other inputs in the next planting season mean that agricultural output will be increased. Variations in the number of agricultural labourers will change the intrinsic growth rate of agricultural outputs and coal mining activity results in outcomes including farmland degradation, high soil pH, lack of microbial activity, and poor water quality (see Chapter Five), which reduce the growth rate of agricultural output. Taking these factors into consideration, agricultural output per household (see Eq. (4)) is generated. All of the relevant coefficients are discussed in Section 7.5.2.2.

The key simulation equations for the Agricultural Production Subsystem are given below:

(3). Growth rate of agricultural output (kg/household):

$$\dot{A} = RG_A\left(1 - \frac{A}{\overline{A}} - S_{PLA}PL_A + S_{NA}N_A\right)A$$

(4). Agricultural output per household (kg/household):

$$\mathrm{A} = \int \dot{\mathrm{A}} dt$$

As discussed in Chapters One, Three and Five, coal mining causes surface subsidence to increase, and degrades the farmland quality. As a result, there is a negative relationship between mining activities and agricultural output. In Equation (3), the effect of coal mining pollution on farmland quality is an important factor influencing the growth of agricultural output. In this simulation model, coal output represents mining activities, which impact on farmland quality and in turn affect the growth rate of agricultural output.

Farmland quality is represented by "effective" farmland size. For instance, coal mining brings dust waste into the area, which degrades the quality of farmland by, for example, altering soil pH. With this relationship between coal production and "effective" farmland size, coal pollution on farmland quality per household (PL_A) is presented in Equation (5). In the simulation model, Equation[18] (5) is based on relevant data. All of these data were collected from local Yearbooks.

The key simulation equations for the Agricultural Production Subsystem is given below:

(5). Effect of coal mining pollution on farmland quality:

$$\mathrm{PL_A} = \gamma(C), \qquad where\ \gamma = LOOKUP$$

[18] The equation will use the LOOKUP function. In Vensim, the WITH LOOKUP function is a very convenient function to specify a nonlinear relationship between two different variables or to construct a situation with more than one breakpoint. Between the specified pairs of values, a range of straight lines can be drawn and the LOOKUP function calculates intermediate values (Kirkwood, 1998). Appendix B presents the specified graph of the values that were used in the LOOKUP function in this thesis.

7.3.3 Tourism Module

The tourism subsystem primarily simulates the growth of tourist numbers in Zoucheng city. The number of tourist arrivals or tourist population is the most common variable used to accurately measure and forecast tourism development (Song & Li, 2008; Nejad & Tularam, 2010). In addition, an accurate forecasting of tourist arrivals will help the government to establish and carry out appropriate tourism-related strategies for long-term success (Australian Bureau of Statistics, 2009).

This subsystem comprises three linked components: government investment in public infrastructure or facilities (INV); pollution effects (i.e., industrial dust discharged) on the quality of the natural environment (PL_T); and the effect of tourism operators (N_T) on tourism service quality.

As discussed in Chapter Two, government support is important in tourism operations and development in Zoucheng. In general, tourism models or relevant studies consider government investments such as infrastructure, transport, services offered by the tourist sites and the quality of the natural environment in defining the attributes of a tourist product (Hernandez & Leon, 2007; Casagrandi & Rinaldi, 2002; Nejad & Tularam, 2010). Government investment in public infrastructure, transportation, information guides and relevant facilities may increase the attractiveness of local tourist sites (Oliveira, 2003; Khadaroo & Seetanah, 2008; Wilson, et al., 2001; Lohmann, et al., 2009). For instance, major constraints and challenges in rural China include difficult access to the transport infrastructure, lack of public transport systems, and bad road conditions, which may limit the mobility of residents and even reduce the attraction of the location for visitors in rural China (Dalkmann, et al., 2008). Government investment is crucial for economic and tourist development in rural areas. For instance, the government helps to provide funds and develop tourism products, such as cultural festivals; this preservation of tradition contributes to the maintenance of rurality (Zou, et al., 2014).

In general, tourists tend to demand high quality in tourism services and the natural environment. The number of tourism operators (i.e., N_T) affects the development of service quality, which eventually influences visitors' long-term satisfaction and growth in tourist numbers (Hsiao & Yao, 2012). Poor environmental quality tends to reduce a region's attractiveness to tourists (Hu & Wall, 2008; Mihalic, 2000; Johnston & Tyrrell, 2005). The dust generated and discharged into the atmosphere and emission factors can be used to estimate the likely level of air pollution in mining areas (Ghose & Majee, 2000). Industrial dust discharge is a typical environmental issue in Zoucheng, which is relevant to coal production in the simulation model. It is estimated based on total coal output (C). With the growth of total coal output and thus industrial dust discharge (i.e., PL_T) in Zoucheng, the attraction of local tourism is reduced and the total tourist numbers per unit time will also be reduced.

Government investment in public infrastructure (INV on Eq. (6)) is predicted from total sectoral output value (Y) in three industries: mining (Y_C), agriculture (Y_A), and tourism (Y_T) and the ratio (0.0631, see Section 7.4.3.1 for the calculation) of public infrastructure to total generated industrial value. In the current situation, the government investment is purely maintenance. Thus, the simulation model uses the ratio of maintenance expenditure in terms of local GDP to avoid overestimating actual situation. Furthermore, overinvestment in public infrastructure may attract more tourists in the simulation model, which could generate a different scenario. Therefore, the ratio of total government investment in public infrastructure is assumed to be constant in Zoucheng. Eq. (6) also indicates that government investment in public infrastructure changes with the growth of total generated industrial value in the simulation model. With more profitable industry development such as mining, local government will invest more in the local public infrastructure system.

The key simulation equation for the Tourism Subsystem is given below.

(6). Government investment in public infrastructure (yuan):

$$INV=0.0062(Y_C+Y_A+Y_T)$$

This subsystem simulates the time period of tourist arrivals. It is important to understand the growth patterns in tourism. The resort or tourism area lifecycle and tourist product lifecycle has been empirically and theoretically discussed in Butler's lifecycle model (1980). Butler's lifecycle model remains the most enduring heuristic to understand the evolution of tourist destinations (Pearce, 2001; Butler, 2006), which has been widely applied and accepted as a conceptual framework for analyzing the historical progression of tourism area from a variety of perspectives (Buhalis, 2000; Cole, 2009; Lundtorp & Wanhill, 2001; Hovinen, 2002; Berry, 2006； Haywood, 2006). The model proposes a growth pattern for tourist destinations, which includes several stages-exploration, involvement, development, consolidation, maturity and stagnation (Butler, 1980; Lundtorp & Wanhill, 2001).

In the first stage (exploration), only a few tourists travel to the destination due to undeveloped facilities and a poorly developed related infrastructure system. The next stage involvement is characterised by an increase in tourist numbers. It is the first stage at which tourists start to become aware of the destination as a tourist base. New businesses such as food and catering, accommodation, leisure activities and site tours begin to spring up. Local residents begin to realize that tourism could be a profitable activity for their livelihood choice. However, initially inadequate infrastructure systems such as roads limit the development of the tourist industry.

In the development stage, the destination's tourism facilities become well developed and the tourist numbers steadily increase. The local tourism industry and economic activities require skilled personnel and general labourers such as activities related to the natural attractions of the site, cultural attractions, restaurants, and other physical attractions. Thus, government investment in detailed advertising and promotional campaigns is necessary to increase the level of tourist knowledge about such destinations.

In the consolidation stage, the tourists number continues to grow, but at a declining rate. The destination becomes well known and the novelty of the destination may

decline over time for tourists who have already visited the destination a number of times (Nejad & Tularam, 2010). Therefore, these potential tourists do not list the destination as a priority. The highest cumulative number of tourists is achieved in the stagnation phase. However, the resort provides nothing new to be discovered. For instance, all tourists know about the destination and its facilities. The destination may face a number of issues involving the environment (e.g. pollution), culture (e.g. culture shocks), and social problems (e.g. crimes) (Nejad & Tularam, 2010). Local government still needs to control and/or regulate these issues. At this stage the destination has two possibilities, decline or rejuvenation. Using Butler's lifecycle theory and framework, many studies apply logistic growth to represent tourist numbers over time (Nejad & Tularam, 2010; Lundtorp & Wanhill, 2001; Cole, 2009; Casagrandi & Rinaldi, 2002; Hernandez & Leon, 2007). Therefore, the simulation model in this study also applies the logistic equation (see Eq. (7)).

Within the logistic equation, the intrinsic growth rate of tourist arrivals (RG_T) is directly influenced by government investment in public infrastructure in the simulation model. More rural tourism operators may improve the quality and service associated with the tourist destination. This leads to an increase in tourism: long-term satisfaction and loyalty enhances potential tourists' intentions to visit Zoucheng city. This consequently increases the number of tourists per season, creating positive feedback on tourist growth in the simulation model. Thus, the factor of tourism operators providing services in Zoucheng was included in Eq. (7). Hsiao et al., (2006; 2012) analysed and simulated a range of service quality attributes in a tourist attraction in Taiwan. Considering the similar traditional culture and behaviours in these two communities, the Vensim model for the tourism quality increment in this study was similar to Hsiao's coefficient of workers on service quality increment; therefore the coefficient relating to the effect of tourism operators on tourism service quality is assumed to be 0.0016. A more accurate coefficient for a county-level city may be derived in future studies.

The key simulation equations for the Tourism Subsystem are given as below:

(7). Growth rate of tourist numbers:

$$\dot{T} = RG_T\left(1 - \frac{T}{\bar{T}} + 0.0016S_{LT}N_T - S_{PLT}PL_T\right)T$$

where:

$RG_T = S_{INVT}INV$

PL_T is mining pollution of the local atmosphere

N_T is the number of rural tourism operators

(8). Number of tourists

$$T = \int \dot{T} dt$$

7.3.4 Social Capital Module

The livelihood approach states that households' disposable assets may impact on the type of activity undertaken and the amount of income earned (Barrett et al., 2005; Brown et al., 2006). Access to livelihood assets is an important factor in determining the choice of household livelihood strategy. In the simulation model of this study, social capital is expected to support an alternative livelihood strategy for rural residents.

This subsystem simulates the factors that control the growth of social capital (SK). The growth of social capital takes one flow variable (i.e., residence period) as a determinant. In system dynamics, variation in the length of residence (RS) represents the characteristics of the dynamics changes in the social capital module, which is more suitable than using non-continual movement variables such as gender. The longer respondents have lived in Zoucheng, the more opportunities they have had to access a greater number of people, interact frequently, and build up long-term relationships in the local community, thus acquiring information through friends and their social circles (Gertler, et al., 2006; Onyx & Bullen, 2000). Policies could empower people to engage in new forms of bridging and social capital by

participating in networks such as livelihood development groups (Kah et al., 2005), which could enable people to participate in alternative livelihood choices (e.g. non-farm activities) (Anderson et al., 2002).

In the simulation model, social capital applications can widen household members' access to alternative livelihoods and incomes in tourism. This draws out some of the links between social capital and livelihood choices. Working and operating in tourism businesses is more complicated than traditional agriculture (He & Chen, 2012). With the growth of social capital, the simulation model considers the relationships and social networks needed to access information and skills about issues such as tourism services, tour guiding, and business management. These social circles can improve the ability of local people to serve outside visitors and consequently impact on tourism incomes in the simulation model. The whole process is consistent with DFID (1999): social capital will improve people's incomes indirectly.

The social capital subsystem captures the dynamics of changes in social capital. Social capital (SK) is linked with the length of residence (RS) in the simulation model. By following the coefficient of RS in the regression model (see Chapter Six) and the characteristics of survey participants such as average years of residence (see Chapter Four), social capital growth with RS is shown in Eq. (9). The initial value of social capital (SK_0) is based on the average length of residence in the city or surrounding rural area. With increasing RS, social networks are likely to expand and further enhance SK. However, local residents may have a limited ability to access additional social capital resources because homogeneous networks (e.g. living in a small village for a long time) reduce the effect of networking as a way of accessing social capital (Lin, 2004). Using a ten year RS in this simulation model, and the distribution of the calculated social capital scores from Chapter Four, we obtain reasonable simulated results (see Figures 8.5 & 8.15).

The key equation for the Social Capital Subsystem is given below.

(9). Social capital:

$$SK = SK_0 + 0.006RS \qquad (0 \leq RS \leq 30)$$

where SK_0 is the initial value of social capital.

7.3.5 Livelihood Outcome Module

This subsystem addresses incomes and employment in agricultural and tourism activities. It may provide some policy suggestions and planning strategies for local development at an equilibrium point by analyzing the effects on incomes and worker migration between agriculture and rural-tourism. These results also suggest possible alternative livelihood choices for mining household members in rural areas.

The income from agriculture (I_A) is determined by crop profits (π_A), which vary with changes either in total agricultural output per household (A), or in the price of agricultural outputs (P_A) and the cost of agricultural production (PC_A). Simulations of agricultural output were discussed in the Agricultural Production Module (Section 7.3.2). The values of initial costs and the initial price of agricultural output are discussed in Section 7.4.5.1. With respect to government influences on local agricultural development (discussed in Chapter Two) and the small area (a county level city) under study, variations in unit price and unit cost received from different amounts of outputs are assumed to be fairly small.

Excluding the effect of total agricultural output per household (A) on the price of agricultural output (P_A), tourism raises agricultural growth by impacting on the price of agricultural outputs in the simulation model. In the simulation model, it is a particularly important way of increasing the total income from farming activity when crop price is assumed to be relatively insensitive in the initial local market. Increased tourist demands will stimulate the price of representative agricultural outputs. In the simulation model, the effect of tourism on the price of agricultural product is based

on the tourism intensity rate (TIR). TIR ($\mathrm{TIR} = \frac{\text{Tourists}}{\text{Population size}}$) compares the relationship between tourist arrivals and the population size (Toops, 1999) and is a way to measure the impact of tourism on an area (Zhang & Zhang, 2003; Keyim et al., 2005). Thus, we employ the TIR to define the tourist effect on agriculture in Zoucheng. In the simulation model, the price of agricultural outputs is varied with the TIR as well.

Equations (10) and (11) show the price and cost of agricultural outputs responding to changes in agricultural output respectively. Equation (12) shows the net profit from an agricultural livelihood.

The key equations for the Livelihood Outcome Subsystem are given below:

(10). Price of agricultural output (yuan/kg):

$$\mathrm{P_A} = (5.13 - 0.0001\mathrm{A})(1 + 0.594\mathrm{TIR})$$

(11). Non-wage cost of agricultural output (yuan/kg):

$$\mathrm{PC_A} = 1.24 - 0.0002\mathrm{A}$$

(12). Expected income from agriculture (yuan/kg):

$$\mathrm{I_A} = \pi_\mathrm{A} = \mathrm{A}(\mathrm{P_A} - \mathrm{PC_A})$$

(As noted above, the parameters of the equations either have been, or will be, discussed in earlier or subsequent sections.)

As explained in Chapters Two and Three, rural tourism operators can provide multiple farmland-based activities including picking fruit and other crops, rural homemade meals, rural natural environment entertainment and adventure to tourists. In the market, more tourists might bring impacts such as contributions to GDP, increasing the employment rate, and creating new sources of household income (Wei, Qu, & Ma, 2013; Nejad & Tularam, 2010). In the simulation model, the number of

tourist arrivals is one of the factors determining the expected incomes from tourism. Each tourist is assumed to bring a constant net profit (π_T). Social capital (e.g., social networks) is another variable that stimulates the tourism incomes. Rural household members can access additional information about operating rural tourism ventures, customers' requirements, and service skills through their social capital. The coefficients of Equation (13) will be discussed in Section 7.5.5.1.

The key equation for the Livelihood Outcome Subsystem is:

(13). The expected income from tourism:

$$I_T = T(1 + S_{SKI}SK)\pi_T$$

Grasso (1998) and Rohorua (2009) used a mathematic model to determine the optimal relationship between economic and the ecological development. Using their approach, labour distribution is based on the different incomes of the involved industries. As mentioned in Chapter Two, high incomes in mining leading to more labourers working in this industry is one of the most notable characteristics of local livelihoods in Zoucheng city. Therefore, the allocation of workers is dependent on their relative incomes at different times. For instance, at any given time, the more income the industry provides, the more workers it attracts.

Considering our model and analyses, some scenarios and assumptions need to be set in terms of the process of labour allocation. First, labour mobility is determined by the profitability of the activities. Second, there is no switching cost for farmers to switch between tourism and agriculture. Third, there is a fixed number of workers. Fourth, agriculture and tourism are independent or are separate activities. Finally, the simulation model avoids the issue of influx of labourers from other cities when alternative activity (i.e., tourism) is proven to be viable. With these assumptions on worker allocation, the simulation avoids "outside shocks" such as extra labourers travelling from other cities to influence the simulated results of livelihood outcomes.

This module derives the distribution of workers as a result of livelihood choices. Different livelihood choices result in different incomes. Rural-tourism activity is an alternative livelihood for some rural households in the simulation model, which allows household members to become self-employed tourism operators. Therefore, the simulation model presents the results of people moving out of farming into tourism. Regarding relative income differences (D_I) between agricultural activity (I_A) and rural-tourism (I_T), the labour distribution between farming (L_A) and tourism (L_T) is distributed between these two activities.

The key equations for the Livelihood Outcome Subsystem are:

(14). Income difference between farming and rural-tourism activities:

$$D_I = \frac{I_T - I_A}{I_T + I_A} \qquad -1 \leq D_I \leq 1$$

(16). Rural tourism operators:

$$L_T = \frac{L(1 + D_I)}{2}$$

(17). Total farming employment:

$$L_A = \frac{L(1 - D_I)}{2}$$

7.4 Specification of Model Parameters and Validation

There are three approaches to specifying the values and interrelationships in the simulation model: (1) Econometric approach: parameters are based on statistical analyses of survey data in this thesis; (2) Background: in some similar study areas in the literature, available historical data and information have been used to calibrate the model; (3) Mathematical programming: some values use in-built functions (e.g. 'IF THEN ELSE' loops, calculus, etc.). Most available historical data are based between 2006 and 2010 so as to correspond to the year (i.e., 2010) that the household survey was undertaken. Five years is the normal period for central and local government to implement their main policies and programmes in China. The scaling constant effects

in equations were estimated based on helping the model achieve sensible results that matched the actual environment. Appendix A evaluates and tests the sensitivity of model to determine its representativeness and authenticity.

7.4.1 Coal Mining Module

The values of parameters in the coal mining module are based on relevant data for coal production from local Yearbooks between 2006 and 2010 (Zoucheng Statistical Yearbook, 2006-2010) and other studies in Zoucheng (e.g. Yang et al., 2007; The conciliation commission of regional economies, 2006, Dec).

Based on the historical data[19], the initial coal production (39.2 million tons) is configured to the mean value of coal production from 2006 to 2010. According to YanZhou Mining Group (2014), the maximum coal production is about 50.5 million tons in the simulation model. The general growth rate of coal production was calculated from the compound growth rate of coal production from 2006 to 2010. The general growth rate is about 0.11%.

7.4.2 Agricultural Production Module

The subsystem considers farmland quality and agricultural productivity as the source of total agricultural output per household.

7.4.2.1 Farmland

Farmland quality refers to ‘effective’ farmland size. Therefore, the farmland section is divided into two modules: farmland size per household and changes in farmland size per unit time. The initial set value of farmland size was obtained from the mean value of data collected from local official government statistics, the household survey conducted in this study and other published literature.

[19] Appendix C provides summarized table data, some of which were used in this simulation.

The mean value of the farmland size per household in the household survey in this study is similar to that in other literature. From local Yearbooks (2006-2010), farmland size per household was around 4 mu. Another report indicated that the local farmland area was about 4.3 mu per household (The conciliation commission of regional economies, 2006 Dec). The mean area of farmland in Zoucheng was based on the household survey for this study, about 4.46 mu. According to other investigations of farmland area per person (National Bureau of Statistics of China (NBSC), 2000; Li, 2000), the area was about 4.64 mu per household in Shandong province, which is slightly higher than the survey data in the present study (i.e., 4.46 mu). Thus, a plausible initial farmland size for the simulation model was taken as 4.5 mu per household.

Pollution effects on farmland quality (i.e., PL_A, see Equation (5)) are assumed to follow total coal output. The relationship between coal mining activities and farmland quality is based on the raw data from the Zoucheng Statistical Yearbooks 2006-2010.

7.4.2.2 Agricultural output

Agricultural output is measured in kilograms per household. Using the local grain yield for the horizon of 2006-2010 (Zoucheng Yearbooks, 2006-2010), the average value of the grain yield was about 2,050.88 kg per household in Zoucheng. This result is based on the average value of the grain yield per mu between 2006-2010 and the initial farmland size per household discussed in the last section (455.75×4.5). According to several experiments in Zoucheng (Sun et al., 2009), the maximum agricultural outputs for wheat and corn were about 653 kg per mu and 924 kg per mu respectively. Considering this range of grain yields and the flexibility of the simulation model, potential or maximum agricultural output ($\bar{A}$) was set at 3,546 (788×4.5) kg. The average grain yield (i.e., 2,050.88 kg) is considered as the initial value for agricultural production.

The growth of China's agricultural production per annum fluctuated from 0.5-4% based on annual grain yields across all provinces from the 1950s to the 1990s (Fan & Zhang, 2002; Liu & Wang, 2005; State Statistical Bureau, 1997). With regard to the main agricultural products (wheat and corn) in this simulation model, Carter, Chen, and Chu (2002) measured the growth of agricultural productivity in China by using national data and provincial aggregate data. The annual growth rate is wheat production was about 1.3% from 1978 to 1996. The annual growth rate in corn was production was about 2.5% in the same period.

In the simulation model, the intrinsic growth rate of agricultural output (RG_A) is calculated by using the data from local statistical yearbooks (2006-2010). During the period 2006 to 2010, the grain yield in 2009 was decreased to 459 kg per mu because of drought and freezing temperatures, which drove down the average growth rate in Zoucheng (Zoucheng Statistical Yearbook, 2006-2010). Based on the mean value of growth rate in the local grain yield, RG_A was about 0.7%.

7.4.3 Tourism Module

This module mainly simulates the number of tourist arrivals (T). This is influenced by government investment in public infrastructure (INV), the number of rural tourism operators (N_T), and the pollution factor's (PL_T) impact on tourist growth. The number of tourism operators (N_T) will be discussed in Section 7.4.5.2.

7.4.3.1 Government investment in public infrastructure

According to local government research (March 2008), if local tourism was expected to develop at a certain scale, the investment required was about 36.2 million yuan. As mentioned in the previous discussion in Section 7.3.3, government investment is a very important factor in stimulating tourism development. The simulation model is based on the current situation and does not focus on additional investment in local tourism. The main purpose of including government investment in this subsystem is

to help estimate an actual level of tourist growth and avoid overestimating local tourism development.

The model allows for the simulation of an aggregate value of production in three industries (agriculture, mining, and tourism). The total values are calculated by adding all of these generated industrial values together. Then, a proportion of total generated values are used in the field of local tourism support including maintenance of facilities in the local city, transportation systems, business promotion and information gathering in the market. All of these investments are generally named "government investment in public infrastructure (INV)" in the simulation model.

The sectoral output value of coal mining (Y_C) follows the total coal output (C) and coal price per ton. The coal price per ton was obtained from the official website of the Coal Industry Bureau of Shandong Province[20]， which lists the products of the coal chemical industry in China, and China's coal resources, at about 600 yuan per ton on average in the local region in recent years (figures are from 2014). This price is similar to that of run-of-mine coal. Run-of-mine coal is the raw material, normally consisting of coal, rocks, middlings, minerals and contamination, which is delivered from the mine to the coal preparation plant. Normally, a mine can produce a large amount of run-of-mine coal.

The sectoral output value of agricultural production (Y_A) is calculated from the total agricultural output per household (A), the price of agricultural outputs (P_A), and the number of households.

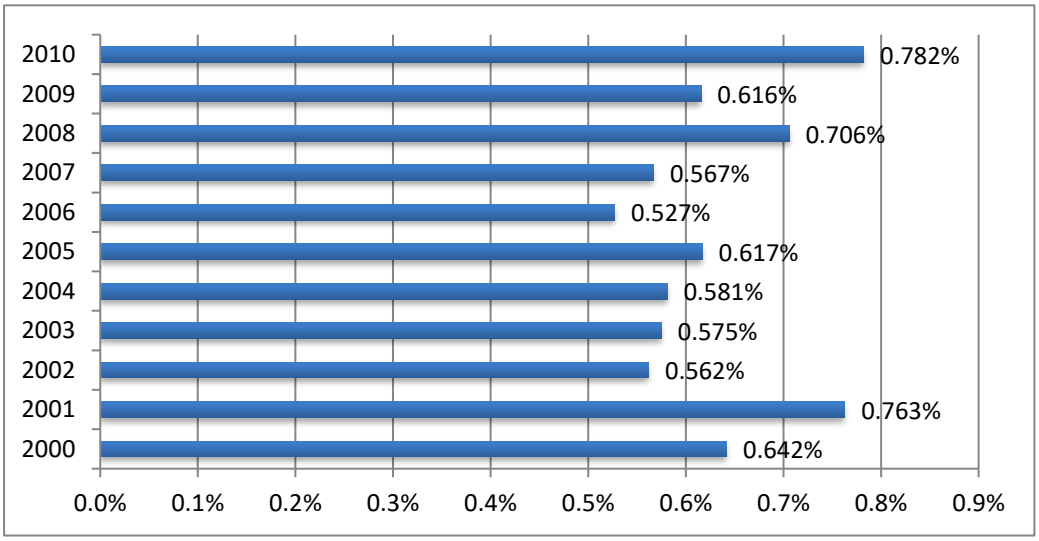
The sectoral output value of tourism (Y_T) is based on total tourist spending. The local government has collected data on tourist spending, using random field surveys (observations=500) in local tourist attractions. Most tourists tend to spend less than

[20]Zoucheng city belongs to Shandong province. There are some news reports and data about coal prices, supply, transport costs etc available at http://www.sdmtw.com/portal/home. Two other sites provide the coal prices in relevant months in China (http://www.sxcoal.com/sdcoal/16027/0/listnew.html; http://www.chemcp.com/channel/meitan/)

500 yuan/visit (in about 40% of total observations) at local tourist attractions (Zoucheng government, March 2008). The simulation model uses the average value that most tourists tend to spend (i.e., 250 yuan). From the official website of the National Bureau of Statistics of the People's Republic of China[21], the average consumer price index (CPI) was about 102.5 from 2008 to 2014. In the simulation model, each tourist is assumed to spend 270 yuan per unit time[22] (i.e., 4 month periods), which is the average value of 250 yuan including the CPI effect from 2008 to 2014.

Government investment in public infrastructure (INV) is calculated as a percentage of the city maintenance expenditure in terms of local GDP. Figure 7.2 presents the yearly percentages in Zoucheng city from 2000 to 2010. Each year, the local government allocated funds for the maintenance of public infrastructures. The highest was 0.782% in 2010. In this subsystem, the investment ratio was based on the mean value (about 0.63%) of these percentages from 2006 to 2010.

Figure 7.2: The proportion of *city maintenance expenditure in terms of local GDP from 2000 to 2010*



Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2010

[21] The official Web site of the National Bureau of Statistics of the People's Republic of China provides the yearly consumer price index (CPI) in China (http://data.stats.gov.cn/index.htm).

[22] The calculated result is based on

$$\frac{(250+250\times(1+2.5\%)+250\times(1+2.5\%)^2+250\times(1+2.5\%)^3+250\times(1+2.5\%)^4+250\times(1+2.5\%)^5+250\times(1+2.5\%)^6)}{7}$$

7.4.3.2 Discharged industrial dust

In this subsystem, the amount of industrial dust discharged changes with total coal production. The model used local data (Statistical Yearbook 2006 – 2010) to simulate the relationship between growth of coal output and the growth in industrial dust discharge (see Appendix B).

7.4.3.3 Number of tourist arrivals per unit time

The dynamics of the model assume that the number of tourists varies according to a rate that depends on three variables: intrinsic growth rate of tourist arrivals (RG_T), tourism service quality (L_T), and the effect of air pollution (PL_T).

The initial value of tourists was referenced from the mean value of the two most important tourist attractions (Meng Temple and Yi Mountain) in Zoucheng. Due to the time steps in the simulation model, the mean value was based on four-month periods. Using the official statistics for Zoucheng (Zoucheng Tourist Administration, 2011), the average number of tourists per four-month period visiting the Meng Temple and Yi Mountain was about 46,100 between 2006 and 2010. The initial tourist numbers in the simulation model starts at about 46,000.

The carrying capacity for potential tourists is calculated on the capacity of local scenic spots. According to the estimated method for scenic spot capacity (Zoucheng government, March 2008), the land area of the Mencius Temple is about 23,250 m^2 and the lengths of the tourist routes on Yi Mountain is about 8,000m. Each tourist has 75 m^2 in the Mencius Temple and 5m on Yi Mountain in 120 working days[23]. The simulation model assumes each current tourist is occupying nearly two tourist spaces based on the carrying capacity for potential tourists at the Mencius Temple and Yi Mountain that will guarantee a good tourism environment in these areas. In other

[23] The calculated result is based on a total of 360 working days and three four-monthly cycles per year (i.e., $\frac{360}{3}$).

words, the Mencius Temple and Yi Mountain can reduce their initial carrying capacity (assumed to be 55% of initial carrying capacity) to provide more tourist spaces for potential tourists. Thus, the carrying capacity of potential tourists[24] per four-month period is 125,000 tourists in the simulation model.

7.4.4 Social Capital Module

In the simulation model, all of the coefficients for social capital are from the previous regression analysis in Chapter Six. It assumes that the collected social capital data and information represent the household level due to the dominant role of mining in mining households, because of the high incomes provided in this sector. In a mining household, a miner's social capital is assumed to cover the range of the whole family's social networks and these social resources could help household members to improve their access to relevant information.

The coefficient of RS is about 0.018 using the previous analysis of factors associated with access to social capital (see Chapter Six). However, the simulation model is based on four-month periods. The coefficient of RS as related to social capital is therefore estimated at 0.006. The initial value of social capital uses the statistical distribution of social capital index (see Chapter Four) and average years of residence (26 years) in Zoucheng. Because the simulation model involves rural households, the coefficient for rural area (-0.409) from the regression analysis (see Chapter Six) is also applied.

7.4.5 Livelihood Outcomes Module

The livelihood outcomes subsystem simulates two processes: expected incomes and worker allocation between agriculture and rural-tourism.

[24] The calculated result is based on $\left(\frac{23250}{75}+\frac{8000}{5}\right)\times 120\times 0.55$

7.4.5.1 Income sources

Agricultural output per household (A), the price of agricultural outputs (P_A), and the cost of agricultural outputs (PC_A) are driving forces in identifying the expected incomes in agriculture.

The agricultural output per household (A) was discussed in Section 7.4.2.2. The costs of planting agricultural products and the net profits from agriculture in Zoucheng are used as references to construct the price of the representative agricultural product in the model. According to the official website of the Commerce Department of the Chinese Government and the State Administration of Grain[25], the average price of maize was about 3.3 yuan/kg, and wheat was about 2.3 yuan/kg in North China in 2014. However, other farm products exhibited high prices, including strawberries at about 10 yuan/kg, spinach at 6 yuan/kg, and some livestock such as chicken at more than 13 yuan/kg. As previously discussed, the price of agricultural outputs (P_A) in this model is mainly referenced on the lowest prices (i.e., wheat and corn) and driven up by the prices of other agricultural outputs in the market until the initial crop profits in the simulation model are similar to practical levels in Zoucheng. According to Wang et al. (2012), the net profits of agricultural output were around 1,800 yuan per mu when farmers chose wheat and corn as their main agricultural products in Zoucheng. Viewed in connection with farming activities in the household survey for this study, the average net profit of agricultural output per rural household was about 7,953 yuan per season (about 1,767 yuan per mu). The average cost of agricultural outputs was about 546.16 yuan per unit area (mu). Given the initial values (e.g., grain yield) set in Section 7.4.2.2, the price of agricultural outputs (P_A) was set at 5.1 yuan per kg and

[25] These two official Web sites provides the daily and weekly fluctuating prices of agricultural products in China (http://www.chinagrain.gov.cn:81/lm/scnew.asp?dq=all&leibie=3m&biaoti=all3m; http://nc.mofcom.gov.cn/channel/gxdj/jghq/index.shtml)

the cost of agricultural outputs per unit (PC_A) was set at 1.2 yuan per kg in the simulation model.

The initial expected income from tourism was based on background data and information in Zoucheng. As discussed in Chapter Two, average monthly net profit is about 1,080 yuan. Regarding four months as the time step and 46,000 as the initial tourist number in the simulation model, the net profit per tourist[26] is set at about 0.094 yuan/tourist. This simulation model sets the tourism income per worker to be around 1,000 yuan/worker at the initial stage of local rural tourism development.

Mining wages are assumed to be constant, which is referenced on the household survey in Zoucheng. On average, the mean value of the monthly wage for rural miners is about 2,700 yuan in rural households. Thus, the mining wage was set at 10,800 Yuan (2,700×4) per unit time in the simulation model.

7.4.5.2 The number of rural households and labourers

The livelihood choices functions (i.e., allocation of labourers) are based on the income differences between agriculture and rural tourism. The alternative livelihood (rural tourism) shows some people moving out of farming into tourism businesses, based on the expected incomes of rural-tourism activity. Total mining households in the rural area are set at 10,000 in the simulation model, as there are more than 500 rural households in each village town in Zoucheng. These approximately 500 rural households in each village town are expected to be the experimental pioneers. They may lead other rural households to develop alternative livelihoods in future, if rural-tourism is a suitable livelihood choice. The total population size is assumed to be one million. In the simulation model, total labourers, number of households, mining workers, and village towns are all held constant in the simulation model. Each rural household provides two labourers in the simulation model. Each household can

[26] The calculated result is based on $\frac{1080\times4}{46000}$

provide one labourer to do a full-time mining work, which means it is recognized as a mining household. Another household member could move between farming and tourism.

Finally, the initial labour allocation needs to be discussed so as to simulate the current status. As discussed in Chapter Two, the average ratio between tourism employees and workers in relevant mining industries is approximately one to three. Therefore, the initial number of tourism operators was set at around 3,400 against a total of 10,000 miners and the rest of the labourers were initially allocated to agriculture in the simulation model.

CHAPTER EIGHT: SIMULATION RESULTS AND DISCUSSION

After all of the variables, linkages, and relevant parameters are specified based on historical time series data, background information, and relevant regression analysis, the simulation can then be processed and performed.

The model presented here is based on local environment issues, relevant livelihood assets (e.g. social capital, natural capital), characteristics of rural households (e.g. resident area, resident period, initial incomes), and interactions between the three economic activities of agriculture, rural tourism and mining. Four scenarios are simulated: current risks of mining activity such as degrading the quality of farmland; the potential impact of developing tourism on additional livelihood activities (i.e., farming and rural tourism); the potential impact of a change in social capital on rural tourism activities (e.g., incomes, number of workers); and comparing viable strategies for local communities, including mining, farming, and rural tourism. All of these scenarios are simulated in four-monthly time steps and ten-years time periods (see Chapter Seven). Thus, there are 30 time steps, which represent the x-axis on all graphs in this chapter, in the simulation model.

The first simulation addresses the effect of pollution issues, caused by coal mining, on rural livelihoods and the number of tourists. The second scenario simulates the effect of a change in government policy on promoting tourism, which uses the simulated results of agricultural output, number of tourists, expected incomes in agriculture and tourism and labour distribution between these two activities. The third simulation looks at the impact of expanded social capital (i.e., SK+1; also see Section 8.3) on livelihood creation, which in turn highlights the role of social capital in facilitating the transition to alternative economic activities. The last simulation moves from two expansions of livelihood activities (farming and rural tourism) to discuss all three viable strategies for local rural households (mining, farming, and rural tourism).

The strengthened social capital in this scenario is still applied to rural tourism activities. By comparing the different incomes of mining, farming and rural tourism that form the different livelihood choices for rural households, the aim is to determine potentially sustainable livelihoods that can take the place of mining activity eventually. Moreover, the last scenario also simulates the situation of pit closures (i.e., C=0; also see Section 8.4) so as to highlight the importance of developing alternative livelihoods before the local mineral resource is exhausted.

8.1 Current issues arising coal mining

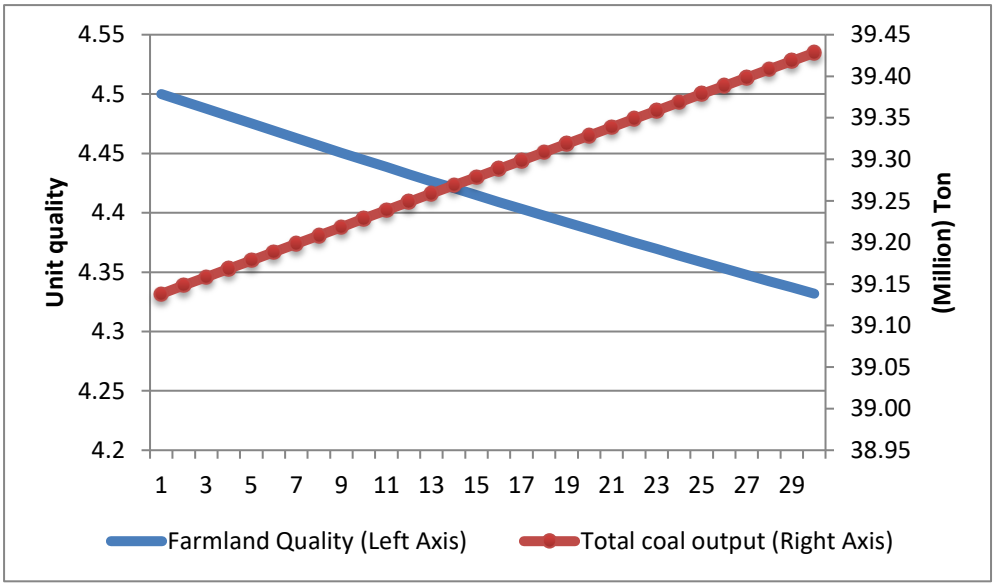
As discussed in Chapters Two and Five, coal mining is the dominant sector in terms of local economic development and livelihoods, which creates environmental issues such as air pollution and loss of land quality. Therefore, the implementation of regulations and policies cannot ignore the current environmental issues generated by coal production. The simulation model in this study must firstly present the current environmental issues in Zoucheng city. It was therefore seen as necessary to model the effect of current environmental issues on agriculture and tourism activities.

Increased coal production puts more pressure on both farmland and air quality, which may influence agricultural output and the number of tourist arrivals. Figures 8.1 and 8.2 focus on these two environmental issues, illustrating the simulated results of the effect of pollution on farmland quality and tourist numbers.

Figure 8.1 illustrates the situation and results. With increased total coal output (C), excessive dust and coal residues could change the pH of the soil, microbial activity and a number of other factors that cause corresponding reduction in the quality of farmland (Q_F). In the simulation model, the farmland quality unit is defined as “unit quality”. Figure 8.1 shows that farmland quality falls from an initial 4.5 unit quality per household to about 4.33 unit quality after approximately 10 years. The reduced soil fertility leads to less total agricultural output per household (A). The growth of agricultural income may be driven down by this trend. With limited job opportunities

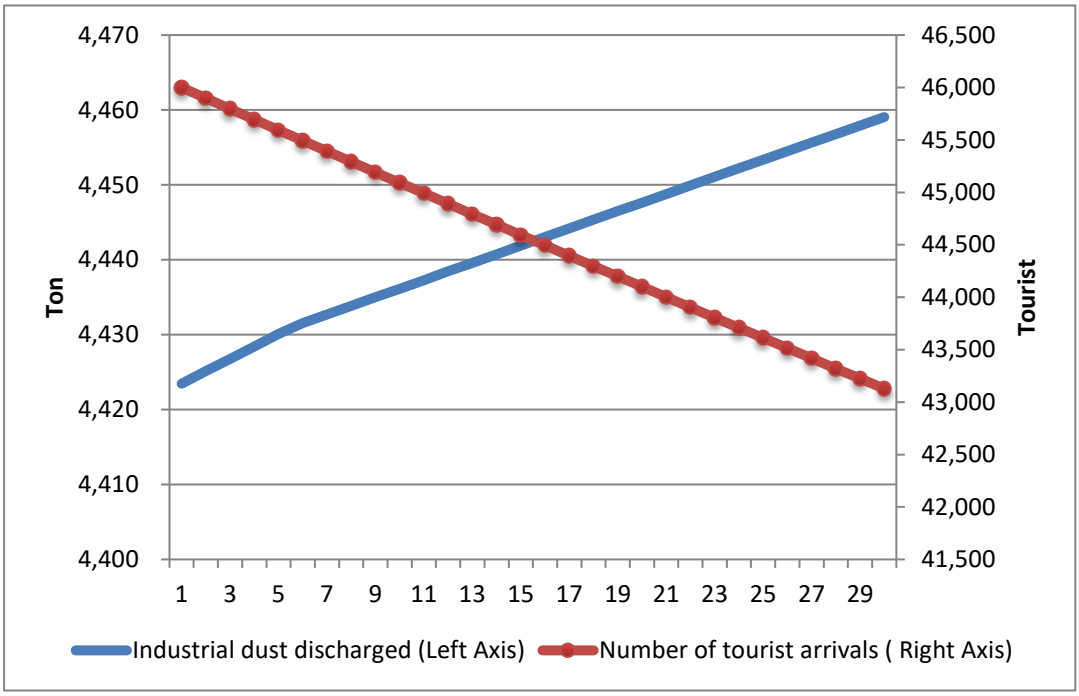
in mining (the model maintains a constant level of employment in the mining sector) and fewer alternative livelihood choices (e.g. without rural tourism), the members of mining households in rural areas would face challenges in increasing their incomes via farming activities.

Figure 8.1: Total *coal output and farmland quality*



Without any other supportive factors in place to improve air quality and tourism development, mining activities create increasing pressures on air quality, because increased coal output will also mean an increase in industrial dust discharged to the atmosphere. Poor air quality will have a direct impact on the perceived environment in the city, which, in turn, is predicted to reduce tourist arrivals from 46,000 to about 43,128 over the whole simulation period (see Figure 8.2).

Figure 8.2: *Industrial dust discharged and tourist numbers*



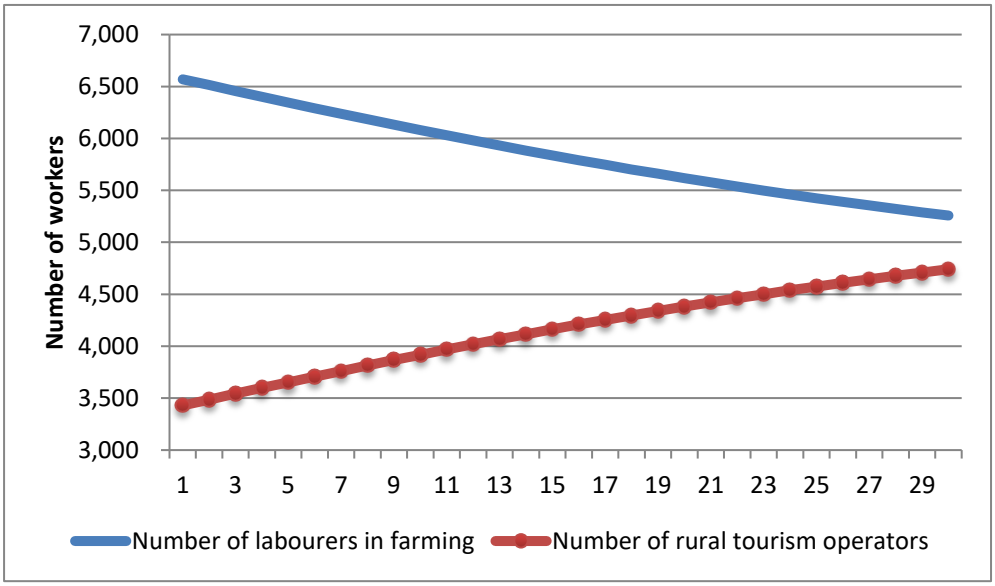
8.2 The potential impact of developing the tourism sector

In the simulation model, the number of mine workers (10,000 miners) and individual miners' incomes (2,700 yuan/month) are held constant. Excluding these mining workers, other household members need more livelihood choices to diversify their livelihoods in a sustainable way. This section concentrates on simulated livelihood outcomes by making tourism available as a factor in local households' livelihood development. The model results focus on the incomes from farming activity and rural tourism activity and the number of workers moving out of farming into tourism. Furthermore, agricultural output per household, crop price, tourist arrivals, and social capital growth are included in the simulation model to allow us to explore their linkages and interactions with the movements of agricultural labour into the tourism sector.

a) Labour allocation between agriculture and tourism

Figure 8.3 presents the initial allocation of workers (labourers). The growth trend for workers in tourism indicates the potential advantages of rural tourism activity. At the beginning of the simulation period, most of the workers are engaged in farming and only about 3,400 are active in the tourism industry. However, once tourism activity picks up, as a result of more tourist arrivals and the development of relevant businesses as a consequence of local social network activity related to tourism, the number of rural workers in tourism increases from 3,430 at the end of the first time period to 4,741 at the end of the simulation period. Correspondingly, in the face of increased livelihood choices (i.e., rural tourism), the number of workers engaged in farming declines dramatically over the same period. In other words, increased tourism activity and the use of social capital results in a decline in the number of farm workers. At the end of the simulated period (ten years) of operation, there are still more household members engaged in farming, in total, but the gap between farming and tourism worker numbers has gradually reduced. Figure 8.3 shown that the difference in labour allocation between agriculture and tourism changes from 3,139 workers initially to 517.

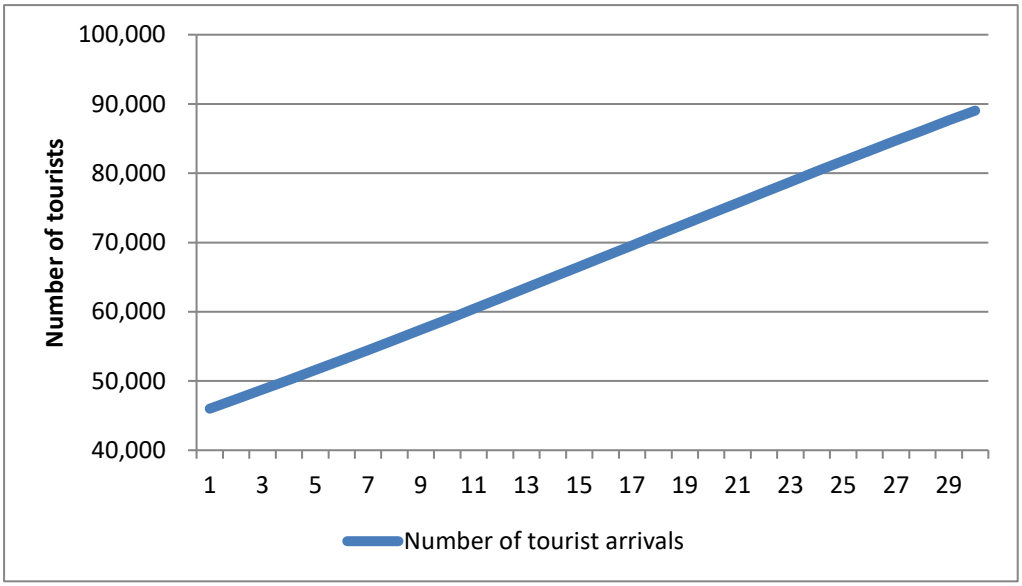
Figure 8.3: *Workers allocation between agriculture and tourism*



b) Tourism sector

Figures 8.4 and 8.5, using the cause and effect flows in the simulation model, illustrate the proposition that business operations created in the tourism sector, together with the growth in tourist arrivals and the associated increase in social capital, could form an alternative livelihood choice for the Zoucheng community due to the transfer of labourers from agriculture to rural tourism.

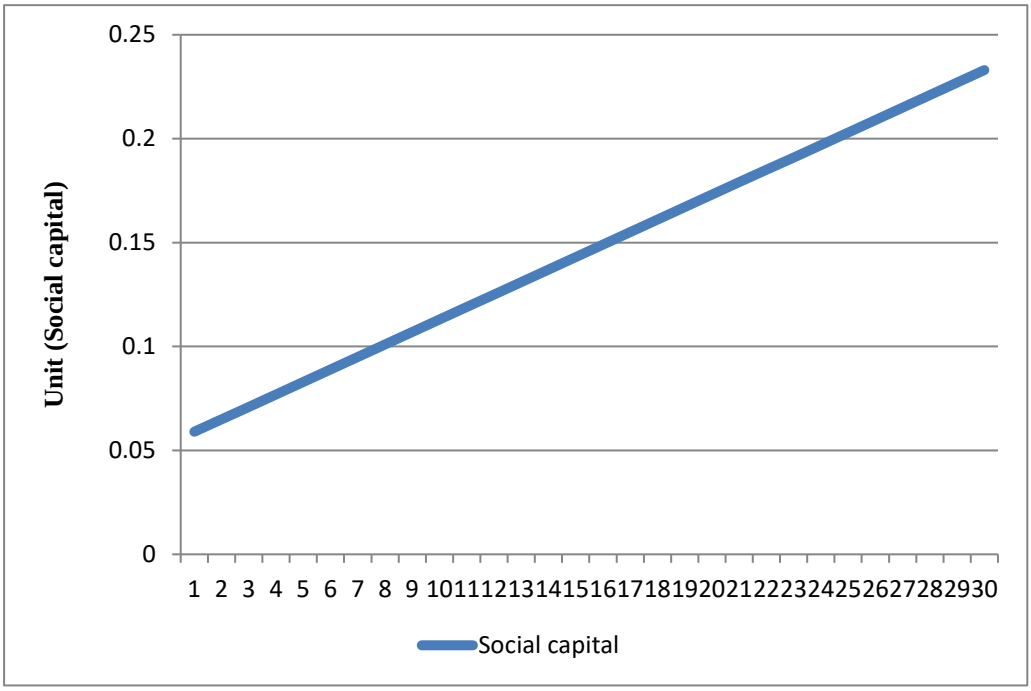
Figure 8.4: *Number of tourists*



As discussed in Section 7.3.3, the growth rate of tourist numbers is based on the logistic equation (see Equation (7) in Chapter Seven). It is expected to have several stages, such as exploration, development, maturity and stagnation, and consequently influence the development pattern for the number of tourists (see Equation (8) in Chapter Seven), such as from rapid growth to a constant or stable number. However, Figure 8.4 presents a linear path. The main reason is that the simulation model is based on the actual historical data in Zoucheng and no other stimuluses such as extra investments from local government or business operators (Section 7.4.3). Therefore, the simulated results (Figure 8.4) conform to the actual tourism development situations (at the exploration or development stage) in Zoucheng (see Chapter Two).

In Figure 8.4, the number of tourists grows rapidly, which provides a new income source for rural labourers in the simulation model.

Figure 8.5: *Social capital*

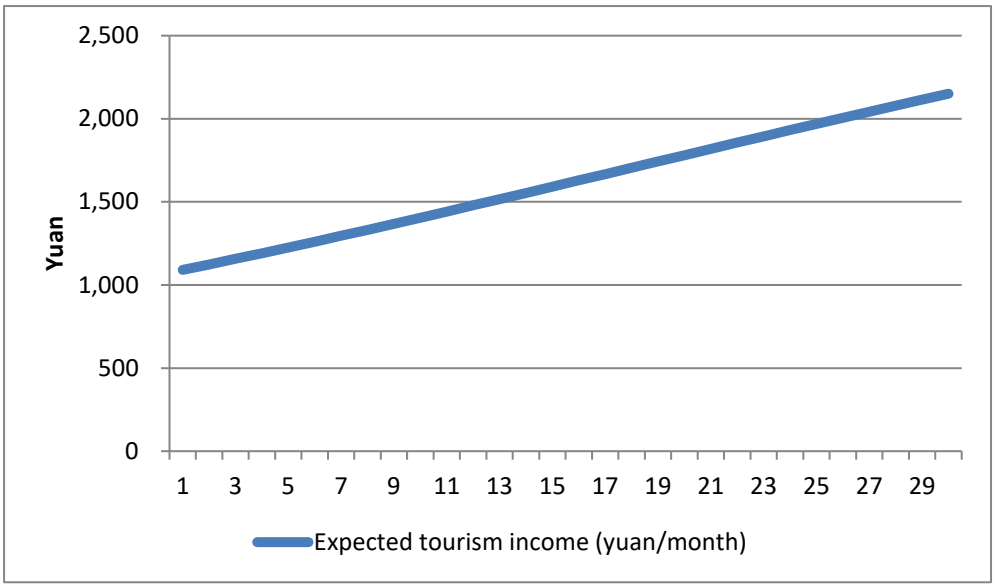


As discussed in Section 7.3.4 of Chapter Seven, social capital grows with increasing time of residence (i.e., RS) in Zoucheng in the simulation model. The length of time that a person has lived in an area has a positive association with access to social capital. The initial value of social capital (i.e., SK_0) is based on the average length of residence. According to the household survey of this thesis, the average duration in Zoucheng is 26 years and the average age is 35 (see Table 4.4). Given a ten-year time of residence in the simulation model, the years resident in Zoucheng are increased from 26 to 36 and age is changed from 35 to 45, which is a stable and solid age group in people's life (e.g. having a family and a steady job). Regardless of some shocks (e.g. reeducation, lottery winning, etc.) on social networks, each resident period (e.g. one year resident period) in Zoucheng is assumed to contribute an equal value to people's social capital. Thus, Figure 8.5 presents a linear movement due to no other effects on social capital in the simulation. Though, of course, social capital is not possible to expand infinitely, it is limited by the simulated time period. This simulation model

uses 10 years time (i.e., $0 \leq RS \leq 30$; also see Equation (9) in Chapter Seven) as one limiting condition for the accumulation of social capital. In the absence of other factors (e.g., education), each worker is assumed to have a stable social circle in local community after 10 years, the scarcity of materials for network resources or homogeneous networks may reduce the accessing better social capital (Lin, 2004). With regard to social capital growth theory (Lin, 2001), the calculated distribution of social capital scores in Zoucheng (see Chapter Four), the social capital growth trend and range (from about 0.059 to about 0.23) are reasonable. With the growth of social capital, workers can learn relevant skills and obtain relevant information about the operation of tourism businesses to further improve their career prospects and expected incomes in tourism. The specific impact of social capital will be discussed in the next section.

Figure 8.6 shows that growth in the number of tourists and in social capital will increase the expected tourism income. Hence, workers will move from agriculture to tourism (see Figure 8.3). Figure 8.6 illustrates that the expected monthly tourism income increases from an initial level of about 1,091 yuan per month to around 2,150 yuan per month after 30 time units. The initial income in the simulation model is very close to the present average tourism income in Zoucheng (discussed in Chapter Two).

Figure 8.6: *Expected tourism income (monthly wage)*



c) Agricultural sector

The growth in tourist arrivals not only benefits expected tourism incomes but the profit from farm products. This happens because an expansion in the number of tourist arrivals will raise the price of representative farm products in the simulation model. As a result, farmers will earn more in the market.

The simulation model links all the causes and effects of the tourism sector to the agricultural sector. Figures 8.7 to 8.12 compare the simulated results for the agricultural sector with and without the effect of the tourism sector.

Without the effect of the tourism sector in the simulation model, the growth rate of farm products maintains an actual level. The current growth rate may be limited by farmland quality and therefore the potential capacity for agricultural output. However, farmland quality is negatively affected by local coal output in the simulation model. Thus, the growth rate of farm products shows a downward trend, falling from about 7.6 kg/unit area to around 7.14 kg/unit area (see Figure 8.7), while the agricultural output per household increases from 2,051 kg/unit area to almost 2,265 kg/unit area

(see Figure 8.8). The crop price and cost are driven down by slow increase of total agricultural output per household. As discussed in the initial assumptions (Section 7.3.5), the effect on unit price and cost of agricultural output per household is fairly small, moving from about 5.08 yuan/kg to about 5.078 yuan/kg for crop prices and from about 1.149 yuan/kg to about 1.135 yuan/kg for crop costs during the 10 year period of the simulation (see Figure 8.8). However, the growth in total agricultural output per household still boosts the crop profits per household (see Figure 7.7). The crop profits per household increase from an initial income of about 8,071 yuan to around 8,931 yuan after 30 time units (see Figure 8.9).

Figure 8.7: *Agricultural output per household & growth rate of farm products*

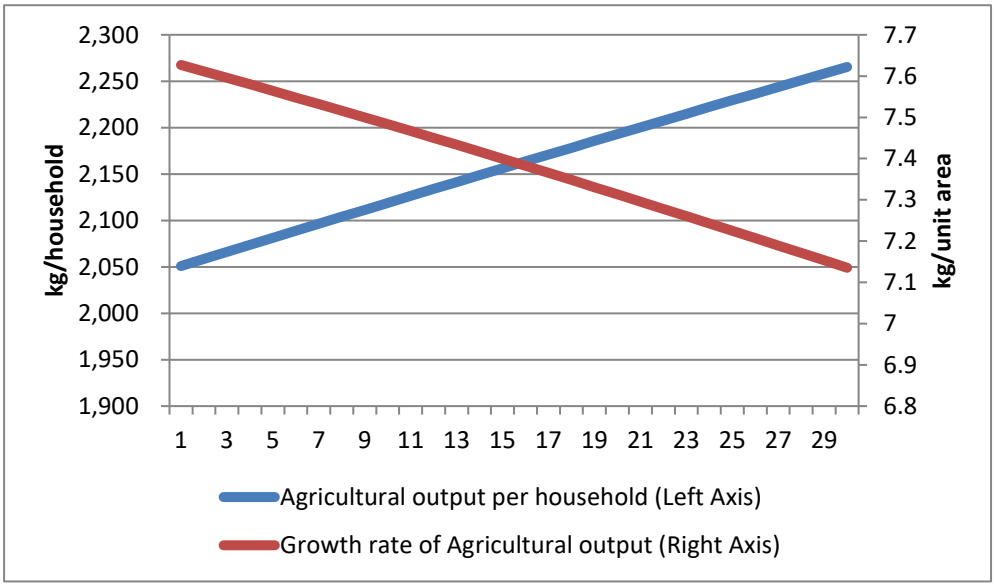


Figure 8.8: *Price and cost of agricultural outputs*

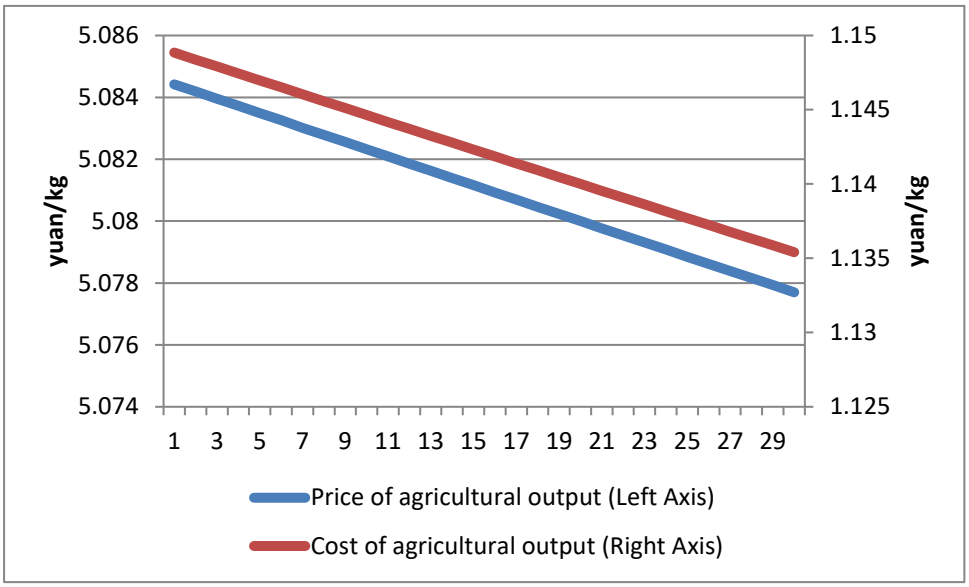
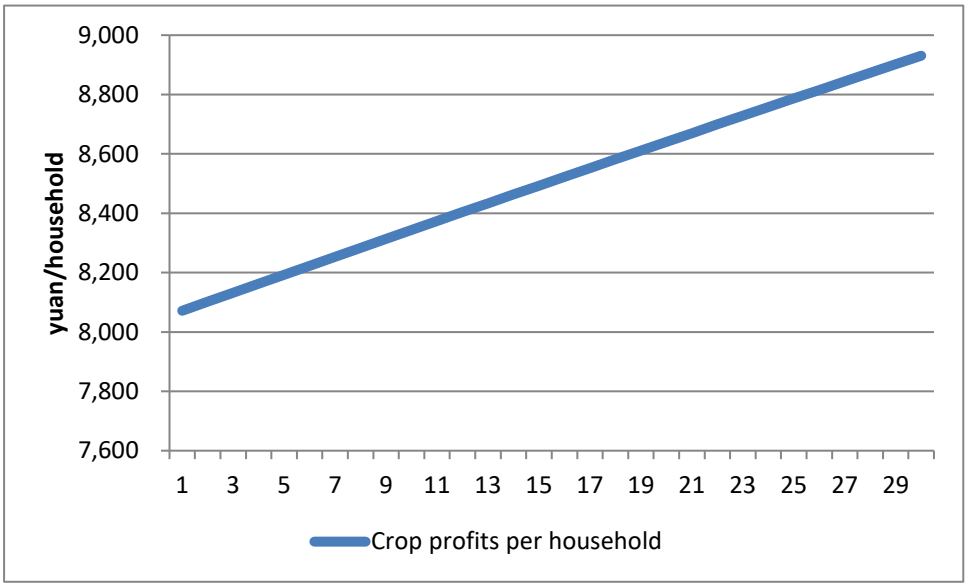


Figure 8.9: *Crop profits per household*



By adding tourism activity, the agricultural sector is likely to get some respite at first, despite the coal mining issues influencing farmland quality. Figure 8.10 shows that tourism cannot directly influence the growth rate for farm products and agricultural output per household. The agricultural output is very similar to that in Figure 8.7. The tiny change reflects the growth rate of agricultural outputs in Figure 8.10. The reason is that farmers will receive benefits (i.e., crop profits) from tourists, which slows down the shift of workers from farming to tourism. The labour input could positively

impact on the growth rate of agricultural output (see Eq. (3)). With the growth of tourist arrivals, the crop price increases from about 5.22 yuan/kg to around 5.35 yuan/kg (see Figure 8.11) after 30 time units. Compared to Figure 8.8, the price of agricultural outputs increases by about 0.3 yuan/kg after 10 years (i.e., 30 time units). The crop cost remains the same in Figure 8.8. The crop profits per household increase from about 8,356 yuan to almost 9,541 yuan (see Figure 8.12). Compared to Figure 8.9, the crop profits per household increase by almost 608 yuan after 30 time units.

Figure 8.10: *Agricultural output per household & growth rate of farm products (tourist effect)*

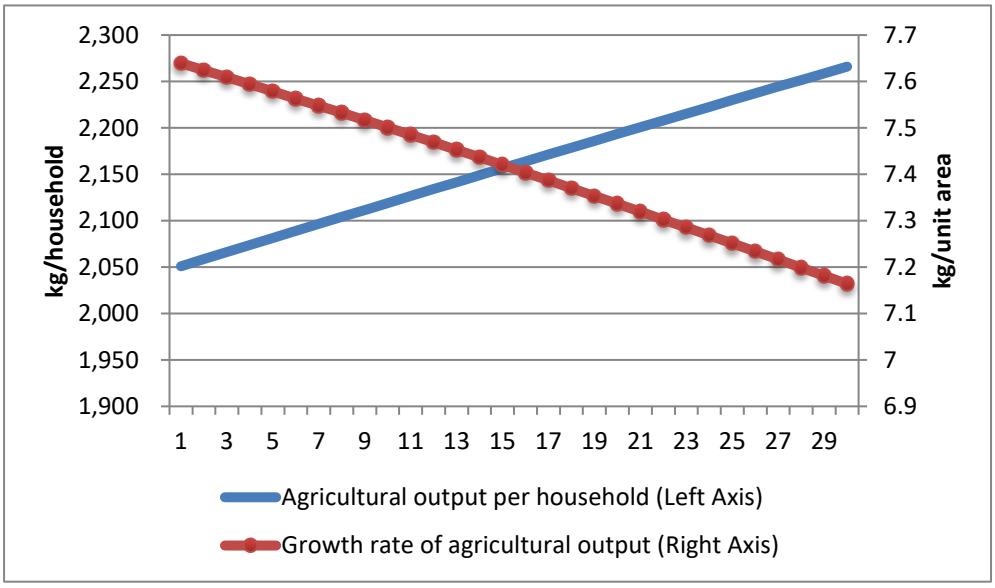


Figure 8.11 P*rice and cost of agricultural output (tourist effect)*

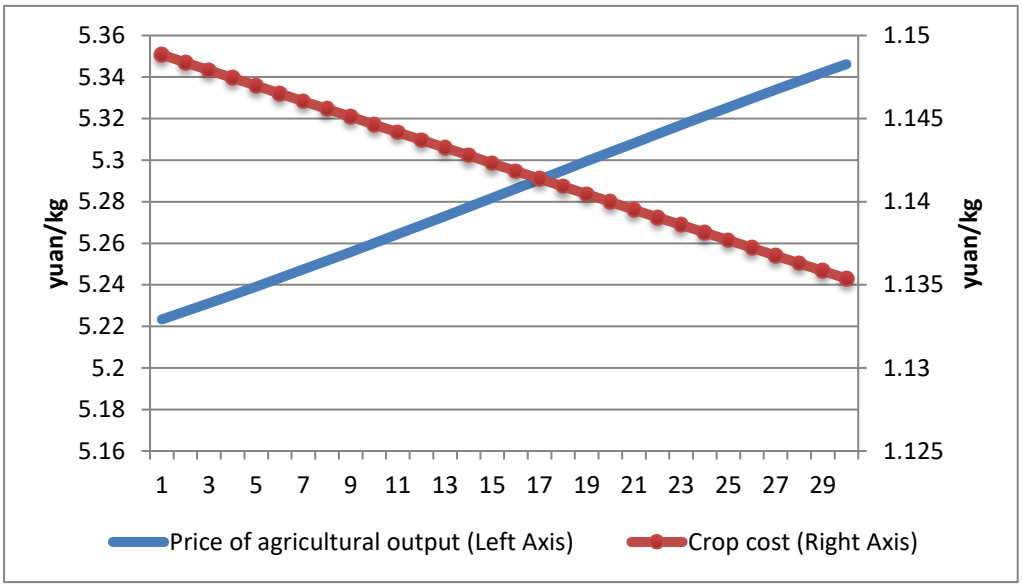
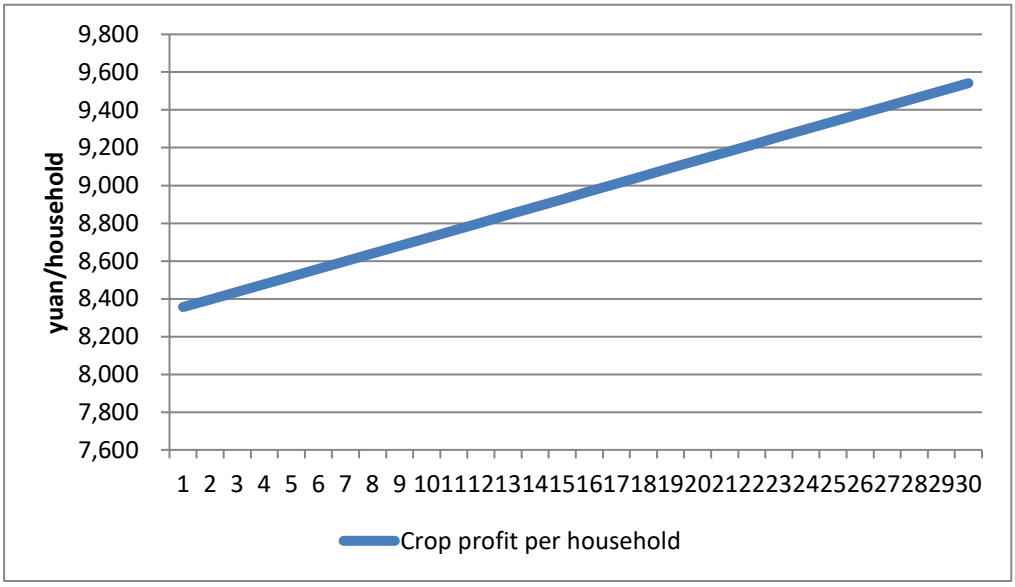


Figure 8.12: *Crop profits per household (tourist effect)*



The expected income in rural tourism and the crop profit per household further affect inter-sectoral profit differences between agricultural and tourism. The relevant variables for expected incomes in agriculture and tourism in the simulation model allow us to explore the interactions between the movements of agricultural labour into the tourism sector.

While there is growth in the tourism sector, the opposite is happening in the agricultural sector. Agricultural employment falls from an initial labour allocation of 6,561 farmers to 5,258 farmers (see Figure 8.3), with a general increase in crop profit

per household from about 8,356 yuan (about 2,089 yuan/month) per household to about 9,539 yuan (about 2,384 yuan/month) per household (see Figure 8.12) and expected tourism income grow from 1,095 yuan per month to 2,150 yuan per month (see Figure 8.6).

From the simulation results above, increased tourism can produce more income for tourism operators, which attracts more workers from farming to tourism. In addition, more tourists raise the price of agricultural outputs, which eventually impacts on crop profits per households. Therefore, the application of tourism and social capital to livelihood development is a 'win-win' situation with benefits to both agriculture and tourism.

8.3 The potential impact of increased social capital

This section simulates the effects of different strengths of social capital on alternative livelihoods (rural tourism and farming). It provides the relevant livelihood results showing the effects of differential access to social capital on livelihood activities. In the simulation model, social capital plays an auxiliary role in rural tourism development. Rural labour is assumed to access more tourism business information and service skills through increased social capital resulting in higher tourism incomes.

Figure 8.13 shows that the expected tourism incomes in models with social capital compared to those without social capital gradually increased from a difference of 7 yuan/month (an increase of about 0.1%) in the first time period to a difference of 54 yuan/month (an increase of about 0.05%) in the final simulated period. Consequently, current social capital has a very limited ability to affect the number of tourism workers because in the simulation model, the initial social capital involves only the length of local residence. The social capital of labourers may limit labourers to a narrow social network in which to search for business information relating to rural tourism operation. Figure 8.14 shows that the numbers of rural tourism workers in models with social capital compared to those without social capital gradually increased from

a difference of 15 (increased by about 0.4%) at the first unit time to a difference of 64 (increased by about 1.4%) at the final simulated period.

Figure 8.13: *Comparing expected tourism incomes with and without social capital (yuan/month)*

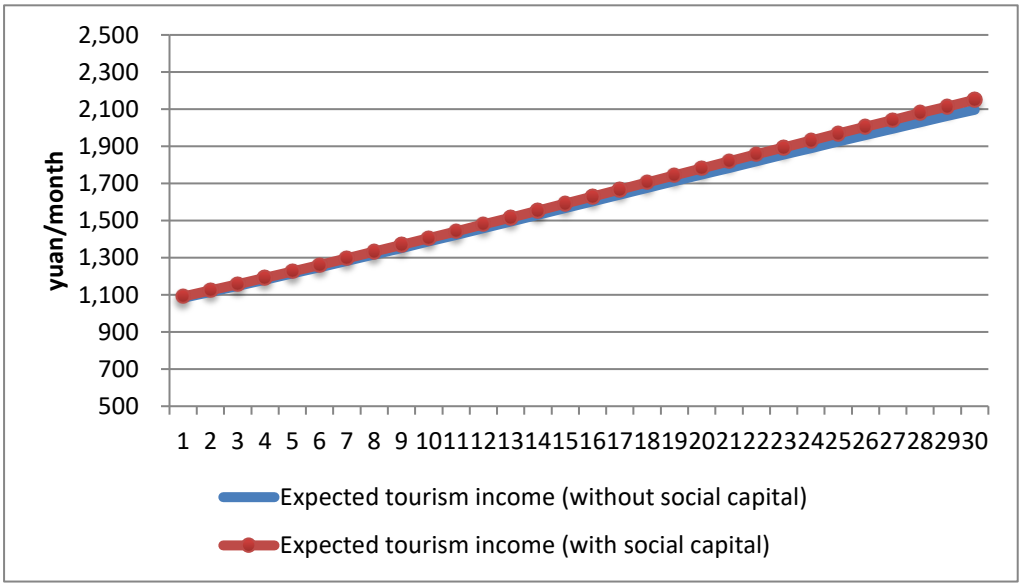
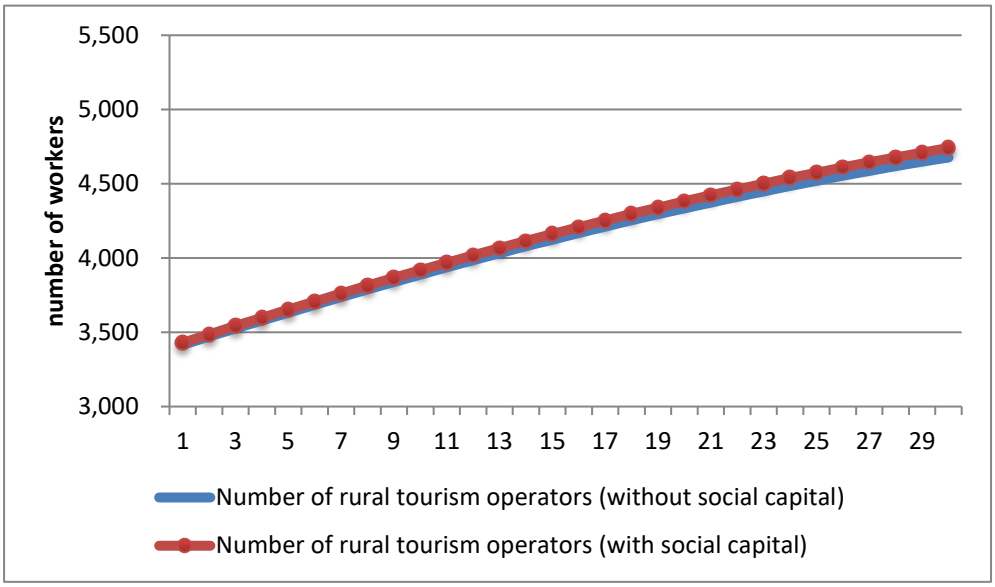


Figure 8.14: *Comparing number of rural tourism operators with and without social capital*

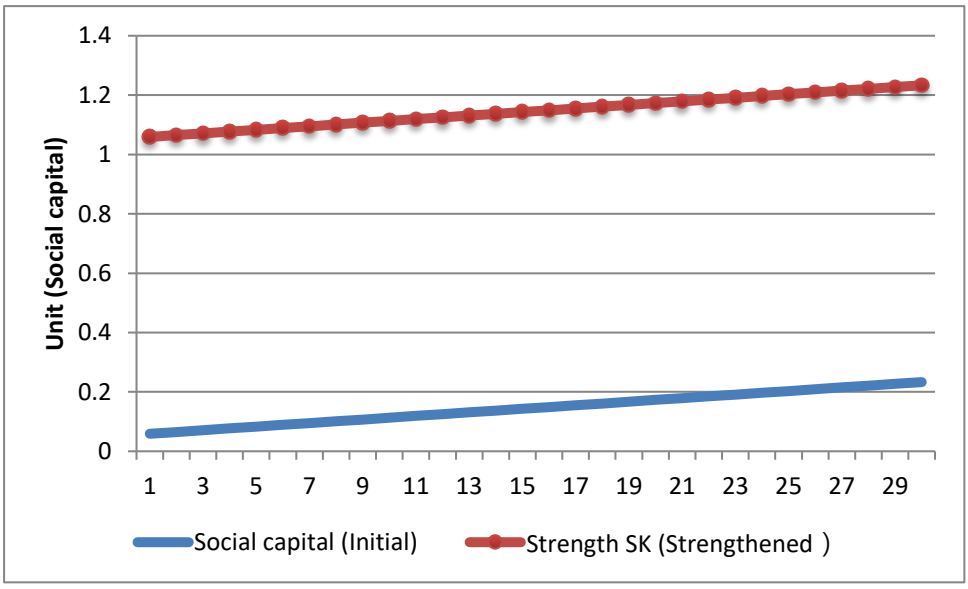


The regression results from Chapter Six suggest that both kin ties and non-kin ties are equally likely to provide access to social capital. There is no statistically significant

difference between the relationship between kin ties and social capital and that between non-kin ties and social capital. Thus, the simulation model ignores the specific impact of a change in kin and non-kin ties on social capital. Social capital (SK) is simply increased by one standard deviation (i.e., SK+1) to evaluate the effect of expanded social capital on all households. Given the distribution of predictive scores on social capital (see Chapter Four), the range of increased social capital is still reasonable (i.e., from about 1.059 to about 1.23).

The following comparisons include models with initial social capital (social capital based on length of local residence) and with expanded strength of relationships (SK+1). In this scenario, workers use different strengths of relationships to access relevant business information for rural tourism operation. The increased social capital enable the community to be better informed of the consequences of decisions relating to the tourism industry. In the simulation model, the initial social capital gains one extra unit with these associated factors (see Figure 8.15).

Figure 8.15: *The different strengths of social capital*

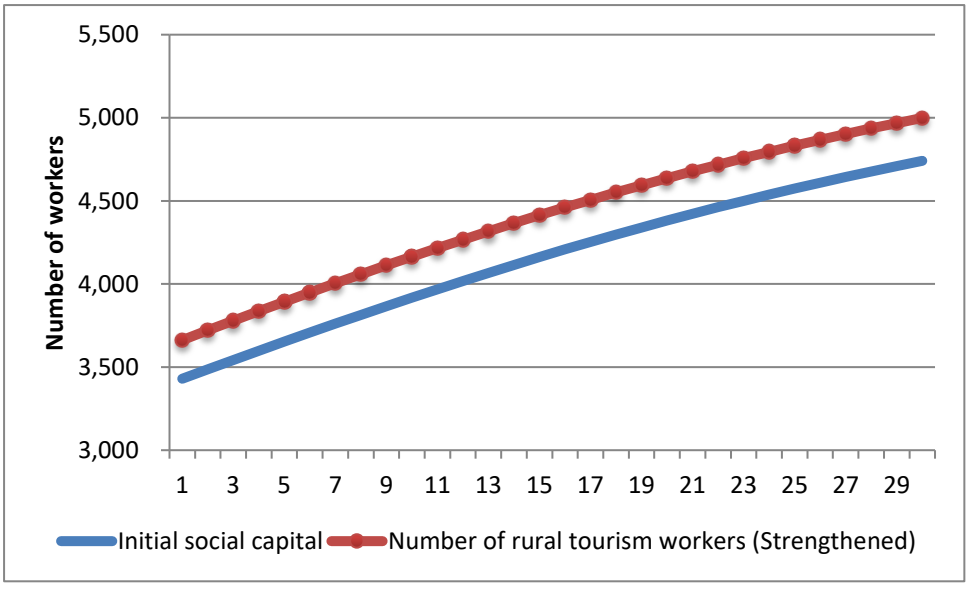


The outcomes show that strengthened social capital causes an approximately 11% increase in expected tourism income by compared to initial social capital in the simulation model (see Figure 8.16). With expanded social capital, the expected

tourism income increases from about 1,091 yuan/month to about 1,207 yuan/month at the first unit time (see Figure 8.16), with 232 extra workers moving from farming to tourism (see Figure 8.17).

Figure 8.16*: Change in expected tourism incomes (yuan/month)*

Figure 8.17：*Change in number of rural tourism workers*



The movement of workers from farming to tourism also impacts on tourism service quality, which in turn alters the number of tourist arrivals. In the simulation model, the increase in social capital has little effect on the number of tourist arrivals. The

simulation result shown in Figure 8.18 illustrates the growth rate of tourist arrivals as related to strengthened social capital. On average, workers with high social capital can increase the growth rate of tourist arrivals by about 0.7% on average. Figure 8.19 shows the growth in number of tourist arrivals by applying either initial or strengthened social capital. Both social capital levels cause very small effects on the number of tourist arrivals. On average, the strengthened social capital stimulates about a 0.2% increase in tourist numbers.

Figure 8.18*: Change in growth rate of tourist arrivals*

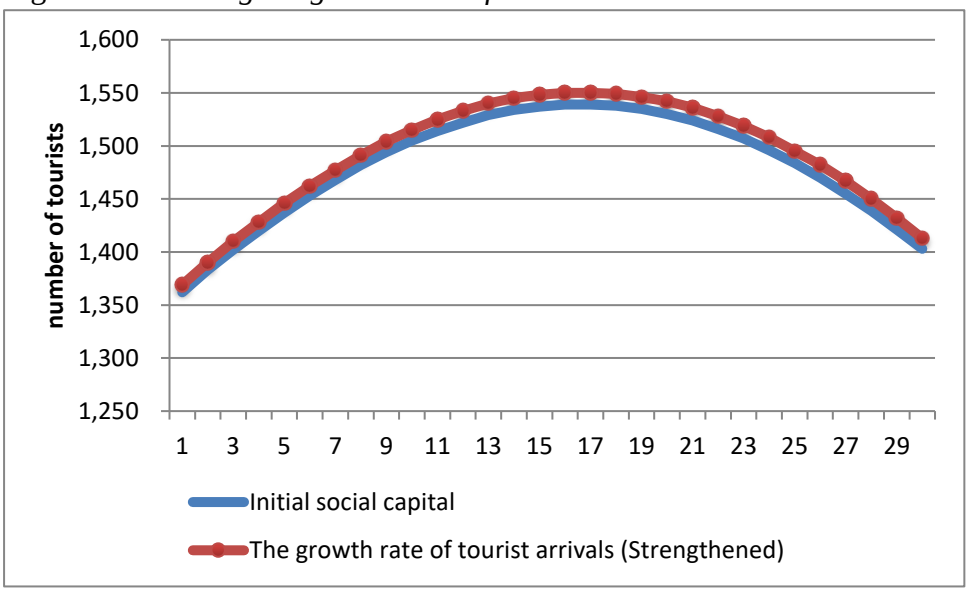


Figure 8.19: *Change in number of tourist arrivals*

In previous discussions, tourism was likely to raise agricultural income by influencing the price of agricultural outputs (see Figure 8.11). However, the price of agricultural outputs and crop profits per household from farming seem almost unaffected by scenarios involving different strengths of social capital (see Figures 8.20 & 8.21). The main reason is the small variation in number of tourist arrivals with increased social capital (see Figure 8.19).

Figure 8.20：*Change in price of agricultural output*

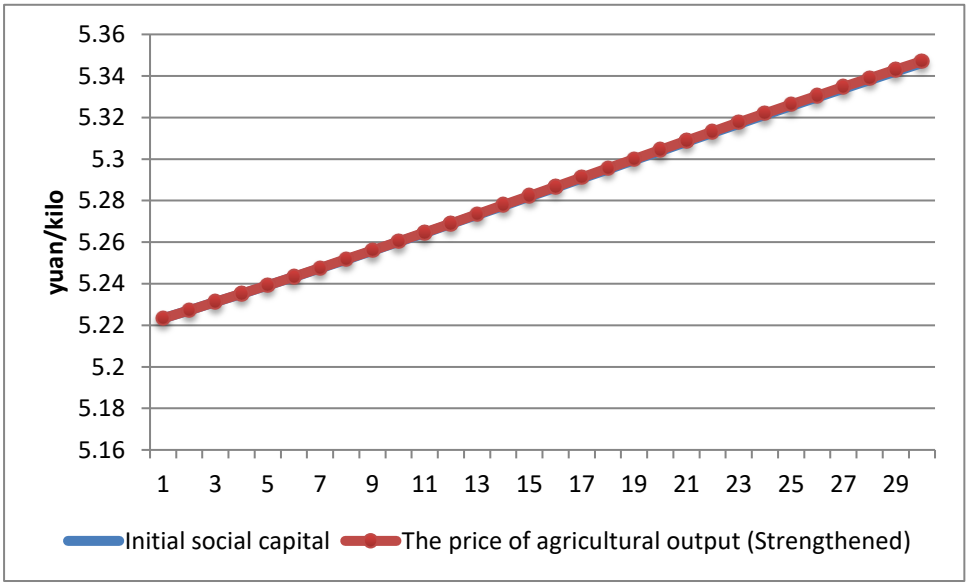
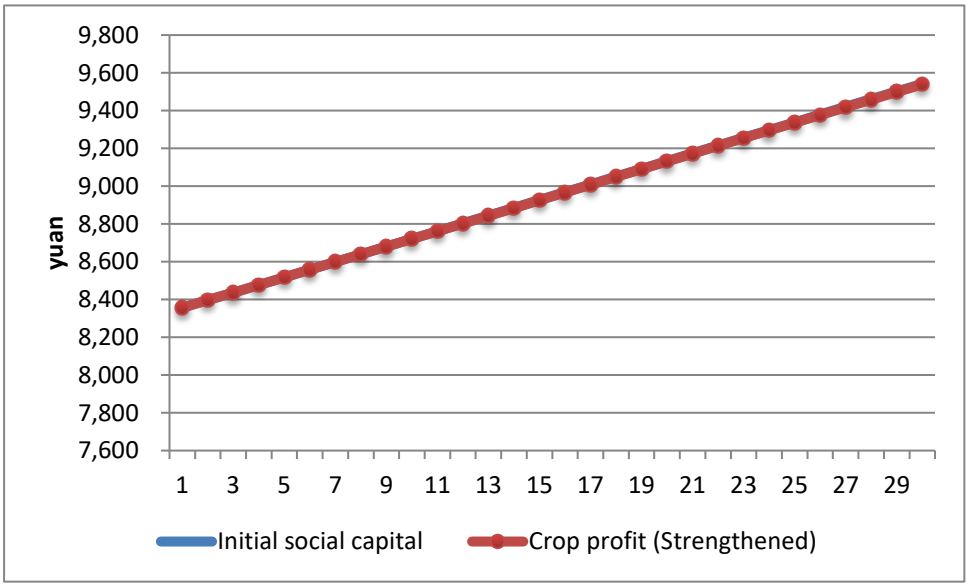


Figure 8.21: *Change in crop profits per household labourer in farming*



Only workers in tourism show a marked response to the increase in social capital, with an increase in tourism incomes due to better social networks (see Figure 8.16). From Figure 8.22, it can be seen that high social capital causes movement of an extra 4.3% of farmers to tourism. In other words, social resources may significantly help rural labourers to access off-farm livelihood choices (rural tourism). As a result, more rural labourers leave to work in tourism, reducing the growth rate of farm products by about 0.6% on average (see Figure 8.23), which in turn decreases the crop profits. However, the negative effect on crop profits is very weak (less than 0.02%; see Figure 8.21). Compared to the expected increased tourism income (see Figure 8.16) for the local community, these losses in farming income can be ignored.

Figure 8.22: *Change in number of farmers*

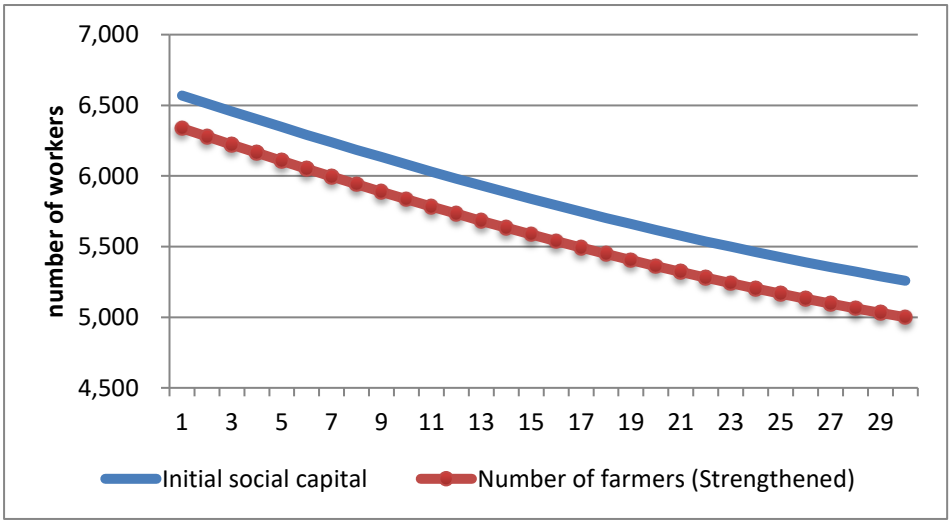
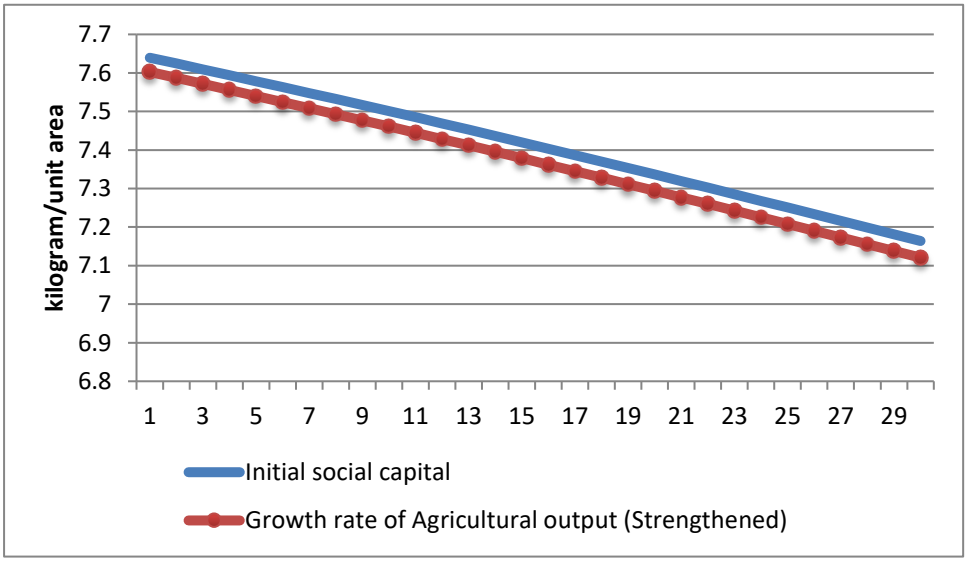


Figure 8.23: *Change in growth rate of farm products*



8.4 Livelihoods development strategies-current livelihoods and alternative livelihoods

This section looks at three different livelihood strategies (mining, farming, and rural tourism) for rural households. In previous scenarios (Sections 8.2 and 8.3), the labour mobility was based on the different incomes from tourism and farming. Hence, the profitability of the livelihood is assumed to play an important role in determining livelihood choices in this section.

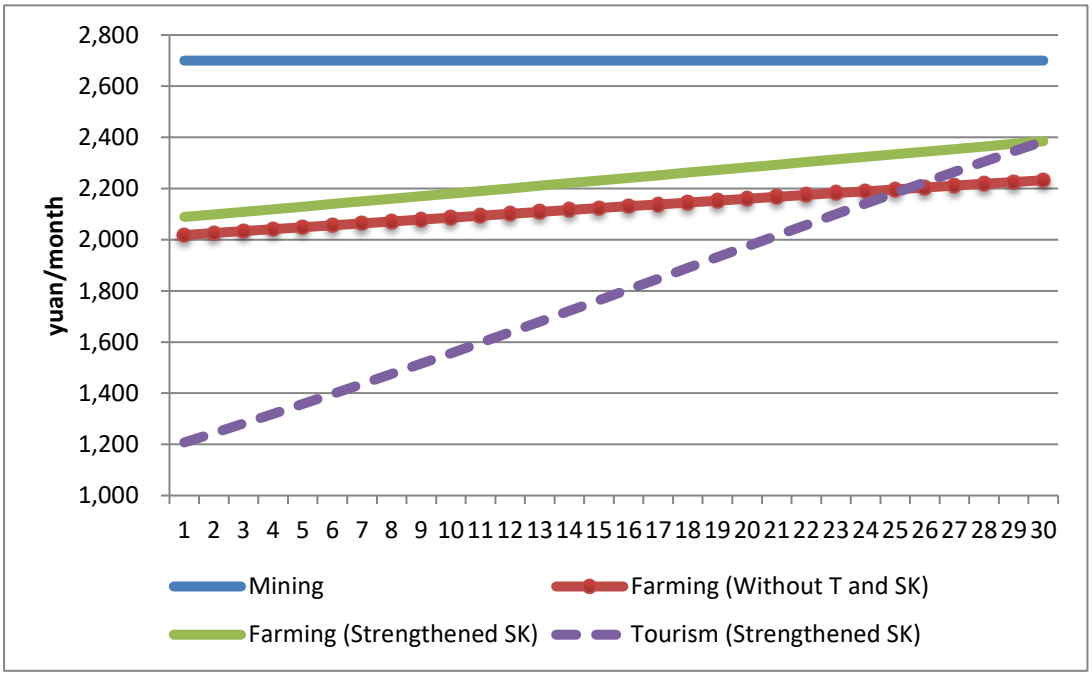
Due to the dominant role of mining activities, the number of jobs and the rate of pay in mining are assumed to be constant in the simulation model. Current income sources for rural households are from mining (constant) and agriculture (without tourism effects). However, tourism activities could be an expanding income source for mining households by using local tourism resources and social networks to develop rural tourism businesses. Thus, the alternative income sources for mining households are either from agriculture (with tourism effects) or tourism alone.

Running the system dynamics model for all three activities as simulations, the income changes can be seen in Figure 8.24, covering a 10-year period. All of the incomes were calculated monthly and social capital was strengthened for all households (i.e., SK+1) to create have a distinct contrast.

From Figure 8.24, it can be seen that mining creates a stable and high income for rural households, which is maintained at the same level throughout the simulation period (i.e., 2,700 yuan per month). However, pollution issues affect the growth rate of farm products and agricultural output (see Figure 8.1 and Figure 8.7). As a non-renewable natural resource, mining activity potentially threats the income sources for rural households in the long term. Without the effects of tourism and social capital on farming, the expected income in farming increased from about 2,017 yuan per month to about 2,233 yuan per month, which is a comparatively sluggish growth rate (see Figure 8.24).

Driven by the development of tourist demand together with social capital, the expected income in farming gradually increased from about 2,089 yuan per month to almost 2,385 yuan per month. The expected incomes in tourism show a remarkable growth, as can be seen in Figure 8.24. Given an increased level of social capital in tourism operations, the monthly income increased from about 1,207 yuan per month to around 2,385 yuan per month after 10 years. Compared to mining, the monthly income gap between mining and farming is reduced from about 611 yuan to about 315 yuan, while the gap between mining and tourism revealed the most powerful reduction, from about 1,493 yuan to 315 yuan. In general, mining activity is potentially replaceable by alternative livelihood choices (tourism and farming) after ten years in this simulation model, particularly as alternative livelihoods develop with strong social capital contributions.

Figure 8.24: *Comparing livelihood development options for rural households*

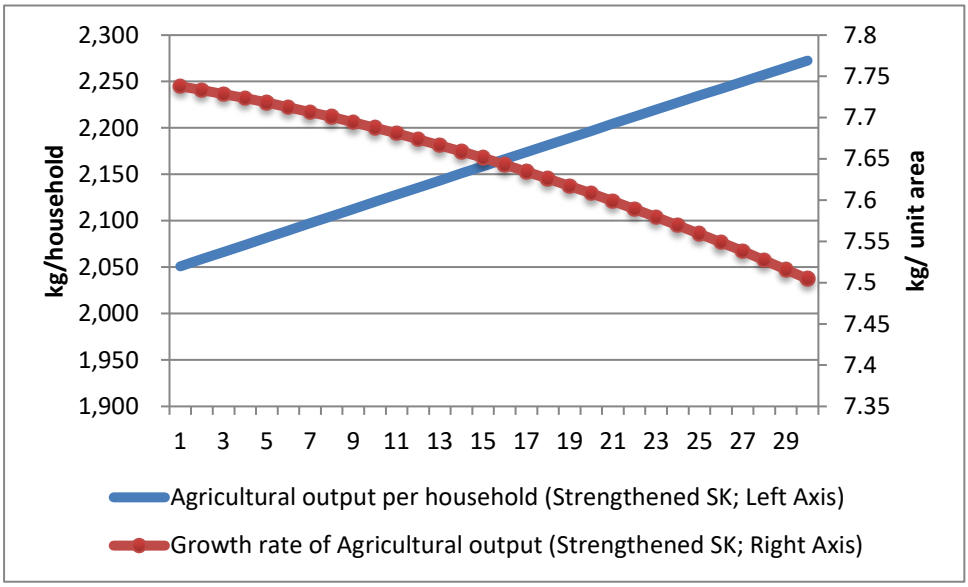


If this simulated alternative livelihood provides a good outlook for rural households, could the local community break out of the mining sector and set its sights on rural tourism initially? The analysis suggests that tourism is a worthwhile alternative to mining for producing acceptable incomes in rural households. However, mining is

closely related to local environmental problems, which then influence the development of agriculture and tourism. Thus, the next model looks at the impact of the Zoucheng government deciding to shut down the local pits (i.e., C=0) in order to encourage alternative livelihood development. This simulation can also be used to estimate the situation after all the existing mineral resources have been exhausted. In other words, there are no coal mining effects in this simulation model. This model focuses on the profitability of farming and tourism activities only, in order to determine the prospects for alternative livelihoods for the local community. In the simulation period, this scenario may cause unemployment amongst miners due to mine closures. It is assumed that local government institutes a ten-year subsidy policy and settles all of the laid-off miners in other relevant departments or industries (e.g., transportation industry), to remain consistent with the initial assumption (i.e., constant "miners") and avoid unemployment acting as a potential cause of social unrest.

When comparing farming activity between coal mining impacts (see Figure 8.10) and pit closure (see Figure 8.25), the growth rate of farm products generally increased slightly by around 0.23 kg/unit area on average after pit closure. As a result, agricultural output per household gradually increased by about 3 kg on average after pit closure. Compared to Figures 8.7 and 8.10, the growth rate and total output of farm products increased (see Figure 8.25) due to fewer pollution issues affecting farmland quality.

Figure 8.25: *Agricultural output per household & growth rate of farm products (pit closures)*



While there is a growth in the agricultural sector (see Figure 8.25), crop prices slightly decreased from about 5.22 yuan/kg to around 5.2195 yuan/kg (see Figure 8.26). In this scenario, the effect of agricultural output per household on crop price has a larger effect than tourist arrivals. However, the crop profits grow from about 8,356 yuan (about 2,089 yuan/month) to about 9,273 yuan (2,318 yuan/month) (see Figure 8.27) due to the increase in agricultural output per household. However, the crop profits seem lower than scenarios including the effects of tourism and coal mining (see Figure 8.12).

Figure 8.26: The *price of agricultural output (pit closures)*

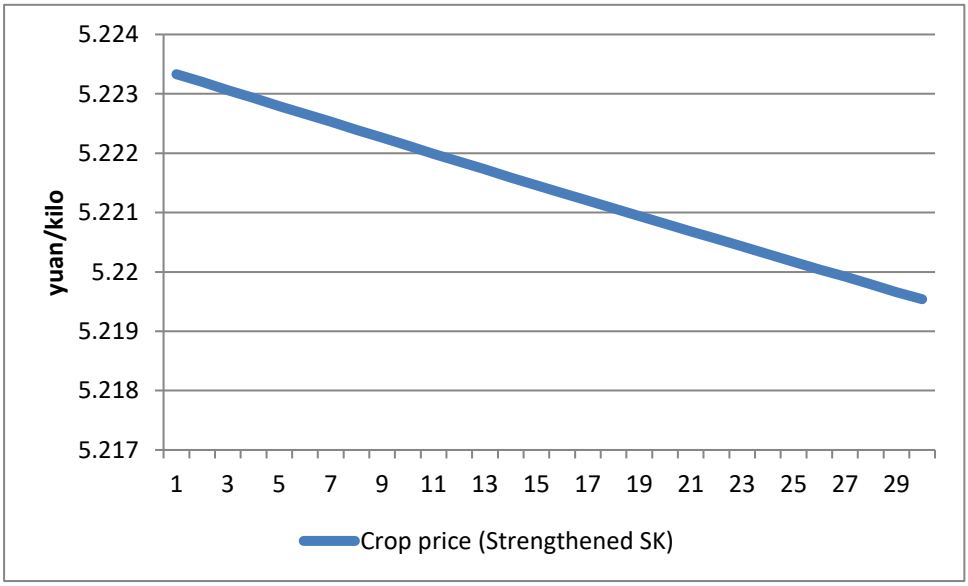
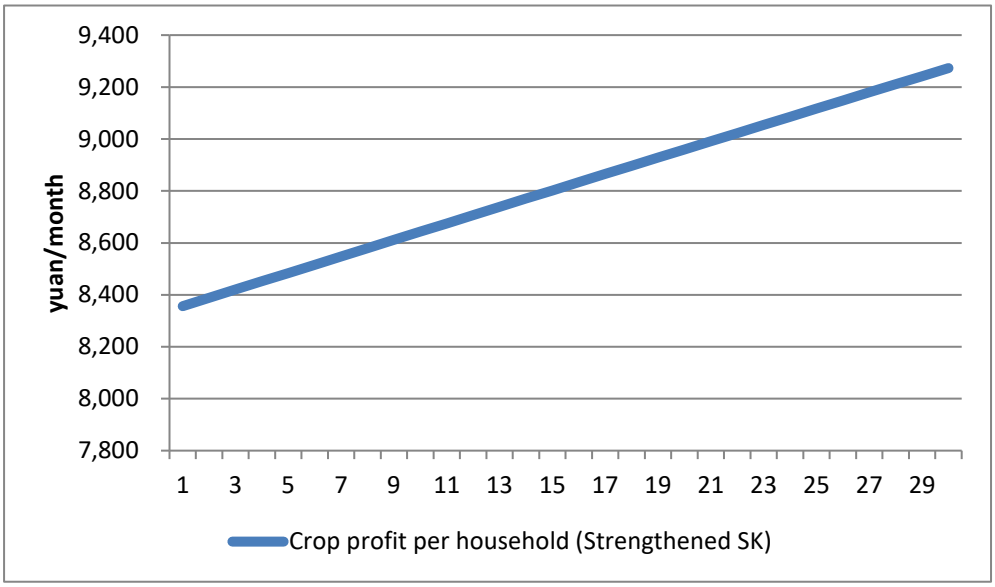
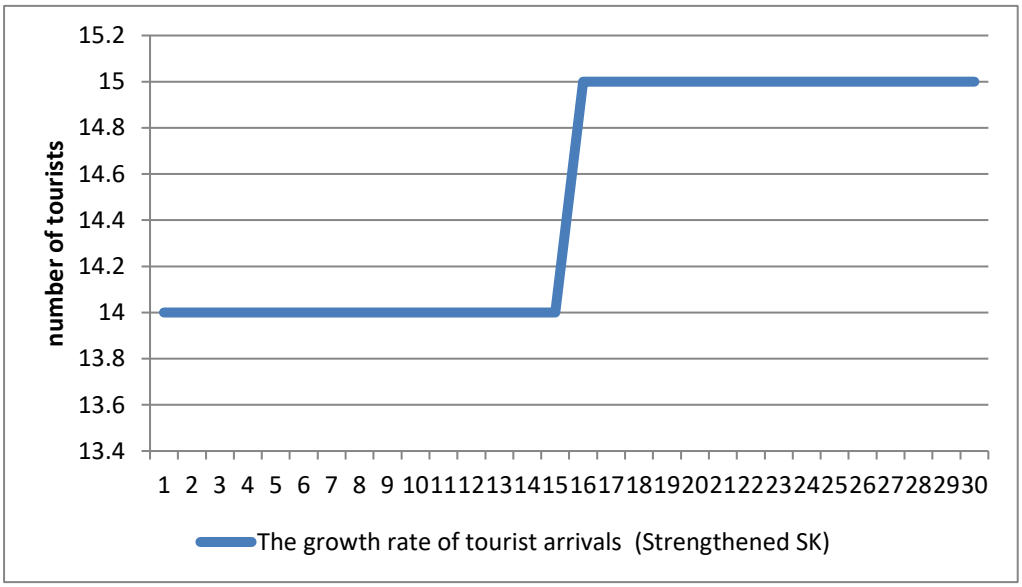


Figure 8.27: *Crop profits per household (pit closures)*



For the tourism sector, the effect of pit closures on the growth rate of tourist arrivals is unexpected. The initial expectation was for pit closures to reduce the effects of environmental issues on tourism and farming developments. However, the growth rate of tourist arrivals per unit time barely increased, only from 14 tourists initially to 15 tourists (see Figure 8.28). (It should be noted that the growth line is not smooth because this model uses integers as tourist units). Consequently, the slow growth rate per unit time dragged the increase of the number of tourist arrivals down. Total tourists increased from 46,000 to approximately 46,420 tourists over the simulated time period (see Figure 8.29). The number of tourist arrivals further affects the expected tourism incomes, which rise from just over 1,091 yuan per month to about 1,121 yuan per month after ten years (see Figure 8.30). The small increase in the number of tourist arrivals can also explain the crop price trends in Figure 8.26.

Figure 8.28: *The growth of tourist arrivals per unit time (pit closures)*



Compared to scenarios including the coal mining sector (see Figure 8.18 & 8.19), the growth of the tourism sector (the growth rate of tourist arrivals and the number of tourist arrivals) is significantly slower with pit closures. The main reason is that pit closures mean one of the main income resources is lost and this also means a loss of revenue to the Zoucheng government. Less income for the government will impact on public investment in local infrastructure, which in turn reduces the growth rate of tourist arrivals. In the simulation model, the government investment in tourist growth decreased from about 4.3% to about 0.05% after pit closures (see Figure 8.31), which contributed to the very small rise in the number of tourist arrivals. Consequently, agricultural sector factors such as crop price and crop profit also responded to the tourism sector. In this scenario, financial support for tourism development has a more powerful influence than environmental issues from mining. This simulation also presents the reality of the situation with respect to the dominant role of mining in Zoucheng.

Figure 8.29: *Number of tourist arrivals (pit closures)*

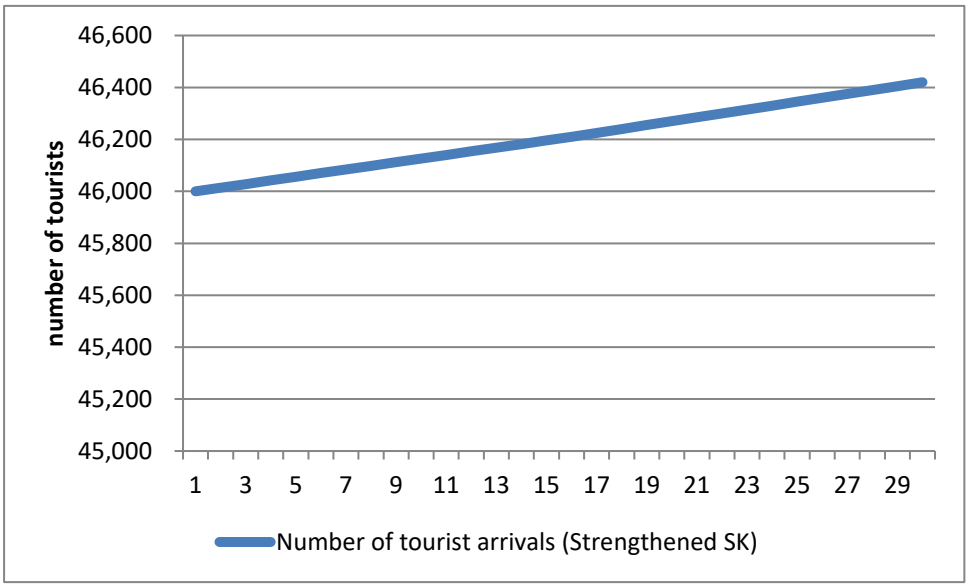
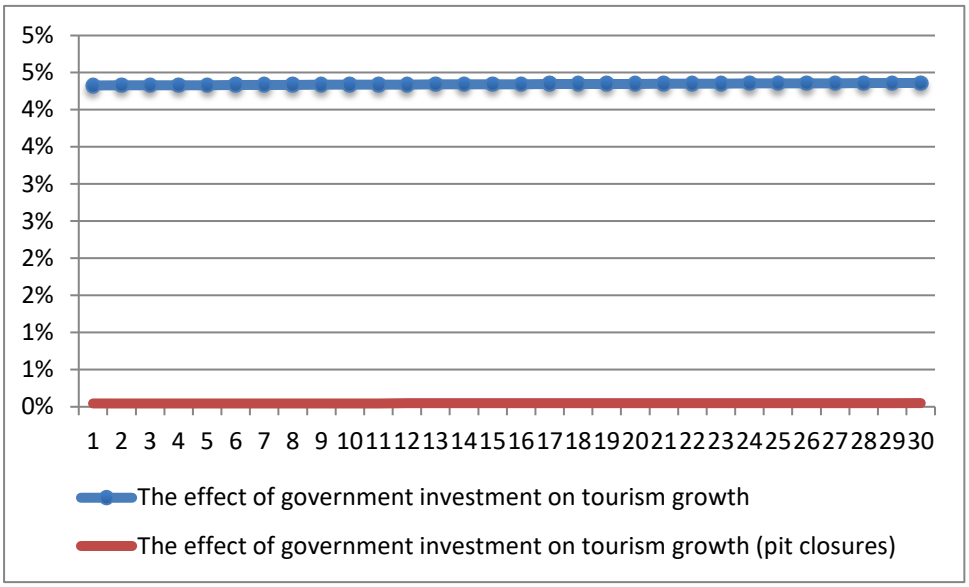


Figure 8.30: *Expected tourism income (pit closures)*

Figure 8.31: *The effect of government investment on tourist growth*



8.5 Summary

Table 8.1 summarises the values of all of the 'outcome' variables for each scenario. Each 'outcome' variable has both an initial value and an end value to show the changes during the simulation period.

The first scenario simulates local environmental issues, presenting two negative relationships (i.e., total coal output vs. farmland quality, and industrial dust discharged vs. the initial tourist number).

The second model is sensitive to the number of workers and incomes in the tourism and agricultural sectors. In the simulation model, tourism presents a brighter outlook. With an increase in the number of tourists, the available livelihood choices (i.e., rural tourism) and income earnings could reduce the vulnerability of household livelihoods (i.e., more income, more diverse livelihoods). This is also seen as contributing towards the enhancement of quality of life in the community. The Zoucheng government might further modify the implementing channel of the developing strategy once tourism becomes large-scale.

For the third model, the increase in social capital can further develop alternative livelihoods. The accumulation of increased social capital seems able to help local

workers to access new careers in tourism businesses. For instance, local workers could access more social resources and networks to obtain tourism information for their rural tourism business operations in the local market. Given a one standard deviation increase in social capital on average for all households (i.e., SK+1), the expected tourism income was increased to a higher level throughout the simulation period compared to using only initial social capital, which also leads to more workers transferring from agriculture to tourism in comparison to the model with initial social capital. However, losing farm labourers does not significantly reduce farming income. For instance, the percentage change for crop profits is similar in scenarios two and three (see Table 8.1).

The final simulation model looks at three livelihood activities (mining, farming, and tourism). In the simulation model, tourism is an alternative livelihood choice for rural households. Regarding the current risks of mining activity (e.g. degrading farmland quality and increasing air pollution), mining households in rural areas can take advantage of the tourist market. Mining households can provide agricultural outputs from their farmlands and gain benefits from tourist demand causing high crop prices and profits. By accessing social networks, workers can more easily access information about rural tourism operations for their own commercial advantage. As a result, the incomes of rural tourism operators increase. The expectation of high incomes in tourism businesses attracts more operators, which can provide more jobs in the local community. This is a "win-win" result for the development of both agriculture and tourism. Thus, there is a good prospect for rural households aiming to develop rural tourism businesses. Therefore, this simulation displays a self-sustaining cycle of growth, which is more sustainable than mining activity.

The final scenario also simulates the impact of local pit closures on the development of the alternative livelihoods. Local government was assumed to incur more burdens (e.g. subsidy policy, resettlement, providing new work for laid-off miners) so as to maintain social stability. As a result, the increase in expected incomes in alternative

livelihood strategies (e.g. rural-tourism) in this scenario (pit closures) is slower than in the model with three industries (coal mining, agriculture, and tourism). The simulation results indicate that industrial transformation and the availability of alternative livelihoods need a long time frame to establish. Therefore, a simulation model is necessary in order to analyse the possible policies. Local government can then implement compatible policies before mineral resource exhaustion occurs.

Table 8.1: *Summary of the simulated results of relevant variables for each scenario*

Scenario	Outcomes				Figures
	Variables	1st unit time	30th unit time	% Change	
8.1: Current environmental issues	Total coal output	39.15 million tons	39.43 million tons	0.7%	Figure 8.1
	Farmland quality	4.5 mu	4.33 mu	-3.8%	Figure 8.1
	Industrial dust discharged	4,424 ton	4,459 ton	0.8%	Figure 8.2
	The initial tourist number	46,000 tourists	43,128 tourists	-6.2%	Figure 8.2
8.2: Potential impact of developing tourism sector	Number of tourists	46,000 tourists	89,035 tourists	94%	Figure 8.4
	Expected tourism income	1,091 yuan/month	2,150 yuan/month	97%	Figure 8.6
	Agricultural output	2,051 kg/household	2,265 kg/household	10%	Figure 8.10
	Growth rate of farm products	7.64 kg/unit area	7.16 kg/unit area	-6.2%	Figure 8.10
	Crop price	5.22 yuan/kg	5.35 yuan/kg	2.34%	Figure 8.11
	Crop cost	1.15 yuan/kg	1.14 yuan/kg	-1%	Figure 8.11
	Crop profits	8,356 yuan/household	9,541 yuan/household	14.2%	Figure 8.12
	Number of labourers in farming	6,569	5,258	-20%	Figure 8.3

	Number of rural tourism operators	3,430	4,741	38%	Figure 8.3
8.3: Potential impact of increased social capital	Social capital	SK+1	SK+1	-	Figure 8.15
	Expected tourism income	1.208 yuan/month	2,385 yuan/month	97%	Figure 8.16
	Growth rate of tourist arrivals	1,369 tourists	1,413 tourists	3%	Figure 8.18
	Number of tourist arrivals	46,000 tourists	89,337 tourists	94%	Figure 8.19
	Crop price	5.2 yuan/kg	5.35 yuan/kg	2.4%	Figure 8.20
	Crop profits	8,356 yuan	9,538 yuan	14%	Figure 8.21
	Growth rate of farm products	7.6 kg/unit area	7.12 kg/unit area	-6%	Figure 8.23
	Number of farmers	6,337	5,000	-21%	Figure 8.22
	Number of rural tourism operators	3,662	4,999	37%	Figure 8.17
8.4: Livelihood development strategies	Mining income	2,700 yuan/month	2,700 yuan/month	0%	Figure 8.24
	Farming income (Without T and SK)	2,018 yuan/month	2,333 yuan/month	11%	Figure 8.24
	Farming income (With T and SK)	2,089 yuan/month	2,385 yuan/month	14%	Figure 8.24
	Tourism income (With SK)	1,207 yuan/month	2,384 yuan/month	98%	Figure 8.24
	Agricultural output (pit closures)	2,051 kilo/household	2,273 kilo/household	11%	Figure 8.25
	Crop price (pit closures)	5.2 yuan/kg	5.2195 yuan/kg	-1%	Figure 8.26
	Crop profits (pit closures)	8,356 yuan	9,373 yuan	12.6%	Figure 8.27

	Growth rate of tourist arrivals (pit closures)	14 tourists	15 tourists	0.7%	Figure 8.28
	Number of tourist arrivals (pit closures)	46,000 tourists	46,420 tourists	0.9%	Figure 8.29
	Expected tourism income (pit closures)	1,091 yuan/month	1,121 yuan/month	3%	Figure 8.30
	Government investment in tourist growth	About 4%	Around 0.05%	-99%	Figure 8.31

The simulation variables are based on recent data and information from Zoucheng city. There are no extra policies to stimulate tourism development in the simulation model. The simulated results for three industries (mining, tourism, and agriculture) in four scenarios did not indicate any exaggeration at variance with the historical facts. The results of the simulations in this thesis provide a possible perspective on the development of alternative livelihoods by using social capital. They also bring some insights for future policy implementation in the area of industry transformation when local mineral resources are exhausted.

Although the dynamic simulation model generated useful results and some possible policy insights for policy-makers, in future there is a need to fill data gaps and use more relevant variables to improve the understanding of several feedback mechanisms within the system. Some other factors with dynamic changes could be found to provide more information about tourist demand, the proportion of breeding livestock in crop-livestock agricultural systems, and other continuous variables relating to social capital and pollution effects so as to increase the integrity and accuracy of the whole simulation model. While the simulation model is currently not fully calibrated to all realistic and specific relationships for all sectors, it can be used to investigate and test livelihood development. The results of the simulation are indicative of trends. Although Zoucheng government has not started to notice the

social capital role during the economic development, some of the local policies and cases potentially revealed its important position. Based on Zoucheng's experiences in rural economic development in recent years, local rural policies have moved to support social networks and relationships in villages to strengthen the villagers' abilities to access resources (e.g., financial capital) and information (e.g., new business operations) (Zong, 2016; Zoucheng Government, 2015). For instance, Xiangcheng village used social networks among villagers and a joint liability for a loan to establish a borrower group to reduce the entry barriers for rural people who want to improve their livelihoods, but have a credit constraint. By the end of 2012, 55 local households joined this borrower group and the loan amount was above 4 million yuan. These loans solved the problem cf money shortages in the developing of alternative activities for rural people (Zoucheng, 2012). In Yishan village, the nearby rural tourism households and local farmers worked together to expand their networks to share business information, cooking materials, and even extra guests. This cooperative society in the local village avoids vicious competition and increases the households' revenues (Zoucheng Tourist Administration, 2013).

CHAPTER NINE: SUGGESTED POLICY IMPLICATIONS AND CONCLUDING STATEMENT

9.1 Discussion and Implications

With regard to the role of social capital in sustainable livelihood development, this study discussed two questions: 1. Can different types of social ties (kin and non-kin ties) lead to differential access to social capital in a small community in China？ 2. Does the strength of social capital alter local livelihood patterns by diversifying household livelihoods, or providing new livelihoods in industries with the potential for development?

Chapter Six used a regression model to explore the factors associated with social capital. The results argued that both kin ties and weak ties are important factors associated with social capital for mining sector residents in Zoucheng. Chapters Seven and Eight established a simulation model, which applied different intensities of social capital to alternative livelihood development (i.e., rural tourism). The simulated results suggested that increased social capital worked better than lower levels of social capital in the process of transition to an alternative livelihood. By enhancing social capital by one standard deviation (i.e., social capital+1), rural tourism operators received more income (increasing by 97%; see Table 8.1) and attracted more self-employed workers (increased by 37%, see Table 8.1) in an alternative livelihood choice. The analyses and findings of this thesis suggest several important conclusions regarding the role of social capital as a support mechanism for sustainable development strategies that can be drawn upon in the process of developing alternative their livelihoods.

Although the simulation model in Chapter Seven simplified the process of increasing social capital, different types of social ties (kin and non-kin ties) may be important indicators for the implementation of policies on community development. In

Confucian and Taoist understanding, everything exists in a state of relatedness and connectedness (Carlisle & Flynn, 2005). The huge population size in China provides the potential to establish complex social networks and social resources. In China, both culture and population size create difficulties for policy-makers wanting to invest in social capital and increase it efficiently. As discussed in Chapter Three, social capital is hard to identify and assess. However, the answer to the first question in this study provides some hints for governments with respect to implementing relevant policies. The regression analysis in Chapter Six tested associated relationships. Both kin ties and non-kin ties are significantly related to access to general social capital. It may be easier for governments to find certain groups of people with different social ties (i.e., kin & non-kin ties) rather than observing the least tangible capital assets (i.e., social capital) in a household, which may be useful for community policy formulation and execution.

The findings of this thesis provide a perspective on the role of social capital in improving livelihood strategies in family systems, communities, or villages. Putnam (1993; 1995) suggests that the level of social capital (e.g., traditional personal networking or family ties) has been declining with the industrialization and modernization of the US since the 1970s. However, China is not likely to follow a similar development path to the US. A traditional East Asian agrarian society is normally focused on family relationships (Pham, 1999). The family is the basis of society and is a historic component of Confucian societies in East Asia (Pham 1999; Dalton, 2001). In China, many villages are named after the largest family living there, emphasising the characteristics of kinship. In these villages, Chinese people customarily use family relationships to communicate with each other before doing any 'business'. Relatives help each other in certain events (e.g. death, birth, or marriage) (Chu, June 2001). Measuring and collecting information about people's kinship may be more efficient and easier than measuring other relationships such as friendships in a village or community. In the process of implementing livelihood development policies, governments could investigate the potential effects on the

largest kin-related households in villages so as to increase the effectiveness of the implementing the policy. These target households might have strong social capital and social networks, considering their kinships and reputations in a village, and could play leading roles to guide the others and increase the overall development in a community. However, the special "guanxi elite" may influence other residents' involvement and allow only a few or limited residents into the "inner circle" of tourism development (Li et al., 2007). Thus, the influence of weak ties is also considered in the process of tourism development. Weak ties may diversify available information and strengthen social capital (Granovetter, 1973, 1974; Bian & Ang, 1997), which could be applied to extend residents' involvement after the early stages of tourism development.

Investment in social capital plays an important role in the process of tourism development. As discussed in Section 3.4.2, social capital can influence residents' collective actions and attitudes to tourism development. Through community members' involvement, a higher satisfaction with tourism development and a higher tolerance for tourists can be achieved (Timothy & Tosun, 2003). For instance, local knowledge and experience in understanding tourism development can be used to empower local residents to participate in tourism effectively (Tosun, 2000), or reduce potential environmental or traditional cultural conflicts between tourists and local aspirations (Aas et al., 2005; Timothy & Tosum, 2003; Stronza, 2000). In the Chinese context, increasing attention has been given to guanxi in tourism development. Based on a comprehensive review of guanxi and relationship marketing, guanxi can influence resident involvement and bring core stakeholders together in tourism development (Li et al., 2007; Lew & Wang, 2004; Geddie et al., 2002). Social capital support (e.g. government policies involving community participation) may provide a more targeted approach to local tourism development in rural communities than "blind" spending by governments on tourism promotion.

Due to the dominant role of mining in household livelihoods in Zoucheng, the collected social capital information from miners was assumed to represent the household level in the simulation model (see Section 7.4.4). Household members with high-ranking positions in mining employment could help other household members to move into alternative livelihood choices or lower-ranking jobs in the mining industry by using their current social resources. The present situation in Zoucheng involves the risks of natural resource dependency. The residents of Zoucheng are over-reliant on mining activity, but the available job opportunities in mining are limited as represented by the constant number of miners in the simulation model (see Chapters Seven and Eight), and cannot satisfy the total job demands from rural households (as discussed in Chapter Two). Regardless of the environmental considerations, the limited job opportunities in mining are another important reason to develop alternative livelihoods for rural households in Zoucheng. One implication for policy decision-making is the relative advantage existing in different job positions. In terms of social ties, people in high-ranking positions are likely to access better resources (discussed in Chapter Three). According to Table 4.2, the Prestige score for a worker/miner is 45 and for a farmer it is only 30 (See Chapter Four). In mining, miners' job positions tend to be reasonably homogeneous in status. In rural households, a household member in farming may take advantage of the status and pay improvements of a mining job. Looking at the simulated results in Chapter Eight, miners' social resources could help other household members to have more alternative livelihood choices (rural tourism).

The superior rates of pay in mining almost preclude the possibility of shifting from mining to tourism in Zoucheng. However, developing the competitive advantage of rural tourism may attract other family members in mining households to transition from farming to tourism, which has the potential to increase the overall benefits in rural mining households. It might provide a good start to developing a more sustainable livelihood, particularly in this case, where there are more than two existing resources (farmland, mineral resource, and tourist resource) in Zoucheng and

the local economy is presently relying heavily on only one natural resource (mineral resource).

By considering social capital, the focus of economic development could change from purely business or monetary-oriented to the context of community interest such as neighbourhoods and service programmes for disadvantaged groups (Lejano & Wessells 2006; Blair & Carroll 2008). In China, the government has implemented many programmes with goals that include the reduction of poverty, but which focus on a narrow range of methods such as allocating food or other daily necessities. However, because social capital assumes such an important role for some households, future policies might consider ways to enhance social capital and thus alleviate poverty, using the analysis provided in Chapter Six, which illustrates clearly the factors that have the greatest relationships with residents' social connections and also discusses their motivational characteristics. The results from the regression model in Chapter Six indicated, that length of residence (i.e., years resident in Zoucheng) and higher educational levels had significant positive relationships with social capital. Therefore, government could invest in education (e.g. hospitality, tourism mangement, or other subjects related to rural economic development). Also, more government welfare policies would benefit local people and encourage longer residence in Zoucheng. Both of these government investments might assist pertain tourism communities by improving local experience and promoting educated knowledge about rural tourism development, which could increase the understanding of tourism businesses and local residents' involvement in effective tourism development processes.

The simulation results in Chapter Eight showed that increased of social capital can further develop alternative livelihoods (i.e., rural tourism). This has implications for policy makers who want to develop tourism in rural areas. The concept of social capital could be applied in establishing and operating rural tourism businesses, particularly in developing areas (Zhao et al., 2011). As the results from the regression

model in Chapter Six show, kin ties are important factors associated with social capital. Members of strong social networks, such as family members, can be encouraged to enter tourism employment, decision-making, sharing rural tourism benefits, or local cultural concerns, which can further increase the involvement of social capital in tourism development. (Ying & Zhou, 2007). For example, it is common to hire family members for the daily operation of small tourism business in China. In the long run, all profits from small tourism businesses are more relevant to the business owner's family as household income rather than any form of individual salary (Zhao, 2009). All of the involved household members could be benefited in operating tourism businesses, which in turn pushes forward tourism development.

The model in Chapter Eight also simulated the scenario of conducting pit closures before making any attempt at establishing a well-developed alternative industry in Zoucheng. This idea proved to be an intellectual dead end, but it does demonstrate some of the risks of economic transformation in the absence of well-developed alternative livelihoods. It is always very difficult to find an equilibrium solution when a developing economy meets issues between environmental costs and monetary costs. Short-term behaviours and blind pursuit of short-term gains are dangers for economic development. The results of the simulation models in Chapter Eight indicate that it may take some time to establish an alternative livelihood choice and replace the current system. It is particularly important for the future viability of Zoucheng livelihoods that the local economy shifts towards a tourist economy, away from the present mineral resource-dependent base in a rural area.

9.2 Conclusion

The main objective of this thesis was to determine whether the strength of social capital can alter household livelihoods and their sustainability. The evidence supports the main research question (Research Question (2)). The empirical results from the simulation model indicate that social capital can generally enhance the effects of

policy implementations in certain cultural contexts. This finding accords with the conclusion of Lin & Si (2010).

This thesis used the Position Generator instrument to measure the social capital of workers involved in the mining industry and residing in rural and urban neighbourhoods of Zoucheng city. Lin's (2001; 2004) theory of social capital in the Chinese context was used for this analysis. The analysis then took the generated social capital scores as the dependent variable, and demonstrated that kin and non-kin ties are equally effective ways to access social capital in a small community. Based on regression analysis results from this study and collected background information available in Zoucheng, simulation models were used to determine the role of social capital in alternative livelihood development. By implementing relevant policies on social capital and rural tourism, the results of these simulation models supported the possibility of replacing the current development strategy (mining). This study also provided a new perspective on the nature of Chinese social capital and its societal consequences during a transition economy in a small city.

The thesis fills a gap in the social capital literature by measuring social networks and the role of kin and non-kin ties in terms of their relationship to social capital in a county-level city, which has been largely ignored to date.

This research can facilitate the application of social capital to promote the implementation of appropriate regulations and policies at the local government level. For instance, in small and medium-sized cities, to solve economic restructuring issues, local policymakers could promote sustainable development of people's livelihoods, and diversify living strategies for communities in rural areas. This would involve selecting the most suitable of the available resources, which can enhance the efficiency of the policies. During the implementation process, access to social capital can increase the likelihood of getting access to more resources (information), which will further expand the variety of livelihood strategies available and reduce vulnerability. The findings have implications for government policy, the personal

career development of individuals in transitional economies, and other researchers analyzing similar areas such as social capital applications with sustainable livelihood frameworks in other countries influenced by eastern Asian culture. This study also provides a foundation for developing social networks to accrue the necessary social capital for the success of other livelihood strategies in rural areas of China.

9.3 Limitations

The analysis and models in this thesis have several limitations. First, although the causality was discussed in Chapter Three, it was not established in the regression model for this study. The interpretation of the regression results for this study on social capital was limited to associations rather than causation. For instance, while human capital may increase social capital, the converse may also be true. With different research purposes, follow-up data in future surveys will provide a longitudinal dataset more conducive to making causal inferences. Second, the measurements were also susceptible to omitted variable bias. For instance, self-reported measures of social networks in current jobs involve subjective assessment by participants. Third, the simulation model assumed no transition cost for workers shifting between different industries. In practice, governments often use preferential policies such as subsidies for specific activities so as to promote economic restructuring. Considering these transition costs in the model could produce different results. Fourth, social capital was directly increased by one standard deviation in simulation model. However, this did not indicate the driving values for this growth. Although the regression model in Chapter Six found that educational level and the strength of social ties (i.e., kin and non-kin ties) are positively associated with access to social capital, the specific “cost” of increasing social capital by one unit is omitted in the simulation model. In addition, the simulation model ignored new entrants to the local labour market such as migrants and workers graduating from school. Finally, some coefficients of the relationships and interlinkages such as the relationship between number of rural tourism operators and tourism service quality in the

simulation model are based on relevant theories and similar study areas, which lack empirical data. This gap may be filled in a future study.

9.4 Possibilities for future research

As far as the research participants in this study were concerned, the mining group tended to be younger than the population average and were more likely to be male. In future, participants could be selected from broader areas, which may be more generalizable to all rural households in China.

There are higher growth and upside potentials in the simulation models. The risks of a natural resource-dependent economy in the simulation model provide the possibility of analysing the environmental and monetary costs involved in the development of multiple industries, as for example in the scenario of pit closure in Chapter Eight. In practice, agricultural outputs could be diversified in the agricultural model. The coefficients for crop price and cost could be calculated from several specific surveys and experiments. More potential factors associated with access to social capital could be used in the simulation model, which needs further work in terms of social capital analysis. The driving values for the growth of social capital corresponding to different livelihood outcomes could be further analysed. As local rural tourism develops in the future, more practical relationships such as local pollution effects on numbers of tourist arrivals, number of tourist arrivals and incomes in rural tourism could be studied in order to refine the simulation model.

The analyses conducted in this study provide some good supplements to existing social capital and sustainable livelihood development literature, particularly in a relation to small cities in China. The study provides a base for future investigations of the role of social capital during the transition to a sustainable livelihood in the Chinese context.

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Appendices

Appendix A: Simulation model evaluation and testing

While scenarios developed on the system dynamics model for this research were based on a set of parameter assumptions, some uncertainties were embedded throughout the iterative model development processes. Validation is the process by which the model establishes confidence in its usefulness (Schwaninger & Grosser, 2009). The process of validation can determine whether the model is an acceptably accurate representation of reality (Schwaninger & Grosser, 2009; Giannasi et al., 2001). However, there is no single test to assert the validation of a model. Forrester & Senge (1980) pointed out that the level of confidence in the model can increase gradually with ongoing evaluation testing. Therefore, the following discussion focuses on the set of model evaluation tests so as to get an impression of the uncertainties with respect to the issue of model validation.

A.1 Structure verification test

The most relevant structure in the sustainable livelihood framework (DFID, 1999) was considered as the basis of the whole model design. During the model building process, partial models were assessed for behaviour consistent with existing knowledge of the system before being incorporated into the whole model structure. For instance, the agricultural production model test demonstrates model behaviour consistent with existing knowledge and information about stock and flow dynamics in North China, and labour distribution was based on financial incomes relevant to the industries in the model. There was no contradiction of the knowledge about the structure of the real system.

A.2 Dimensional consistency

Dimensional consistency involves specifying the units of measure for each variable in the simulation model, as well as checking for dimensional errors. Vensim provides

a tool to check the unit consistency of model equations. The model was found to have no significant dimensional inconsistencies.

A.3 Data used for assessment

Data used for system dynamics model were sourced from first-hand information (i.e., the household survey in Zoucheng city) and secondary data in Zoucheng city such as the 2006-2010 Statistical Yearbooks and tourist data collected by Zoucheng Tourist Administration. Thus, the patterns generated in the simulations are in tune with the patterns in real-life situations. In other words, the generated model behaviour is judged against historical behaviour patterns.

A.4 Boundary adequacy test

In line with the research purposes of this thesis and the general model structure, the simulation model considered all important variables related to the system such as all relevant variables in local three industries (agriculture, mining, and tourism), and relationships between livelihood assets (e.g. social capital, natural capital, and human capital).

A.5 Sensitivity test

To ensure the reliability of recommended policies, sensitivity analysis is necessary to provide insight on how uncertainties in the model outputs respond to the input variables and which input variables tend to affect behaviour changes in the outputs (Guan, Gao, Fukahori, & Watari, 2010; Powell, Fair, LeClaire, Moore, & Thompson, 2005; Moxnes, 2005). With sensitivity analysis of the model, it is easier to choose the methods such as optimization of state variables related to the parameters, direct measurement, literature etc. used to assign values to the parameters (Guan, et al., 2010; Powell, et al., 2005).

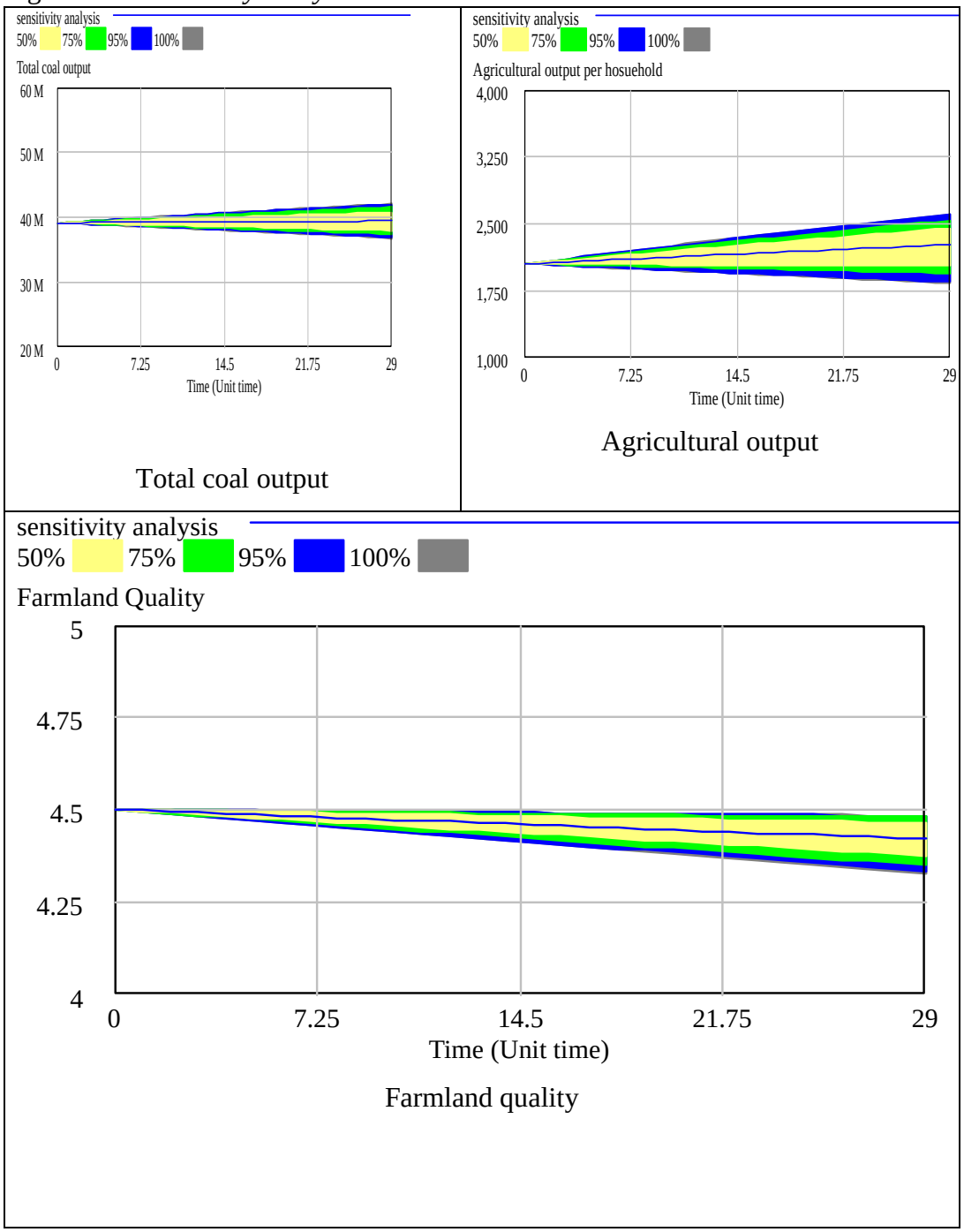
The Vensim software provides a tool to examine how the model behaves in response to changes in the values of particular parameters. The first step is to identify relevant input parameters and ranges (Hekimoglu & Barlas, 2010; Taylor et al., 2010) and enter these parameter ranges and distributions in Vensim's Sensitivity simulation module (Ford & Flynn (2005). However, it is not sufficient to use one-variate sensitivity analysis to understand the whole model (Hekimoglu & Barlas, 2010). Thus, the model used Monte Carlo sensitivity simulations (also known as multivariate sensitivity simulation) to perform multivariate sensitivity.

In the simulation model for this thesis, the parameters change of growth rate in Coal Production Subsystem and Agricultural Products Subsystem were used for the system sensitivity analysis. For instance, the parameters fluctuated within the range of historical behaviour patterns. Thus, the study selected these parameters and assigned maximum and minimum values along with a random distribution over which to vary them to examine their impact on model behaviour. The ranges of two parameters are listed as follows: (1). Intrinsic growth rate for coal output (RG_C): (-0.0089, 0.0129); (2). Intrinsic growth rate for agricultural output (RG_A): (-0.0077, 0.021). With the distribution for each parameter specified, the number of simulations was set at 200 to perform the multivariate test, which means this process was repeated 200 times. The probability distribution values for each parameter was drawn from a Random Uniform Distribution (i.e., any number between the maximum and minimum values is equally likely to occur).

Three typical output values (i.e., total coal production (C), agricultural output per household (A), and farmland quality per household (AF)) were summarized because of their important role in the simulation process. The results of the sensitivity test are shown in Figure A1. The shaded areas show the range of results that were found on varying the focal parameters. The sensitivity is expressed as confidence bounds of 50%, 75%, 95% and 100%, which are coloured on the chart. The graphs display the uncertainty in the relevant variables over a period of time. The test result reveals that

the model behaviour does not exhibit implausible changes as a number of key parameters vary.

Figure A.1: *Sensitivity analysis on simulation model*



Appendix B：LOOKUP

Figure B.1: Coal mining pollution on farmland quality (Input: Total coal output)

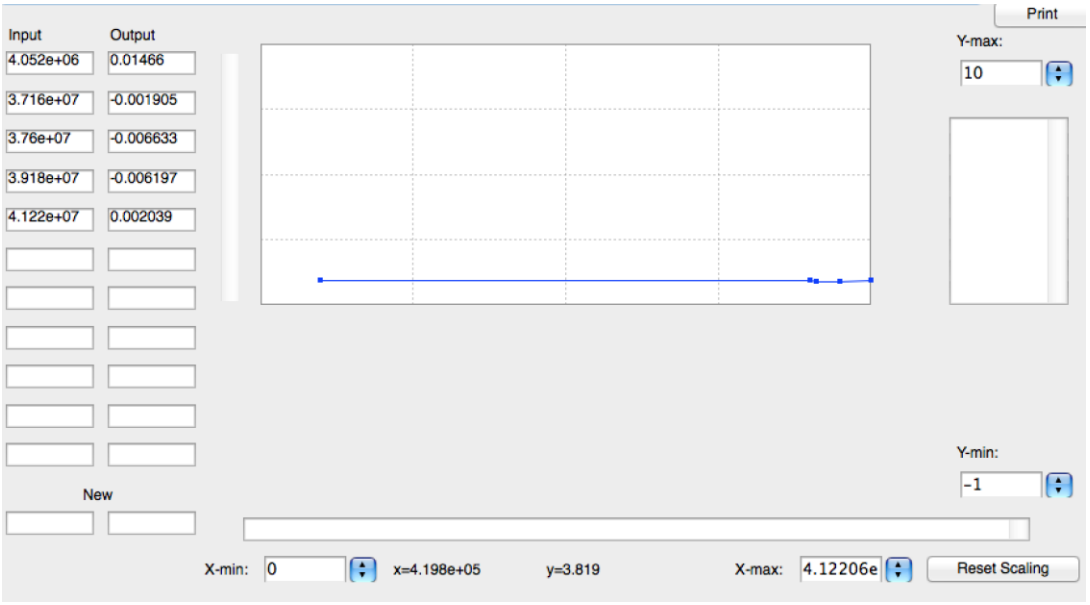
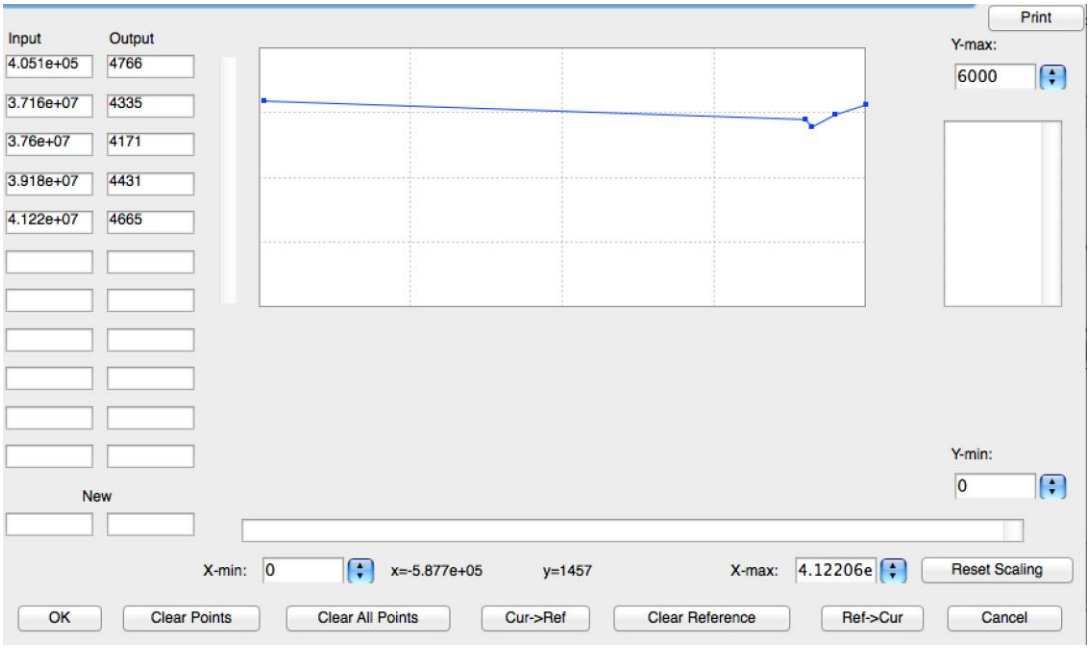


Figure B.2: Total coal output and industrial dust discharged (Input: Total coal output)



Appendix C: Summarized data for simulation model

Table C.1: Coal production and employment

Year	Coal production (Ton)	Employment (Miner)
2000	28,817,091	-
2001	37,860,460	99,863
2002	42,952,692	101,893
2003	48,542,663	102,024
2004	44,531,537	99,595
2005	39,727,014	99,618
2006	40,520,789	101,808
2007	37,604,524	102,919
2008	39,183,914	82,754
2009	37,160,832	84,584
2010	41,220,639	95,809
Average	39,829,287*	97,087

Source: Author's compilation from Zoucheng Statistical Yearbook, 2000-2010

Table C.2: Grain yield (2004-2013)

Year	*Grain yield* (Kilogram/Mu)
2004	460.71
2005	458.18
2006	447.41
2007	444.88
2008	462.47
2009	459
2010	465
2011	472.8
2012	484.8
2013	490.9

Source: Author's compilation from local Yearbook 2004-2013

Table C.3: Number of tourists in Meng Temple and Yi Mountain from 2003 to 2010

Year	Meng Temple	Yi Mountain	Total Arrivals
2003	23,399	99,263	122,662
2004	37,765	79,058	116,823
2005	39,060	107,379	146,439
2006	42,086	92,223	134,309
2007	34,223	54,355	88,578
2008	33,078	72,137	105,215
2009	26,926	138,725	165,651
2010	65,231	132,786	198,017

Source: Author's compilation from Zoucheng Tourist Administration, 2011

Appendix D: Household survey

<table>
<tr><th colspan="10">SECTION A: GENERAL BACKGROUND QUESTIONS ON PARTICIPANTS</th></tr>
<tr>
<td>1.
Including yourself, how many people live in your household ?</td>
<td>2.
Sex

Male……1
Female...0</td>
<td>3.
Relationship to the household head

1…Head
2…Wife/husband
3…Child
4…Child in law
5…Parents
6…Sister/brother
7…Grand mother (or father)
8…Grand child
9…Other relationship</td>
<td colspan="2">4. How old are you?
If age is less than or equal 05 years, both month and year should be recorded
Record 2 digits | Record 2 digits

YEARS | MONTHS</td>
<td>5.
Type of registered permanent residence

1…Agricultural household
2…Non-agricultural household</td>
<td>6. Where were you born?
(City and Province)</td>
<td>7. Are you a “one child”?

1. No
2. Yes</td>
<td>8.
Where are you living in Zoucheng city?

1. Rural area
2. Urban area</td>
<td colspan="2">9.
Which village town are you living?
1.Qianquan.2.Gangshan.3.Fushan.4.Yishan.5.Kanzhuang.6.Xiangcheng.7.Zhangzhuang.8.Tianhuan.9.Daisu.10.Zhongxin.11.Beisu.12.Tangcun.13.Pingyangsi.14.Taiping.15.Guoli.16.Shiqiang.17.Chengqian.
18. Others (Specify)</td>
</tr>
<tr>
<td>10. How many years have you lived in Zoucheng city?</td>
<td>11.
Marital status

1. Married
2. Divorced or separated
3. Widowed
4. Never been married(go to next section)</td>
<td>12.
How many children do you have?</td>
<td colspan="2">13.
Organisation type that you and your partner working in?
1. Government agencies
2. Public organizations
3. State-owned firms
4. Collective firms
5. Private firms and hybrid firms
6. Foreign invested company
7. Village
8. Miner
9. No job, housekeeping or retired</td>
<td>14.
Is your husband or wife living with you in Zoucheng city?

1. Yes2. No</td>
<td colspan="4">15. What is the composition of your household? (Filling in numbers)
<table>
<tr><td></td><td>Female</td><td>Male</td></tr>
<tr><td>0-4 years</td><td></td><td></td></tr>
<tr><td>5-9 years</td><td></td><td></td></tr>
<tr><td>10-14 years</td><td></td><td></td></tr>
<tr><td>15 years or older</td><td></td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td></td><td></td><td></td><td>You</td><td>Partner (if have)</td><td></td><td colspan="4"></td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4"></td>
</tr>
</table>

SECTION B: SOCIAL CAPITAL-POSITION OF SOCIAL CAPITAL							
Of your relatives, friends, and acquaintances… (If you knew more than one occupant of the position, we asked respondent to think of the first occupant who came to mind.)							
Occupation	**1.** Do you know people in the position? 1. Yes. 2. No	**2**. What is his/her relationship to you? 1. Kin. 2. Friends. 3. Acquaintances. 4. Others (specify)	**3.** Did you know the person when you were looking for your present job? 1. Yes. 2.No	**4.** If you do not know such a person, through whom are you most likely to find him or her? 1. Kin. 2. Friends. 3. Acquaintances. 4. Others	**5.** What is this person's occupation?	**6**. How long have you known each other?	**7.** Do you know each other well? 1. Very well. 2. Well. 3. Normal. 4. Not well. 5. Not at all.
Elementary school teacher							
Journalist							
Administrative personnel of public or private enterprises							
Electrician							
Chief of a section							
Head of public or private enterprises							
University professor							
Worker							
Farmer							
Head of a bureau							
Lawyer							
Housemaid							
Mayor							
Provincial or city party secretary							
Party secretary of a bureau							
Party secretary of a factory							

SECTION C: INFORMATION & LEARNING Information & SOCIAL NETWORKS

What information or knowledge did your household get, and by whom in past 24 months? (*Farming techniques include information/knowledge about irrigation and other facilities that can increase the farming productivity. **Business: information/knowledge about earn more incomes from non-farm business. ***Money management: helping people using their financial resources (cash, bank deposits and other financial investments) to achieve better livelihood objectives.

2. Did (Have) these information positively impact (impacted) on your job or your household livelihood over the past 2 years?
1…Yes
2…No

3. Please explain how if the answer given on Q.2 is yes (if it is possible, please recording %changed on your income after gotten information):

Areas	Information sources (selecting code from right column)	**Sources of information access:** 1. Relatives, neighbours, & friends; 2. Other individuals (Specify) 3. Community loud speakers or bulletin board; 4. Village/local markets 5. Newspaper 6. Radio, TV, internet; 7. Business or work organisations; 8. Agricultural extension agents; 9. Other groups or mass organizations (Specify); 10. None.		
1. Farming*				
2. Credit and insurance				
3. Government policies				
4. Money management***				
5. Business**				
6. Estate				
7. Education & other technics				
8. Jobs				

SECTION D: HUMAN CAPITAL

1.
The highest education you and your family members obtained?

0= None, 1=elementary school （ first year ）2= elementary school （ second year ）,3= elementary school （ third year ）, 4= elementary school （ fourth year ）, 5= graduation from elementary school （ fifth year or sixth year ）, 6=junior high school (first year), 7=junior high school (second school), 8=graduation from junior high school (third year), 9=senior high school (first year), 10=senior high school （ second year ）, 11=graduation from senior high school or graduation from Technical secondary school 12=Technical/vocational certificate, 13=Diploma, 14=College/university undergraduate (Bachelors degree), 15=College /university graduate/postgraduate, 16= PHD,17=Other (Specify).

Household member	Education level	Household member	Education level
1. You		6	
2. Your partner		7	
Other members (record relationship with household head):		8	
3		9	
4		10	
5		11	

2. How old were you when you stopped full-time education?

3.
How many years have you been in paid employment since the age at which you stopped full-time educations?

4.
Did you attend any of the following courses in the last 24 months?

Name	Mark X if you did in the past 2 years	Total fees for that training (if its free, filling in 0)
University/College		
Technical/vocational training school		
Other training courses		
Taught by individuals (your friends, relatives etc.)		
Taught by groups/organisations (local government, communist party etc.)		
Others (specify)		

5.According to your situation, which one is the most acceptable training fee?
1. Below 200 yuan 2.200-400 yuan
3.400-800yuan 4. 800-2000
5. above 2000

6. The main purpose for this training?

1. Job wage 2. Professional title test 3. Job position transition 4. Change job to other organisation 5. Other (Specify)

7. Did the job-training programme help you to get your initial purpose?
1…YES 2…NO

8. Your wage or other income sources e.g. stocks were increased by about ……. % per month in your company,organisation/farming or other

SECTION E: ECONOMIC ACTIVITIES-FARMING

(e).1. CROP PRODUCTION				**(e).2. Fruits**			
Code	**Name**	1.1 Over the last 12 months, did your household grow: Mark X, if the answer is yes	1.2 What was the area has been cultivated?	**Code**	**Name**	2.1 Over the last 12 months, did your household grow: Mark X, if the answer is yes	2.2 What was the area has been cultivated?
1	**Wheat**			1	Watermelon		
2	**Corn**			2	Melon		
3	Pachyrhizus			3	Strawberry		
4	Millet			4	Apple		
5	Sorghum			5	Pear		
6	Soy bean			6	Grape		
7	Peanut			7	Peach		
8	Mung bean			8	Apricot		
9	Sesame			9	Red jujube		
10	Cotton			10	Persimmon		
11	Potato			11	Hawthorn		
12	Other root crops (Specify)			12	Kiwi fruit		
				13	Cherry		
				14	Other fruit trees (Specify)		

SECTION E: ECONOMIC ACTIVITIES-FARMING

(e).3. Vegetable

Code	Name	3.1 Over the last 12 months, did your household grow: Mark X, if the answer is yes	3.2 What was the area has been cultivated?
1	Spinach		
2	Celery		
3	Chinese cabbage		
4	Cabbage		
5	Canola plant		
6	Leek		
7	Cucumber		
8	Squash		
9	Dongguan		
10	Carrot		
11	Garlic, chili, ginger & spring onion		
12	Eggplant		
13	Tomato		
14	French bean		
15	Cowpea		
16	Kidney bean		
17	Lotus root		
18	Mushroom		
19	Other vegetables (specify)		
20			

(e).6. Were all of the items together (from e. (1) to e.(4) the main source of income to your household or family over the last 12 months? 1.Yes 2.No

(e).4. Livestock/aquaculture production

Code	Name	4.1 Over the last 12 months, did your household grow: Mark X, if the answer is yes	4.2 Units
1	Cattle		
2	Cow		
3	Horse		
4	Donkey		
5	Mule		
6	Pig		
7	Sheep		
8	Coat		
9	Rabbit		
10	Chicken		
11	Duck		
12	Goose		
13	Silkworm		
14	Other livestock (specify)		

e). 5.total cost from e. (1) to e. (4) per agricultural season over the last 12 months?
Total net profits from e. (1) to e. (4) per agricultural season over the last 12 months?

(e). 7. Were all of the items together (from e. (1) to e. (4), is the income from this type of work or job sufficient to maintain daily/monthly expenses of your family? 1…Yes 2. No

SECTION E: ECONOMIC ACTIVITIES-NON FARM ACTIVITIES				
Code	Name	**1.** What are other sources or alternative sources e.g. any business of income to your household budget in the past 12 months? (if yes, mark as "x") (excluding your farm activities, jobs)	**2** Was this item the main source of income to your household or family over the last 12 months? 1.Yes 2.No	**3** Is the income from this item to maintain daily/monthly expenses of your family? 1. Yes 2.No
1	Making or selling woven basket or other artifacts			
2	Running a shop or market stall			
3	Home processed food or (repackaged) e.g. Tofu			
4	Running another business (Specify)			

SECTION E: ECONOMIC ACTIVITIES-MINING

1. What is your household members' monthly income?		**2. What is the main activity of the company or organization where you work?** 1=underground Mining Operator assistant, 2= underground Mining Operator, 3=surface operator, 4=Superintendent, 5=officer, 6=Machinist or Mining Technician, 7=transport work, 8=sales work 9=logistic work e.g. security, medical staff, chef etc., 10=others (specify)	**4.** Is your job the main source of income to your household or family? 1. Yes. 2.No	**5. How did (or will) you deal with job loss? (circle one only)** 1.... Did nothing 2…Sold farmland/residential land or Sold other assets (motorbike, livestock, furniture, durable goods) 3…Found a new job in urban areas 4…Took children out school 5…Cut down expenditure 6…Asked for help/support from relatives, friends 7…Borrowed from relatives/friend/ private money lender 8…Borrowed from banks 9…Borrowed and received support from government and other organizations (NGOs) 10. ...Government supported. 11. ...was a migrant to other cities. 12…Borrowed from other sources 13…Used savings 14…Got insurance payment 15…Others (specify)
Relationships to household head:	**Monthly wages**			
			5. Is the income from this type of work or job sufficient to maintain daily/monthly expenses of your family? 1. Yes. 2.No	

SECTION F: WORKING CONDITIONS & ACTIVITIES OUTSIDE WORKS							
1. Please tell me, using the following scale, are you exposed at work to…? (Tick one only on each row)							
Tick one only on each row	**All of the time**	**Almost all of the time**	**Around 3/4 of the time**	**Around half of the time**	**Around 1/4 of the time**	**Almost never**	**Never**
Vibrations from hand tools, machinery, etc.							
Noise so loud that you would have to raise your voice to talk to people							
High temperatures which make you perspire even when not working							
Low temperatures whether indoors or outdoors							
Breathing in smoke, fumes (such as welding or exhaust fumes), powder or dust (such as wood dust or mineral dust) etc.							
Breathing in vapours such as solvents and thinners							
Handing or being in skin contact with chemical products or substances							
Radiation such as X rays, radioactive radiation, welding light, laser beams							
Tobacco smoke from other people							
Handing or being in direct contact with materials which can be infectious, such as waste, bodily fluids, laboratory materials, etc.							
2. Does your job involve…?							
Tick one only on each row	**All of the time**	**Almost all of the time**	**Around 3/4 of the time**	**Around half of the time**	**Around 1/4 of the time**	**Almost never**	**Never**
Working at very high speed							
Working to tight deadlines							
3. Does your work affect your health, or not? 1. Yes 2. No			4. On the whole, are you …with working conditions in your main paid job? 1. Very satisfied 2. Satisfied 3. Not very satisfied 4. Not at all satisfied with working				
5. What kind of employment contract do you have? 1. An indefinite contract. 2. A fixed term contract. 3. A temporary employment agency contract. 4. An apprenticeship or other training scheme. 5. No contract 6. Others (specify)							

SECTION G: HOUSEHOLD EXPENDITURE

In the past 12 month, on average, what is your household expenditure on the following items per month? (Please just filling in an approximate figure on each item)

Code	Item	Expenditure per month (RMB)	Code	Item	Expenditure per month (RMB)
1	Food e.g. Vegetables, rice, meat, wheaten food etc.		**7**	Water &electricity	
2	Drink e.g. Beer, wine etc.		**8**	Phone and Internet charge	
3	Cigarettes		**9**	Housing rental fees (if you have)	
4	Education fees on children		**10**	Other living cost e.g. toothpaste, soap etc.	
5	Other fees on children e.g. pocket money, toys etc.		**11**	Other events e.g. wedding	
6	Coal, wood, sawdust, chaff, gas fees				