

Article

An Analysis of Rural Household Livelihood Change and the Regional Effect in a Western Impoverished Mountainous Area of China

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Abstract: Taking Longnan, in the western Qinling Mountains region of Gansu province, China, as our study area, and using the Sixth National Population Census alongside household survey data, we analyze changes in household livelihoods, and consequent regional effects, following the instigation of the “Grain for Green” program in 1999. Our results show rural livelihood changes with respect to natural assets (e.g., reduction of arable land, planting structure changes), human assets (e.g., labor quality improvement, fluidity of population), financial assets (e.g., income channels widening, income increasing), physical assets (e.g., optimized production tools), and social assets (e.g., information network development, increased outreach opportunities). We suggest that increased household livelihoods play an important role in improving land space utilization efficiency, resource conservation and use, and the ecological environment. However, owing to the natural environment, there are also some problems, such as “hollows” in rural production and living spaces, as well as local environmental degradation. To address these issues, regions such as the western, mountainous, impoverished area of our study should establish a policy of using ecosystems, as well as agriculture, for development in order to improve household livelihoods, build an efficient spatial structure, and providing support for the creation of a resource-saving societal system.

Keywords: assets; ecosystems; Grain for Green program; household; livelihood change; poverty area; sustainable rural livelihood

1. Introduction

The concept of “livelihood”, as proposed by Chambers and Conway [1], refers to a means of securing a living, and includes peoples’ livelihood capabilities and activities, as well as their tangible assets (stores and resources) and intangible assets (claims and access). It may also be defined depending on the research angle; for Scoones (1998), whose Institute of Development Studies paper focuses on sustainable livelihoods, a livelihood comprises “the capabilities, assets (both material resources and social resources), and activities required for a means of living” [2]. Ellis (2000) [3], from the perspective of livelihood diversification, points out that “a livelihood comprises the assets (natural, physical, human, financial, and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household.” Although scholars analyze the concept of “livelihood” in different ways, its definition consistently features elements such as assets, rights, and actions.

Since the 1990s, rural poverty and rural development have received increasing international attention, and the concept of “livelihood” has provided researchers with a new perspective through which to study rural poverty alleviation, as well as the environmental protection of rural development in developing countries [4–7]. Fundamentally, a household is observed to be poor in relation to

its vulnerability and location in a high-risk living environment. In China, areas of poverty and of ecological fragility are highly consistent in spatial distribution [8]. A fragile ecological environment, shortage of water resources, ecological problems, ineffective communication structures, and other issues are all associated with a high vulnerability of household livelihood and lack of livelihood strategies [9,10]. Therefore, household livelihood capacity improvement and sustainable ecosystem construction can be seen as contributing factors toward rural poverty alleviation. At the end of the last century, to address the problem of poverty in the country's western provinces, the Chinese Government implemented a series of poverty alleviation policies, including the "Grain for Green" (or "Sloping Land Conversion") program, in which farmers were paid to return cropland on steep slopes to forest or grassland. The program, which began in 1999, has already effected 9.1 million hectares of farmland afforestation, involving 25 provinces (cities), more than 32 million households, and 124 million farmers [11]. Of the six key forestation projects implemented in China at the end of the 20th century, Grain for Green is considered to be the most significant in terms of area, scope, investment, and policy—and is closely related to the individual interests (assets, rights, and actions) of thousands of farmers [12]. The program has not only had a remarkable effect on controlling soil erosion and improving China's rural ecological environment, but has also played an active role in the adjustment of the country's agricultural economic structure, and in increasing the earning opportunities for many farmers. In contrast to the European Union policy CAP [13], China's Grain for Green program focuses on reversing the situation of land deterioration in ecologically fragile areas, reducing the heavy food demand and over-reclamation, and developing those areas stuck in long-term poverty caused by these factors. Its aim is to restore the natural environment and to improve household livelihood. Nevertheless, the two agree on the goals of the diversity of household livelihood and the sustainability of rural areas.

Our paper takes Longnan city, located in the Qinba Mountains, as its study area for analysis of changes in household livelihoods, as well as in regional resources and the environmental effects of returning cropland to forestland or grassland. As one of the 14 poverty areas, the Qinba Mountains is a key target of the Grain for Green program. Based on the theoretical framework of the sustainable household livelihood analysis set up by the British Government's Department for International Development (DFID), we study and generalize the characteristics of sustainable household change since the launch of the Grain for Green, in terms of natural, human, financial, physical and social assets. Furthermore, we analyze the positive regional effects observed from the Grain for Green program on the intensification of agricultural production space, urbanization, the resource utilization, and the environmental protection, to provide a scientific basis for the further policy establishment.

In China, through a general deepening of research into the issues of poverty, studies of household livelihoods have become more widespread, too [14]. The literature shows that different livelihood strategies not only influence the type and intensity of land utilization, for example, but also the effective allocation of livelihood assets and activities, and the improvement of income and living standards (e.g., [15,16]). Traditional livelihoods increase land burden, ecological overload, and the probability of degradation. Moreover, the frequency and scale of ecological disasters, such as flooding, are increasing too, and the natural environment is deteriorating under burgeoning population pressure. More recently, the ecological effect of the transition of agricultural households' livelihoods has also been seen to be significant [17,18], as since the 1980s, migration has become popular as farmers seek alternative sources of employment; furthermore, ecological vulnerability deterioration has been alleviated for migrant areas. However, while the ecosystem has been seen to have improved from a national and even an international perspective, the local environment has deteriorated.

2. Study Area

Our study area is located in the southeast of Gansu province (Figure 1), between 32°38' N–34°31' N and 104°1' E–106°35' E, and has a total area of 27,900 square kilometers. Longnan is the only region in Gansu through which the Yangtze River flows. It is situated in the convergence of the Qinghai–Tibet

Plateau, Loess Plateau, and western Qinling Mountains, and has a complex and varied terrain; it is higher in the northwest than in the southeast, and there are mountains, valleys, hills, and basins interwoven throughout.

Longnan city is in the East Asian monsoon climate zone, with an average annual rainfall of 450–1000 mm concentrated in the summer (July–August). There are 3762 large and small rivers within the territory, which belong to the Jialing, Bailong, Baishui, and Xihan major river systems. Administratively, the region comprises one urban district, Wudu district, eight counties, (Cheng county, Hui county, Liangdang county, Wen county, Dangchang county, Li county, Xihe county, and Kang county), 191 townships, and 3200 villages.

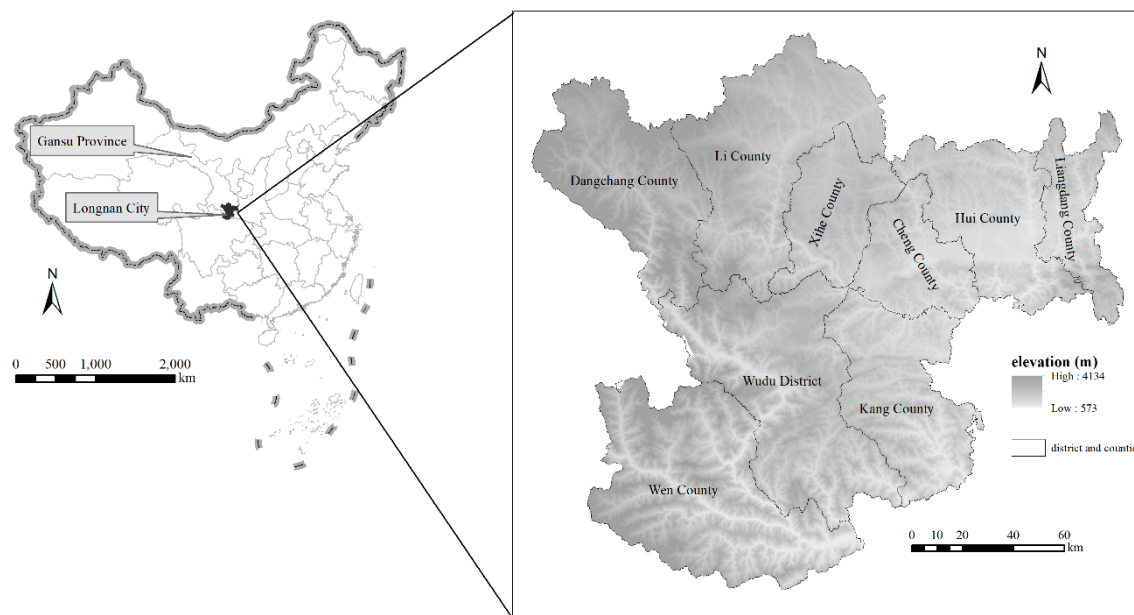


Figure 1. Location map of study area.

It is home to 21 ethnic groups, including the Han, Hui, Tibetan, and Zhuang peoples. At the end of 2012, its total population was 2.58 million, including 1.98 million rural people (accounting for 76.6% of the total population). The region's GDP was 22.6 billion yuan (N.B. All monetary units in this article are RMB; the exchange rate for the dollar is 1 USD = 6.2855 yuan at the time of publication), representing 3.98% of Gansu's GDP. Longnan's rural per capita net income was 3088 yuan—much lower than Gansu's 4506.7 yuan, as it is one of the province's less developed rural regions.

3. Materials and Methods

Data Collection

The graphic data required for research was sourced from the international scientific data service platform and the man–land system database of the Chinese Academy of Sciences. Household data was obtained through Gansu's 2010 population census [19], and through the use of questionnaires. We selected 19 typical villages situated in different geomorphologies to obtain farmers' livelihood data, including situation of population, education, cultivated land area and type, income and expenditure, housing, water, energy, infrastructure, and so on. In total, 455 questionnaires were sent out, 428 of which were returned (94%). In addition, economic data were derived from the "Statistical Yearbook for Gansu Province", the National Territory Bureau, the Forestry Bureau, and the Office of Poverty Alleviation and Reduction, among other official sources.

The sample region is the Wudu district, which is the administrative seat of Longnan city. It is the region with the most significant population distribution, the highest density, the most considerable

land pressure, and is the affected by the Grain for Green program. Further, the sample region located on the mid-west of the study area includes almost all physiognomy types and modes of production in the area. Regarding selecting sample areas, the study not only takes different types of landforms into account, letting the research cover as many of the main livelihood characteristics of rural households in different regions as possible, but also considers the differences in the income of households in different areas. Table 1 shows the basic information of households in the sample region.

Table 1. Basic statistics of sample questionnaires.

	Overall	Each Household			
		Average	Max	Min	Mode
Population (person)	2342	5.1	12	1	4
Population aged 15 and under (person)	418	0.9	5	0	1
Population aged 60 and over (person)	462	1.0	4	0	2
Illiterate population (person)	233	0.5	2	0	1
Population college graduate and over (person)	212	0.5	3	0	0
Labor force (person)	1256	2.8	5	0	2
Arable land (hm ²)	155	0.3	1.3	0.01	0.2
Annual income (yuan/person)	3250	/	/	/	/
Annual income (yuan/household)	/	16,728.6	40,000	400	20,000
“Grain for Green” area (hm ²)	42.2	0.2	0	0.01	0.1

4. Research Design

The concept of sustainable development, or sustainability, can be traced to the 1987 report of the UN World Commission on Environment and Development (or, the Brundtland Commission), “Our common future” [20]. The term “sustainable livelihood,” commonly used by researchers and development actors with a focus on poverty reduction and livelihoods in developing countries, is one of several derivatives of “sustainable development.” An early attempt at defining sustainable livelihood in the spirit of the Brundtland Commission’s report was made by Chambers and Conway [21], whose definition was, in turn, modified by Carney [22]: “A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base” (e.g., [23,24]).

The sustainable livelihood framework is a conceptual approach used to understand the linkages between livelihood assets and activities, and to identify livelihood strategies and the ways in which local people respond to shocks and stresses. It is a people-centered dynamic that bridges gaps between micro- and macro-development approaches, which focus on people’s strengths rather than on their needs [25,26]. The framework brings together all relevant aspects of sustainable livelihoods into development theory, and provides a way to understand the complexity and diversity of livelihood systems. The sustainable livelihoods approach focuses on the diverse ways in which people attain their livelihoods, which is particularly relevant in poor and rural communities, such as those in our study area, where people attain livelihoods through multiple activities rather than through a single, formal job [27].

Organizations that have developed or adopted various versions of the sustainable livelihood framework include the Sustainable Livelihoods research program of the Institute for Development Studies (University of Sussex, UK), the British Government’s Department for International Development (DFID), the United Nations Development Programme, the International Fund for Agricultural Development, and CARE, a non-governmental relief agency [24]. DFID’s version of the sustainable livelihood framework is perhaps the most cited in the literature, and the most representative. A sustainable livelihoods approach to development generally focuses on the existing capital of local people in five capital-based assets: (1) natural, (2) financial, (3) physical, (4) human, and (5) social [2,28–30].

In our study, a specific conceptual framework for sustainable rural livelihoods was designed for Longnan, as illustrated in Figure 2. We focus on vulnerability analyses, and on livelihood (assets) changes, strategies, and outcomes for Longnan.

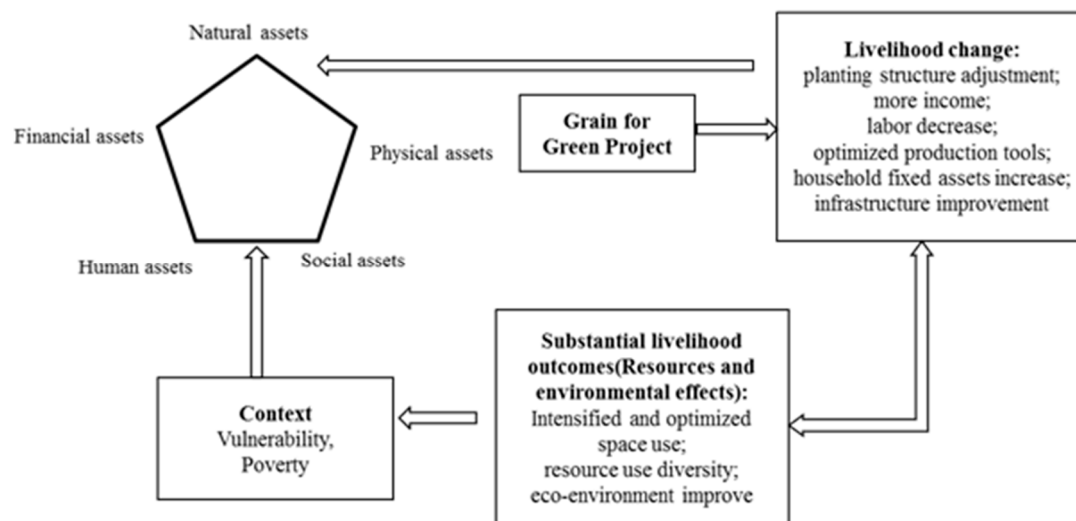


Figure 2. The specific conceptual framework for sustainable rural livelihoods on Longnan.

5. Background

5.1. Research Context

Longnan, located to the west of Qinling Mountains, is a traditionally poor and ecologically key, yet fragile, area of China [31,32]. It is also ascribed to the Qinba Mountains region, one of 14 poverty areas identified in China's "Twelfth Five-Year Plan" which guides national poverty alleviation planning. Its poverty and ecological fragility are delineated as follows.

5.2. Lack of Living Space and Production Space

As shown in Figure 3, in Longnan, land area with a slope gradient greater than 25 degrees is 43% of the total land area, and below 15 degrees is a quarter of the total land area; within the latter category, below 8 degrees, which is suitable for large-scale urbanization and industrialization, is 2350.4 square kilometers, accounting for just 8.4% of total land area. Based on data from the Land Department of Longnan, the city's industrial and urban land area is only 34.6 square kilometers, accounting for 0.12% of the land area (per capita, only 13.2 square meters); the central city per capita construction land area is only 51 square meters, which is only equivalent to half that of the national per capita rate. Cultivated land accounts for one-fifth of total land area, but if slope farmland is removed, below 15 degrees arable land accounts for only 5% of the land area (see Figures 3 and 4). Large areas of ecological space feature alongside a lack of production and living space in Longnan, so it is difficult to construct a scale benefit spatial structure, which has seriously restricted development.

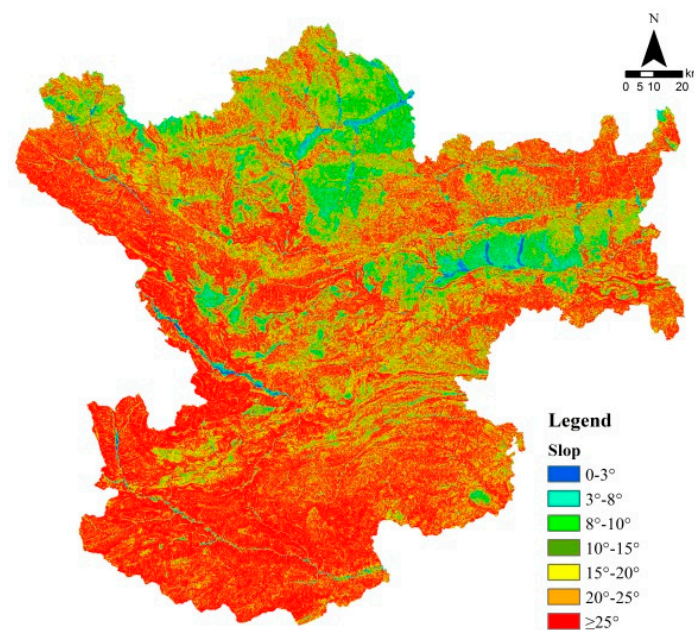


Figure 3. Slope in Longnan.

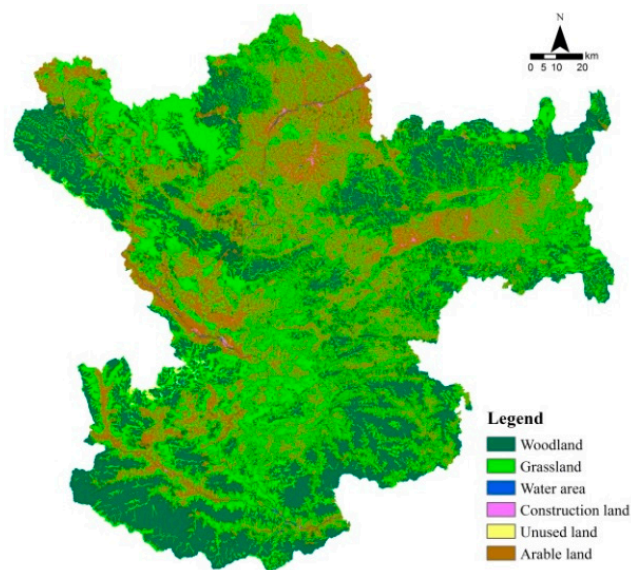


Figure 4. LUCC in Longnan.

5.3. Fragile Ecological System, Heavy Ecological/Environmental-Protection Task

On the one hand, with the area's geological structure, broken geomorphology, over-reclamation, and other factors, the phenomena of flood-waterlogging, landslides, mud-rock flow, and soil erosion are particularly problematic in Longnan. According to information provided by the region's Land Resources Bureau, Longnan, as one of the most frequent mud-rock flow areas, is a key mud-rock flow defense site. To date, the mud-rock flow area is about 11,658 square kilometers, or 41.8% of the total area. Meanwhile, the landslide distribution area is around 9076 square kilometers, accounting for 32.5% of the total area. In addition, the deterioration of the natural environment in some places, due to long-term land cultivation and unauthorized mining of mineral resources, is so severe that to build effective and sustainable ecological areas will require considerable time and extensive ecosystem restoration and management.

On the other hand, Longnan has an important ecological protection status, in which the “two jiang and one river” (the Bailong Jiang and Baishui Jiang tributaries and the Xihan River) area represents an important ecological region of the upper Yangtze River, and has an important water conservation function. More than 60% of the area is listed as an ecological function zone (Figure 5), with areas within it categorized, according the national territory development plan, as “prohibitive development” or “limited development” zones. Among these, limited development zones include the Baishui Jiang Nature Reserve in Wen county, Jifengshan National Forest Park in Cheng county, Tianchi National Forest Park in Wen county, and Guanegou National Forest Park in Dangchang county; national prohibitive development zones, such as in Qinba; and biodiversity and conservation ecological regions, such as in Wudu district, Dangchang county, Liangdang county, Wen county, and Kang county.

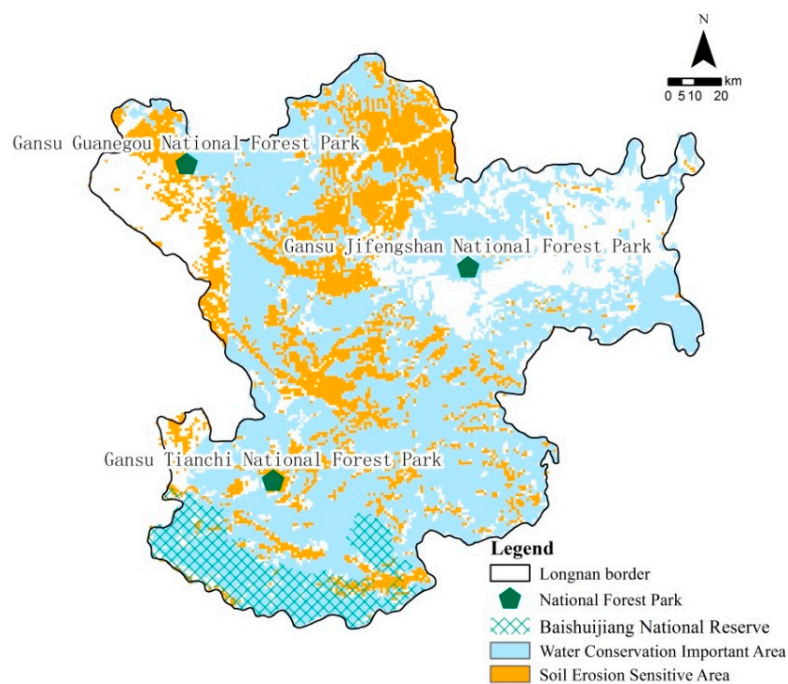


Figure 5. Main Area of Ecological Construction in Longnan.

5.4. Large Poverty Areas, Ecological Construction Policy Implementation Facing “Failure” Risk

The rural poverty area in Longnan is large. Before the latest “poverty area” categorizations published in China’s national poverty alleviation guidance, other than Cheng county and Hui county, seven of the region’s nine district/counties (182 townships, 2338 administrative villages, which, respectively, account for 95% of the total townships and 73% of the total administrative villages) were identified as poverty areas. Moreover, in the recent national “Twelfth Five-Year Plan” for poverty alleviation, all of Longnan’s district/counties were all listed within Qinba key poverty areas, owing to the implementation of a new poverty alleviation standard. Comparing Longnan’s rural per capita net income with the national and provincial averages shows that only Cheng county’s and Hui county’s rural per capita net income are more than 50% of the national average, or more than 95% of the province’s average (Table 2). The remaining seven district/counties’ rural per capita net income are all less than 40% of the national average, or less than 70% of the provincial average.

Table 2. Comparison of per capita net income of rural households in Longnan with national and provincial averages.

District, Counties	Accounting for the Proportion of National (%)	Accounting for the Proportion of Province (%)
Longnan	38.84	67.13
Wudou	37.42	64.68
Cheng	55.50	95.92
Dangchang	31.64	54.69
Xihe	35.50	61.35
Hui	56.07	96.92
Liangdang	30.66	53.00
Li	37.15	64.21
Kang	36.39	62.90
Wen	33.57	58.02

In late 1990s, the national Grain for Green program was launched as an important strategic measure to curb the deterioration of the natural environment, and alleviate regional ecological pressures, as well as to address rural poverty. However, owing to factors such as the very large areas of mountainous agricultural land and poverty areas, relatively fragile household livelihoods, low income available through local agricultural production, and issues of technical upgrading, product quality improvement, as well as the combating market fluctuations of eco-composite agricultural production, there have been problems with rehabilitation and with interplanting high-stalk crops. In some places, such crops are even planted in the spring and destroyed in autumn in Longnan on the returned farmland. According to a 2005 study from the Forestry Department of Wudou District, the area of high-stalk crops is more than 40% of 180,000 new afforestation lands.

Furthermore, because of low levels of urbanization, limited capacities of the receiving surplus population, the migrant workers proportion is high, but not the migrant population ratio; that is to say, this particular population reduction and alleviation mechanism has not completely been integrated. Given the current situation, if there is no other, more effective population policy or system to alleviate poverty in these areas, population pressures will increase again, and once the “floating population,” or migrants from the area, return home, the Grain for Green program will face the risk of failure.

5.5. Traditional Resource Utilization Mode Is General, Economizing Resources Utilization Mode Faces Technical Bottleneck

From the perspective of agricultural land output benefit, because of the changes in agricultural planting structures since the launch of Grain for Green, the proportion of economic crop with high output has significantly increased, and forest-under-economy has also seen rapid development. Since 2005, the gross agricultural production value of units of cropland (including gardens) is 2.3% to 2.5% higher than that of the province, and the total production value of farming, forestry, herding, and fishery units of agricultural land is 4% higher than that of the province. However, because Longnan is located in a mountainous area, the establishment of an economizing type of intensive, recycling resources utilization model would require high investment costs and technical requirements. Therefore, the traditional, extensive resource utilization model is still relatively common.

At present, the extensive use of resources is mainly manifested in two ways. On the one hand, affected by the land form, rural settlements are scattered in layout, the degree of intensive utilization is low, and per capita rural residential land is 159 square meters (more than the national standard of 150 square meters). On the other hand, while the benefits from mining mineral resources are low, the exploitation of mineral resources, in some areas, is still in the state of low efficiency and effect serious damage to the environment.

6. Results and Analysis

Longnan, by the end of 2011, completed a total of 231,230 hm^2 under the Grain for Green program, of which farmland afforestation was 82,430 hm^2 , barren hill afforestation was 140,533 hm^2 , and closing forest area was 8267 hm^2 ; furthermore, 9 counties/district, 0.27 million households, and 1.1 million rural populations benefitted. Our study has observed rural livelihood change, due to Grain for Green, as follows.

6.1. Changes in Natural Assets: Reduction of Arable Land, Planting Structure Change

Land is the main farmer-dependent natural capital, in which cultivated land area change could indicate land-capital and land-use patterns change. According to statistics, during the period from 1999–2010, the cultivated land area decreased $1.1 \times 10^4 \text{ hm}^2$, the sown area of grain crop has reduced more than 7000 hm^2 , and the proportion of total arable land reduced by 12 percentage points (Figure 6). Since the Grain for Green program's implementation, with the help of Government payments, farmers have increased economic forest planting areas—including pepper, apple, walnut, and so on—and so the proportion of sown areas of cash crops has seen a significant increase. Taking pepper as an example, according to an agriculture department survey, during the period 2001–2011, pepper planting areas have increased by 38,666.7 hm^2 , output has increased by nearly $2200 \times 10^4 \text{ kg}$, and pepper output value was worth 13.5 billion yuan in 2011.

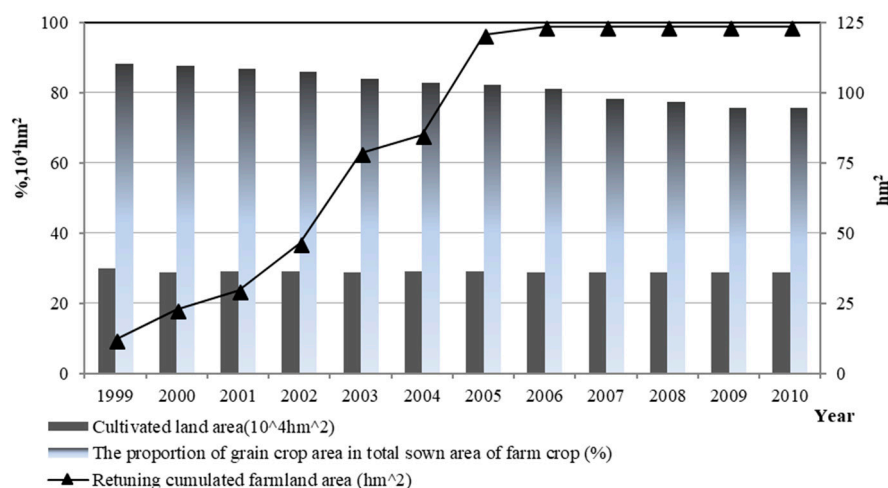


Figure 6. Area Changes of Longnan Cultivated Land and Grain Corp.

6.2. Changes in Human Assets: Quantity of Labor Force Reduced, Burden Coefficient Increased

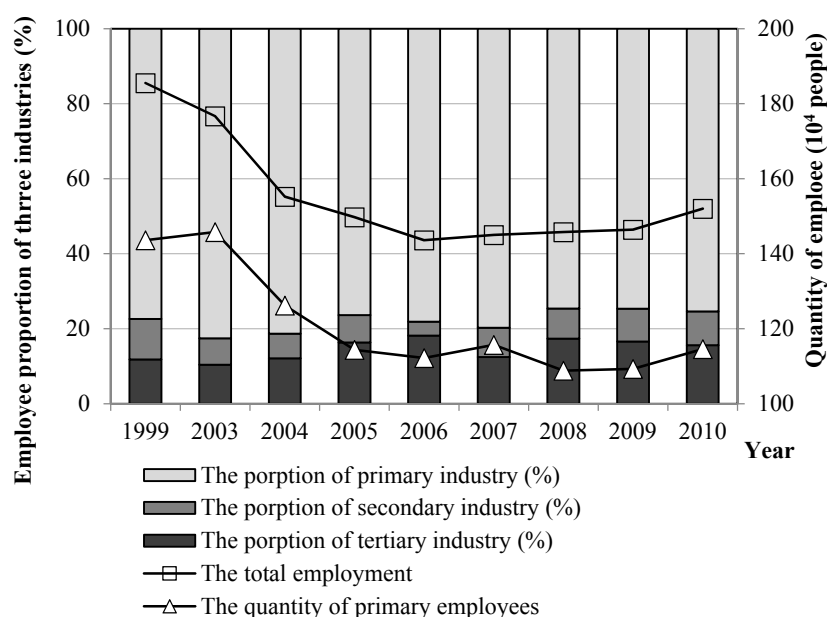
The reduction of the labor force prefigures farmer–human-capital reduction. Population statistics show that the registered population increased by 0.17 million people, the resident population reduced by 0.02 million people, and the agricultural population decreased by 0.07 million people during the period 2000–2010 in Longnan. Based on “Sixth Census” data, the rural population in Longnan accounted for 80.9% of its total population, 16.8 percentage points higher than the average of the province, and the rural labor force (from 15 to 59) accounted for 66.4% of the rural population, 0.4 percentage points lower than the provincial average. In addition, the agricultural population change is a repeating phenomenon. Table 3 shows that the county’s agricultural population decreased from 2002 to 2008, but, after 2008, showed an increasing trend, especially Xihe county and Dangchang county; the agricultural population in 2010 is significantly more than in 2002, which suggests the repeatability of the policy implementation effect.

Table 3. Rural population Changes of Longnan (10^4 people).

Area	2002 Year	2004 Year	2006 Year	2008 Year	2010 Year
Wudou	46.70	44.62	40.69	39.36	44.50
Wen	22.08	21.44	20.53	20.38	20.90
Kang	18.73	18.51	17.69	17.58	17.84
Li	48.77	48.88	46.58	46.00	47.70
Liangdang	3.97	3.92	3.98	3.95	3.96
Cheng	22.39	16.98	16.08	15.55	16.19
Dangchang	27.35	27.34	24.20	24.15	28.06
Xihe	34.45	35.40	34.21	33.83	38.92
Hui	19.28	19.28	18.91	18.73	18.95

The reduction of human capital leads to a heavy labor dependency burden. In 2010, Longnan's rural labor burden coefficient is 70.4%, 0.4 percentage points higher than in the province. Among them, the dependency ratio of individuals over 60 years old and over 65 years are, respectively, 50.6% and 40.7%—0.9 and 0.6 percentage points higher than in the province. In addition, the emigration of a high-quality labor force leads to a low culture level in the population that remains. According to statistics, in 2010 the illiteracy rate was 26.3% in people from ages 15 to 65 years old, 11.8 percentage points higher than the provincial average.

As a result of the implementation of Grain for Green program, much of the local labor force could detach from the land, and thus “go-outside”. In other words, migration became an important livelihood activity of mountain farmers. The reason for the agricultural labor force reduction, on the one hand, is peasants working away from home, and, on the other, that they turned to other industries, especially a third industry (see Figure 7). According to employee statistics, since 1999, the number of employees has reduced by 330 thousand people, and those in the primary industry has reduced by 290 thousand people. Employment–industry analysis shows that the employee proportion of the primary industry has decreased by 2 percentage points; that in the non-agricultural industries has been increasing, mainly in the tertiary industry; the employee proportion of the tertiary industry has increased by 3.8 percentage points; and the employee proportion of the secondary industry has reduced by 1.8 percentage points.

**Figure 7.** Structure Changes of Employment in Longnan Primary Industry.

6.3. Changes in Financial Assets: Income Increase, More Capital Source Channels

According to statistics, the per capita net income of farmers in Longnan has increased from 889 yuan in 1999 to 2299 yuan in 2010, a 2.6-fold increase. At the same time, the per capita disposable income of urban residents increased 3.1-fold (Figure 8). The income of urban residents increased from 3.8-times net income per capita, in 1999, to 4.6-times in 2010; income range increased from 2498 yuan to 8324 yuan, or by 3.3-times. This shows that, although farmers' income is increasing, the income gap between farmers and urban residents is widening, which undermines the value of the increase.

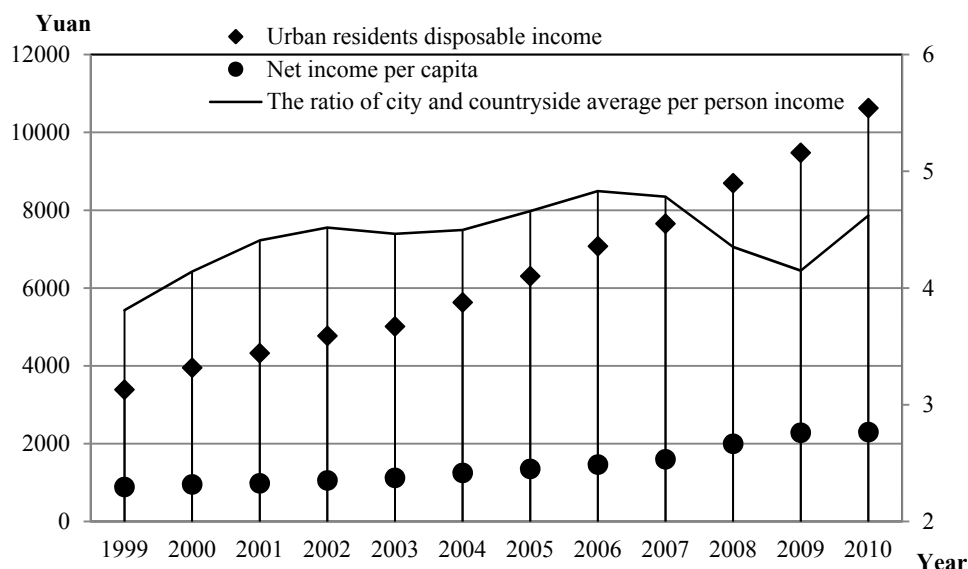


Figure 8. Income Changes of Longnan Urban and Rural Residents since 1999.

The results of our questionnaire survey show that household income comes from agricultural planting, migrant work, livestock-raising, business, various subsidies (such as subsidy of the retirement of cultivated land), and so on. Among these, for our sample households, migrant work and farming are the main income sources, accounting for 79% of total revenue, while livestock-raising, doing business, and other income account for 21%. Loans used in reproduction investment mainly come from banks or credit unions, or relatives and friends, respectively accounting for 64% and 21% of the total surveyed households. Moreover, 3% households hold exorbitant usuries, and 12% have more than two or three loans. In addition, 68% of surveyed households could raise funds when they need a loan or loans, but 32% of surveyed households find it difficult to obtain cash loans. Examining the use of the loans, only 23% are used for agricultural production, business, and other investments; 63% are for building or buying household equipment, as well as 48% for children in school, and 28% for the doctor.

6.4. Changes in Physical Assets: Production Tools Are Gradually Reduced, Domestic Luxury Goods Are Increasing

Influenced by terrain and cropland retirement, as well as more opportunity for migrant work, the number of agricultural machinery tools began to decline from the middle of the 1990s. Statistics show that, in 2008, all farmers only have two large and medium-sized tractors in Wudu district in total, as well as 720 small tractors. Total tractor ownership was only 61% in 1990, in which large- and medium-sized tractor ownership was only 1%.

Findings from our questionnaire survey show that production tools are gradually decreased, and that housing and household appliances, automobiles, motorcycles, and other consumer goods have become the main fixed assets, of which the change of houses is the biggest. In Wudu district, rural housing area in 2010 is 1.8-times that of 1998, and housing structure has thoroughly changed, too,

with the proportion of adobe, civil structure-dominated to the reinforced concrete-structure housing areas in all types of housing increasing from 2% in 1998 to 40%, followed by 21% of brick structures.

6.5. Changes in Social Assets: Infrastructure Is Rapidly Increasing, Outreach Opportunity Is Increasing

The opportunity for farmers to obtain social capital depends on the degree of the social network. A network of social relations is the main way for farmers to understand and grasp market sales, experience, and technology information. In the face of difficulties, the overall resources that farmers can obtain from a social relations network can be divided into three types: financial (capital) help, such as cash loans or other loan; human (labor) help, such as friends and relatives to help with agricultural production or technical guidance in busy farming seasons; material help, such as tools, seeds, and other support from friends in the production process.

When transportation and communications infrastructures are relatively backward, the establishment of a rural social relations network basically depends on blood relationships, the village committee, and neighborhood relations. Statistics show that, in 2010, highway mileage, internet users, and mobile phone subscription numbers increased by 435%, 313.7%, and 583.2% respectively. Compared with 2004, this is 2- to 2.6-times higher than the provincial average levels. With the improvement of infrastructure, the ways that farmers access information have been extended. According to the results of our household survey, in the acquisition of agricultural production/sales information channels, 67% is obtained by neighbors and friends, 18% through the village, and 15% through cooperatives/agricultural associations, the network, or other channels.

7. Substantial Livelihood Outcomes

Given the significant poverty pressures and the fact that economic and social development remains relatively backward, and the implementation of Grain for Green has not been perfect, while there is evidence of a continuous improvement of household livelihoods and other positive regional effects, there have also been some problems in Longnan.

7.1. Agricultural Production Space Is Ecological and Intensive

In Longnan, pepper, walnuts, and so on are brought into the “forest species” category under the Grain for Green program, and the implementation of the policy has reduced the agricultural production space for food crops, but increased the agricultural production space for ecological use. Ecology and diversity of cultivated land use patterns occur simultaneously, leading to the rising proportion of particular crops. According to Department of Agriculture statistics, the total area of suitable, characteristically agricultural, industry development zone has reached 756,666.7 hm² in Longnan. It reached 524,633.3 hm² of characteristic agricultural planting base by the end of 2009, an area equivalent to 90% of the total arable land and garden area, with the main characteristic industries, including walnuts, pepper, olive, herbs, vegetables, and so on.

Intensification of agricultural production space, primarily due to rural migrant labor reduction, provides an opportunity for the peasant household production factors agglomeration and land-scale management to promote the development of characteristic agriculture industrialization. According to the Land Department statistics, by the end of 2012, in Wudou, the cumulated area of land circulation is 7200 hm². In 2013, there are new, 3200 hm² transfers of land, including arable (2133.3 hm²) and barren hills and slopes (1066.7 hm²). From a circulation point of view, there are rental (2533.3 hm²) and swap (666.7 hm²), involving 43,000 farmers. Evidence of intensive land management and high agricultural production efficiency includes a grain yield per hectare increase from less than 750 kg, in 2001, to 982.5 kg in 2010, or yields increased by 232.5 kg per hectare.

7.2. High Density of Living Space in Center City

Urbanization, as one of the main measures to ease population pressure in ecologically fragile areas, has attracted a large number of the rural populations since the reform. In Longnan, the urbanization

rate in 2010 was 22.6%; from 2005 to 2011, the urban population density domain reduced from 145.8 people/km² to 143.1 people/km². While the national economic system is still predominantly based in agriculture, in 2010, the proportion of employees in the three industries were 76.38:7.31:16.31, the proportion of the second industrial output value is just over that of the first industrial output, and three industries' output value structure was 26.27:28.63:45.10. Therefore, in the urbanization process, there is only population concentration, but also a lack of supporting economic entities, which leads to surges in urban population density. Figure 9 shows an increase in the population density of Longnan from 97.6 people/km², in 2005, to 3855 people/km² in 2011.

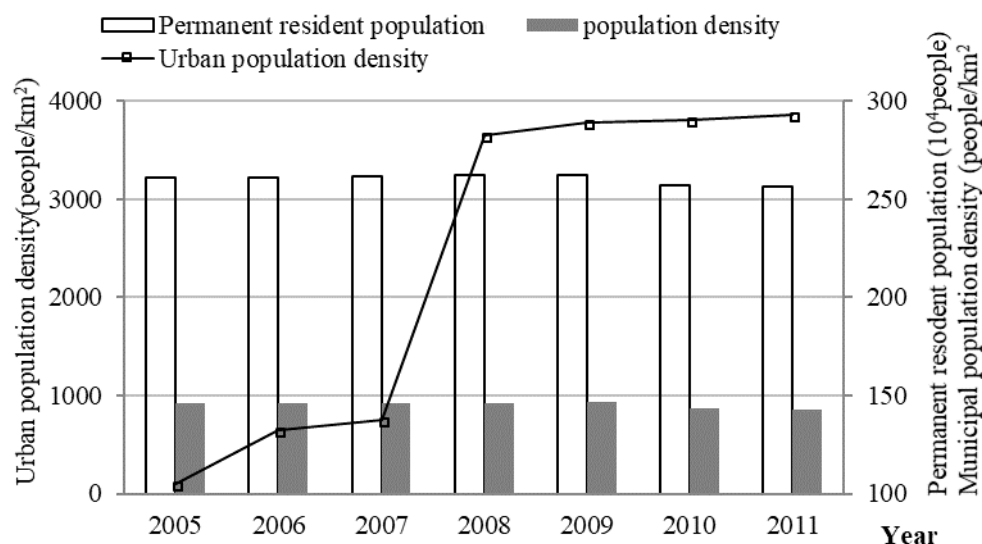


Figure 9. Urban Population Density Changes of Longnan (2005–2011).

7.3. “Hollows” in Rural Production and Living Space

One “hollow” is the decline in quantity and quality of the labor force engaged in agricultural production, resulting in wasted cultivation and production degradation. A second is the emergence of “hollow villages”, the phenomenon of a high “floating” rural residential population, resulting in a waste of land resources. Commonly, “hollows” are associated with the diversification of the production mode and economic income of farmers, and mean that in many situations there are still crops cultivated, but labor is perennial work outside of the area, leaving the older people and children in the villages, and the “empty nest” phenomenon becomes widespread. Then, the population keeps declining, households reduce, and the houses and infrastructure become older (Ma et al., 2008). A result of these “hollows” is the overall decline of the rural regional economy, infrastructure, social service system, and so on.

In Longnan, a hollow appears mainly in terms of rural living space. Among the nine counties/districts (Figure 10), there are three counties in which the per capita rural residential land is higher than the provincial average level. And, in five counties, it is higher than the national average level. According to related research and the land use planning of every county [33], four counties will have more village construction land use per capital more than the recent nation average level, which means the “rural hollow” efficiency will remain for a long time.

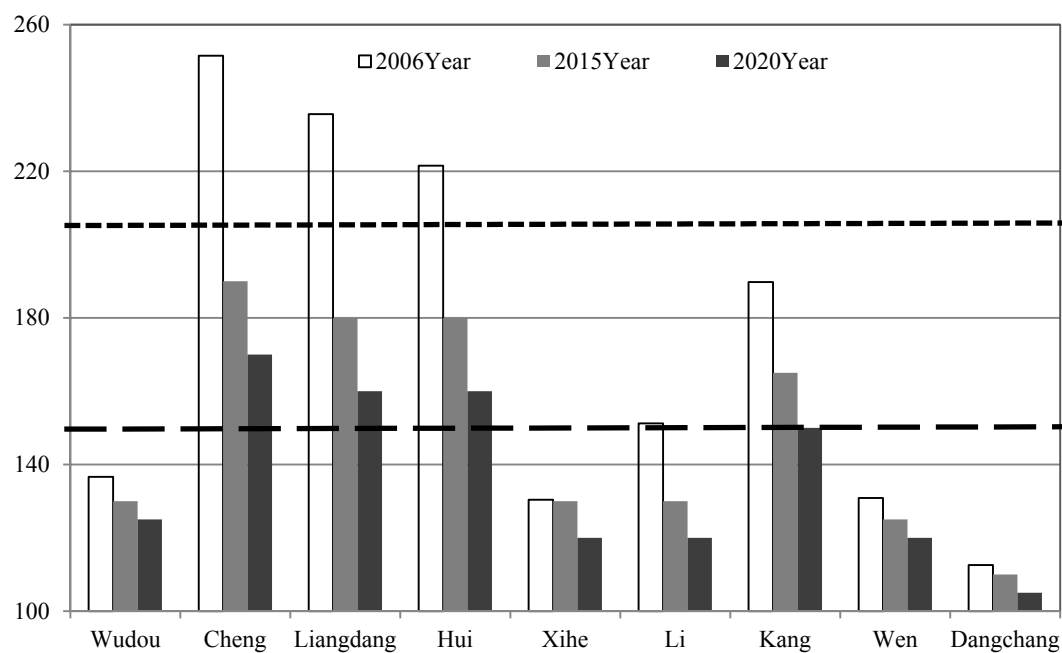


Figure 10. Rural Residential Area Planning of Longnan Counties.

7.4. Resource Utilization Diversification

With the increase in urban population, resource consumption intensity is increasing, and the original approach to coexistence with the natural ecological resources is gradually disappearing, with industrialization and modernization greatly changing the way resources are consumed, such as water and energy use in rural contexts. Our survey shows that, with the implementation of the rural water projects, most peasant families use tap-water (nearly 72% in all samples), while 18% use pump water, and 10% use it in traditional ways, such as carrying water from rivers.

Regarding the use of land resources, such as orchard, woodland, and grassland use, in 19 villages in Wudu, more than one-third of land is used as grassland, 26.7% is farmland, 19% is forestland, and 18.3% is gardens. Among these 19 villages, the highest rate of farmland use is about 46.2%, and only 4 villages use more than 40%. The number of villages with more than 50% of garden, woodland, and grassland are, respectively, 3, 4, and 5 villages. These figures suggest that, since the start of the Grain for Green program, use of cultivated land as household's main assets is weakening, and a trend of diversification has appeared.

7.5. The Overall Environment Is Ecologically Benign, Local Environment Is Malignant

Through the implementation of the project of returning farmland to forestland, ecological conditions have been improved in Longnan, and soil erosion has been effectively curbed. According to the forestry statistics, since 1999, through the implementation of returning farmland to forest—as well as natural forest protection, and protected forest, ecological forest, nature reserve, and green corridor demonstration zones, environmental protection, and ecological restoration engineering construction—the forest coverage rate has increased from 38.9%, at the end of the last century, to 42.5%.

However, compared to ecological restoration overall [34,35], the local, regional, ecological environment remains problematic. One issue is the mining areas causing ecological damage, with some disorderly exploitation of mines leading to a large area of vegetation stripping, waste residue, and mine tailings discharge, which is, in turn, causing soil erosion, destruction of farmland, water sources drying up, or even a reduction in biodiversity. A second problem is the use of fertilizers, pesticides, mulch, and livestock and poultry breeding, leading to the contamination of surface water and groundwater;

a third is the fact that, with the development of resources and economic development in rural areas, the rural non-point source pollution problems gradually increased, and continue to spread.

8. Conclusions

The research shows that positive institutional constraints and policy guidance will improve the livelihood capacity of rural households, as well as significantly promote living standards. Since the implementation of the Grain for Green program from 1999, it has proven to be beneficial to the ecological restoration and the poverty alleviation of local households from the present perspective.

From the results of empirical research in Longnan, an increase in household livelihood ability plays an important role in improving land space utilization efficiency, resource conservation and use, and the ecological environment. An effective system, with constraints and policy guidance, and the increasement of farmers' ability, provides an appropriate adjustment of the land use model, improvement of human assets quality and more liquidity, more and suitable physical assets, broadened financial capital source channels, and more abundant social assets. In particular, the enhancement of household livelihood ability promotes optimal utilization of land space, the establishment of a saving resource utilization system, and the benign cycle of the ecological environment, which, together, lay a solid foundation for regional sustainable development.

From the results of Longnan, the implementation of the Grain for Green program changed the average household's livelihood capital significantly, which shows through the reduction of cultivated land making the methods of land use more scientific, and then the planting of cash crops being beneficial to improve the income of local households. The labor force detached from the land can gradually participate in secondary and tertiary industries. The change of local population age structures caused by the youth "go-outside" leads to an increase of the labor dependency coefficient. Planting of economic crops and going out to work become the primary channels for the household to increase income, which also changes the income structure based on cultivated activities. Household livelihood becomes more diverse. The consumption of households' physical assets tends to increase more in the purchase of high-end consumer goods, and reduce for that of production tools. It also makes a positive contribution to infrastructure improvement and has helped households accumulate social assets.

For the whole region of Longnan, the adjustment of the suitable planting structure promotes the ecologicalization of land utilization, which also diversifies the use of land resources. The reduction of the rural labor force provides excellent opportunities for the agglomeration of production factors and scale of land management, and has positive influences on the improvement of the land and space utilization efficiency. However, with the rapid increase in numbers of migrant workers, the partial region shows typical characteristics of "hollows", which includes the decline in population, the decrease in households, and the collapse of infrastructure. Also, the population of the central city has increased dramatically in the short-term, far exceeding the expectations of urban planning and urban construction, a phenomenon from which emerges high-density megacities. Regarding the ecology and the environment, the forest area expands, and the forest coverage rate has significantly increased, but new environmental problems begin to appear in some local areas. The utilization of chemical fertilizers, pesticides, plastic film, as well as livestock and poultry breeding, cause the pollution of surface water and groundwater, resulting in the problem of non-point source pollution in rural areas to gradually intensify.

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