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Study on the evaluation of the effectiveness of centralized post-disaster housing reconstruction in rural areas of Dujiangyan city after the Wenchuan earthquake

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Abstract. The Wenchuan earthquake caused severe damage to rural areas in Dujiangyan. Determining the reconstruction plan for farmers' housing and unifying reconstruction opinions, while ensuring the rational distribution of resources, became a key focus for the government. As post-disaster reconstruction planning progressed and neared completion, comparative and innovative studies on rural land systems before and after the earthquake, as well as patterns of farmers' housing reconstruction, became important research topics. Traditional studies lack empirical assessments of rural housing reconstruction models from a micro perspective. This paper analyzes and compares the resettlement effects of three typical housing reconstruction models in rural Dujiangyan, aiming to supplement empirical assessments of post-disaster rural reconstruction effectiveness. It reflects the impacts and effects of different reconstruction models selected through collective resolutions in typical towns of Dujiangyan, considering aspects such as development intensity, resettlement efficiency, economic income, and living environment. This analysis helps understand the differences that various reconstruction methods may bring to communities, aiming to summarize past experiences, optimize reconstruction planning and management, and enhance the satisfaction and well-being of disaster-affected people in rural housing reconstruction.

Keywords: Wenchuan earthquake, Rural areas, Housing reconstruction models

1. Introduction

On May 12, 2008, at 14:28 CST, a devastating 8.0-magnitude earthquake struck Wenchuan County, Sichuan Province, China, causing extensive property damage and loss of life. The affected areas included Sichuan, Gansu, Shanxi, and Chongqing provinces and municipalities. A total of 4,667 townships and 48,810 villages were affected, directly impacting 46.256 million people, including 15.106 million requiring emergency relocation. The earthquake caused 69,227 deaths, 17,923 missing persons, and 374,000 injuries. Additionally, 7.967 million houses collapsed, 24.543 million were damaged, and direct economic losses amounted to 852.309 billion yuan [1]. The earthquake's epicenter was only 60 km from Dujiangyan. According to the "Overall Plan for Reconstruction and Rehabilitation after the Wenchuan Earthquake," the primary tasks of post-disaster reconstruction were planned to be completed in approximately three years, with economic and social development restored within eight years. The "Overall Plan for Reconstruction after the Dujiangyan Earthquake" proposed completing the transformation and



development of urban and rural housing, infrastructure, and public service facilities within three years (2008-2010). Economic and social development was expected to be restored within the next 5 to 8 years.

Frequent disasters can devastate people's lives and long-established homes [2-4]. To enhance the resilience and sustainability of human society, it is essential to acknowledge the occurrence of disasters and continually learn from them [2, 5-6]. For individuals affected by disasters, housing is more directly related to their interests and losses than other infrastructure, significantly influencing the overall benefits of post-disaster reconstruction [7-8]. Therefore, the recovery and reconstruction process must be completed as quickly as possible, making it one of the most urgent priorities for the government [9-12]. However, the urgency and instability of post-disaster housing reconstruction often lead to decisions that lack comprehensive consideration. This not only fails to restore pre-disaster societal, economic, and environmental levels but may also exacerbate vulnerabilities [5]. A common risk is that reconstructed housing may fail to meet residents' needs and be rejected by them [13]. Relocation can result in negative consequences such as loss of livelihoods, disruption of daily life, and community conflicts. Significant expenditures on the physical environment in disaster areas may not always yield satisfactory outcomes. Therefore, it is essential to promptly review and evaluate past reconstruction efforts to avoid vulnerabilities resulting from lingering issues and to enhance the recovery capacity of reconstruction areas.

Traditional research topics on housing reconstruction encompass geological and environmental assessments, self-identification of disaster-affected populations, social assistance, policy mechanisms, and overall evaluations using indicator systems [13-16]. However, these studies often focus on the application and improvement of theories in housing reconstruction and reflect on policies from a micro perspective. There is relatively less empirical research on post-disaster housing reconstruction models in rural areas [6, 17], especially following large-scale reconstruction efforts like those after the Wenchuan earthquake, which have distinct Chinese characteristics [2, 10]. Therefore, this paper aims to analyze and compare the actual resettlement effects of various housing reconstruction models in rural areas of Dujiangyan after the Wenchuan earthquake by collating historical data and policies. It seeks to supplement empirical research on post-disaster reconstruction effectiveness in rural areas and to reflect the impacts of the reconstruction models chosen by typical towns in Dujiangyan. This will aid in understanding the differences that various reconstruction methods may bring to communities in the later stages.

2. Characteristics of Housing Damage in Rural Areas of Dujiangyan

In Dujiangyan city, 94% of the 132,487 rural households (excluding those in intact condition) experienced varying degrees of damage. Among these, a large proportion suffered severe destruction and collapse, accounting for 58% (44.34% and 14.12%), while moderate or slight damage accounted for 35% (16.57% and 18.64%). Safety assessments indicate that 73% of the damaged houses (95,130 households) need repair, while 27% (34,447 households) require reconstruction. The spatial distribution of housing damage shows that most areas near the Longmenshan fault zone in the mountainous regions suffered destructive damage. The damage rates of houses in Longchi Town, Xiang'e Township, Zipingpu Town, Yutang Town, and Hongkou Town were 100%, 88%, 94%, 87%, and 69%, respectively.

From the perspective of disaster prevention planning, the characteristics of housing damage in rural areas primarily reflect issues in urban planning and management. Before the earthquake, there was a lack of disaster prevention measures for geological hazards (potential danger zones) and earthquake faults, indicating insufficient safety considerations in the layout. There was a gap in seismic standards for rural housing, and issues with housing construction management (e.g., illegal construction) and lax administrative procedures for housing land use permits.

It also reflects issues concerning farmers' disaster prevention awareness and the seismic resistance of housing structures. Most self-built rural houses were constructed with local materials. Buildings jointly constructed by rural collectives lacked professional technical guidance, resulting in lower awareness of seismic standards among farmers. Some rural areas outside the old urban centers had brick-and-wood or adobe structures for farmers' housing, which had very fragile seismic performance.

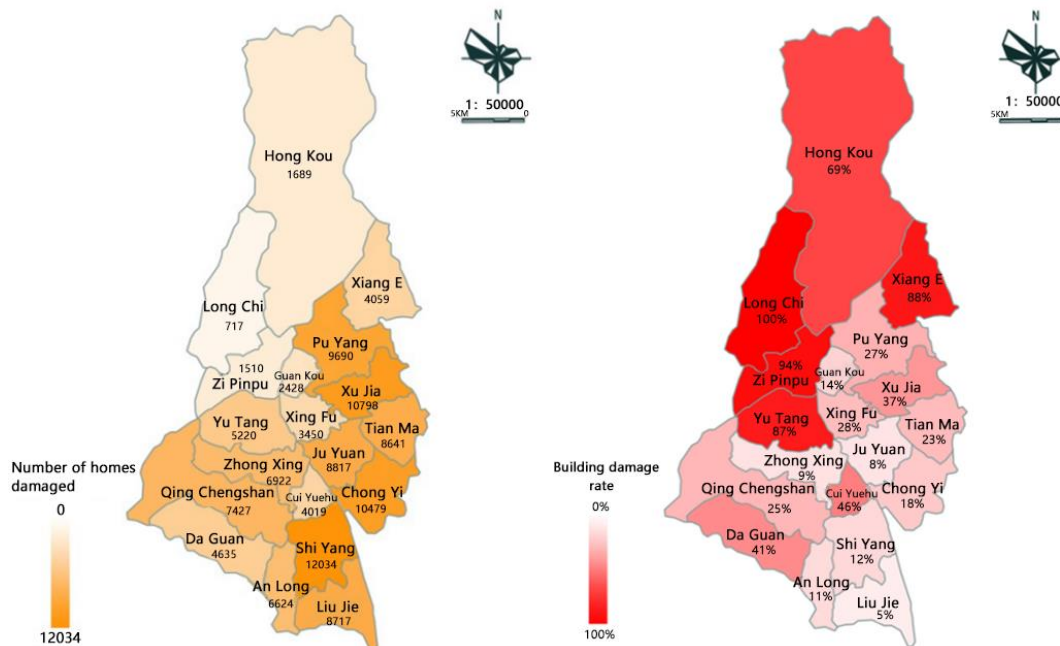


Figure 1. Analysis map of rural housing damage in Dujiangyan

3. Rural Housing Reconstruction System in Dujiangyan

In August 2008, the Dujiangyan municipal government introduced a housing reconstruction selection system for disaster-affected farmers and farmer collectives. This system offered six options for housing reconstruction: reconstruction on original sites, self-construction according to unified standards, government-guided unified standards construction, market-oriented unified standards construction, monetary compensation, and repair and reinforcement. Specific housing reconstruction systems were provided for each option, and disaster-affected farmers made their selections on a village or group basis. Except for the self-construction option on original sites, the approval of two-thirds of the village committee was required for other options.

This paper categorizes rural housing reconstruction into three types based on the organization of fund procurement and reconstruction planning systems: (1) self-construction housing reconstruction (reconstruction on original sites and self-construction according to unified standards), (2) government-guided unified standards construction, and (3) market-oriented unified standards construction.

3.1 Self-construction Housing Reconstruction System

The subject of self-construction according to unified standards includes farmers outside urban planning areas, with village-wide unified standards construction as the primary approach. The funds for housing reconstruction come from deposits, subsidies, marketization of land resources (including funds for urban and rural construction land increment and decrement, land

consolidation subsidies, and land circulation funds), housing reconstruction loans, donations, and other sources.

For planning guidance, land for unified standards construction is limited to rural planning areas. The layout selection and reconstruction planning design are based on the unified opinions of the village committee, village groups (farmers), and the government. The government provides planning design, infrastructure, public facilities standards, and safety standards (including seismic structures).

For land circulation, after the completion of infrastructure reconstruction and the return of original housing land to farming, the remaining collective construction land is converted into operational land (for tourism, services, commerce, industry, etc.) through circulation, with the profits belonging to collective economic organizations. This ensures a source of funds for housing reconstruction for disaster-affected farmers.

For reconstruction property rights, farmers themselves handle the return of original housing land to farming and the demolition of dangerous houses, thereby canceling the original property rights. The ownership of reconstructed housing land and circulated development land belongs to collective economic organizations, while the right to use belongs to farmers or developers. The ownership of above-ground buildings belongs to farmers or developers.

3.2 Government-guided (Unified Standards) Housing Reconstruction System

Government-guided (unified standards) housing reconstruction involves the exchange of indicators through agreements between the government and collective economic organizations. This means that through centralized resettlement reconstruction, the remaining collective construction land indicators are transferred to government management. As compensation, the government provides reconstructed housing and living environments to collective economic organizations. The scale of reconstructed housing mainly includes large and medium-sized units, with resettlement grades ranging from new village communities to concentrated residential areas based on villages.

For the selection of subjects, disaster-affected farmers in urban planning areas can apply for resettlement housing, while collective economic organizations outside urban planning areas can apply for unified standards construction on a village basis. The land department formulates projects and handles administrative procedures through methods such as "linkage between urban and rural construction land increment and decrement" or "demolition and reconstruction."

For planning guidance, the main body for the formulation of unified standards construction housing planning design is the government, with the prerequisite being the unified opinions of village committees in rural planning areas (with two-thirds agreement from villagers). The construction subject in rural planning areas is collective economic organizations or developers.

For land circulation, farmers in urban planning areas who undergo unified standards construction are subject to land acquisition policies, i.e., collective land ownership is transferred to state ownership. Compensation and resettlement for disaster-affected farmers are conducted according to land acquisition policies. Farmers in rural planning areas achieve land circulation through collective construction land circulation (marketization of remaining housing land) or linkage between urban and rural construction land increment and decrement.

For reconstruction property rights, collective ownership in urban planning areas is transferred to state ownership, with citizens (original disaster-affected farmers) owning the property rights of resettlement housing and the right to use state-owned construction land. Collective land ownership in rural planning areas is retained. Disaster-affected farmers and developers have the right to use development land, while surface buildings belong to both parties. After the return of original housing land to farming, it is managed by collective economic organizations.

3.3 Market-oriented (Unified Standards) Housing Reconstruction System

Market-oriented (unified standards) housing reconstruction involves the exchange of development rights through bidding contracts between developers and collective economic organizations. This means that with the prerequisite of unified opinions from over two-thirds of collective economic organizations, development rights (the right to use collective construction land) are transferred to developers through centralized housing development. As compensation, disaster-affected farmers receive reconstructed housing and living environments.

For planning guidance, the selection of reconstruction housing planning layout is determined based on the unified opinions of the government, village committees, and developers. The construction subject is the developer, who uses unified planning design and safety standards.

For land circulation, economic development land (for tourism, services, commerce, industry, etc.) in urban or rural planning areas undergoes changes in land use. The government provides market procedures for the circulation of remaining collective construction land and administrative permits for development land (certificates for the use of collective construction land).

For reconstruction property rights, aside from land acquisition, ownership of remaining land for reconstruction and reconstructed housing land belongs to collective ownership. Disaster-affected farmers have the right to use reconstructed housing land and ownership of the house.

4. Typical Case Implementation Effects

4.1 Housing Reconstruction Settlement Overall Effects

There are 56,013 households eligible for settlement across the entire city. Approximately 96% of farmers were resettled (excluding reconstruction at original sites and relocation), with non-disaster-affected farming households accounting for 40%. A total of 205 settlement sites were selected with the consent of two-thirds of village committees. The total land area occupied is 11,477.2 mu (a traditional Chinese unit of measurement, 1 mu = 666.67 m²), averaging 0.21 mu per household. The total construction area is 5.7927 million square meters, averaging approximately 32 square meters per person. Based on the pre-earthquake residential land area (0.8 mu per household), the average remaining land for centralized settlement is estimated at approximately 0.59 mu per household, with around 31,638 mu of construction land being indicator-based (market-oriented). The marketization of land resources is an important source for raising funds for farmers' housing reconstruction.

Table 1. Overall effects of rural housing reconstruction and resettlement based on government data.

Reconstruction Type	Space Classification	Number of replacements	Construction area	Building area (million m ²)	Ratio		Number of settled households		Settlement Point Ratio	Rate of affected persons	
					Construction area	Building area	Number of resettlement households	Number of affected households			
Self-reliant	Central City	4	234	7	2.00%	1.20%	570	570	1.10%	1.10%	
	Self-construction after unified planning	Key town	25	627	28	5.50%	4.90%	2305	1525	4.30%	2.80%
	New Town	67	1766	65	15.40%	11.50%	5706	4545	10.70%	8.60%	
	General town	27	731	32	6.40%	5.70%	3083	3054	5.80%	5.80%	
	Total	123	3358	132	29.30%	23.30%	11664	9694	21.90%	18.30%	
Government-led	Central City	11	1706	123	14.9%	21.5%	13610	5034	25.5%	9.4%	
	Unified planning and construction	Key town	7	1056	68	9.2%	12.0%	5602	2563	10.5%	4.8%
	New Town	8	762	37	6.7%	6.4%	2850	1685	5.3%	3.2%	
	General town	22	1958	75	17.1%	13.2%	6518	6587	12.2%	12.4%	
	Total	48	5481	303	48.0%	53.2%	28580	15869	53.6%	29.8%	
Market-oriented	Central City	4	56	2	0.5%	0.4%	149	149	0.3%	0.3%	
	Unified planning and construction	Key town	7	766	46	6.7%	8.0%	3753	2181	7.0%	4.1%
	New Town	7	1088	58	9.5%	10.1%	6721	1831	12.6%	3.4%	
	General town	13	682	29	6.0%	5.0%	2436	2088	4.6%	3.9%	
	Total	31	2591	134	22.7%	23.5%	13059	6249	24.5%	11.7%	
Total		202	11429	570	100.0%	100.0%	53303	31812	100.0%	59.7%	

4.2 Self-Help Housing Reconstruction - A Case Study of Hejia Village and Dongyi Village in Anlong Town

Hejia Village and Dongyi Village in Anlong Town decided to adopt a unified planning and self-construction approach for housing reconstruction through post-disaster reconstruction meetings organized by the village committees. Corresponding administrative services mainly include secure layout selection, provision of planning and design schemes, property rights registration, and more. After obtaining the consent of more than two-thirds of the villagers in the village group, the planning and design scheme received administrative approval. The characteristics of this plan include determining the boundaries of residential reconstruction (new buildings, preserved buildings, roads, ditches, planned lines for water edge green belts, and so on), improving the traditional housing patterns of the Qiang ethnic minority in the western Sichuan Plateau, functional zoning of land use, preservation of agricultural cultural landscapes, and planning of water supply, rainwater, sewage, natural gas, electricity, telecommunications facilities, and more. The housing reconstruction adopts a small-scale, centralized development model. The scale of housing reconstruction ranges from 50 to 111 resettlement houses per group. The total construction land area is 61,949 square meters, averaging 49.5 square meters per person. Various types of flat layout options are provided to disaster-affected families while increasing development intensity. For example, the plot ratio is limited to between 0.47 and 0.68, and building density is limited to between 44.1 and 48.8.

Table 2. Reconstruction Situation of Self-built Houses in Hejia Village and Dongyi Village

Category	Classification	Hejia village		Dongyi Village			Sum
		Group 1	Group 6&7	Group 1	Group 6	Group 15	
Disaster-affected farmers	1 persons/household	5	11				16
	2 persons/household	7	17			5	29
	3 persons/household	13	38	61	29	15	156
	4 persons/household	13	29	22	21	21	106
	5 persons/household	15	16			14	45
	number of resettlement households	53	111	83	50	55	352
	number of resettled individuals	185	355	181	321	209	1251
construction scale	planned land area (mu)	23	37	64	34	61	218
	construction land area (m ²)	8942	18045	15510	9008	10445	61949
	residential building area (m ²)	5863	12347	7311	4907	6357	36784
development intensity	plot ratio (%)	0.66	0.68	0.47	0.55	0.61	
	building density (%)	48.3	45.1	44.1	46.4	48.8	
investment	construction projects (yuan)	4690000	9880000	5850000	3930000	5090000	29430000
	overall planning projects (yuan)	1340000	2060000	2350000	1500000	1600000	8850000
	total investment (yuan)	6040000	11940000	8200000	5420000	6680000	38280000
per capita area	land area (m ²)	82	69	236	70	194	
	construction land area (m ²)	48	51	86	28	50	

Through field investigations conducted in Hejia Village and Dongyi Village in Anlong Town (2009-2019), the effects of the unified planning and self-construction approach for housing reconstruction are reflected as follows: 1. Disaster-affected farmers choose the unified planning and self-construction approach voluntarily. The village committee serves as the implementing body at each resettlement site. 2. The village committee determines the reconstruction approach for each group, and together with farmers, selects the layout sites, government-provided planning and design schemes, and construction companies. 3. The construction cost per household for housing reconstruction is 10,875 yuan, and with interior and exterior decoration costs added, it totals around 130,000 yuan per household. The sources of reconstruction funds include housing loans of approximately 40,000 to 50,000 yuan per household, land consolidation subsidies of 8,000 yuan per person, as well as housing reconstruction subsidies and savings, etc. 4. Farmers reclaim the original housing land on their own. 5. Disaster-affected farmers move into new residences with urban-style living environments, equipped with complete infrastructure and public facilities. 6. Villagers maintain traditional agricultural production methods. There are large-scale pig farms and flower and plant cultivation bases in the village, but specific industries have not been scaled up. Individual operation remains predominant, and there is a lack of government guidance on planning for characteristic industries, resulting in limited radiation and insufficient future prospects.

4.3 Government-led Housing Reconstruction: A Case Study of Xiang'e Township

Xiang'e Township convened a post-disaster reconstruction meeting on "Housing Reconstruction Approaches" at the village level, deciding to adopt a government-led (unified planning and construction) approach. The government acts as the planner and executor of the housing reconstruction. The main reason for choosing this approach is insufficient funding for housing reconstruction. Additionally, the strategy of modern ecological agriculture can ensure an increase in farmers' income. Simultaneously, government-led construction can ensure housing safety. Corresponding administrative services mainly include selecting layouts for permanent resettlement housing, proposing adjustment plans for overall township planning, handling administrative permits, interpreting policies, publicizing them, and implementing the priority ranking system for turnover indicators of land increase and decrease projects under the Ministry of Land and Resources. So far, the overall township planning has resettled all 3,566 households from scattered areas into 16 permanent resettlement points (new communities). The 16 permanent resettlement points include 11 medium-sized points (100 to 300 households), 3 large points (over 300 households), and 2 small points (less than 100 households).

Permanent resettlement sites cover a total land area of 1452 mu, nearly 63% less than the housing land area before the earthquake. Concentrating resettlement generated 2471 mu of surplus residential land indicators, which were subscribed by the Chengdu Municipal Bureau of Land and Resources for 600 million yuan. Following the principle of differences in prefectural-level income, the government provides free reconstruction housing and urban residential environments to rural farmers. This development approach has intensified the development of rural areas. Field investigations in Xiang'e Township (2009-2019) revealed the provision of facilities such as water, electricity, gas, internet, telephone, sewage treatment, roads, village committee buildings, activity rooms, rural summer resorts, and innovative industries within the reconstructed residential land. The reconstructed housing consists of 2-4 and six-story residential buildings with a building density of 37%. Reclaiming surplus residential land has added 2471 mu of arable land to the township. Land consolidation has accelerated the construction of modern agricultural ecological demonstration zones. This has promoted the expansion of four characteristic industries: kiwi fruit, green tea, bamboo shoots, and medicinal herbs. It has also facilitated the transition from traditional to modern production methods.

In October 2010, leveraging the property rights system reform, Xiang'e Township established a cooperative model involving agricultural enterprises and village collective economic organizations through share agreements. This model operates under the framework of "agricultural enterprises + collective economic organizations + farmers + government." Agricultural enterprises handle agricultural product processing and market sales. Farmers lease their agricultural land rights to these enterprises, and the government provides subsidies for cultivated land. Additionally, 39% of the farmers (1500 households) who were landless before the earthquake have become industrial farmers. Through government-led housing reconstruction and modern agricultural development, farmers have enjoyed urban-style living environments and gradually transformed into industrial workers (landless farmers), thereby increasing their income and living standards. Recently, it has been observed that some villages, such as Luchi Village, have experienced disinvestment by contracting enterprises due to mismanagement and high operating costs, resulting in resource wastage and failure to achieve rational utilization. Therefore, sustainable models for modern agricultural transformation and development, as well as long-term revitalization paths for post-disaster rural areas, are research topics that need further exploration.

4.4 Market-oriented Housing Reconstruction - A Case Study of Shiqiao Village in Qingchengshan Town

Shiqiao Village in Qingchengshan Town decided through a village meeting to adopt a market-oriented, unified planning and construction approach for housing reconstruction. They appointed

a developer for rebuilding residences via public transfer. The relocation method for housing reconstruction involved concentrating all village households (910 households) into a new type of community. Among them, non-displaced households accounted for 61% of the total. The total construction land area for housing reconstruction was 140,000 square meters (120 mu), equivalent to 56% of the pre-earthquake total area. Of this, 110,000 square meters were intensively allocated for collective construction land. This indicator was delegated to the developer for the development of the village tourism and summer resort area. In exchange for development indicators and the physical assets of the new community, the developer provided the collective economic organization of farmers with a new type of community, including housing reconstruction.

The new community comprises residential areas, commercial buildings, and public facilities. The residential area features the characteristics of clustered settlements in western Sichuan. The total construction area for housing reconstruction is 80,000 square meters, averaging 40 square meters per person. Residential land area, including internal roads within clusters, is 36.57 square meters per person. Orchards and farmland between residences account for 55.43 square meters per person. The residences are mainly two or three-story buildings, equipped with earthquake-resistant design and construction, fire protection, flood control, and other engineering measures. The layout ranges from single-person to four-person households, considering household economics. The courtyard format features characteristics of rural guesthouses, youth hostels, and leisure apartments for sale. The commercial land area for commercial buildings is 6,000 square meters. Farmers own 3 square meters per person as shares, transferred to the collective economic entity, considering the sustainability of collective economic organizations. The total land area for public facilities is 2,000 square meters. It includes the village committee, police station, kindergarten, agricultural market, cultural activity center, public toilets, garbage disposal site, and primary school, managed autonomously by the village committee.

The implementation effect of the market-oriented unified planning and construction housing reconstruction approach in Shiqiao Village, Qingchengshan Town (2009-2019), is reflected through on-site investigations. 1. After the original housing land is cultivated and forested, the saved collective construction land and forest land are commercialized according to the villagers' wishes to ensure funding for housing reconstruction. 2. Leveraging post-disaster reconstruction to build relatively centralized new communities creates a good living environment for farmers, with considerations for the sustainability of collective economic and farmer incomes. However, due to the local reliance on the tertiary industry (agrarian tourism, characteristic homestays, etc.), it is significantly affected by the market. Although incomes are relatively high, stability is low. 3. On one hand, transforming the lifestyle and production methods of farmers, gradually transitioning them from agricultural laborers to individual households, promotes local economic development. On the other hand, as farmers move away from agricultural land and enjoy urban-style living environments, their production and living costs also increase.

5. Conclusion

Rural housing reconstruction corresponds to the development control of rural housing reconstruction, leveraging the centralized development opportunity for farmers. It is the first collective construction land market system constructed since China's reform and opening up, realizing the market circulation of urban and rural land resources. The marketization of surplus residential land indicators (land resources) solved the difficulty of raising funds for rural housing reconstruction and provided a guarantee for the supply of funds for post-disaster housing reconstruction.

On the one hand, post-disaster housing reconstruction has accelerated rural transformation and agricultural modernization to a certain extent. Displaced farmers have moved into new urban-

style residences with complete infrastructure and public facilities, centralized management, and rural areas have taken on a new look, facilitating urbanization. The intensive post-disaster housing reconstruction model has addressed the problem of excessive rural construction land and insufficient arable land by converting scattered homesteads into arable land, thereby increasing the arable land area to some extent. Concentrated arable land facilitates collective contracting, transitioning agricultural production to large-scale, mechanized modern methods. The post-disaster reconstruction process also provides an opportunity for industrial adjustment and transformation. The introduction of market mechanisms has diversified rural industries, such as tourism and eco-agricultural plantations, contributing to increased rural industrial profits and improved farmers' incomes. Post-disaster housing reconstruction places more emphasis on safety layout, housing quality, and the construction of disaster prevention facilities. Villages also strengthen disaster prevention planning, publicity, drills, and investment in disaster prevention funds, enhancing defense capabilities against natural disasters such as earthquakes and improving rural disaster resilience, which is constructive for the development of disaster prevention and reduction in rural areas.

On the other hand, post-disaster housing reconstruction either concentrates farmers or increases the construction density and plot ratio of rural residential areas, often lacking consideration for ancillary spaces necessary for rural production and living, such as poultry farming, vegetable planting, and storage of agricultural implements. This change in farmers' production and living styles leads to increased living costs and raises concerns about the advantages and disadvantages of collective housing, as well as the destruction of rural cultural landscapes. At the same time, issues reflected in the post-disaster reconstruction process in rural areas, such as an imbalanced rural population structure and a lack of long-term considerations in industrial planning, will also become relevant topics for future research on rural revitalization.

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