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Post-Earthquake Housing Reconstruction Management and Implementation in Rural Areas: Review and Lessons from Dujiangyan, Wenchuan Earthquake

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Abstract: Housing reconstruction plays a crucial role in renovating disaster-hit areas. Rural areas are considerably different from urban areas in terms of geographic environment, building size, residential culture, and social organization. Therefore, post-disaster recovery and reconstruction models for urban areas cannot be applied directly to disaster-hit rural areas. This study, based on the experience of rural housing reconstruction after the Wenchuan earthquake, identified key strategic issues in housing reconstruction that must be addressed to achieve the goal of "building back better" in the future. By taking the experience of Dujiangyan as our reference, the study found that the following strategies are important for successful housing reconstruction in rural areas: (1) actively involve disaster victims through a participatory institutional design; (2) coordinate the interests of governments, markets, and disaster victims and the functions of living, production, and ecology through a classified housing reconstruction system; and (3) activate the quota for rural collective construction land and create a new source of funding for housing reconstruction through the market circulation of urban-rural land. Additionally, in the context of urban-rural integration, changes in land use can lead to rural spatial reconstruction and sustainable regional development, providing a reference for formulating optimal post-disaster reconstruction strategies.

Keywords: housing reconstruction; earthquake disaster; recovery; rural community; Jiangyin

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1. Introduction

For people in developing countries, housing is usually one of the most precious assets. In the event of disasters (especially sudden disasters), housing is usually impacted or damaged most severely and suffers the greatest losses among the overall impacts on the national economy. Therefore, many post-disaster recovery programs allocate the largest proportion of resources and give first priority to housing and infrastructure reconstruction compared with other sectors [1]. Reconstructing housing post-disaster is considerably different from reconstructing other forms of infrastructure and public facilities (particularly, interest re-allocation arising from the diversity of property rights), as it involves directly engaging with the victims. Thus, housing reconstruction has been the primary concern of victims and governments in the aftermath of disasters. Post-disaster housing reconstruction involves repairing structural damage to housing and providing necessary services and facilities to ensure the health, safety, and security of local residents [2,3]. During the reconstruction period, resettlement of victims, reinforcement of damaged housing, and construction of new housing are critical issues for post-disaster emergency management and reconstruction. Early studies of post-disaster recovery focused on describing the behavioral responses of victims and recovery and reconstruction organizations during and after post-disaster recovery [4]. By investigating the responses of individuals and communities across the recovery and reconstruction processes, Barton [5] argued that conflicts and contradictions between victims and local governments are more significant

at the intermediate stage than during the emergency aid period or at later stages. Rubin suggests that well-targeted policy measures can effectively solve conflicts during the reconstruction period [6]. Alesch argues that post-disaster reconstruction should promote further development and progress in disaster-hit areas rather than merely restoring the pre-disaster state [7]. Developing countries should implement post-disaster recovery and reconstruction in conjunction with regional vulnerability analysis to overcome the vulnerabilities of disaster-hit areas [8,9]. Housing reconstruction is crucial for overall reconstruction effectiveness and involves direct stakeholders and long-term relationships with diverse parties [10]. Many housing reconstruction cases worldwide have revealed three major problems: management and coordination, funding and compensation, and major reconstruction participants [11–13]. Among them, reconstruction funding is the first prerequisite to ensuring rapid recovery in disaster-hit areas. Further, reasonable victim compensation and fund allocation are an important basis for evaluating the effectiveness of housing reconstruction and a significant factor in maintaining the order of the housing market. A statistical analysis of 209 articles [14] shows that ineffective management and coordination failure are the most frequently mentioned challenges to housing reconstruction in the existing literature because they increase the frequency of repetitions, errors, and faults during urban-rural housing reconstruction.

Since the 2004 Indian Ocean tsunami and 2005 US hurricane Katrina, academic seminars and studies on post-disaster reconstruction planning have increased sharply [15]. This, combined with the increasing international attention on global climate change, has led to an increasing number of people realizing the importance of disaster adaptability in human settlements [16,17]. One of China's major structural problems is the urban-rural dichotomy, which has resulted in a significant urban-rural gap. Rural areas are considerably different from urban areas in terms of geographic environment, building size, residential culture, and social organization. Therefore, post-disaster recovery and reconstruction models for urban areas cannot be applied directly to disaster-hit rural areas. Li et al. have investigated in detail the urban housing reconstruction policy and reconstruction pattern after the Wenchuan earthquake [18]. This study provides a thematic analysis and systematic summary of the entire process of post-disaster rural housing reconstruction in four aspects (including planning system and special policy, implementation mechanism and management process, land supply, and reconstruction effectiveness). As a supplement to the planning and management mode of housing reconstruction after major earthquakes, our findings will serve as a reference for rural post-disaster emergency management.

2. Study Area

Dujiangyan City is located in the northwestern Sichuan Plain. The Wenchuan earthquake impacted the housing of 132,487 rural households (approximately 94% of total rural households in Dujiangyan), with 75% being either collapsed or damaged. Safety appraisal shows that the severely damaged and collapsed houses collectively accounted for 58% (44.34% and 14.12%), and the moderately and slightly damaged houses collectively accounted for 35% (16.57% and 18.64%). Additionally, 73% of the impacted houses (95,130 rural households) needed to be repaired, and 27% of the impacted houses (housing 34,447 rural households) needed to be reconstructed. The rural housing was mainly distributed in mountainous areas near the Longmen Mountain Fracture Zone, with most of these areas being devastated. The damage rate of rural housing in Longchi Town, Xiang'e Township, Zipingpu Town, Yutang Town, and Hongkou Town was 100%, 88%, 94%, 87%, and 69%, respectively. Compared with the above townships/towns, the damage rate of rural housing was relatively low in the townships/towns adjacent to or along the mountainous areas of the Longmen Mountain Fracture Zone. However, compared with the townships/towns in plain areas, the damage rate of rural housing was relatively high (e.g., 25% and 41% in Qingchengshan Town and Daguan Town, respectively). The damage rate of rural housing was considerably low in most plain areas (e.g., 8%, 18%, 12%, 5%, and 11% in Juyuan, Chongyi, Shiyang, Liu-jie, and Anlong Town, respectively) but relatively

high in certain plain areas (e.g., 23%, 37%, and 46% in Tianma, Xingfu, and Cuiyuehu, respectively), as shown in Figure 1.

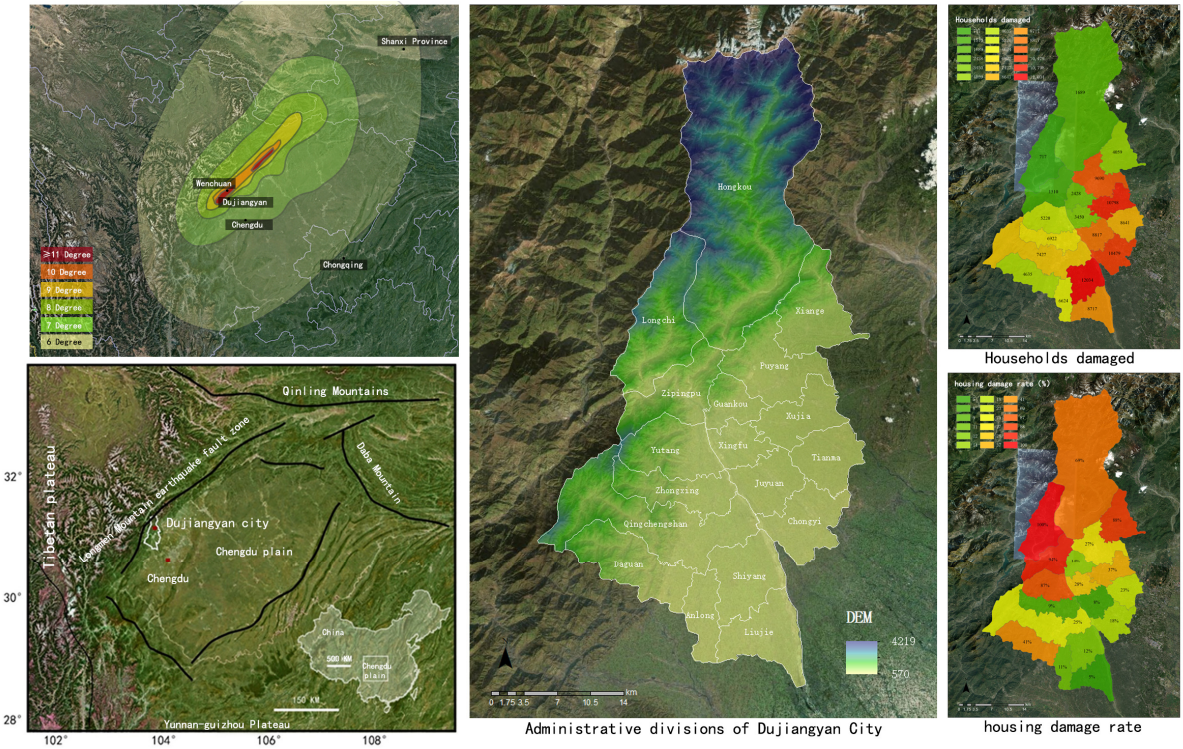

Figure 1. Regional location and spatial distribution of housing damage in the study area.

3. Differences between Urban and Rural Planning Systems

3.1. Changes in China's Legal Systems of Urban and Rural Planning

Figure 2 describes the changes in China's legal system for urban and rural planning. Before the implementation of the new planning law, urban and rural areas were planned and constructed in accordance with different laws or regulations. Specifically, urban planning and construction complied with the City Planning Law of the People's Republic of China (hereinafter referred to as the "Old Planning Law"), whereas rural planning and construction complied with the Regulations on the Planning and Construction of Villages and Towns (hereinafter referred to as the "Old Rural Regulations"). As a national law adopted by the National People's Congress, the old planning law stipulates that urban land is state-owned and may be used on a paid basis. The old rural regulations fall under administrative regulations, stipulating that rural land is collectively owned and that the right to use rural land may be transferred to governments before peasants are compensated for the requisitioned land. The new planning law was promulgated at the end of 2007 and came into force on 1 January 2008, while the old planning law became null and void. The new planning law is groundbreaking in proposing the requirement for urban-rural integrated development and management, suggesting that China's modernization and urbanization entered a new stage. Compared with the old planning law, the new planning law emphasizes urban-rural integrated planning and management, specifically the following: (1) planning industry and agriculture, cities and villages, urban residents and rural villagers as a whole; (2) performing institutional reforms and policy adjustments to promote urban-rural integration in terms of planning and construction, industrial development, market information, policy measures, ecological and environmental protection, and social undertakings and change the long-standing urban-rural dual economic structure; (3) achieving equality in policies, complementarity in industrial development, and equality in national treatment (e.g., helping peasants enjoy the same civilization and benefits as

urban residents); and (4) achieving all-round, coordinated, and sustainable socioeconomic development of both urban and rural areas.

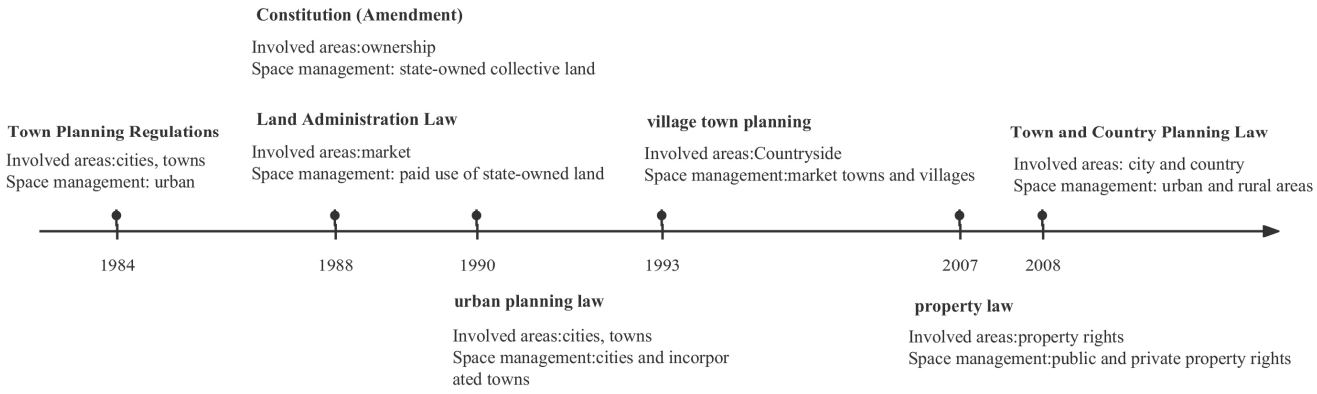

Figure 2. Changes in China's urban and rural planning legal systems.

3.2. Institutional Background of Post-Disaster Reconstruction Planning

Chengdu City has established a national-level demonstration zone for urban-rural integrated development, with a focus on reforming the rural property rights system, freeing up the circulation of rural land markets, and adjusting the spatial structure of modern ecological agriculture. These reforms provide the legal and institutional background for Dujiangyan's rural reconstruction planning. Property rights are the core of rural land systems, and the registration of land ownership and property rights is a crucial aspect of rural reconstruction. In 2007, Chengdu took the lead in implementing the rural property rights confirmation and registration system in China, which explicitly confirmed related property rights (e.g., collective land ownership, use rights of collective land, housing ownership, land contracted management rights, and use rights of forest land) and provided rural land to rural collective organizations and households [19]. According to the Decision on Deepening the Reform in Strict Land Management promulgated by the State Council in December 2004, Chengdu implemented an increase and decrease linkage system of urban-rural construction land to facilitate rural reconstruction after the Wenchuan earthquake. On the premise of expert review and approval, as well as the consent of at least 66.7% of villager representatives, the following reform measures were implemented: (1) further consolidating and allocating land through the "demolition and reconstruction" project; (2) transforming the surplus quota for collective construction land in a market-oriented way; and (3) helping rural households in demolition areas earn extra revenue from the differential rent of circulated land [20].

3.3. Institutional Connection between Post-Disaster Reconstruction Planning and Pre-Disaster Rural Planning

The Decisions of the Central Committee of the Communist Party of China on Several Major Issues in Building a Harmonious Socialist Society (promulgated in 2006) have planned to "actively promote the construction of rural communities, develop a perfect management and service system for new-type communities, and turn rural communities into well-managed, well-served, civilized, and peaceful social life communities." The concept of "rural communities" was first used in an official document released by China's central government. Dujiangyan's New Rural Community Planning (2007–2020) has planned to reduce Dujiangyan's total peasant population from 390,000 to 270,000. Specifically, (1) 120,000 peasants will be resettled in new rural communities, (2) 150,000 peasants will be settled in Linpan (Dujiangyan's traditional rural settlements) residential conservation areas, and (3) 120,000 peasants will be turned into rural citizens by developing amalgamated dwellings in urban planning areas. Before the Wenchuan earthquake, Dujiangyan's overall plan for urban-rural integration was formulated, considering a "large concentration" pattern. After the Wenchuan earthquake, the Chengdu municipal government proposed the

planning principles of "three concentrations" in August 2008, specifically the following: (1) industrial parks where manufacturing enterprises are concentrated; (2) concentration of rural towns or new rural communities; and (3) large-scale concentration of agricultural land. The "three concentrations" principle aims to achieve compact, concentrated, and intensive development and promote the coordination of industrialization, urbanization, and agricultural modernization. The Dujiangyan Municipal Government further proposed four principles for rural reconstruction (development, diversity, sharing, and compatibility) and specified 15 new-type rural communities in the original rural reconstruction planning as permanent resettlement housing, which is intended to accommodate 16% of the total resettled rural population. Accordingly, Dujiangyan's overall planning of urban-rural integration was adjusted and revised to highlight a pattern of "relative concentration and small concentration" [21]. To date, "large concentration" and "relative concentration and small concentration" are the dominant patterns of rural development planning. "Large concentration" enables residents to manage the relevant infrastructure and public service facilities conveniently but increases the cost of travel between people and land and is averse to the implementation of agricultural activities. The scale of this kind of reconstructed rural community is generally large, which is not only not conducive to the development of agricultural activities but also has a certain degree of impact on the local traditional settlements and agricultural cultural landscape [22]. "Relative concentration and small concentration" inherit the characteristics of rural settlement and facilitate the development of large-scale and modern agriculture, but incur extra costs due to the capital construction of public services.

4. Rural Housing Reconstruction Planning and Its Implementation

4.1. Objective Management and the Management Process of Post-Disaster Reconstruction

In the context of the Dujiangyan region, the reconstruction of rural residences follows a bifocal managerial approach encompassing reconstruction goal management and re-construction process management. The crux of reconstruction goal management revolves around the strategic imperative of effecting a seamless culmination of housing reconstruction initiatives within a concise biennial temporal span (as depicted in Figure 3). Noteworthy temporal milestones encompass the accomplishment of transitional resettlement within the tri-monthly ambit subsequent to seismic events; the fruition of development intentions pertaining to housing reconstruction within the hexa-monthly aftermath of the seismic occurrence; and the consummation of permanent domicile construction endeavors within the biennial post-seismic timeline, notably culminating on 12 May 2010.

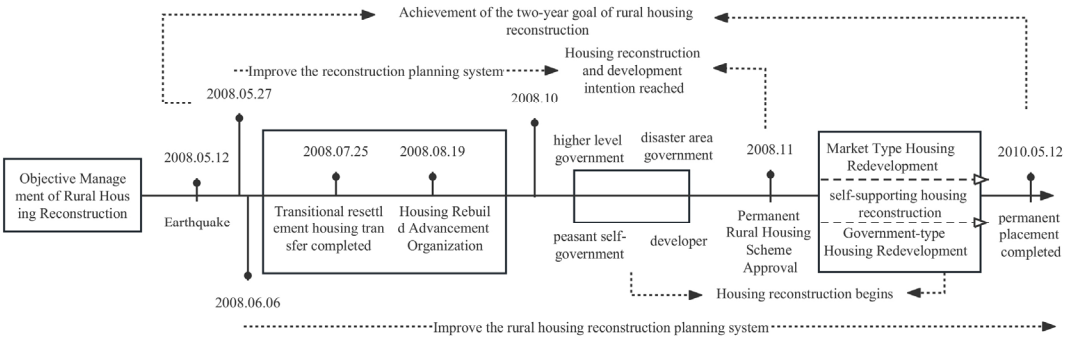

Figure 3. Flowchart on Dujiangyan's rural housing reconstruction objective management.

Facilitating the reconstruction process (as delineated in Figure 4) entails a dual-faceted approach comprising seismic disaster response strategies and housing reconstruction strategies. The former is principally geared towards damage evaluations coalesced with comprehensive safety assessments. The latter, marked by its comprehensive ambit, encapsulates a tri-level strategy. Commencing with the trajectory of planning guidance, the constitution of a Rural Recovery and Reconstruction Work Promotion Organization, as

expounded in Section 4.2, synergizes the objectives of transitional settlement paradigms and fosters sustainable development, all while aligning with doctrinal positions stipulated within regulatory frameworks concerning rural housing reconstruction. This august organization duly engenders a comprehensive blueprint catering to the perpetual reconstruction of rural domiciles. Subsequently, within the rubric of implementation systems, this pivotal organization promulgates a specialized set of policies spanning four cardinal dimensions, encompassing land tenure systems, financing frameworks, property rights reform frameworks, and administrative support services, all geared towards fortifying the reconstruction enterprise. Lastly, within the terrain of development models, anchored upon a bedrock of respecting the volition of disaster survivors and safeguarding their inalienable rights, an assortment of five distinct reconstruction paradigms is presented for selection, encompassing on-site self-reconstruction, government-driven standardized construction, government-driven standardized construction coupled with a self-reconstruction facet, community-participatory standardized construction, and community-participatory standardized construction complemented by self-reconstruction.

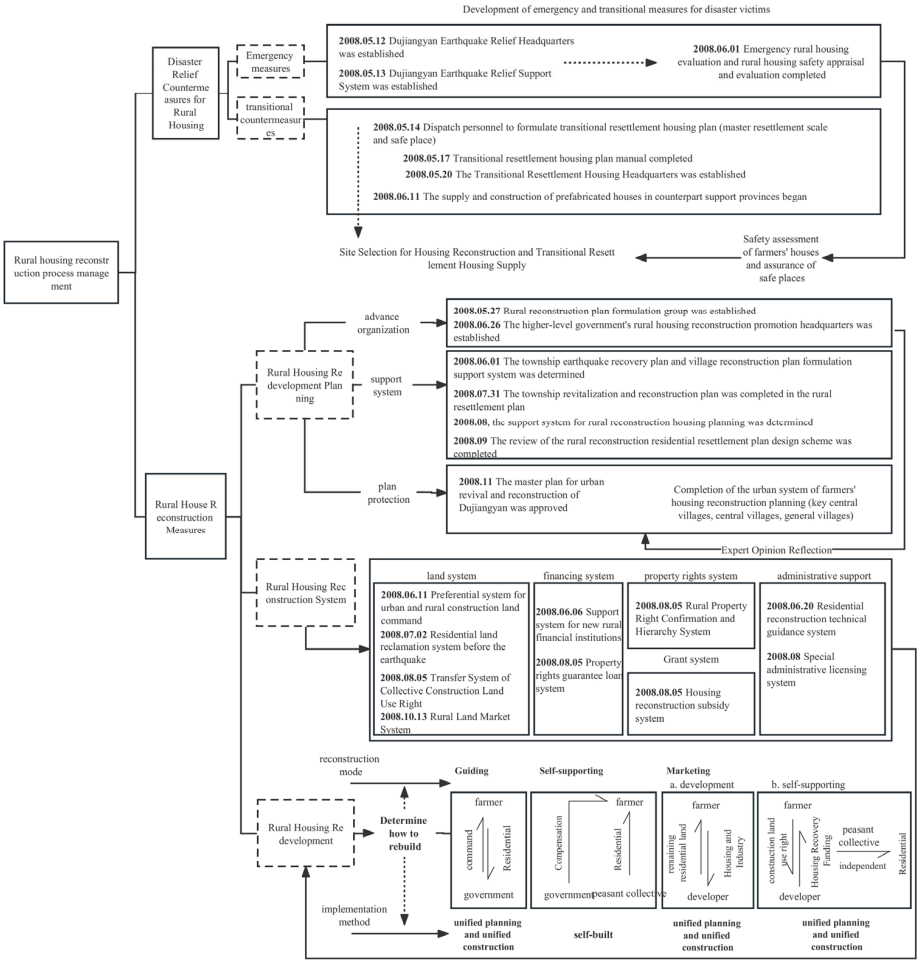

Figure 4. Flowchart on Dujiangyan's rural housing reconstruction process management.

4.2. Executive Organizations for Rural Housing Reconstruction

4.2.1. Government-Led Executive Organizations and Task Allocation

- Executive organization at the planning formulation stage

After the Wenchuan earthquake in China on 12 May 2008, local governments in the affected rural areas initiated post-disaster rural housing reconstruction planning on 25 May 2008, and were scheduled to complete it within two months. The planning included township, town and district, village, and rural housing reconstruction planning.

Dujiangyan formed a post-disaster reconstruction planning coordination team on 27 May as the supreme decision-making body for rural housing reconstruction planning, responsible for programming, outlining, management, and coordination. Planning formulation teams were established under the coordination team to receive guidance from higher-level governments. A support system for planning formulation was established on 1 June 2008, based on pairing-assistance and dispatched talents or volunteers in planning and design. The coordination team was responsible for the following: (1) determining the scale (including construction land and resettled population) and safe layout of town reconstruction, investigating the disaster status, and formulating the overall planning (for townships, towns, districts, and villages), and (2) investigating the intentions of township/town-level governments, village committees, and rural households.

- Executive organization at the planning and implementation stage

The executive organization for rural housing reconstruction was established on 5 August 2008, with the Dujiangyan Municipal Government as the main implementer. The executive organization was responsible for policymaking and announcements, as well as decision-making on work programs and objective management. The executive organization comprised seven municipal government agencies (the Coordination Bureau, Civil Affairs Bureau, Planning Bureau, Land Resources Bureau, Construction Bureau, Housing Management Bureau, and Economy Bureau) and township/town-level governments with a vertical work responsibility system (Table 1). The policy announcement covered the following content: (1) means and methods of housing reconstruction; (2) housing reconstruction policies and measures; (3) technical guidance and investment for reconstructed housing; (4) inspiration for revenue allocation to rural households or collective economic organizations; (5) social attention; (6) progress and key events in housing reconstruction; and (7) new situations and problems in the process of housing reconstruction. Policy announcements were mainly conducted through the news media, the Internet, and news conferences. The management aimed to achieve housing reconstruction and reinforcement on a village scale, according to the project ledger for rural housing reconstruction.

Table 1. The executive organization and task allocation of rural housing reconstruction.

Task Allocation	City-Level Government	Township/Town-Level Government
Administrative services	Issuing one letter and three permits [1] (i.e., a letter of site selection opinion, a planning permit of construction land, planning permit of construction engineering, and a planning permit of rural construction) for administrative licensing and re-registering land property rights (including land ownership, the use right of collective construction land, the contracted management right of agricultural land, the use right of forest land, and rural housing ownership).	Receiving and reviewing the applications for construction land and housing land at resettlement points, handling the related administrative procedures, and applying for the property rights of resettlement housing and land.
Market services	Circulation of collective construction land and increase and decrease linkage of urban-rural construction land.	Confirming, bulletining, and registering the adjustment of land property rights, adjusting the interest distribution of intensive construction land, and supervising the progress in housing land development.
Housing reconstruction	Handling the application for housing safety appraisal, disaster-hit housing subsidies, and housing reconstruction and resettlement agreements on the village or villager group scale.	Handling the selection of housing reconstruction models, investigating and reviewing the profile of rural households, and adjusting the ownership of resettlement land.

Table 1. *Cont.*

Task Allocation	City-Level Government	Township/Town-Level Government
Reconstruction planning guidance	Specifying the boundaries of urban planning areas and rural planning areas, performing field boundary measurement for collective construction land and reconstructed housing, conducting layout design and safety appraisal for post-disaster reconstructed permanent housing and centralized resettlement points, and specifying the supporting facilities for the increase and decrease linkage of urban-rural construction land.	Publicizing the superior governments' related policies to rural households or collective economic organizations and providing guidance to the circulation of collective construction land.
Reconstruction planning formulation	Providing unified guidance to reconstruction planning and design, architectural landscape, architectural quality, infrastructure, and public facilities.	-
Technical guidance and supervision	Providing technical guidance and supervision, including construction quality supervision, safety management, and engineering completion inspection and acceptance for reconstructed housing, completion inspection and acceptance for land circulation and development projects, and inspection and acceptance for cultivated land development on the township, village, or villager group scale.	Application management, construction supervision, and completion inspection and acceptance records for small-sized engineering projects.

[1] The Urban and Rural Planning Law expressly stipulates the setting of planning permission as well as the bulletining and disclosure of the implementation procedure, condition, process, and results of planning permission. Articles 36, 37, 38, and 40 stipulate that the related systems (e.g., letter of site selection opinion, planning permit of construction land, and planning permit of construction engineering) are implemented for urban planning in China; Article 41 stipulates that the rural construction planning permit system is implemented for rural planning in China.

4.2.2. Villager Self-Governed Executive Organization and Task Allocation

On the premise of respect for victims' willingness and villager self-governance, five housing reconstruction models (in situ reconstruction, unified planning and self-construction, unified planning and unified construction, monetized resettlement, and market-oriented development) were available for victims or rural collective economic organizations in accordance with the opinions on the implementation of rural housing reconstruction (released by Dujiangyan Municipal Government in August 2008). On a village or villager group scale, grass roots (e.g., township/town-level) administrative organizations publicized the post-disaster relief and resettlement policy and investigated the victims' basic information and need for housing reconstruction.

Except for in situ reconstruction, the planning programs for the four other housing reconstruction models must be based on the premise of close communication between design institutions and victims, and the implementation programs must be based on the opinions of village cadres and victim representatives. A victim discussion system was established for the planning and implementation programs, for example, according to the unanimous opinion of the village meetings, villager representative meetings, village council meetings, and courtyard meetings. The discussion results were published on the bulletin boards of villages or villager groups to solve the problem of interest adjustment (2009, field survey). The earthquake victims made decisions about related issues (e.g., land consolidation, industrial development, living environment governance, and concentration mode of collective construction land) within villages or villager groups. Unified planning and self-construction were mainly implemented by village committees, and in situ reconstruction was mainly implemented by rural households or joint-tenancy parties.

Property management was performed for villager groups' self-resettlement points based on the principles of autonomy, voluntarism, and self-government and through democratic consultation, and villager group committees addressed the difficulties and contradictions faced by property management at centralized resettlement points.

4.2.3. Technical Guidance from Dispatched Experts and Task Allocation

In mid-August 2008, a technical guidance system for housing reconstruction planning and design was implemented under the leadership of the Construction Committee of the Chengdu Municipal Planning Bureau. Under the technical guidance system, experts from Chengdu's more than 100 registered planning and architectural design institutions constituted the executive organization for rural housing reconstruction planning and were dispatched to the earthquake-hit areas to provide guidance for reconstruction planning. The following tasks were allocated to them: (1) providing technical guidance to rural planning and construction in various aspects (e.g., safe layout, construction standard for public and municipal facilities in rural resettlement points, architectural configurations, built environments, architectural landscapes, and architectural structures); (2) meeting the requirements for the four principles of planning and design (including diversity of regional characteristics, sharing of infrastructure, integration of production, living and ecological integration, and development); and (3) providing rural planning and construction atlas (e.g., drawings for environmental design, architectural configuration, residential building, and aseismic structure design) to guide peasants' self-built housing. In particular, to satisfy the housing needs of peasants, the experts must fully understand the disaster severity and victims' willingness for housing reconstruction, consider diverse factors (e.g., cost-effectiveness and practicality of building space design, household size, blood relations, and family relatives), design appropriate apartment layouts, and ensure equality in the design of construction land and construction area.

4.3. Special Systems and Policies for Rural Housing Reconstruction

4.3.1. Cash Subsidy and In-Kind Relief System for Rural Housing Reconstruction

Cash subsidies for Dujiangyan's rural housing reconstruction were sourced from post-disaster reconstruction funds allocated by the central and local governments of different levels (including the people's governments of Sichuan Province, Chengdu City, and Dujiangyan City) and granted to rural households whose housing was considered to meet the standard for damaged housing. Depending on the severity of the housing damage, household income, and household composition, the subsidy standard was set at CNY 20,000 per general rural household and CNY 23,000 per poor rural household. Cash subsidies were advertised and confirmed in the villages or village groups concerned before they were granted. Rural households were not eligible to receive cash subsidies if they had no earthquake-damaged housing and were centrally resettled; rural households were eligible to receive transferred subsidies separately if they were resettled from geologically hazardous areas. By using the pairing-assistance funds or social donations, in-kind aid was used to centrally resettle and take care of the disadvantaged groups (e.g., orphans, solitary elderly, and solitary disabled people, as well as homeless, vagrant, and five-guarantee peasants) in welfare houses, elderly nursing homes, and happy civil dwellings. According to the field surveys in 2009 and 2010, in-kind aid mostly existed in the centralized resettlement peasant communities and in situ, self-reliantly reconstructed areas where related service facilities were not available.

4.3.2. Special Loan System for Rural Housing Reconstruction

In August 2008, Dujiangyan implemented a special loan system for rural housing reconstruction among rural households and rural collective economic organizations that selected self-reliant in situ reconstruction, unified planning, and self-construction. As a newly established and solely state-owned enterprise with corporate property management rights, Dujiangyan Property Rights Circulation Financing Guarantee Co. Ltd. provided loan

guarantees for rural housing reconstruction. Meanwhile, an administrative registration and licensing system was implemented to protect the legal rights and interests of the loan guarantor and reduce the risk of loans (government interview records, 2009/3). The financial institutions of Dujiangyan granted special loans for rural housing reconstruction, with a maximum loan amount of CNY 60,000, a maximum repayment period of eight years, and a preferential loan rate of 60% of the benchmark loan rate for three years subsequent to the Wenchuan earthquake. Additionally, rural households registered with the special loan system before 2009 were exempt from the administrative handling fee. For rural households who paid off their loan principal before the end of 2009, Dujiangyan's special funds for post-disaster reconstruction would pay their loan interest in full; for rural households who paid off their loan principal before the end of 2010, Dujiangyan's special funds for post-disaster reconstruction would pay 5% of their loan interest [23].

4.3.3. Innovative Rural Land Systems

Property rights circulation system for rural land. In October 2008, Chengdu established the Chengdu Rural Property Rights Exchange, with subordinate branches established in Dujiangyan City and towns under its jurisdiction. The exchange was renamed the "Urban-rural Property Rights Exchange" in 2009 and provided one-stop market services for the property rights circulation of urban-rural land. The property rights circulation system for rural land aimed to subsidize the conversion of agricultural land into state-owned construction land and restrict the transfer of rural collective construction land. This system was China's first land marketization system, institutionalizing the free circulation of agricultural land and the marketization of rural collective construction land.

Increase and decrease the linkage system of urban-rural construction land. The increase–decrease linkage system of urban-rural construction land mainly has the following features: (1) the increase or increase in rural collective construction land linked with the change of land use; (2) higher priority for the earthquake-hit areas in Chengdu; (3) the obligatory to demolish existing buildings and reclaim land in the original collective construction land; (4) the earthquake-hit rural households were eligible to take advantage of the housing, infrastructure, and public facilities reconstructed according to the rural housing reconstruction planning; and (5) the surplus quota for collective construction land was used for the development of earthquake-hit areas or large cities' peripheral areas.

Property rights re-registration and reconfirmation of rural land. A city-level liaison meeting system is developed to coordinate, manage, and supervise the property rights re-registration of city-wide rural reconstruction land and implement integrated property rights management of urban and rural land. Hence, it is necessary to develop a two-level (town-level and township-level) management system that provides administrative services for property right re-registration (e.g., definition of property rights, property right registration, policy announcement, and certificate handling), clarifies the land revenue relationship, and issues certificates for five rights (land ownership, use right of collective construction land, contracted management right of agricultural land, use right of forest land, and rural housing ownership). Official statistics showed that in 2009, Dujiangyan totally issued 2259 certificates on collective land ownership, 91,744 certificates on use rights of collective construction land, 74,995 certificates on use rights of forest land, and 54,192 certificates on rural housing ownership.

Contracted management rights re-registration and reconfirmation of agricultural land. Villages, villager groups, and rural households jointly assist the land management authorities to demarcate the farmland of each rural household. Subsequently, the results of farmland demarcation are signed and confirmed by rural households if they are bulletined without any objection. Finally, rural households are granted the certificate of contracted management rights if villages and villager groups file an application for registration and confirmation with the township/town-level land management authorities, and such an application is reviewed and approved by Dujiangyan's rural land management authorities. The above procedure is applicable to the area adjustment and contract extension regarding

farmland contracted management rights. It is of considerable significance for ascertaining the total amount of agricultural land, simplifying administrative management, and publishing market information on agricultural land circulation.

Use the right registration and confirmation of collection of construction land for rural housing reconstruction. Eligible investors and village or villager group collective organizations may apply for the construction land use right of jointly built housing, which is China's first property rights recognition system. Eligible real estate developers and village or villager group collective organizations may apply for the collective construction land use right of centrally rebuilt housing (including the collective construction land use right of centralized peasants' residential areas and new urban development areas).

Ownership registration and confirmation of peasants' reconstructed housing. The ownership of buildings in reconstruction areas should be registered and confirmed. Depending on the method of housing reconstruction, there are three types of ownership: ownership of scattered rural households' self-constructed housing; ownership of resettlement housing in centralized residential areas; and ownership of jointly constructed peasant housing. Jointly constructed peasant housing includes scattered rural households' jointly constructed housing and jointly reconstructed housing, with their ownership owned by rural households and the joint-construction party.

4.3.4. Classified Housing Reconstruction System

Table 2 describes the effectiveness of Dujiangyan's classified rural housing reconstruction policy. The first type is self-reliant housing reconstruction, including in situ reconstruction (e.g., in situ self-reconstruction and in situ joint reconstruction) and unified planning and self-construction. The second type is government-led unified planning and unified construction. As agreed, rural collective economic organizations transfer the surplus quota for collective construction land generated during centralized resettlement to governments, in return for which governments provide collective economic organizations with reconstructed housing and living environments. Governments are the main implementers of unified planning and unified construction. The third type is market-oriented unified planning and unified construction. With the consent of at least 66.7% of total rural households and in accordance with the bidding contract, rural collective economic organizations may transfer the surplus quota for collective construction land to real estate developers, in return for which disaster victims are provided with reconstructed housing and living environments.

4.3.5. Centralized Resettlement System

According to the principle of "three concentrations," Dujiangyan's overall planning of post-disaster reconstruction defines three types of centralized resettlement points: (1) new-type community of the key central village level or large rural resettlement point with at least 300 rural households; (2) new-type community of the central village level or medium rural resettlement point with 100 to 300 rural households; and (3) a resettlement point of the basic village level with less than 100 rural households. Table 3 describes their spatiotemporal distribution characteristics. Among them, the largest single centralized resettlement point has 1017 rural households, 1.6 times the average village size before the Wenchuan earthquake (635 households per village). Centralized resettlement enables governments to acquire the urban development rights to 4,860,000 m^2 of construction land and the ownership of such land. When earthquake victims are resettled in urban-type, centrally managed housing, they are registered as urban households and entitled to enjoy community management.

Table 2. Implementation effect of housing reconstruction in rural areas of Dujiangyan rural area.

			Reconstruction Funds						Living Environment			Housing Reconstruction Achievements				
Category	**Reconstruction Method**	**Implementing Subject**	**Own Funds**	**Subsidies**	**Pothook Project**	**Land Transfer**	**Loan**	**Contribution**	**Infrastructure Renovation**	**Public Facility Renovation**	**Management of Original Residential Land**	**Placement Point (Location)**	**Land Area (mu)**	**Floor Space (m^2)**	**Number of Resettlement Households**	**Number of Households Destroyed by Disaster (Including)**
Self-reliant	In situ reconstruction	Farmer	✔	✔			✔	✔			Reserve					1994
	Unified planning and self-construction	Farmers' Committee	✔	✔	✔	✔	✔	✔	✔	✔	Return to cultivation	85		850,400	7444	6262
Government-led	Unified planning and unified construction	Government		✔	✔			✔	✔	✔	Return to cultivation	48		3,043,000		16,009
Market-oriented	Unified planning and unified construction	Developer				✔			✔	✔	Land consolidation	31		1,340,000		6249
	Unified planning and self-construction	Farmers' Committee / enterprise	✔	✔	—	✔	✔	✔	✔	✔	Land consolidation	39	960.12	481,300	4233	3455
	Joint reconstruction	Investor				✔			✔	✔	Land consolidation	2	26	78,000	168	93
Monetizing	Resettlement	Farmer		✔							Land consolidation					395
Total												205	11,477.2	5,792,700	41,870.9	34,447

Table 3. Implementation effect of a centralized resettlement system for housing reconstruction in Dujiangyan rural area.

Resettlement Type	Reconstruction Method	Placement Point (Location)	Construction Area (mu)	Floor Space (mu)	Internal Ratio (%)		Overall Ratio (%)		Resettlement Households		Affected Person Ratio (%)	Scale of Centralized Resettlement		Per Capita Area (m^2)	
					Land Area	Floor Space	Construction Area	Floor Space	Transferred House-holds	Destroyed House-holds		Average Number of Reset-tlement House-holds	Placement Ratio (%)	Land Area	Floor Space
≥300	UPUC [1] (government-led)	24	4012	251	64	68	36	45	24,410	10,821	44	12,017	46.4	32	30
	UPUC (market-oriented)	12	1970	110	32	30	18	20	11,153	4641	42	797	21.2	35	29
	UPSC [2] (market-oriented)	1	70	5	1	1	1	1	350	426	122	350	0.7	39	42
	UPSC (government-led)	1	185	4	3	1	2	1	347	537	155	347	0.7	105	354
	sub-total	40	6237	370	100	100	56	66	36,260	16,425	45	907	68.9	34	30
100–300	UPUC (government-led)	20	1306	47	38	36	12	8	3796	3471	91	190	7.2	67	36
	UPUC (market-oriented)	6	473	19	14	14	4	3	1390	1143	82	232	2.6	67	40
	UPSC (market-oriented)	9	531	23	16	18	5	4	2183	1876	86	243	4.2	48	31
	UPSC (government-led)	22	1100	41	32	32	10	7	3491	2878	77	159	6.6	62	35
	sub-total	57	3409	130	100	100	30	23	10,860	9168	84	191	20.6	62	35
≤100	UPUC (government-led)	3	145	3	9	5	1	1	204	257	126	68	0.4	139	42
	UPUC (market-oriented)	11	149	6	10	9	1	1	516	465	90	47	1	57	32
	UPSC (market-oriented)	26	194	14	12	23	2	3	1151	967	84	44	2.2	33	36
	UPSC (government-led)	62	1074	40	69	64	10	7	3606	3237	90	58	6.9	58	32
	sub-total	102	1561	62	100	100	14	11	5477	4926	90	54	10.4	56	34
	Total	199	11,207	562			100	100	52,597	30,519	58	264	100	42	31

[1] UPUC = unified planning and unified construction; [2] UPSC = unified planning and self-construction.

5. Characteristics and Benefits of Dujiangyan's Rural Housing Reconstruction

5.1. Self-Reliant Housing Reconstruction

Rural households that selected self-reliant in situ reconstruction, unified planning, and self-construction collectively accounted for 17% (9438 households). In situ reconstruction was mainly implemented by rural households, was unplanned and completely self-reliant, and was not provided with public infrastructure but retained the use rights of the original housing land. Unified planning and self-construction were mainly implemented by village committees, which implied that public infrastructure would be built as planned and original housing land would be reclaimed as farmland. For unified planning and self-construction, the development scale was relatively small; the resettled rural households accounted for 14%, the covered land area accounted for 21%, the floor area accounted for 15%, and the average floor area was 114 m^2 per household. Here, the reconstruction of Anlong Town is taken as an example. Specifically, 13% (872 households) of its total rural households registered before the Wenchuan earthquake were resettled in seven reconstructed residential areas, and 40% of the 872 rural households selected government-led unified planning and self-construction, as typified by Hejia Village and Dongyi Village. Dujiangyan Urban and Rural Planning Institute provided planning and design services for the resettlement points, adopting the Linpan-style layout of Western Sichuan, in which courtyards, gardens, and lanes were interlaced, forming unique spatial characteristics (retaining the original scattered residence and forming a relatively centralized residence pattern).

5.2. Government-Led Housing Reconstruction

Numerous rural households (28,720 households, 54%) selected government-led unified planning and unified construction. For government-led unified planning and unified construction, the covered land area accounted for 48%, the floor area accounted for 53%, and the average floor area was 106 m^2 per household. Government-led unified planning and unified construction were mainly implemented by local governments and characterized by unified planning and construction based on government-led market attributes. Governments could recover the surplus quota for collective construction land generated by the centralized development of construction land, in return for which disaster victims were provided with reconstructed housing, infrastructure, and public facilities. Additionally, disaster victims' original housing land was reclaimed as farmland. Here, the housing reconstruction of Xiang'e Township is taken as an example. Government-led unified planning and unified construction were adopted with the consent of 94.5% of peasant voters. With the raised housing reconstruction fund of approximately 600 million yuan, 16 new rural communities were built to resettle 3425 rural households, saving nearly 4000 mu collective construction land. Furthermore, land preparation was performed to promote the development of modern ecological agriculture (e.g., kiwi fruit, green tea, shoot bamboo, and three types of medicinal herbs [Eucommia ulmoides, Magnolia officinalis Rehd et Wils, and Cortex Phellodendri Chinensis]) and form a large-scale distinctive agricultural base (approximately 10,000 mu), transforming the traditional modes of life and production into modern modes of life and production.

5.3. Market-Oriented Housing Reconstruction

Rural households that selected market-oriented unified planning and unified construction, unified planning and self-construction, or joint construction collectively accounted for 31%. These housing reconstruction models were mainly implemented by real estate developers or village committees. In market-oriented unified planning and self-construction or joint construction, rural collective organizations or households transferred their surplus quota for collective construction land to real estate developers and received reconstructed housing, infrastructure, and public facilities. For market-oriented unified planning and unified construction and unified planning and self-construction or joint construction, the resettled rural households accounted for 31% (17,460 households), the covered land area accounted for 31%, and the floor area accounted for 33% [24]. Moreover, housing recon-

struction was accompanied by land preparation. Here, Shiqiao Village in Qingchengshan Town is taken as an example. With the consent of at least 66.7% of the villagers of Shiqiao Village, market-oriented unified planning and unified construction were adopted, and the surplus quota for collective construction land was publicly transferred to decide on housing reconstructors. Real estate developers provided village committees with reconstructed housing (hereinafter referred to as "new communities") that was self-governed by rural households and rural collective economic organizations. Thus, all 11 villager groups and 910 rural households (2000 people) registered before the Wenchuan earthquake were resettled in one new community. After the original housing land was reclaimed as farmland and Linpan land was reclaimed as forest land, the surplus quota for collective construction land and forest land might be circulated in the market to raise funds for housing reconstruction. For example, the 110,000 m^2 collective construction land in Shiqiao Village was circulated and used to develop "Happy Farmhouse" rural tourism.

6. Discussion and Conclusions

The primary issue with rural housing reconstruction is that the property rights subject of rural land is unclear, and the disposal of rural land ownership is not governed by the land property rights system [25]. In other words, peasants do not truly own land, and their property rights in rural areas cannot be sufficiently guaranteed. In the post-disaster housing reconstruction process, implementing key land management systems such as the land planning system, land requisition system, land property rights system, and collective construction land system, as well as efficiently using, supervising, and planning rural land, is challenging. The goal of Dujiangyan's post-disaster rural reconstruction planning is to achieve population concentration and land circulation through expert technical support, villager participation, administrative guidance, and information disclosure. Currently, post-disaster housing reconstruction models continuously affect subsequent rural planning and development. The recent survey of rural planning in Chengdu (including Pidu District, Dujiangyan City, and Chongzhou City) shows that villagers universally preferred government-led unified planning and construction for resettlement housing construction, and they had increasing basic life needs. Owing to various reasons (e.g., significant differences in fiscal situation between local governments and implementation of the Linpan repair and preservation project—one of Chengdu's ten major projects for happy and good life), the housing reconstruction model varied across regions, and local governments considered how to address the relationship between rural housing construction and preservation of traditional residential modes. Nevertheless, local governments have universally implemented a certain scale of centralized resettlement so that the surplus quota for construction land can be freed up to facilitate further land consolidation and industrial development. According to follow-up surveys, the various housing reconstruction model options lead to cultural inappropriateness due to a lack of understanding of local needs by implementing agencies. It is reflected in the size and style of the house, the design of the interior and surrounding space of the house, the choice of building materials, and the infrastructure services, which are all obviously inconsistent, especially the typical regiment barracks layout in the resettlement area. This is consistent with earlier observations that cultural gaps and inappropriate questions have persisted for a long time. From early survey studies [26–29] to more recent observations [30–32], there are still widespread failures and obstacles in post-disaster housing reconstruction. To address this issue, it is necessary to allocate rights and responsibilities through institutional reform, exercise administrative power according to law, and use the surplus quota for housing land intensively to generate revenue for victims. For example, planning guidance can be provided to facilitate housing reconstruction planning and land use control, increase, and decrease linkage of urban-rural construction land and rural land circulation (market services), land use change permits for the surplus quota for housing land (land development guidance), and land property right re-registration (protection of housing rights and interests). This will help promote the

market circulation of urban-rural construction land and provide a new source of funding for rural reconstruction.

To sum up, post-Wenchuan earthquake reconstruction is different from conventional general planning and construction. It requires a complete and mature plan to be formed in a short period of time, which places high demands on the implementation of reconstruction. Before the Wenchuan earthquake, China's urban and rural planning systems were undergoing dramatic changes. Rather than posing a challenge, post-disaster rural housing reconstruction presents an opportunity for further reform. During the reconstruction process, the central and local governments also promulgated and implemented a series of related policies according to actual needs and properly handled the relationship between rural people and housing and between people and land. Today, in the upsurge of rural revitalization, a series of post-Wenchuan earthquake reconstruction measures have laid a solid foundation for rural development, and their internal logic and experience are worth studying and further summarizing.

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References

1. Lyons, M. Building back better: The large-scale impact of small-scale approaches to reconstruction. *World Dev.* **2009**, *37*, 385–398. [CrossRef]
2. Lang, H. Community housing in post disaster area on Nias islands, Indonesia: Responding to community needs. In Proceedings of the 4th International i-Rec Conference, Christchurch, New Zealand, 30 April–2 May 2008; University of Canterbury: Christchurch, New Zealand, 2008.
3. Wang, L.; Nagarajaiah, S.; Shi, W.; Zhou, Y. Seismic performance improvement of base-isolated structures using a semi-active tuned mass damper. *Eng. Struct.* **2022**, *271*, 114963. [CrossRef]
4. Comerio, M.C. *Disaster Hits Home: New Policy for Urban Housing Recovery*; University of California Press: Berkeley, CA, USA, 1998.
5. Barton, A.H.; Fogleman, C.W.; Drabek, T.E. Communities in disaster: A sociological analysis of collective stress situations. *Am. Sociol. Rev.* **1969**, *35*, 150.
6. Rubin, C.B. Recovery from disaster. In *Emergency Management: Principles and Practice for Local Government*; Drabek, T.E., Hoetmer, G.J., Eds.; International City Management Association: Washington, DC, USA, 1991; pp. 224–262.
7. Alesch, D.J. Complex urban systems and extreme events: Toward a theory of disaster recovery. In Proceedings of the 1st International Conference on Urban Disaster Reduction, Kobe, Japan, 18–22 January 2005.
8. Clinton, W.J. *Lessons Learned from Tsunami Recovery: Key Propositions for Building Back Better*; Office of the United Nations Secretary-General's Special Envoy for Tsunami Recovery: New York, NY, USA, 2006.
9. Kennedy, J.; Ashmore, J.; Babister, E.; Kelman, I. The meaning of "build back better": Evidence from post-tsunami Aceh and Sri Lanka. *J. Contingencies Crisis Manag.* **2008**, *16*, 24–36. [CrossRef]
10. Lloyd-Jones, T. Building back better: How action research and professional networking can make a difference to disaster reconstruction and risk reduction. In Proceedings of the RIBA Research Symposium, London, UK, 2007.
11. Chang, Y.; Wilkinson, S.; Potangaroa, R.; Seville, E. Resourcing challenges for post-disaster housing reconstruction: A comparative analysis. *Build. Res. Inf.* **2010**, *38*, 247–264. [CrossRef]
12. Pearce, L. Disaster management and community planning, and public participation: How to achieve sustainable hazard mitigation. *Nat. Hazards* **2003**, *28*, 211–228. [CrossRef]

13. Steinberg, F. Housing reconstruction and rehabilitation in Aceh and Nias, Indonesia—Rebuilding lives. *Habitat. Int.* **2007**, *31*, 150–166. [CrossRef]
14. Bilau, A.A.; Witt, E.; Lill, I. Analysis of measures for managing issues in post-disaster housing reconstruction. *Buildings* **2017**, *7*, 29. [CrossRef]
15. Safapour, E.; Kermanshachi, S.; Pamidimukkala, A. Post-disaster recovery in urban and rural communities: Challenges and strategies. *Int. J. Disaster Risk Reduc.* **2021**, *64*, 102535. [CrossRef]
16. Yi, H.; Yang, J. Research trends of post disaster reconstruction: The past and the future. *Habitat. Int.* **2014**, *42*, 21–29. [CrossRef]
17. Guo, Y. Urban resilience in post-disaster reconstruction: Towards a resilient development in Sichuan, China. *Int. J. Disaster Risk Sci.* **2012**, *3*, 45–55. [CrossRef]
18. Charles, S.H.; Chang-Richards, A.Y.; Yiu, T.W. A systematic review of factors affecting post-disaster reconstruction projects resilience. *Int. J. Disaster Resil. Built Environ.* **2022**, *13*, 113–132. [CrossRef]
19. Li, Q.; Umaier, K.; Koide, O. Research on post-Wenchuan earthquake recovery and reconstruction implementation: A case study of housing reconstruction of Dujiangyan city. *Prog. Disaster Sci.* **2019**, *4*, 100041. [CrossRef]
20. Cheng, L.G.; Zhang, Y.; Liu, Z.B. Does rural land rights confirmation promote rural land circulation in China? *Manag. World* **2016**, *1*, 88–98.
21. Kabilijiang, W.; Shi, Y. *Project Management for Post-Disaster Urban Infrastructure Reconstruction after the Wenchuan Earthquake*; Sichuan University Press: Chengdu, China, 2015; pp. 105–107.
22. Zhu, L. Study of the Increase and Decrease Linkage Policy of Urban-Rural Construction Land. Ph.D. Dissertation, Southwest University, Chongqing, China, 2010.
23. Li, G.Y.; Wang, M.; Wu, J.Z. Preliminary study of the Chengdu pattern of urban-rural coordinated development. *Chin. J. Syst. Sci.* **2010**, *18*, 67–71.
24. Luo, D.L. Legal Choice in Housing Construction after the Wenchuan Earthquake. Ph.D. Dissertation, Southwestern University of Finance and Economics, Chengdu, China, 2009.
25. Liu, Y.Q.; Su, C.G.; Long, H.L.; Hou, X.G. Innovation in China's rural land management system in the context of urban-rural integration. *Econ. Geogr.* **2013**, *33*, 138–144.
26. Davis, I. *Shelter after Disaster*; Oxford Polytechnic: Oxford, UK, 1978.
27. Skinner, R. Peru: Low-income housing. In *Mimar 38: Architecture in Development*; Concept Media Ltd.: London, UK, 1992; pp. 52–55.
28. Delaney, P.; Shrader, E. *Gender and Post-Disaster Reconstruction: The Case of Hurricane Mitch in Honduras and Nicaragua*; World Bank: Washington, DC, USA, 2000.
29. Boen, T.; Jigyasu, R. Cultural considerations for post disaster reconstruction post-tsunami challenges. *UNDP Conf.* **2005**, 1–10.
30. Gharaati, M.; Davidson, C. Who knows best? An overview of reconstruction after the earthquake in Bam, Iran. In Proceedings of the 4th International i-Rec Conference, Christchurch, New Zealand, 30 April–2 May 2008.
31. Pamidimukkala, A.; Kermanshachi, S.; Safapour, E. Challenges in post-disaster housing reconstruction: Analysis of Urban vs. Rural communities. In Proceedings of the Creative Construction e Conference, Opatija, Croatia, 28 June–1 July 2020.
32. Wang, L.; Nagarajaiah, S.; Zhou, Y.; Shi, W. Experimental study on adaptive-passive tuned mass damper with variable stiffness for vertical human-induced vibration control. *Eng. Struct.* **2023**, *280*, 115714. [CrossRef]