DECISION MODEL FOR DEVELOPING CONCENTRATED RURAL SETTLEMENT IN POST-DISASTER RECONSTRUCTION: A STUDY IN CHINA

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Decision Model for Developing Concentrated Rural Settlement in Post-disaster Reconstruction: A Study in China

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A thesis submitted to in partial fulfilment of the requirements for the Degree of Doctor of Philosophy

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CERTIFICATE OF ORIGINALITY

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Signature: _____

Name of student: PENG Yi

Dedication

To my wife, Cong Tan, who gives me the warm love and always supports my pursuit of dreams

To my little cute daughter, Lukming, who came into the world at the final stage of the study

To my Parents and younger Brother

ABSTRACT

It has been estimated that between 1900 and 2011 the total deaths worldwide from natural disaster was 32 million, the total number made homeless was 167 million and the total cost of the damage was nearly 2.36 trillion US dollars. Natural disasters cause greater devastation in rural areas than those to urban areas. The approach to reconstructing rural settlement after a natural disaster influences how quickly normal life can be restored and to what extent the reconstruction will be sustainable. Common approaches for rural settlement reconstruction include resettlement and reconstruction in-situ, each of which has advantages and disadvantages. In line with these developments, there is an increasingly strong appeal for sustainable development based post-disaster reconstruction. Concentrated rural settlement (CRS) is considered an effective means to achieve sustainable post-disaster construction by providing sufficient infrastructure and public services, more employment opportunities, and improved environmental quality. However, there has been little research into the development of CRS within a particular village after a natural disaster. Meanwhile, the existing decision system of CRS development under normal means (without disasters) and rural housing reconstruction could not be directly applied in developing CRS in post-disaster reconstruction in China due to inherent problems. Therefore, there is a need to know how to develop CRS in post-disaster reconstruction in China.

The study aims to discover how to develop CRS in post-disaster reconstruction in China. In line with this overall aim, four specific objectives were undertaken with references to CRS development after the 5.12 Sichuan Earthquake in 2008 in China, which include investigating

the opportunity to develop CRS, identifying the critical determinant factors (CDFs) for implementing CRS, establishing a decision model for implementing CRS in post-disaster reconstruction, and validating the developed model.

This study has both theoretical and practical significances. In theory, it provides developing CRS within a village as an optional way of rural settlement reconstruction besides reconstruction in-situ and resettlement, which is considered to be more sustainable and resilient. In practice, it helps understand why developing CRS is different under normal conditions and that under disaster conditions in China. Also, it contributes to the understanding of critical determinant factors for implementing CRS in post-disaster reconstruction when making decisions in China. Moreover, it provides Chinese village-level government with knowledge for delivering CRS in post-disaster reconstruction through the established decision model. Although this study focused on post-quake reconstruction in China, the identified CDFs and decision model provides a useful reference for reconstruction after other types of natural disasters and in other regions of the world.

PUBLICATIONS

1. Refereed Journal Papers----Arising From the Thesis

Peng, Y., Shen, L. Y., Tan, C., Tan, D. L. and Wang, H. (2013). Critical determinant factors (CDFs) for developing concentrated rural settlement in post disaster reconstruction: A China study. ***Natural Hazards***, 66(2), 355-373.

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2. Refereed Journal Papers----Others

Lu, W. S., **Peng, Y***., Shen, Q. P. and Li, H. (2013). A generic model for measuring benefits of BIM as a learning tool in construction works. ***Journal of Construction Engineering and Management, ASCE***, 139(2), 195-203.

Shen, L. Y., Ochoa, J. J., Zhang, X. L. and **Peng, Y**. (2013). Experience mining for decision making on implementing sustainable urbanization. ***Automation in Construction***, 29, 40-49.

Zhang, X. L., Skitmore, M. and **Peng, Y.** (2013). Critical assessment factors for measuring constraints of industrialized building in China. ***Habitat International***, Accepted.

Lai, Y. N., **Peng, Y***., Li, B. and Lin, Y. L. (2013). Industrial land development in urban villages in China: A property rights perspective. ***Habitat International***, Accepted.

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Wang, H., Shen, Q.P., Tang, B.S., Lu, C., **Peng, Y**. and Tang, LYN. (2013). A framework of decision-making factors and supporting information for facilitating sustainable site planning in urban renewal projects. ***Habitat International***, Under Review.

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Peng, Y., Shen, L. Y., Zhang, X. L. and Ochoa, J. J. (2011). Investigation on why the practice of rural residence land exchange is different under development driven condition and disaster induced condition. *Third International Postgraduate Conference on Infrastructure and Environment*, 11-12 July 2011, Hong Kong, China.

4. Book Chapters

Peng, Y. (eds.) (2012). *Exploring construction industrialization in China: the status quo and the challenges*. International Council for Research and Innovation in Building and Construction, ISBN: 978-90-6363-071-3.

Lu, W. S. and **Peng, Y**. (2010). Construction market in China, in Shen, L. Y., Leung, B. Y. P. and Hao, J. J. L. (eds.). *Construction and real estate practice in China*, The Hong Kong Polytechnic University, Hong Kong.

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1 INTRODUCTION

Rural housing reconstruction is an important issue after the occurrence of natural disasters, especially in developing countries. The traditional approach of reconstructing rural housing in-situ and resettlement is not sustainable. Although developing concentrated rural settlement (CRS) within a village is more sustainable and resilient than traditional reconstruction approaches, few studies and practices for developing CRS have been reported. This thesis reports research conducted with the aim of helping village-level government in China understand the process of developing CRS in post-disaster reconstruction, with particular reference to the earthquake that devastated China's Sichuan Province on May 12, 2008 (hereinafter referred to as the 5.12 Sichuan Earthquake). The first chapter presents the research background, specifies the scope of the research, settles the major aim and objectives, describes the corresponding methodologies, and, finally, outlines the structure of the thesis.

1.1 Background of the Research

1.1.1 Impacts of natural disasters

Definition of natural disasters

Disaster is a vague term without a universally accepted definition (Turner and Pedgeon, 1997). A widely cited definition of disaster was given by Fritz (1961: 655) as "an event, concentrated in time and space, in which a society or a relatively self-sufficient subdivision of a society undergoes severe damage and incurs such losses to its members and physical appurtenances that the social structure is disrupted, and the fulfillment of all or some of the essential functions of society prevented". Other definitions are more dependent on the professional background of

those providing it (e.g., Kinston and Rossser, 1974; Kreps, 1984; Quarantelli, 1988; Parker, 1992; Richardson, 1994). However, although such definitions tend to stress a particular area of concern, the causes and consequences are usually the same.

The causes of disasters can be classified as either man-made or natural (Turner and Pedgeon, 1997). Man-made disasters are induced by the breakdown of regular processes within the social system, e.g., large industrial accidents, transport accidents, nuclear accidents, episodes of mass violence, and technological failures (Parker, 1992; Albala-Bertrand, 1993; McFarlane and Norris, 2006; Norris et al., 2008).

A natural disaster is "a time-and place-specific event that originates in the natural environment and the resulting disruption of the usual functions and behaviors of the exposed human population" (Combs et al., 1999: 1125). It includes assorted events such as meteorite, earthquake, volcanic eruption, red tides and forest fires. Although natural disasters may be natural in origin, it is the way in which societies have developed that causes them to become disasters, especially in a world where people interact with nature frequently and profoundly (Brien et al., 2006). It is sometimes hard to discriminate explicitly between man-made disasters and natural disasters. Figure 1.1 provides an overview of the relative level of natural and man-made disasters from the aspect of human acceptance and disaster impact. Disasters with a high level of natural causation are more involuntary in terms of human acceptance and more intense in terms of disaster impact (Smith and Petley, 2009).

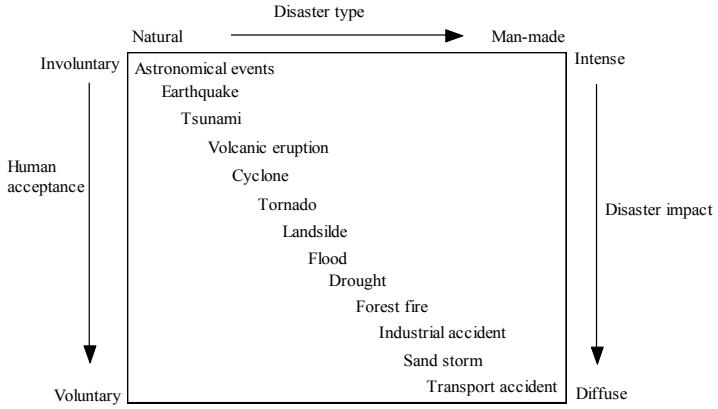


Figure 1.1 A spectrum of natural and man-made disasters

Source: Smith and Petley (2009)

Types of natural disasters

Natural disasters can induce massive damage and losses beyond the control of individuals, and therefore has been of great concern throughout history (Taylor, 1999). They can be divided into sudden disasters, like earthquake, hurricane, and flood, and slowly developing disasters, like drought, epidemic, and desertification. The major difference between these two kinds of disasters is the duration of the impact and the severity of the direct effects. A sudden disaster typically has a short impact duration and immediately evident direct effects but limited indirect effects. On the other hand, a slowly developing disaster has longer impact duration and typically fewer obvious immediate direct effects, which involves a long-standing aggregation of direct and indirect effects until a threshold is suddenly reached such as with famine and mass epidemic. Prevailing social conditions and endogenous processes play a much greater role in slowly developing rather than sudden disasters, but the evidence of socio-political and economic inequalities appears much faster immediately after the impact of sudden disasters (Albala-Bertrand, 1993). An overview of natural disasters is provided in Table 1.1 immediately below.

Table 1.1 Summary of the duration and frequency of natural disasters

Type of natural disasters	Frequency	Duration of impact
Lightning	random	instant
Avalanche	Seasonal/diurnal; random	Seconds
Earthquake	Log-normal	Seconds-minutes
Landslide	Seasonal-irregular	Second-decades
Tornado	Seasonal, negative binomial	Seconds-minutes
Hail	Seasonal/diurnal; poisson, gamma, negative binomial	Minutes
Tsunami	Random	Minutes-hours
Subsidence	Sudden or progressive	Minutes-decades
Frost or ice-storm	Seasonal/diurnal; markovian, binomial	Hours
Hurricane	Seasonal/irregular	Seconds-hours
Snowstorm	Seasonal; modified Poisson	Hours
Environmental fire	Seasonal; random	Hours-days
Volcano eruption	Irregular	Hours-years
Insect infestation	Seasonal; random	Hours-days
Flood	Seasonal	Minutes-days
Draught	Seasonal	Days-months

Source: Alexander (1993)

Natural disasters can also be classified according to the type of natural force that generates them, such as forest fires, earthquake, and volcanoes (Albala-Bertrand, 1993). However, there are no clear and universal standards for the classification, which leads to difficulty in interpreting different disaster data compilation initiatives (Below et al., 2009). Therefore, the two most influential international disaster databases, namely NatCatSERVICE and EM-DAT took action to unify the natural disaster category classification and definition of common standards (Below et al., 2009). Table 1.2 summarizes the common natural disaster classification reached by NatCatSERVICE and EM-DAT. There are four levels in the classification system, with first level as group, second as main-type, third as sub-type, and fourth as sub-sub type. At the first level, natural disaster is classified into six groups, namely, geophysical, meteorological, hydrological, climatological, biological and extra-terrestrial. The corresponding main-type, sub-

type, and sub-sub type under each group explains more details about the attributes of the mentioned natural disasters.

Table 1.2 Classification of natural disasters

Natural disaster group	Natural disaster main-type	Natural disaster sub-type	Natural disaster sub-sub type
Geophysical	earthquake	Ground shaking	
		Tsunami	
	volcano	Volcanic eruption	
	Mass movement (dry)	Rockfall	
		Avalanche	Snow avalanche
			Debris avalanche
		Landslide	Mudslide, lahar, debris flow
		Subsidence	Sudden subsidence
			Long-lasting subsidence
Meteorological	Storm	Tropical storm	
		Extra-tropical cyclone (Winter storm)	
		Local/Convective storm	Thunderstorm/Lightning
			Snowstorm/Blizzard
			Sandstorm/Duststorm
			Generic (severe) storm
			Tornado
			Orographic storm(strong winds)
Hydrological	Flood	General (river) flood	
		Flash flood	
		Storm surge/coastal flood	
	Mass movement (wet)	Rockfall	
		Avalanche	Snow avalanche
			Debris avalanche
		Landslide	Mudslide, lahar, debris flow
		Subsidence	Sudden subsidence
			Long-lasting subsidence
Climatological	Extreme temperature	Heat wave	
		Cold wave	Frost
		Extreme winter conditions	Snow pressure
			Icing
			Freezing rain
			Debris avalanche
	Drought	Drought	
	Wild fire	Forest fire	
		Land fires (grass, scrub, bush, etc. …)	
Biological	Epidemic	Viral infectious diseases	
		Bacterial infectious diseases	
		Parasitic infectious diseases	

		Fungal infectious diseases	
		Prion infectious diseases	
		Grasshopper/Locust/Worms	
	Animal stampede		
Extra-terrestrial	Meteorit/Asteorit		

Source: Below et al.(2009)

Losses brought about by natural disasters worldwide

By referring to the operational classification discussed in the above section, it is possible to analyze the natural disasters in history and the trends in future. Figure 1.2 shows that the number of natural disasters has been increasing in recent years, although it has decreased a little compared to the peak in 2001. Figure 1.3 shows the trend of extreme temperature, drought, flood, storm, mass earth movement, fire, earthquake, volcano and infectious disease. It is clear that the number of floods, storms and earthquakes has increased dramatically in recent years.

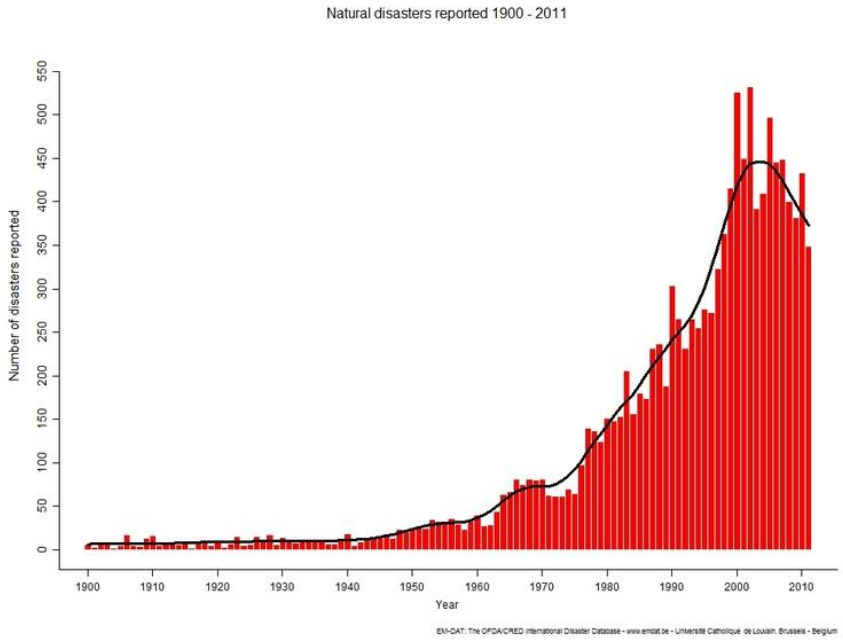


Figure 1.2 The number of natural disasters worldwide from 1900 to 2011

Source: EM-DAT (2013)

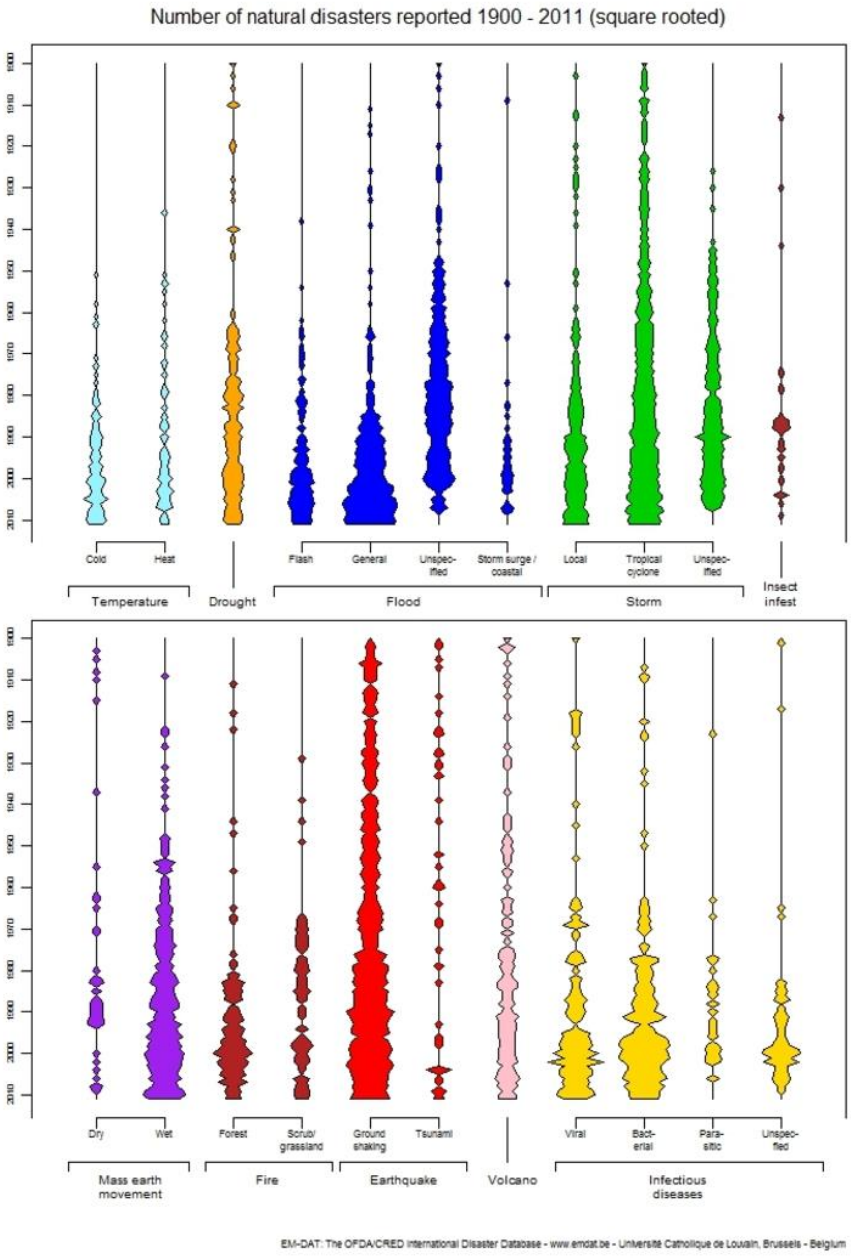


Figure 1.3 The number of natural disasters in the square rooted form from 1900 to 2011

Source: EM-DAT (2013)

Figure 1.4 shows the number of deaths caused by natural disasters from 1900 to 2011. As a result of better disaster management measures and medical services, the number of people

reported killed shows a decreasing trend and has been much less in recent years.

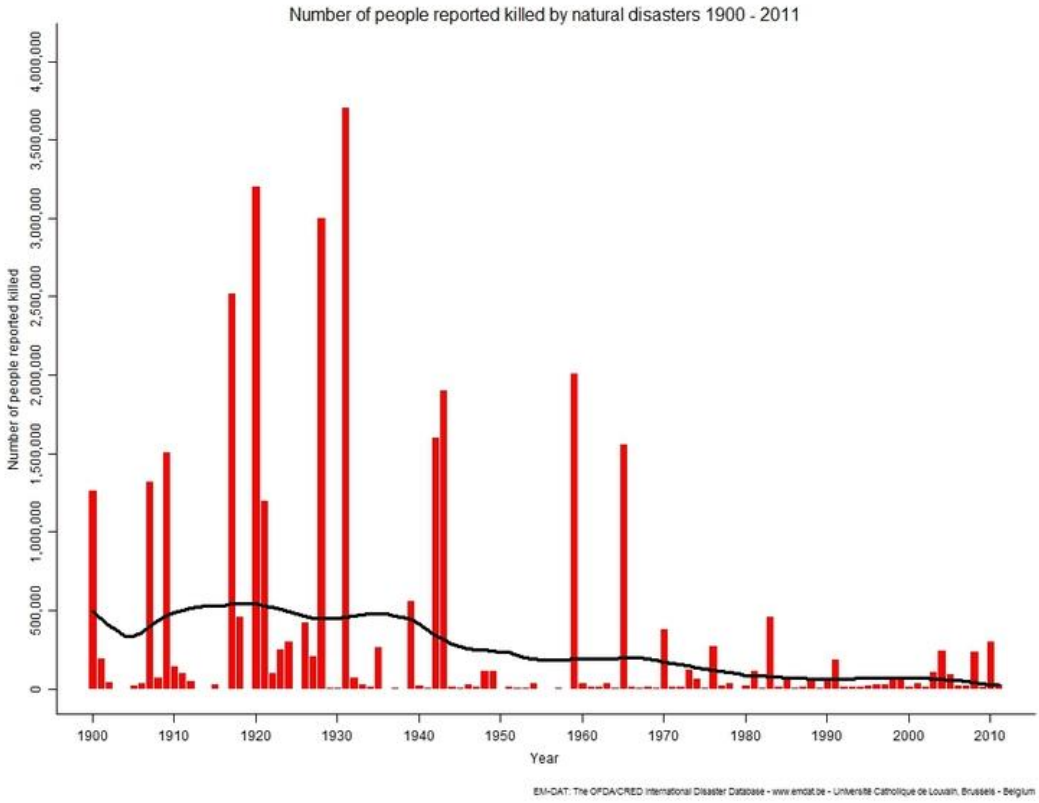


Figure 1.4 The number of deaths caused by natural disasters from 1900 to 2011

Source: EM-DAT (2013)

Figure 1.5 shows the estimated damage caused by natural disasters wordwide from 1900 to 2011. The total loss of nearly 2.36 trillion US dollars, which translates to about 58 million US dollars per day, has been caused by natural disasters from 1900 to 2011. It also shows that the highest damage caused was by the Honshu Tsunami in Japan in 2011, the second by Hurricane Katrina in the USA in 2005, the third by the Kobe earthquake in Japan in 1995, and the fourth by the 5.12 Sichuan Earthquake in China in 2008.

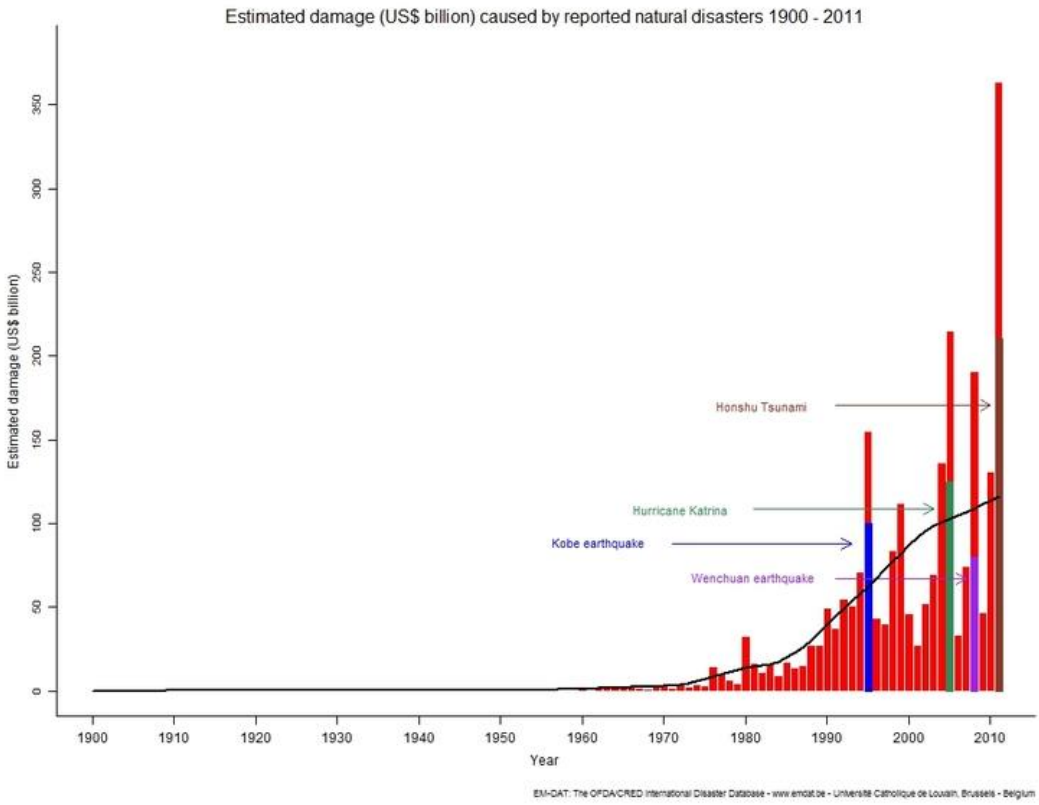


Figure 1.5 The estimated damage caused by natural disasters from 1900 to 2011

Source: EM-DAT (2013)

Table 1.3 lists the number of deaths, the number of homelessness, and the amount of damage caused by natural disasters from 1900 to 2011. In terms of fatalities, drought caused the greatest number of deaths, epidemic caused the second greatest number, while flood caused the third. For those rendered homeless as a result of natural disasters, flood was responsible for the most, while storm was second and earthquake third. From the aspect of damage, storm induced the most amount of damage, while earthquake induced the second most and flood the third. By comparison with the other types of natural disasters, earthquake is notorious for causing damage and homelessness.

Table 1.3 The statistics of classified natural disasters from 1900 to 2011

Type of natural disasters	Number of deaths	Percentage (%)	Number of homelessness	Percentage (%)	Damage (,000 USD dollars)	Percentage (%)
Drought	11,708,271	36.04	20,000	0.01	98,147,906	4.16
Earthquake (seismic activity)	2,563,226	7.89	22,539,420	13.45	735,935,084	31.20
Epidemic	9,574,254	29.47	0	0.00	7	0.00
Extreme temperature	169,211	0.52	250,340	0.15	57,374,542	2.43
Flood	6,929,305	21.33	88,121,314	52.57	559,237,000	23.71
Insect infestation	0	0.00	0	0.00	230,125	0.01
Mass movement dry	4,935	0.02	5,981	0.00	203,600	0.01
Mass movement wet	59,154	0.18	4,219,554	2.52	8,449,998	0.36
Storm	1,380,151	4.25	51,920,916	30.97	844,179,677	35.78
Volcano	96,312	0.30	375,790	0.22	3,040,348	0.13
Wildfire	3,622	0.01	177,134	0.11	52,307,055	2.22
Total	32,488,441	100.00	167,630,449	100.00	2,359,105,342	100.00

Source: EM-DAT (2013)

Developing countries are more vulnerable to the consequences of natural disasters (Spence 2004). According to the report by United Nations International Strategy for Disaster Reduction (UNISDR 2004), the losses caused by natural disasters such as earthquake in developing countries are 20 times greater (as a percentage of GDP) than those in developed countries. The time needed for recovery in developing countries is much longer than that in developed countries (Ofori 2004). From the aspect of different continents, Figure 1.6 depicts the average annual damage caused by natural disasters in Africa, Americas, Asia, Europe, and Oceania from 1990 to 2011. It is found that Asia bears the highest average annual damages caused by natural disasters. The damages caused by earthquake account for the largest part of the whole damages, while those by flood are second and those by storm third. From the database of EM-DAT (2013),

it is known that China has the largest number of natural disasters, the largest number of deaths, the largest number of homelessness, and the second largest of damages brought about by natural disasters in Asia. The next section briefly introduces the losses brought about by natural disasters in China.

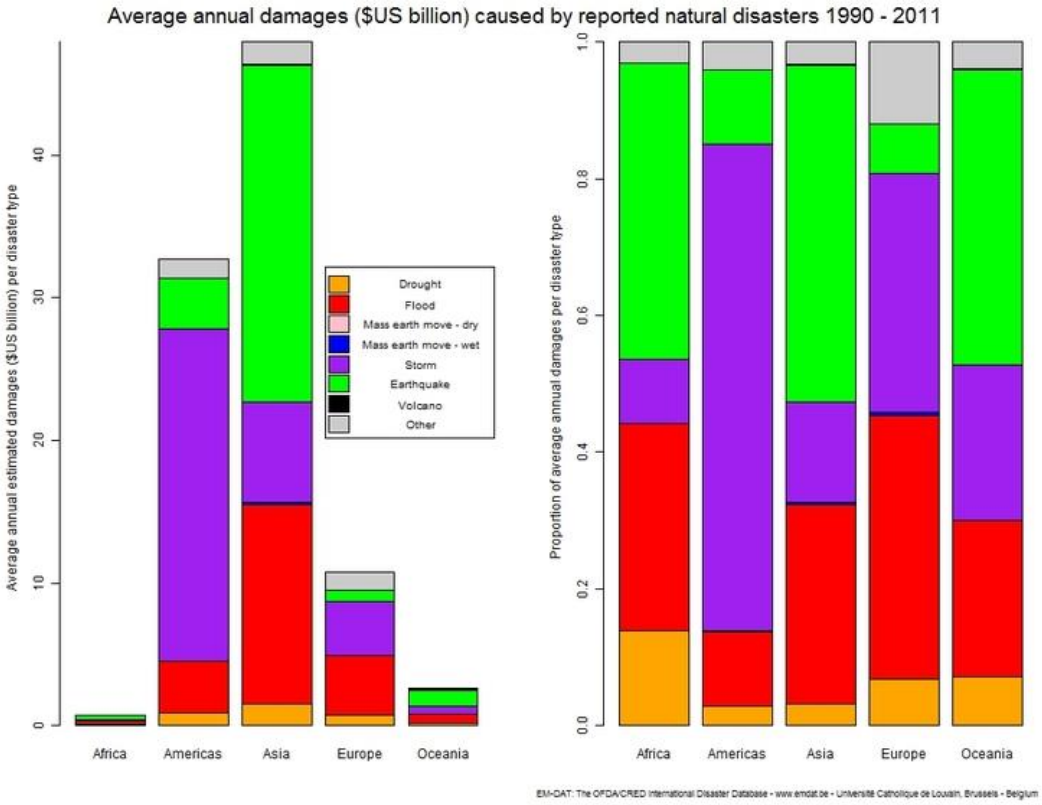


Figure 1.6 Average annual damage caused by natural disasters from 1900 to 2011

Source: EM-DAT (2013)

Losses brought about by natural disasters in China

China is a country with a highly frequency of natural disasters. According to the database of EM-DAT (2013), from 1900 to 2011, there were 681 natural disasters, which resulted in about 12 million deaths, 63 million homelessness, and damages costing nearly 363.43 billion US

dollars. Table 1.4 shows the losses brought about by classified natural disasters in China: storm is the most frequent, and flood causes the largest number of deaths, homelessness and damages. What is more, losses caused by natural disasters have been on the rise in recent years.

Table 1.4 Losses brought about by natural disasters in China from 1900 to 2011

	Number of occurrence	Number of death	Number of homelessness	Damage (,000 USD dollars)
Drought	33	3,503,534	0	26,080,420
Earthquake (seismic activity)	130	875,334	4,507,827	95,059,707
Epidemic	10	1,561,498	0	0
Extreme temperature	11	339	233,000	21,410,000
Flood	211	6,597,809	43,352,129	169,953,463
Insect infestation	1	0	0	0
Mass movement dry	6	454	340	0
Mass movement wet	57	5,252	26,304	1,850,400
Storm	216	173,607	14,904,332	48,965,445
Volcano	0	0	0	0
Wildfire	6	265	300	110,000
Total	681	12,718,092	63,024,232	363,429,435

Source: EM-DAT (2013)

Figure 1.7 shows the distribution of central places for major natural disasters in China. Earthquake is one of the most serious natural disasters in China, which has had 1/3 of the devastating earthquakes worldwide even though the land area of China occupies only 1/4 of the world (Zhang, 2010). China recorded an earthquake of magnitude 6.0 or higher 26 times, including earthquake of magnitude 7.0 or higher 7 times (Na and He, 2011). Moreover, it is found that more than 80% of the earthquakes above magnitude 5.0 occurred in rural areas and brought huge losses (Jin, 2008). In addition, the statistics show that housing damage explains about 70%~80% of the economic losses (Cheng et al., 2010).

For example, the 5.12 Sichuan Earthquake, measured at 8.0 on the Richter scale, struck the western China on May 12, 2008 (Dunford and Li, 2011). The destructive earthquake affected 14,565 villages, 417 counties in 10 provinces, which led to 69,226 deaths, 17,923 people missing, and 374,643 people injured. Moreover, 7,789,100 houses collapsed, and 24,590,000 houses were damaged. In addition, 328,667 hectares of crops, 112,533 hectares of farmland, 76,000 greenhouses, and 524,000 biogas digesters were damaged. In sum, the direct economic losses were estimated at 41.896 billion RMB with more indirect losses (State Council, 2008; Wu et al., 2012; He and Zhou, 2013).

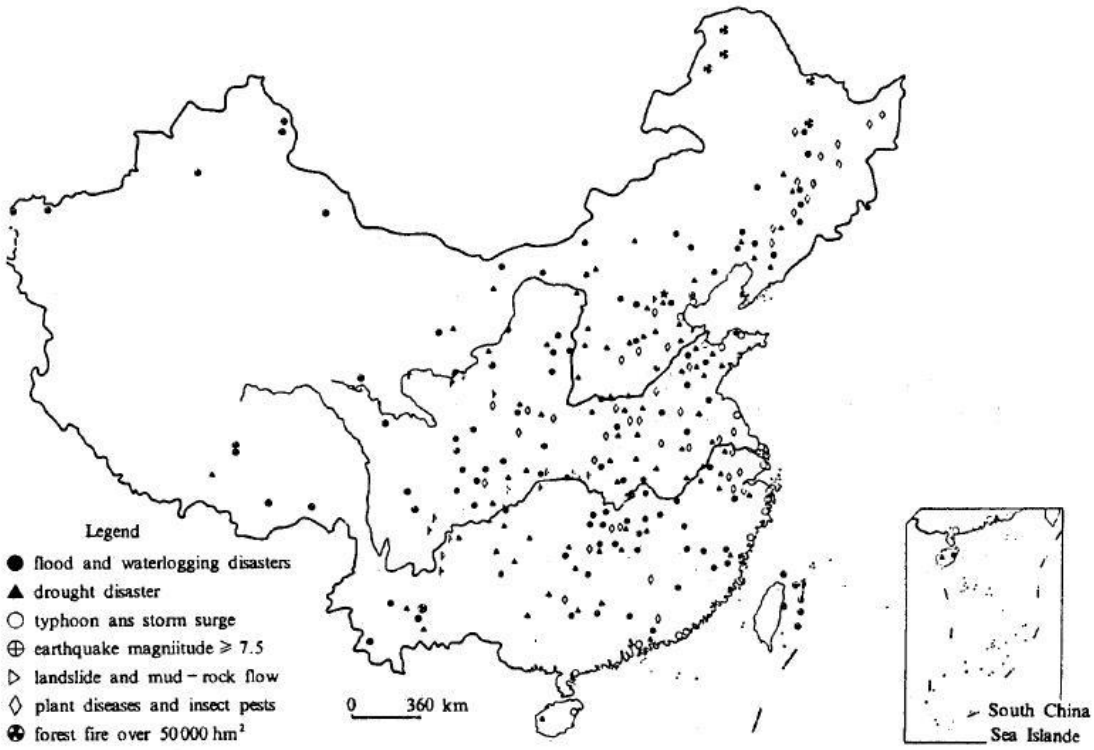


Figure 1.7 Distribution of central places for major natural disasters in China

Source: Zhang et al. (1995)

Natural disasters bring about large number of deaths, make countless others homeless, and

cause a huge amount of damage in both rural and urban areas. It is difficult to compare the losses between rural areas and urban areas caused by natural disasters as there is no international database of disaster losses that disaggregates data by urban and rural area (Pelling, 2007). However, it is considered that the rural areas face more disadvantages than the urban areas due to insufficient infrastructure, lack of information about natural disasters, and social inequality. For example, as shown in Table 1.5, housing damage brought about by the 5.12 Sichuan Earthquake in rural areas was much higher than in urban areas of Sichuan Province. As well, it is found that the housing damage is the main loss for the farmers especially in developing countries, such as China (Cheng et al., 2010). As a result, recent research on post-disaster reconstruction has focused on housing reconstruction in rural areas of developing countries.

Table 1.5 The statistics on collapsed houses caused by the 5.12 Sichuan Earthquake

Affected region	Urban areas		Rural areas	
	Number of households	Areas of damaged houses (hectares)	Number of households	Areas of damaged houses (hectares)
Chengdu	8,100	54	100,900	1,514
Dujiangyan	4,800	38	37,300	560
Deyang	176,100	1,233	208,500	3,128
Mianyang	141,000	1,128	298,000	4,470
Beichuan	16,600	131	29,300	440
Guangyan	23,700	327	141,700	2,126
Ya'an	4,200	14	11,000	165

Source: Liu (2009)

1.1.2 Approaches to post-disaster reconstruction for rural settlement

A summary of post-disaster reconstruction practices as depicted in Figure 1.8 reveals that rural settlement reconstruction can have the following three modes: resettlement, reconstruction in-situ, and concentration within a village.

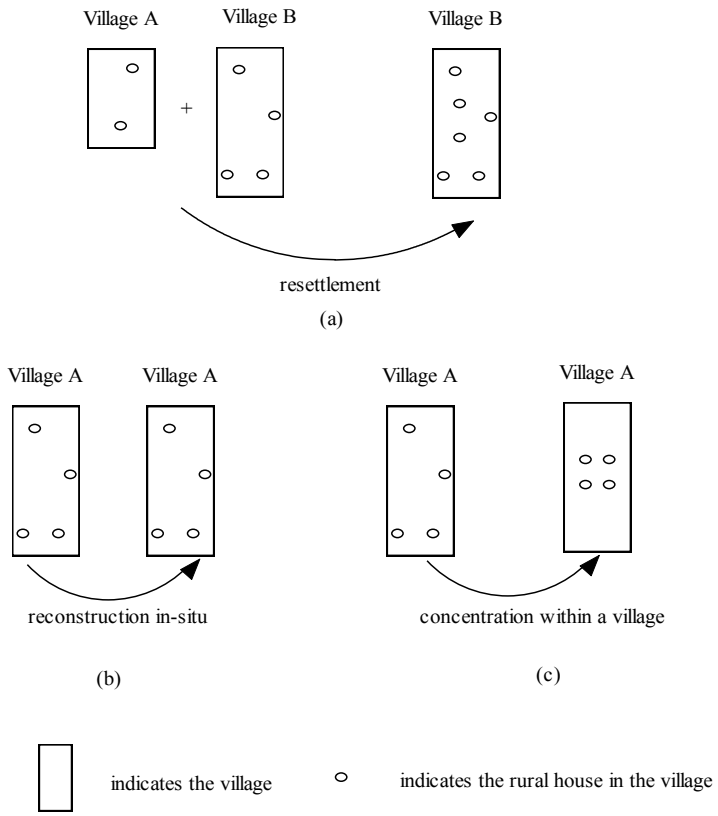


Figure 1.8 Approaches to rural settlement reconstruction

Resettlement, also known as regrouping between villages, refers to building new houses in a new site with giving good attention to safety considerations. It is considered to improve the livelihood of those affected by providing better access to employment opportunities and public services. Consequently, planned and forced resettlement has been promoted for post-disaster reconstruction in developing countries in recent years (Badri et al., 2006). However, experience shows that resettlement can undermine livelihoods, disrupt social networks, and result certain social tensions between displaced and host people (Birkmann et al., 2008; Bang and Few, 2012). Eleven years after the 1990 Manjil earthquake in Iran, the relocated families found themselves confronted by serious socio-economic challenges especially respecting work, income, women's empowerment and lifestyle issues (Badri et al., 2006). Although this approach can reduce the

average cost of providing infrastructure and public services in rural areas, it may erode social and economic sustainability.

Reconstruction in-situ is an approach to replace the damaged houses with new ones in pre-disaster location. It is quite common, especially when post-disaster reconstruction aims to return families to their former way of life rapidly. Compared to resettlement, reconstruction in-situ can access predefined resources, requires fewer mobilizations, and does not cause social tensions (Badri et al., 2006). However, the original location has been shown to be unsafe and may therefore be prone to future disasters, and the socio-economic condition would remain unchanged. So although the in-situ approach is useful for rapid recovery, it does not provide new infrastructure and public services to reduce inequalities between urban and rural communities and is therefore socially unsustainable.

Except for the two common approaches mentioned above, concentration within a village is another optional approach to reconstruct rural settlement. Concentration within a village means to concentrate rural victims in several specific locations within a village. Experience from urban areas demonstrates that the concentration approach have both advantages and disadvantages in light of vulnerability to disasters. On the one hand, concentration contributes to vulnerability through various factors such as an increased concentration of energy or energy transportation routes, the likelihood of disease transmission, possible synergy between hazards, and limited escape routes (Hewitt 1997; Bull-Kamanga et al. 2003; Alarslan 2008). On the other hand, concentration with good management measures brings diversity, market efficiency, jobs, quality public services, improved infrastructure, and health improvement, which can help the individual

and society prevent or reduce the negative impacts of disasters and enhance recovery from disasters (Glaeser, 1998; Allenby and Fink 2005; Dye, 2008).

This research argues that developing concentrated rural settlement (CRS) within a village increases the resilience of rural villages and provides a basis for sustainable development after a disaster. Compared to concentrated urban areas, dispersed rural areas face serious threats attributable to various factors such as lack of sufficient infrastructure, lack of information about disasters, lack of social capital, socio-economic inequality, and poverty (Donner and Rodriguez 2008; Boano and García, 2011; Aldrich, 2012; Kage, 2013; Milallos, 2013). Developing CRS allows sufficient infrastructure, better public services, poverty alleviation and building social capital (Turnock 1991; Rural Issues Work Group 2002; Mulwaree Shire Council 2003; SEAP 2011). These benefits help rural areas to confront their vulnerability while concentrated settlement patterns serve as growth-engines and stabilizers of urbanization and economic growth through linking rural and urban areas, which provides a basis for sustainable post-disaster development (Qadeer 2004; Alaci 2010).

Compared to resettlement, which also is favor of concentration, CRS within a village would not bring social tensions and disrupt social networks, while compared to reconstruction in-situ, CRS within a village would still own the former resources and taking advantage of opportunities to improve infrastructure and public services. If properly managed, the CRS approach would receive support from rural victims. For example, Tianma Town of Dujiangyan, an area affected seriously by the 5.12 Sichuan Earthquake, adopted a rural residential land exchange to develop CRS, which was accepted by 55% of the rural victims. The practice of Dujiangyan was widely

considered to be a post-disaster reconstruction success (Deng, 2010).

1.1.3 The importance of sustainable post-disaster reconstruction

Post-disaster reconstruction is indispensable for restoring disaster-hit areas. It not only restores the physical stock such as infrastructure and houses, but also has an effect on long term development. Traditionally, post-disaster reconstruction aims to solve the immediate problem of accommodation for the victims of the disaster. Experience suggests that during the confused and chaotic aftermath of a natural disaster, poor decisions are often hurriedly made and disaster resistant materials and construction expertise are scarce. As a result, home owners put back what they can to house themselves and most often a temporary solution turns into a long term one (Jigyasu, 2002; Wu and Lindell, 2004; WBOED, 2005). Also, short-term oriented organizations involved in post-disaster reconstruction are often hard to consider longer term issues such as participation and sustainability (Koria, 2009). Hence, policies and guidelines for dealing with long-term issues are vital.

Policies formulated for post-disaster development have vital short and long term effects on disaster-hit areas (Afolayan, 1987). On the one hand, if appropriately planned, reconstruction offers opportunities to adopt new development modes. On the other hand, substantial development initiatives in post-disaster reconstruction can be ruined if improperly managed (Badri et al., 2006). Therefore, besides physical reconstruction, social reconstruction should also gain enough attention (Ashtiany and Hosseini, 2008). Post-disaster reconstruction should not be divorced from ethics, culture or the broader social and environmental systems that sustains the society (Etkin and Stefanovic, 2005). Nevertheless, the rebuilding of ecological, cultural and

social aspects must be conforming to the consideration of performances (Chang et al., 2006), which is echoed by sustainable development principles.

With reference to the three approaches to rural settlement reconstruction, resettlement and reconstruction in-situ have some difficulties to achieve sustainable development while concentration within a village integrates the advantages of the other two approaches to achieve sustainable development. Although the concentration approach is widely promoted under normal conditions (namely without disaster conditions), it faces some resistances from farmers in China and few studies have explored whether it is feasible under disaster conditions.

1.1.4 Statement of research problems

The critical research problem in this study is how to develop CRS within a village in the aftermath of a natural disaster in China. China also promotes CRS under normal conditions. The Coordinated Urban-Rural Development Strategy (CURDS), the strategy of new socialist countryside construction, and the "increasing versus decreasing balance" policy (which is a short for "The balance between the increase of construction land in urban areas and the decrease of that in rural areas") are three major policies used to promote CRS. However, under normal conditions, these policies are misused as a tool for increasing construction land in urban areas by forcibly pushing forward CRS in rural areas. This development-driven practice has resulted in farmers' unwillingness and resistance to participate in the concentrated settlement scheme. Four characteristic decision systems namely, Jiangsu mode, Tianjing mode, Shandong mode and Chengdu/Chongqing mode were developed for guiding CRS development under normal conditions. Although these decision systems are useful references for this research, they can not

be used for developing CRS in post-disaster reconstruction for the following reasons: (1) inherent disadvantages in the four decision systems such as involuntary participation, insufficient subsidies, and drastic change of rural lifestyle without further support, (2) little attention to CRS at the village level, thus CRS planning may not be reasonable, (3) the voluntary principle is difficult to follow with and farmers' concerns are hard to take into considerations, and (4) the disaster condition is chaotic, unordered, and complex with a limited budget and project duration, which is quite different from normal conditions.

The existing decision system of rural housing reconstruction in China specifies the policies, operation agency, general principles, financial sources, and operation process, which is a useful tool for organizing the activities of CRS after a disaster. However, the existing decision system lacks effective pre-disaster planning for developing CRS at the village level, which may result in unreasonable reconstruction activates and thereby reduce sustainability due to disordered, complex, and limited finance conditions. Also, the decision system mainly relies on government agencies and overlooks the role of non government organizations (NGOs) in post-disaster reconstruction. Most importantly though, the existing decision system stresses reconstruction in-situ and takes little account of community management of CRS. As farmers would face many problems after a sudden change in their rural lifestyle, measures should be taken in the community to manage CRS after a disaster.

It seems that there has been little research into the development of CRS within a particular village after a natural disaster, although it is considered to be more sustainable and resilient. Meanwhile, the existing decision system of CRS development and rural housing reconstruction

could not be directly applied in developing CRS in post-disaster reconstruction. Therefore, there is a need to know how to develop CRS in post-disaster reconstruction in China. The understanding of developing CRS can facilitate local governments to achieve sustainable development in post-disaster reconstruction. The findings from this study can provide useful information for local governments to determine whether the preconditions of developing CRS after a natural disaster are satisfied and how to develop if possible.

1.2 Scope of the Research

The scope of this research was confined to the development of CRS during post-disaster reconstruction of villages in China. There are three aspects to the scope:

- Concentrated rural settlement at the village level in China;
- Organization domain of villages in China; and
- Rural housing reconstruction in the aftermath of the 5.12 Sichuan Earthquake in China.

The study focused on developing CRS at the village level in China, rather than at the regional or national level. This is a response of community participation in post-disaster reconstruction with the aim of achieving sustainable construction. Case studies limited the investigation to Xiangrong, Qingjiang, Shiqiao and Luchi villages in Dujiangyan county-level city, Chengdu, Sichuan Province, China, which are widely reported as successful examples of developing CRS. However, generalization to other parts of China and to other countries was one of the research objectives. Reconstruction in the aftermath of the 5.12 Sichuan Earthquake was selected as the background not only because it was one of the most grievous world-wide natural disasters at the

time, but also because rural development in China has a tremendous impact on the development of China as a whole as well as world development.

There are two critical concepts in this research that need to to be defined:

Concentrated rural settlement is where settlement is grouped into compact villages or large hamlets. By contrast, dispersed rural settlement is where the majority of farmers dwell on their own lands scattered over the commune. The methods of classifying rural settlement world-wide are by personal observation and quantitative methods. The degree of concentration and dispersion can be measured through various methods (Mandal, 1989). However, the criterion for distinguishing concentration and dispersion is still not established. Therefore, Inouye (1964) devised a criterion on the basis of 50 meter spacing. According to this criterion, dispersed means less than 3 houses within 50 meters of each other, concentrated means more than half of the houses in a village are distributed into one group within a 50 meters range, and condensed means more than half of the houses in a village are centralized into one core (Mandal, 1989). In this study, relocating households with less area of rural residential land than they had before the disaster, which would reduce the dispersion degree, is considered concentration. Due to political sensitivity, geographical data could not be accessed making it impossible to calculate dispersion reductions. However, the case study described in Chapter 5 qualitatively analyzes the reductions. Moreover, CRS implies concentration within a village rather than arbitrary regrouping between villages in this research.

Post-disaster reconstruction is a critical integral part of recovery. Post-disaster recovery implies bringing the post-disaster situation to some level of acceptability in the terms of economic,

social and environmental development (Quarantelli, 1999). It holds a much more comprehensive meaning, compared to restoration, which implies reestablishing prior or pre-impact physical and social patterns, and rehabilitation mainly suggesting restoration of people (Quarantelli, 1999). Commonly, four types of activities are required for full post-disaster recovery: (1) emergency responses relating to search and rescue, removing debris, and providing temporary housing and social services; (2) reparation of critical infrastructure such as road, electricity, and communication system; (3) returning capital stock to pre-disaster levels; and (4) launching further development activities involving economic growth, social development and ecological restoration (Berke et al. 1993). Post-disaster reconstruction stresses rebuilding of the physical structures, such as infrastructure and house destroyed or damaged in a natural disaster (Quarantelli, 1999). Although social researchers stress social process, reconstruction is still important in the recovery after a disaster. Reconstruction provides the physical basis for settling down the victims, restarting industry production, hence facilitating economic recovery and restoring environmental functions. As reconstruction is performed by people, community restoration or reformation, such as with community participation and a decentralized approach, can be better implemented through physical reconstruction (Lyons, 2009). Physical reconstruction is even important for psychological recovery, as physical buildings provide the sense of place, which is critical to psychological recovery (Diaz and Dayal, 2008).

1.3 Research Aim and Objectives

The overall aim of this research was to discover how to effectively develop CRS in post-disaster

reconstruction in China. The objectives were to:

- Investigate the opportunity to develop CRS in post-disaster reconstruction in China;
- Examine the critical determinant factors (CDFs) for implementing CRS in the aftermath of a natural disaster in China;
- Establish a effective decision model for implementing CRS in China; and
- Validate the decision model.

1.4 Research Rationale

The rationale of this research is explained in order to provide a better understanding of how the research aim and objectives influenced the choice of research methodology detailed in this section. Firstly, a fundamental question was asked: why investigate the development of CRS in post-disaster reconstruction? The reason is that a suitable degree of concentration is able to increase the resilience of rural villages and provide a basis for sustainable development after a disaster. However, there has been little research on this issue and therefore there were various problems in developing CRS in the aftermath of the 5.12 Sichuan Earthquake. Also, the existing decision system for CRS development and rural housing reconstruction could not be directly applied to develop CRS in post-disaster reconstruction. This research was therefore conducted so that local governments may use the findings to better understand how to develop CRS during post-disaster reconstruction.

How was the research conducted? This study adopted four steps. The first step was to compare

the behavior of local government and farmers in developing CRS under normal conditions and those under disaster conditions in order to determine whether disaster conditions provide an opportunity to develop CRS. The second step was taken in order to identify the critical determinant factors (CDFs) for developing CRS in post-disaster reconstruction. As explained in Chapter 5, it is important to identify the pre-conditions, as developing CRS is not a panacea for rural housing reconstruction. The third step was taken with the aim of producing a decision model for developing CRS in post-disaster reconstruction. The final step was intended to validate the decision model and determine the extent of its applicability in China. Details of the adopted methodology would be discussed in Chapter 3.

1.5 Significance of the Research

The theoretical and practical significance of this research can be explained as follows:

- Previous studies on resettlement in post-disaster reconstruction mainly focused on resettlement, which is useful to achieve concentration and reduce the average cost of providing infrastructure and public services. However, this approach can undermine livelihoods, disrupt social networks, and result in certain social tensions between displaced and host people. Few studies have investigated developing CRS within a village in post-disaster reconstruction, which can retain social networks and share the same resources while enjoying improved infrastructure and public services. The theoretical findings from this study could be used to promote developing CRS in appropriate rural areas to achieve sustainable post-disaster reconstruction in theory.

- The established decision model can provide a useful tool for the local government to

decide whether it is feasible and how to develop CRS in China in order to achieve sustainable outcome from post-disaster reconstruction. Although this study was based on cases in China, it can be generalized to other countries and regions.

1.6 Structure of the Thesis

This thesis consists of eight chapters. Chapter 1 introduces the study by explaining the research background, research problem, scope, research aim and objectives, research methodology, significance and structure of the thesis.

Chapter 2 presents a comprehensive literature review for this research. It builds up a theoretical understanding of rural settlement patterns and post-disaster reconstruction. It also reviews advantages of CRS, housing reconstruction, resettlement and reconstruction in-situ. In addition, it reviews existing decision systems for developing CRS under normal conditions and rural housing reconstruction in China. The problems of the existing decision system are analyzed and it is found that it could not be directly applied to CRS development in post-disaster reconstruction. This review reveals the research gap and stresses the importance of establishing a decision model for developing CRS in post-disaster reconstruction and provides the policy context of analysis in the following chapters.

Chapter 3 describes the research design and methodology adopted in this study. It presents a detailed description of the research process and data collection procedures. It also demonstrates various techniques to analyze the data collected, and the validation method adopted to examine the applicability of the decision model.

Chapter 4 firstly investigates the opportunity to develop CRS in post-disaster reconstruction in China. Although many studies viewed disaster as a window of opportunity, many of them are anecdotal without strong logic or empirical evidence. This chapter employs game theory to compare the implementation of rural residential land exchange, which is considered as a means of developing CRS under normal conditions and under disaster conditions. The results show that the overall benefit and efficiency of the practice under disaster conditions is higher than that under normal conditions. The findings suggest that post-disaster reconstruction does provide an opportunityto develop CRS in China.

Chapter 5 investigates the CDFs of implementing CRS in China, which can be considered as a substantial step towards converting the opportunity to practices. A preliminary factor list for developing CRS in post-disaster reconstruction was found by reviewing the factors favoring CRS and the success/failure factors for resettlement. Interview is used to identify the CDFs for developing CRS in post-disaster reconstruction. Case studies of four villages in Dujiangyan, Chengdu are conducted to deepen the understanding gleaned from the interviews. The CDFs that concurred with those identified by the experts are taken as the final results.

Chapter 6 elaborates the decision model for developing CRS in China. Reasonable decisions are considered essential for the success of post-disaster reconstruction. This chapter maps the process of implementing CRS during post-disaster reconstruction in the four villages in Dujiangyan. Interviews are used to identify the experiences and problems in the four cases. By integrating the results of case studies and summarized experiences and problems along with the identified CDFs in Chapter 5, the generic decision model for CRS is finally and firmly

established.

Chapter 7 validates the decision model for implementing CRS in China by interviewing officials and professionals. The results of the validation show that the developed model would be useful as a decision tool. It provides specific guidelines that local government could use to improve the effectiveness and efficiency of developing CRS as a part of post-disaster reconstruction.

Chapter 8 concludes the thesis by discussing the critical findings of the study, highlighting the limitations of the study, and providing recommendations for further research.

2 LITERATURE REVIEW

2.1 Introduction

This chapter presents the review on the existing research on rural settlement patterns in terms of concentration and dispersion and post-disaster reconstruction. First, a review is conducted on rural settlement patterns from the aspect of measurement of dispersion and concentration, general principles of rural settlement patterns, spatial equilibrium theory on rural settlement patterns, theory on diffusion of rural settlement, and the advantages of concentrated rural settlement (CRS). On the other hand, the concepts of post-disaster recovery and post-disaster reconstruction are introduced in order to provide a theoretical basis for understanding this subject. Based on this, the process model of post-disaster reconstruction is discussed and sustainable post-disaster reconstruction is emphasized. Housing is stressed as a foundation for physical and social reconstruction. Then housing reconstruction is reviewed, especially with regard to pre-disaster planning, temporary housing and permanent housing reconstruction, resourcing in post-disaster reconstruction, and resettlement and reconstruction in-situ.

In addition, this chapter presents the the existing policy context and decision system of CRS development under normal conditions in China. In addition, existing policy context and decision system of rural housing reconstruction in China is also introduced. Moreover, the problems of existing decision systems of CRS development and rural housing reconstruction are commented on. These analyses provide a basis for investigations in following chapters and are useful to stress the importance of a decision model for developing CRS in post-disaster reconstruction in China. Finally, the summary identifies the theoretical foundation of this research and specifies

the research gap and significance of this research.

2.2 Rural Settlement Patterns

Settlement is defined as "the place, where one person or more dwells regularly, or the act of establishing a permanent residence" (Mandal, 1989: 2). The emergence of semi-permanent or permanent settlement is a result of agriculture development, the demand for defensive protection, demographic pressure and modernization (Roberts, 1996; Grossman and Siddle, 1998). The settlement development usually passes through a series of evolutionary stages including that of the hunter, then the trader, the pastoral stage, the initial cultivation stage, then finally rural settlement with more intensive cultivation, urban center and settlement of the city system (Mandal, 1989). With the emerging distinction of rural areas and urban areas, settlement can be categorized as urban and rural.

2.2.1 Classification between concentration and dispersion

Rural settlement is situated in rural areas associated with agriculture (Bunce, 1982). There are two extreme distributions of rural settlement, namely concentrated rural settlement and dispersed rural settlement. Concentrated rural settlement is where settlement is grouped into compact villages or large hamlets. Dispersed rural settlement is characterised by a pattern of numerous settlements scattered and separated by great distances throughout rural areas (Muir, 2000). In reality, many are the intermediate forms, as the relative proportions of concentrated and dispersed rural settlement vary widely (Fawcett, 1939). As a result, earlier research has been devoted to distinguishing between concentrated and dispersed rural settlement through measuring the degree of concentration and dispersion.

The degree of concentration and dispersion can be measured through various methods including qualitative and quantitative methods. In 1909, Woiekof devised the following formula to measure the degree of concentration (Mandal, 1989):

$C=P/H$ (Formula 2.1)

where C is the degree of concentration, P is the number of inhabitants and H is the number of inhabited places. However, this measure only portrays the average population size of rural settlement without considering settlement concentration. Similarly, Kristofferson considered the rural settlement below 50 meters' spacing as dispersed and more than 50 meters as concentrated in 1924 (Mandal, 1989). In 1926 Lefevre set the basis of classification of settlement types by classifying the number of houses per square kilometer into 1-10, 11-25, 26-50, 51-100, 101-250, 251-500, 500-1000, and 1000+ (Mandal, 1989). Yet this method only gives the density classes of houses without specifying the criteria for distinguishing concentration and dispersion.

The French scientist Bernhard developed another formula in 1931 (Mandal, 1989):

$$C = \frac{S \times M}{N^2}$$ (Formula 2.2)

where C is the degree of concentration, S is the total number of houses, M is the area and N is the number of houses in the concerned site. However, this measure does not distinguish between settlement variations, thus C can be the same in value with very different patterns.

Zierhoffer postulated another formula based on the assumption that the degree of dispersion of settlement will increase with the corresponding increase of area per dwelling in 1934 (Mandal,

1989). The degree of dispersion can be represented as the following:

$$R = \frac{P \times S}{d} \times K \qquad \text{(Formula 2.3)}$$

where R is the degree of dispersion, P is the average area per dwelling, S is the number of house groups in the commune, d is the total number of inhabitants, and the constant K is 0.005. However, this method does not set the threshold value for distinguishing dispersion and concentration.

In 1964, Inouye developed a measure of dispersion of rural settlement on the basis of 50 meters of spacing. In this measure isolated settlement means less than 3 houses within 50 meters of each other, concentrated settlement means more than half of the houses in a village located into one group within 50 meters range, condensed settlement means more than half of the houses in a village centralized into one core (Mandal, 1989).

The qualitative and quantitative measures of concentration and dispersion discussed above provide a useful tool for investigating the patterns of rural settlement. In the following chapters, this measurement will be used to help qualitatively explain that concentration is attained during post-disaster reconstruction when the degree of dispersion is reduced. However, due to simplification and measurability, the essence of rural settlement such as culture and natural environment, cannot be explored in these developed measures, which blocks the thorough understanding of rural settlement. Therefore a number of theoretical and empirical studies have been conducted to explain the distribution of rural settlement.

2.2.2 General principles of rural settlement patterns

Exisiting research has devoted to establishing general principles for the explanation of rural settlement patterns in terms of concentration and dispersion. Meitzen opined that the type of agricultural system and ethnic structure determine the existence of concentration or dispersion in Europe. According to his study, open-field cultivation was related to concentration while individual cultivation was associated with dispersed patterns. He then attributed the emergence of open-field village to Germanic influence and the independent farmstead to Celtic impact (Bunce, 1982).

General factors affecting the form of a rural settlement are also investigated, including the natural environment, availability of materials for building, social and economic needs, cultural traditions, political systems, defense and water supply (Short, 1992). Cultural traditions usually play the most important role in determining settlement organization forms and land division systems. This is resulted from both institutional and individual decisions. Except for culture, economic factors play a role through agricultural land use. For example the relative commercialism of agriculture and the type of farming affect the size and distribution of farms, the spacing of service centers and the density of the rural population. As agricultural land use is influenced by the physical environment, the natural environment therefore also has a strong effect on the distribution of rural settlement (Bunce, 1982). In conclusion, the ways in which these factors influence settlement patterns vary according to local conditions.

However, these theories failed to recognize that settlement patterns are much more complex. Moreover, the early theories were essentially inductive since they attempt to make explanatory

generalizations from empirical observations (Bunce, 1982). Recent theories of rural settlement patterns are quite different in their approach. First they are concerned with the evolution of patterns in general rather than distinguishing between concentration and dispersion. Second, they are deductive approaches as part of modern spatial analysis, which will be introduced in the following sections.

2.2.3 Spatial equilibrium theory on rural settlement patterns

There are two main types of theories which are relevant to the analysis of rural settlement patterns. The first are spatial equilibrium theories which intend to find how an optimal pattern of settlement will be realized through competition for space. The second group is that which examines the diffusion or spread of settlement across an area (Bunce, 1982). Spatial equilibrium theory has been widely used to explain the pattern of CRS especially in North America. Its basic hypothesis is that competition between places for consumers will result in a hierarchy of central places which will in turn determine the spacing of settlement through the size of their market areas. Rural places will be at the lower end of the hierarchy, providing lower-order goods to smaller number of consumers within smaller market areas (Bunce, 1982). The theory of growth poles and growth centers and central place theory are good examples of these theories being used to explain CRS.

Theory of growth poles and growth centers

The theory of growth poles and growth centers explains two opposing forces controling the movement of economic prosperity. The first of these forces is that of “backwash” (Myrdal, 1957) or “polarization” (Hirschmann, 1958), which concerns the tendency for central nodes to attract

factors of production, such as labor, raw materials or savings, from their surrounding areas. The second force associated with the growth pole model is that of “spread” or “trickle down”, where economic prosperity is transmitted from a center to its fringe through various ways such as the transfer of income earned in the center to the service sector of surrounding settlement.

The growth pole theory was used to justify CRS as a growth pole or growth center of rural areas. However, the growth pole model has evolved through analysis at regional or national level rather than the village level in theory. Empirical investigation suggests that agglomeration economies promoting sustained industrial growth needs a threshold population of at least 25,000 and that a fully functional growth center needs a population of 250,000, which is a scale that the CRS could not reach (Cloke, 1979).

In view of both theoretical and empirical evidence, CRS is not sufficient enough to being a growth center. However, the rural scale does not necessarily need the industrial agglomeration to solve problems such as lack of infrastructure and public services. The growth pole theory does imply that a certain scale of CRS can act as a small scale rural growth center allowing employment growth as well as easy approach to provide infrastructure and public services, especially if government help is involved (Cloke, 1979). Therefore, growth centers in rural areas are widely used, for instance in the Appalachian region of the US and in Ireland (Cloke, 1979).

Central place theory

Central place theory is a geographical theory developed by Christaller that aims to explain the number, size and location of human settlement. Christaller (1933) assumed that settlement simply acts as “central places” providing services to surrounding areas. He put forward a

hexagonal service area surrounding each settlement to establish a nested hierarchy of settlement, with the ranking of an individual settlement in this hierarchy, which is dependent on the size of the settlement and its level of service provision.

The geographical and planning scientists devote to finding a universal settlement hierarchy in theory and practice. Christaller (1933) produced evidence of a sequence of marketing centers of differing levels in Bavaria. Being independent of and concurrent with the work of Christaller, Dickinson (1932) highlighted the existence of a hierarchy of settlement by introducing the concept of nucleated settlement which acted as a focus for serving the surrounding area. This understanding of a service center-hinterland relationship had a direct impact on the planned promotion of service centers within the countryside.

Central place theory is also employed to justify CRS for providing services to surrounding areas. However, the central place theory was essentially generalized cartographic representations of empirical observations. It usually fails to work when taken out of their original context and revealed nothing about the social, economic and political processes behind the settlement development (Woods, 2005).

2.2.4 Theory of settlement evolution

Researchers have also tried to explain the evolution of human settlement by learning from plant and animal ecologists. The early studies of Dacey (1962) and Getis (1964) endeavored to explain how settlement has evolved since the inception of the colonization process through treating the settlement systems as patterns of points in two dimensional spaces. While borrowing some basic methodological tools from biology, these studies further improved the

methodology and generated a number of statistical models and quantitative techniques, such as nearest neighbor theory and quadrant analysis. As well, these studies recognized the importance of the diffusion and colonization processes in settlement evolution. However, most studies have an unreasonable assumption taking rural settlement as fixed locations in static and theoretically isotropic space rather than as places of change and adaptation in practice.

A number of Euro-American theorists have moved toward analyzing processes of change. Bylund (1960) established a multi-stage model and simulated the process of early colonization in the marginal areas of Northern Sweden, which is a process of continuous colonization and re-colonization, with related groups avoiding competition for space. In the primary phase, there was a long distance migration into a new territory, which resulted in "clone colonization" or the branching of new offshoots from the original roots. This stage was then followed by a series of short distance expansions under the pressure of population increases. Finally, the settlement pattern is somewhat concentrated in response to certain economic needs (proximity to markets and roads) and socio-religious needs (proximity to churches and relatives).

Based on Bylund (1960), Hudson (1969) placed a great emphasis on competition rather than on its avoidance and proposed a model consisting of three phases. The model was similar to the diffusion approach in ecology, which was more mathematically based and less concerned with cultural factors than the Bylund's model. Except for "colonization" and "spread", which were also mentioned in Bylund's model, Hudson (1969) introduced a Darwinian stage of competition. Thus, when the increased population in the second phase leads to competition for space, the less fit are forced out, and the final stage is a regular settlement pattern.

However, these quantitative studies have severe constraints imposed by the models. They assumed a sequential process with no room for further incursion by competing cultures with different requirements. As a result, Hudson himself pointed out that not all rural settlement development should pass through the stages he posited as there are also many exogenous variables influencing the processes (Hudson, 1969). In addition, the biological models seem to be preoccupied with time as a progressive and linear continuum. However, the nature of rural processes is varied and unstable, which implies that the biologically derived theory is ill fitted to deal with complex transformations of this kind.

2.2.5 Advantages of concentrated rural settlement

Dispersed rural settlement is usually criticized as one of the major contributors to rural disadvantages and under-developments. It has been well appreciated that dispersed rural settlement has a relatively negative impact on landscapes, resulting in land fragmentation, proliferation of septic tanks and declining water quality (O'Siochru, 2003; Scott, 2005; Gkartzios and Scott, 2009). It is difficult to provide infrastructure and deliver services such as public transport, telecom services and emergency health services (Joseph and Smit, 1985; Scott, 2005; O'Leary, 2008; Gkartzios and Scott, 2009). It results in inaccessibility and social isolation, lower than average activity rates, scarce local services, and underemployment (Higgs and White, 2000). Dispersed rural settlement imposes extra environmental, economic and social costs and is therefore unsustainable in the long run (O'Siochru, 2003). As a result, it is necessary to control dispersed rural settlement and advocate concentrated settlement (Gkartzios and Scott, 2009).

In response to the disadvantages of dispersed rural settlement, CRS is considered an effective

means of improving living standards in the countryside, thus achieving sustainable development without compromising the farmers' well-being. Previous studies suggest that rural residential settlement should be close to community facilities, linking into the functional hierarchy in order to maximize access to goods, services and opportunities and reduce the need to travel (Turnock, 1991; Rural Issues Work Group, 2002; Mulwaree Shire Council, 2003). Concentrated settlement not only reduces the rural disadvantages and alleviates the imbalance of welfare distribution between urban and rural areas, but also contributes to achieving sustainable development by saving land consumption. Alaci (2010) argued that concentrated settlement patterns serve as growth engines and stabilizers of urbanization and economic growth through linking rural and urban areas. Concentrated settlement is considered an important strategy for practicing sustainable development principles, particularly in developing countries with a growing population (Qadeer, 2004).

Therefore many countries have been introducing various mechanisms to implement CRS. For example, Britain implemented a large-scale rural development program between the 1950s and 1970s, with the aim of concentrating the people within central villages. In line with this program, a set of comprehensive policies was formulated to guide investment in housing, infrastructure and public service facilities, and employment tilting to the central villages (Cloke, 1979). In China, various policies such as urban-rural coordinated development strategy, the strategy of new socialist countryside construction, and "the balance between the increase of construction land in urban areas and the decrease of that in rural areas" are used to advocate CRS. However, developing CRS is usually purposely conducted under normal conditions. Few studies have

explored developing CRS within a village under disaster conditions.

2.3 Post-disaster Reconstruction

Mitigation, preparedness, response and recovery are four critical phases in disaster management, which attract much research attention. However, the recovery phase is the most poorly understood, although it has a long term impact on economic, social, and environmental development (Drabek, 1986; Rubin 1991). Post-disaster recovery implies bringing the post-disaster situation to some level of acceptability from the aspects of economic, social and environmental development (Quarantelli, 1999). It holds a much more comprehensive meaning compared to restoration, which implies reestablishing prior or pre-impact physical and social patterns, and rehabilitation mainly suggests restoration of people (Quarantelli, 1999).

Post-disaster reconstruction is a critical, integral part of recovery. Post-disaster reconstruction stresses rebuilding of the physical structures, such as infrastructure and house destroyed or damaged in a natural disaster (Quarantelli, 1999). The pioneering research by Haas et al. (1977) provides a conceptual framework in which urban reconstruction proceeds in four sequential stages: (1) emergency responses relating to search and rescue, removing debris, and providing temporary housing and social services; (2) reparation of critical infrastructure such as road, electricity, and communication system; (3) returning capital stock to pre-disaster levels; and (4) launching further development activities involving economic growth, social development and ecological restoration. Reconstruction is viewed as “ordered, knowable and predictable” and each subsequent stage has approximately ten times the duration of the preceding one. However, through investigating real cases of post-disaster reconstruction, it is found that the four stages

can be coinstantaneous or in different sequences instead of sequential (Rubin, 1991; Berke et al., 1993; Bolin 1993).

Following studies have provided other models like the three peaks model by Rubin and Popkin (1990), and the five key stages model by Brunsdon and Smith (2004). The three peaks model addresses concerns for physical recovery, societal recovery, and community betterment (Rubin and Popkin, 1990). The five key stages model consider reconstruction as a mega project, which can be managed from impact assessment, reconstruction proposal, funding arrangements, regulatory process and physical construction (Brunsdon and Smith, 2004).

The researchers, especially the social researchers, stress social process is important in the recovery after a disaster (Hutanuwatr et al., 2012). Therefore, the recent research moved beyond physical reconstruction, and laid the concern for the social process and sustainable post-disaster reconstruction (Nigg, 1995; Mileti, 1999; Miles and Chang, 2006). However, physical reconstruction provides the basis for settling down the victims, restarting industry production, hence facilitating economic recovery, and restoring the environmental function. As physical reconstruction is performed by people, community restoration or reformation such as community participation, and a decentralized approach can be better implemented through means of physical reconstruction (Omidvar and Zafari, 2007; Lyons, 2009). Physical reconstruction is even important for psychological recovery, as the physical building provides the sense of place, which is critical and helpful in achieving psychological recovery (Diaz and Dayal, 2008). As a result, an increasing number of studies have been conducted on post-disaster reconstruction, particularly in housing reconstruction and relevant aspects.

2.3.1 Housing reconstruction as the priority

Housing is not only a place to shelter people; it is also a process to achieve that function (Turner, 1972; Johnson, 2007). Quarantelli (1995) distinguishes sheltering from housing through investigating their functions in the disaster scenario. Sheltering denotes "the activity of staying in a place in the immediate aftermath of a disaster, where regular daily routines are suspended", and housing denotes "the return to normal daily activities such as work, school, cooking at home, and shopping" (Johnson, 2007: 436). Four stages, namely emergency shelter, temporary shelter, temporary housing and permanent housing, are therefore used to investigate housing reconstruction although they are not necessarily sequential. The four stages are listed as below:

- Emergency shelter is mostly used for a few days during the emergency. It can be a public sanctuary or refuge at a friend's house. As this stage is so short, it is unnecessary to provide a lot of food and prolonged medical services.

- Temporary shelter is usually used for a few weeks after the emergency responses stage. It may take the form of a tent or a public mass shelter, where basic commodities such as food, water and medical treatment are necessary.

- Temporary housing provides a place for returning to daily life, although it is still a temporary habitancy. It can take various forms such as a rented apartment, a prefabricated home and a small shack.

- Permanent housing is the return to the home, no matter on the former site or the relocated site, living on a permanent basis. This may take a few years to be fully

realized.

Housing reconstruction is always the top priority issue in the reconstruction process as housing damage is usually the biggest visible impact on the victims' lives, especially in rural areas in developing countries. Delays in housing reconstruction may generate social problems, such as homelessness of the low-income people, joblessness, and crime (Bolin and Bolton, 1986; Comerio, 1998; Phillips, 1998; Liu et al., 2011; Ophiyandri et al., 2013). Thus, well-timed housing delivery is not only a major signal of community recovery, but also a critical guarantee for the security and redevelopment (Wu and Lindell, 2004; Ganapati, 2013; Jordan and Javernick-Will, 2013). Many studies have been conducted to stress how to meet the challenges to complete housing reconstruction successfully. Special attention has been given to pre-disaster planning, temporary housing and permanent housing.

Pre-disaster planning

Pre-disaster planning is a key for the timely housing reconstruction, as the disaster context leaves insufficient time to engage in proactive planning and stakeholder consultation (Wu and Lindell, 2004; Badri et al., 2006). It may facilitate a rapid decision on whether to resettle, how to tackle the resourcing problems, and how to organize and therefore help to reconstruct on time, satisfy the victims and achieve long-term sustainable development (Mitchell, 2004; Badri et al., 2006; Al-Nammari and Lindell, 2009). Although the disaster context may be different from the planning, the biggest benefit of pre-disaster planning lies in the planning process rather than the written plan itself (Wu and Lindell, 2004).

Some studies found various critical elements of pre-disaster housing planning, such as

organization, land use, regional coordination, building standards, household preparation, and construction sector preparation (Wu and Lindell, 2004). In addition, drawing on local resources, meeting local living standards and culture, and selecting location are also necessary (Johnson, 2007). Furthermore, in order to achieve sustainable development, flexible design, minimal energy consumption, and community participation should also be emphasized (Arslan, 2007; Davidson et al., 2007; Johnson and Smilowitz, 2012; Mulligan and Nadarajah, 2012).

Research on the spatial level of pre-disaster housing planning shows that planning should place different priorities and bear different functions at the household level, neighborhood level, community level and regional or wider level (Xu et al., 2006). However the spatial analysis of pre-disaster housing planning is insufficient. Further research is therefore needed to integrate the planning at different spatial levels and study the effects of pre-disaster housing planning on the housing spatial distribution and economic development.

Temporary housing

Temporary housing provides a place for returning to daily life, although it is still a temporary habitancy. It has been considered unnecessary, costly, too slow, too lasting and taking resources from reconstructing permanent housing (UNDRO, 1982; Bolin, 1990; Bolin and Stanford, 1991; Geipel, 1991; Dandoulaki, 1992; Gilbert, 2001). However, through examining the real cases of post-disaster reconstruction, temporary housing is found beneficial for rapidly settling down the victims and providing sufficient time for safe rebuilding.

Various factors should be taken into consideration in temporary housing. The common concerns include timing, cost, the overall reconstruction strategy, unit design, location, services and its

long-term use (Johnson, 2007). In order to respond to these concerns, initial planning, building process, long-term use, and recycling should be seriously considered. The initial planning of temporary housing should specify how to be rapidly available, point out how to draw on local resources, determine how to meet local living standards, plan the long term use for the units, and figure out how to reduce the negative impacts related to temporary housing. Furthermore, the planning must be made before the disaster occurs, but should be flexible enough to fit the specific post-disaster situation.

During the building process, due attention should be paid to six critical activities namely, site selection, regulation, participation , land ownership, logistics, and evaluation in order to ensure the quality of temporary housing (Leon et al., 2009). Participation of victims in decision-making generates positive results in building process and production. However, participation is rarely achieved and the capabilities of victims are usually wasted. In addition, an automated system is developed to optimize several vital objectives, such as minimizing negative socioeconomic impacts, minimizing negative environmental impacts, and maximizing housing safety during temporary housing reconstruction (El-Anwar et al., 2009). This system is considered beneficial in decision-making for optimizing temporary housing arrangements after a natural disaster.

Long term use of temporary housing is another important concern. Without proper management, the remaining temporary housing usually results in serious social problems such as extremely high crime rates and high suicide rates as usually poor families and the elderly are left behind in the temporary housing (Comerio, 1998; Lizarralde and Johnson, 2003). Therefore, long term use of temporary housing should be planned in advance with better guidance and management.

Otherwise, it should be demolished when the permanent housing is built.

Recycling of temporary housing is therefore important to achieve sustainable development if it needs to be demolished. Arslan (2007) introduced the practice of re-use and recycling of temporary housing empolyed after the Kocaeli Earthquake in Turkey in 1999 as shown in Figure 2.1. It is emphasized that good design of temporary housing in terms of sustainability, flexibility, long term effects, and minimum energy consumption should be available before the disaster. Furthermore, Arslan and Cosgun (2008) expanded the research into the recycling and reuse of temporary housing sites as shown in Figure 2.2. Temporary housing units, temporary housing land, and temporary housing infrastructure can be recycled or reused for permanent housing.

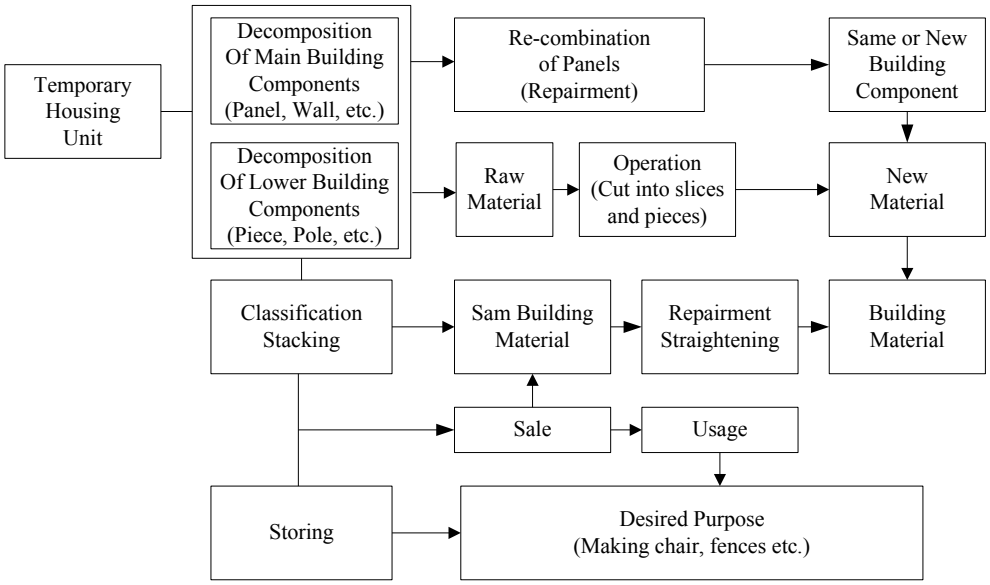


Figure 2.1 Recycling and reuse process of temporary houses

Source: Arslan (2007)

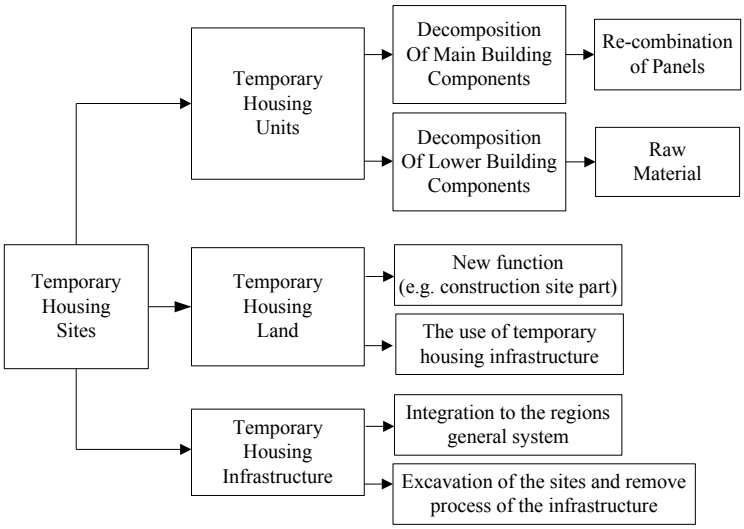


Figure 2.2 Recycling and reuse process of temporary housing sites

Source: Arslan and Cosgun (2008)

Permanent housing

Successful reconstruction of permanent housing needs good planning, design and building (Ahmed, 2011). Tas et al. (2007) conducted a survey and found several critical factors in area selection, area planning, house design, and house building. For area selection, "the ground state", "nature of the disaster" and "financial burden" are three highest priority factors followed with "social factors". For area planning, the most important factors are "forming urban functions separated from each other" and "providing security for those evacuated". For house design, "simplifying the planning to facilitate construction", "practicability (possible for the users to change it according to their lifestyles)", "ensuring quality materials", and "the relationship between the inner spaces of the housing" are considered the most important. For house building, "quality warranty" is given the greatest priority. In addition, surveys found that better performances of permanent housing in physical, social, aesthetic, economic and technological terms would result in better satisfaction for the victims (Tas et al., 2007).

2.3.2 Resourcing in post-disaster reconstruction

Resources are usually insufficient in the aftermath of a disaster, therefore resourcing is considered critical in post-disaster reconstruction. Resourcing involves various activities including resource management for post-disaster reconstruction projects, pre-disaster resource planning, resource acquisition, resource logistics, and resource alternatives development (Chang et al., 2010). Resource insufficiency is resulted from many factors including the lack of suitable resources, inaccessibility of available resources, limited ways of procuring resources, organization failure and lack of pre-disaster planning. It is partly caused by the disaster itself and partly caused by the pre-disaster problems. Experiences of post-disaster reconstruction have been reviewed to identify the critical factors affecting resourcing as shown in Table 2.1.

Table 2.1 Critical factors affecting resourcing in post-disaster reconstruction

Type	Factors	Reference
Lack of suitable resources	Resource shortage	Steinberg, 2007
	Manufacturing and construction badly damaged	Nazara and Resosudarmo, 2007
	Historical problems of the local industry	Singh and Wilkinson, 2008
Inaccessibility of available resources	Supply chain disruption	Zuo et al., 2009
	Disruption of transportation and energy supply	Cho et al, 2001
Limited ways of procuring resources	Constrained government's fiscal capacity	Jayasuriya et al, 2005
	Price escalation	Brunsdon et al.,1996; Nazara and Resosudarmo, 2007
Organization failure	Ineffective resourcing	UNDP, 2005; IFRC, 2006
	Imperfect resource management	Steinberg, 2007; Kennedy et al., 2008
	Inadequacy of effective institutional arrangements	Sulivan, 2003
	Lack of proactive involvement of the construction industry	Lorch, 2005; Pheng et al., 2006; Bosher et al., 2007
Absence of pre-disaster planning	Absence of pre-disaster planning	Alexander, 2004; Orabi et al., 2009

Many approaches, such as new investment in production and importing resources from unaffected areas, have been adopted to solve the resourcing problems in practice (Walker, 1995; Jayasuriya and McCawley, 2008; Zuo et al., 2009). As information flow is essential for resourcing, the hinderance factors for information flow, such as inaccessibility, inconsistent data and information formats, inadequate information stream, undertimined information priority and difficulty of source identification has been identified through investigating the real cases (Day et al., 2009). Furthermore, a multi-objective optimization model has been developed for resource utilization (Orabi et al., 2010). With this model, it is easy to allocate limited resources to different reconstruction projects, to estimate the reconstruction duration and cost related to specific reconstruction plans, and to find optimal trade-offs between minimizing the reconstruction duration and that of cost.

Research has also been conducted to compare the mode of resourcing, including government driven, donor driven and market driven mode (Chang et al., 2010). By examining resourcing problems after the 2009 Victorian bushfires in Australia, Chang et al. (2010) specified the challenges for resourcing of market driven as insurance payment shortfalls, non-synchronization of building code changes, shortage of registered builders, logistics and accommodation for non-local builders, and provision of low-cost housing. Through investigating the resourcing after the 5.12 Sichuan Earthquake, Chang et al. (2011a) identified the factors hindering the resourcing for government driven mode as "(1) reconstruction schedule and speed, (2) the impacts of the 2008 global financial crisis, (3) inadequate local transportation capacity, (4) dysfunction of the construction market, and (5) insufficient engagement of local construction industry". Also,

Chang et al. (2011b) found the key factors obstructing the resourcing for donor-driven mode as NGO-related factors, external hurdles and community-related factors. It is found that successful resourcing depends on multi-stakeholder collaboration and institutional tools to integrate market flexibility, donor management, and government intervention (Chang et al., 2012).

2.3.3 Resettlement versus reconstruction in-situ

Resettlement and reconstruction in-situ is the two common approaches to housing reconstruction after natural disasters. Resettlement after natural disasters is usually impacted by geological safety, reconstruction cost and development opportunity given by the disaster. The top reason for resettlement is that the former site is subject to continued or expanded vulnerability, which is extremely dangerous for further living (Bayulke, 1983; Oliver-Smith, 1991; Dikmen, 2006). Even if geological safety is not the crucial concern in the decision making, resettlement may still be necessary, as reconstruction in the same site costs much more than resettlement (Aysan and Oliver, 1987; Dikmen, 2006). Furthermore, the government might purposely resettle the victims, as the disaster provides convenient pretexts for population concentration and a chance to re-plan the regional development (Oliver-Smith, 1991).

Resettlement provides opportunities to improve the livelihood of the affected by better access to employment and public services. Consequently, planned and forced resettlement has been promoted for post-disaster reconstruction in developing countries in recent years (Badri et al., 2006). However, experience shows that resettlement can undermine livelihoods, disrupt social networks, and result in certain social tensions between displaced and host people (Birkmann et al., 2008; Bang and Few, 2012). The key risks in the process of resettlement can be summarized

as: landlessness, unemployment, homelessness, marginalization, food insecurity, inaccessibility of common property resources, increased morbidity and community disruption (Cernea, 1997). In order to lessen the negative economic impacts of resettlement, due attention should be paid to strengthening production capacity, diversifying economic activities, increasing financial support for the most vulnerable victims and balancing the use of natural resources (Badri et al., 2006).

Many researchers have investigated the factors influencing the failures of resettlement. Some scholars found that the organization of resettlement is critical to decide its progress. Young (2004) pointed out that complex institutional arrangements, unclear responsibility and fragmented authority would affect the progress of resettlement and therefore lead to delays in completion and dissatisfaction of the victims. Others suggested that quick decision-making, lack of victim participation in the decision-making process, and inadequate guidance to the beneficiaries would cause the refusal of the resettlement (Lamping, 1984; Razani, 1984; Oliver-Smith, 1986; Dikmen, 2006). Furthermore, some studies have also been reviewed in terms of site selection, layout and housing design (Oliver-Smith, 1991). Priority is laid on whether resettlement is easy to relate to the old village and the social relationship. Some also argued that the capability of the community to develop itself is also important. All these factors are summarized in Table 2.2.

Table 2.2 Failure factors of resettlement

Aspects	Factors	Reference
Organization	Complex institutional arrangements and unclear responsibility and fragmented authority	Young (2004)
	Quick decision-making; lack of victim's participation in the decision-making process, and inadequate guidance to the beneficiaries	Lamping, 1984; Razani, 1984; Oliver-Smith, 1986; Dikmen, 2006
Site selection	Faraway to employment and social services	UNDRO (1982)

	Ignorance or lack of concern for ecological and economic concerns	Oliver-Smith (1991)
	Distance from resources such as water, pasture, labor and commodity markets	Lamping, 1984; Oliver-Smith, 1986
	Distance from the old village	Kronenburger, 1984; Lamping, 1984; UNDRO, 1982; Razani, 1984
Layout	Lack the variety as well as the culturally constructed ritual spaces required by people	Razani, 1984; Kronenbeuger, 1984
	Do not permit the clustering of kin and old neighborhood groups	Coburn et al (1984)
	Insufficient space around dwellings for tool sheds, animal pens and other agricultural needs	Lamping, 1984; Kronenburger, 1984; Oliver-Smith, 1986
Housing design	Faulty construction and inferior materials	Lamping, 1984; Razani, 1984; Coburn et al (1984); Ulubas, 1980
	Too small for large rural extended families	Ulubas, 1980; Lamping, 1984;
	The loss of privacy	Ulubas, 1980;
	Inappropriate for domestic activities which require different kind of spaces for different uses according to seasons	Coburn et al (1984);
Further development	The capability of the community to develop itself	Coburn et al (1984)

Unlike resettlement, reconstruction in-situ is quite common especially when post-disaster reconstruction aims to bring back the former life rapidly. Compared to resettlement, reconstruction in-situ can access the predefined resources, needs less mobilizations, and would not bring social tensions thus it is easy to build back the former life (Badri et al., 2006). However, this approach is criticized for suffering possible secondary disasters and future disasters, as the disaster has already shown the original location is not safe. Moreover, the socio-economic condition would remain unchanged and it is a shame to waste the opportunities to improve the infrastructure and public services in rural areas. Although this approach is useful for rapid recovery, it could not help to provide sufficient infrastructure and public service and to reduce urban rural inequality, thus it is unsustainable especially from the social aspect.

However, both resettlement and reconstruction in-situ, as the common reconstruction approach,

do not emphasize the change in housing patterns. This insufficiency matters a lot, especially in rural areas where dispersed settlement and concentrated settlement co-exist and have different impacts on rural living. As a result, developing CRS is overlooked as an optional method of rural housing reconstruction.

2.4 Decision System of CRS Development under Normal Conditions

2.4.1 Policy context of CRS development

The coordinated urban-rural development strategy

The urban-rural dual system was established after PRC was founded in 1949, which contributed to industrialization between the 1950s and 1970s but resulted in increasing gaps between urban and rural areas (Lin, 2004). The urban-rural dual system can be demonstrated as: (1) the household registration management system is different in urban and rural areas. Although many farmers are working in urban areas, however, they find it difficulty to obtain an urban identity, not to mention equal welfares. That is why the term “migrant workers” was created (Xie and Yao, 2006). (2) the land ownership is different in urban and rural areas. The rural land is owned by rural collectives while the urban land is state-owned. According to the land laws, only the state-owned land can be transferred in the land market, while the rural collective land must be expropriated by the local government to transform it as state-owned land. Under this context, the property rights of rural collective land are difficult to guarantee (Chen and Lu, 2008). (3) the resource allocation between urban and rural areas is unequal. The urban public goods are almost all provided by the national finance investment. However, limited finance is put in rural areas (Tan and Qu, 2006). The dual system brings many disadvantages to farmers even in the face of

natural disasters.

Coordinated Urban-Rural Development Strategy (CURDS) was introduced in China in 2002. This national strategy, by recognizing the remarkable imbalance between China's urban and rural development, aims to solve the tough problems of Agriculture, Rural Areas, and Farmers (named "San Nong" Problems) and achieve a compatible development between urban and rural areas (NDRC, 2005). The fundamental requirement of CURDS is to develop a new urban-rural system, which can change the existing urban-rural dual system, make the resources flow freely, and protect the farmers' rights. Within this context, the market mechanism can play a key role in the allocation of resources between urban and rural areas, and the farmers can gain revenues from improving the efficiency of resource allocation, which is useful to unify efficiency and fairness (Qu and Tian, 2011).

The existing system is inevitably broken if CURDS is implemented; therefore, Chengdu and Chongqing were selected as two experimental reform zones for urban-rural coordinated development, which was further officially approved by the State Council in 2007 (Le et al., 2012). The government of Chengdu took various measures to implement the CURDS as shown in the following:

(1) Advance three types of concentration

In the first stage of implementing the CURDS, three types of concentration were advanced, namely concentrating industrial development in key development zones, concentrating the farmers in towns/cities, and concentrating the land for large-scale operation. Concentrating

industrial development in key development zones is useful to promote intensive development, resource conservation, environmental protection, and innovation of management and technology. Concentrating the farmers in towns/cities is helpful to create business opportunities, transfer rural labor to the secondary and tertiary industries, and favor large-scale operation of land. Concentrating land for large-scale operations is favorable to transform the means of agricultural production and promote modern agriculture.

(2) Integrated urban and rural planning in Chengdu

A basic co-operation framework of various government departments was developed to implement coordinated urban-rural development. The institutional system of coordinated urban and rural development was therefore developed, as shown in Figure 2.3. Furthermore, the integrated urban and rural planning system, which covers the whole region of Chengdu and enables coordination between various specific planning works, was developed. In the planning process, a reasonable blueprint of urban-rural coordinated development was made through advanced development concepts, improved legal system, efficient organizational structure, standardized implementation process, effective supervision mechanisms, broad public participation, and breaking departmental barriers.

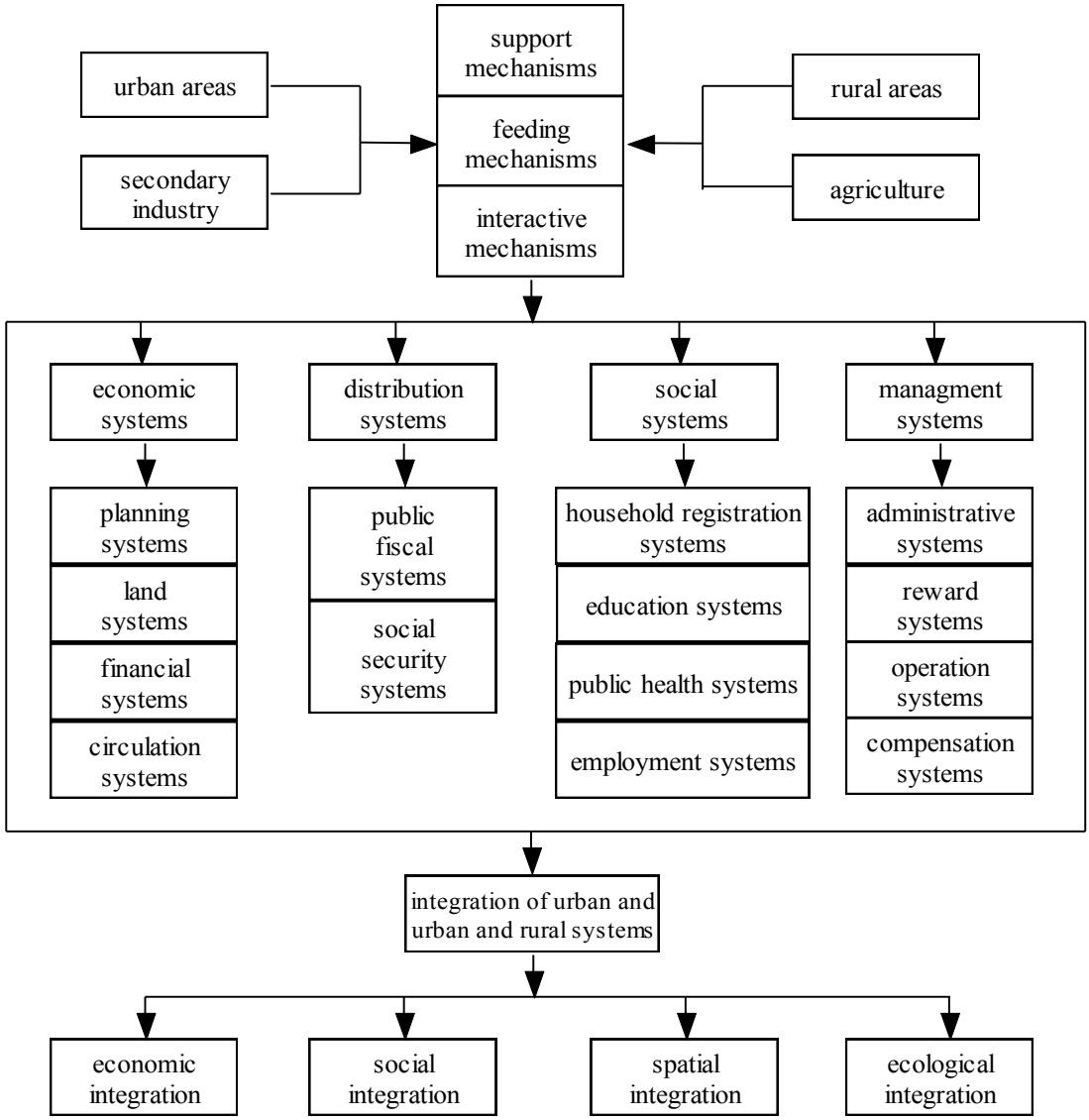


Figure 2.3 The institutional system of coordinated urban and rural system in Chengdu

Source: Lu et al. (2012)

(3) Four key rural reforms

The Chengdu government also proposed four key reforms in rural areas in order to establish an urban-rural unified factor market, ensure rural stability, and create a system of sharing outcomes of reform and development between urban and rural areas. First, rural property rights system reform has been undertaken. In 2008, Chengdu government started the market-oriented reforms

in rural areas through property rights system reform. The farmers' contracted land, residential land, and housing were investigated, registered, and certified. In addition, the rural property rights trading institution was established at the city and county levels. Also, agricultural guarantees and investment and insurance mechanisms were introduced to enable farmers to become the main players in the market. All these measures targeted developing a modern rural property system with clearly established attribution, clear responsibilities, strict protection and smooth transfer. Under this context, the farmers can transfer their use right for contract land and residential land based on voluntary principles (Qu and Tian, 2011). Second, the new governance mechanisms have been built at the village level. In recent years, direct election of the party secretary and evaluating cadres by the public has been implemented at the village level. It gradually becomes a new governance mechanism, where the village council (representatives of villagers) makes decisions, the village-level government implements the determined issues, the supervision board oversees the implementation process and results, and other social organizations actively participate. Third, reform of public services and public administration at the village level was initiated. The fund for public services and social management is included in budget. Twenty thousand Yuan is allocated annually for each village for expenditures on sports, education, health care, employment, social security, rural infrastructure, agricultural production, and public administration. Last, comprehensive land harnessing was put forward in rural areas. Measures were taken to improve farmland, forests, and infrastructure such as road, and sewage facilities and make the farmers adapt to the urban lifestyle.

The strategy of new socialist countryside construction

The CPC Central Committee put forward new socialist countryside construction as an important mission in the "proposal of the eleventh five-year plan on the national economic and social development" in 2006 (Wu, 2006). It is suggested that the new socialist countryside should have a high level of agricultural production, well-off life, civilized lifestyle, clean environment, and democratic management. It is required that the new socialist countryside construction should be implemented according to the reality and farmers' willingness in each village (Wu, 2006). It is considered an inevitable result of implementing the CURDS. It is clearly required that the government should provide more investment, the secondary industry should feed agriculture, the urban areas should support the rural areas, and all social members should be mobilized to participate (Cao, 2012). Various mechanisms have been suggested to promote new socialist countryside construction (Gu, 2006):

(1) The leading role of government

Rural areas usually face disadvantages in providing public services and goods. Unlike the urban areas, the rate of investment in rural areas is quite low due to scattered population and low level of industry agglomeration. As a result, the market mechanism usually fails to play a role in countryside construction. In addition, countryside construction mainly implies public services and public goods at the physical construction level. Therefore, the government should play a leading role in starting this strategy by funneling more investment to rural areas. However, government should only play a role where the market fails (Wen and Chen, 2007).

(2) The main participation role of farmers

Farmers should be the main participants in new socialist countryside construction, although the government plays a leading role to start and invest in this scheme. If the farmers cannot participate in this scheme, it is difficult to achieve the expected results of new socialist countryside construction, even if the government invests greatly in rural areas. If the farmers take this scheme as an imposed task or the government's image project, the new socialist countryside construction would fail. Therefore, it is of great importance to disseminate the relevant policies among farmers, which could make them realize that this scheme is directly related to their own interests, and mobilize them to participate in the new socialist countryside construction. Some incentive system, such as giving more financial support to the active villages, can be used to attract the farmers' investment and push forward the new socialist countryside construction.

In addition, it should be noticed that many young labors have migrated to urban areas for work or doing business and there is a lack of labors in rural areas. However, new socialist countryside construction must rely on farmers with knowledge, good skills, and management capabilities. Therefore, education should be provided to improve the farmers' skills. Also, measures should be taken to encourage enough young labors to stay in rural areas for new socialist countryside construction while guiding rural labors to urban areas (Zhang, 2010).

(3) Advocating social participation

The "Sannong" problem directly relates to the common interests of the society, as China is still

a largely agricultural country. Therefore, we should attract much more social capital to support new socialist countryside construction. Moreover, various measures like “One Enterprise One Village” should be advocated to develop the local economy rather than simple donations.

(4) The guiding role of city

New socialist countryside construction cannot just focus on rural areas. The long term mechanism of “industry feeding agriculture and urban areas supporting rural areas” should be established to ensure the smooth progress of the new socialist countryside construction. Industrialization and urbanization should play a guiding role in new socialist countryside construction from three aspects: 1) more public finances generated from industrialization and urbanization can be put in new socialist countryside construction; 2) more farmers can work in the secondary and tertiary industry and settle down in urban areas through industrialization and urbanization; 3) modern urban civilization could play a role in rural life through providing good public services and infrastructure.

(5) Reforms in advance

Various reforms should be undertaken to break the urban-rural dual system, which is the institutional hindrance to new socialist countryside construction. The system of household registration, social security, education and health care should be reformed, so that the farmers can enjoy similar public services in urban areas. The land management system should be adjusted to make more added land revenues to be used in new socialist countryside construction. Also, the national income distribution pattern should be adjusted to correct current unreasonable

condition. In addition, funneling public finance to new socialist countryside construction should be considered, which further promotes the agriculture development and increases farmers' income. Finally, the social management system at the village level should be reformed to better serve the local farmers.

The policy of 'increasing versus decreasing balance'

With rapid economy development and urbanization, China faces a prominent conflict between protecting cultivated land and satisfying the demand for construction land (Ding, 2007). Urban construction land is relatively scarce while the use of rural construction land is disordered and inefficient (Zheng and Fu, 2007). Moreover, rural settlement is abandoned as a result of farmer's emigration to cities for better living environments, which cause a substantial amount of land waste. As a result, the Ministry of Land and Resources of China (MLR) introduced a regulation on "The balance between the increase of construction land in urban areas and the decrease of that in rural areas" in 2008, which is short for 'increasing versus decreasing balance' (MLR, 2008).

Although other types of rural construction land are also involved, rural residential land is the most common type of land in practice, where 'increasing versus decreasing balance' is more frequently called as rural residential land exchange. According to official guidelines of rural residential land exchange, farmers are required to live in concentrated settlement in order to save rural construction land. The saved rural construction land is reclaimed as cultivated land, the size of which is recognized based on the quality of the reclaimed cultivated land. After the reclamation, the right of occupying cultivated land as construction land for the reclaimed

cultivated land will be transferred to the urban areas through a land use right ticket, the so-called land ticket. The farmers will receive a certain amount of compensation by giving the land ticket to the government. The government can then sell the right to developers by allocating the same size of a site plot in the urban areas. In this way, the gross construction land and cultivated land remains unchanged while the distribution seems more reasonable than before. All the cost incurred in the process of rural residential land exchange is covered by the revenue from issuing land tickets. Based on the above discussion, the typical process of rural residential land exchange can be shown in Figure 2.4.

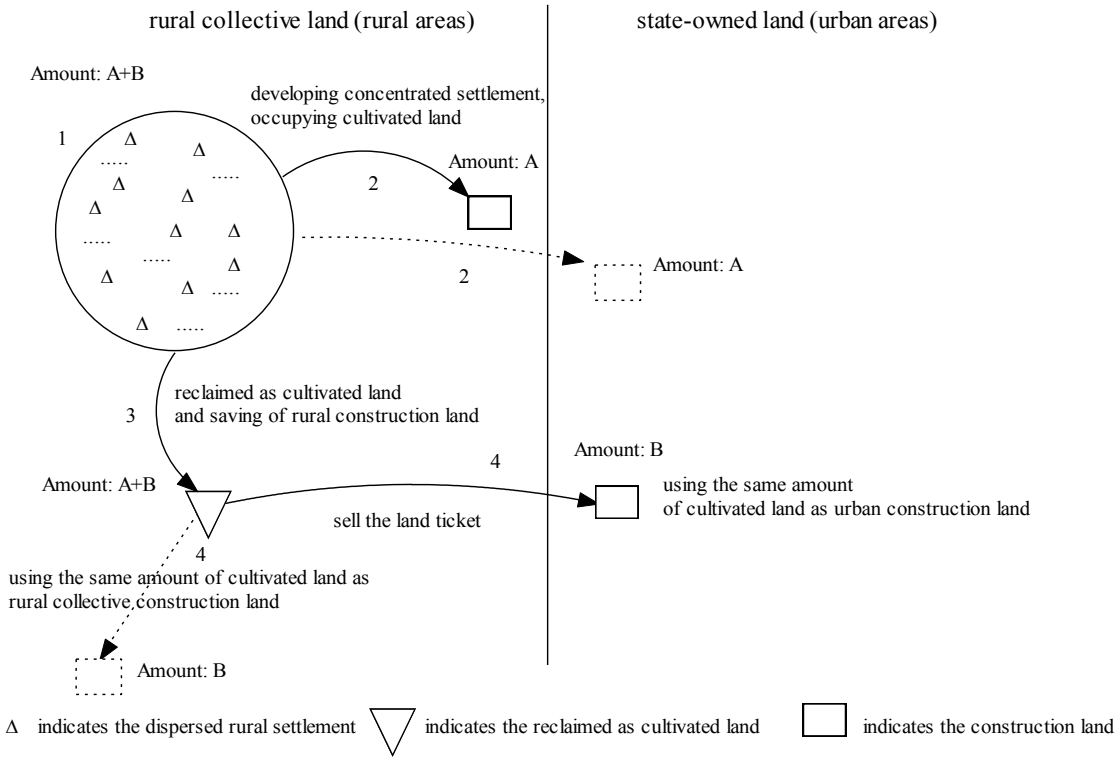


Figure 2.4 The typical process of rural residential land exchange

Step 1: The local government should first select the suitable villages, for example the dispersed

rural settlement occupying amount of A+B rural residential land as shown in Figure 2.4, for implementing rural residential land exchange. The government should define compensation schemes, select the place for the new settlement, and get the approval from the official departments in charge. If the planned location for concentrated settlement would occupy cultivated land, for example the amount of A cultivated land as shown in Figure 1, the provisional quota of the amount of the cultivated land should be attained in advance, which is used to control the scale of rural residential land exchange.

Step 2: A new concentrated settlement will be usually built before removing the old settlement. The concentrated settlement can be built in rural areas, for example occupying amount of A cultivated land in Figure 2.4, in line with relevant town planning and land use planning. The affected farmers would remain rural residents. On the other hand, the concentrated settlement can also be built in urban areas, in line with urban planning and land use planning. The affected farmers will live in a concentrated settlement, and they will also be converted to urban residents and receive the urban social security by giving up the share of cultivated land.

Step 3: The farmers would move into the new settlement according to the preset compensation schemes. As the concentrated settlement costs more than the traditional rural house, the farmers usually get less building area or spend extra money to get the same amount of living area. The former houses are removed and the relevant rural residential land is reclaimed by the local government. The amount of the reclaimed cultivated land would be recognized according to its quality, which can be specified as amount A+B in Figure 2.4. A portion of amount A would be used to make up for the cultivated land occupied by the newly developed concentrated

settlement in step 2. Then the provisional quota of occupying cultivated land is cleared.

Step 4: As a result of concentrated resettlement and reclamation, a significant amount of rural residential land can be saved, for example amount B in Figure 2.4. Through land tickets, the right to occupy amount of B cultivated land as construction land can be transferred to the urban areas. Various developers can therefore bid for the land ticket in the transaction market. After attaining the land ticket, the developers can identify and choose the same amount of cultivated land in urban areas for developing properties in line with urban planning and land use planning. In this way, the gross area of urban and rural construction land remains unchanged. There are two transaction markets for rural residential land exchange: Chongqing City and Chengdu City. However, many other local governments take similar approaches, although they have no transaction markets. The revenue from land ticket becomes the source of removal, reclamation, and compensation. Also, the village could use the saved collective construction land to attract investments and develop industry or commerce. The farmers can share the interests generated from industry and commerce development.

Although this policy aims to provide a tool for balancing the construction land in rural and urban areas, the natural outcome of this policy is more concentration in rural settlement. Moreover, the farmers can attain extra income from transferring the construction land use right from rural areas to urban areas. Therefore, together with the CURDS, and new countryside reconstruction, it is widely used as a tool for implementing CRS. The following section briefly introduces the existing practices of developing CRS under normal conditions in China.

2.4.2 Operating process of CRS development

CRS can be developed as a result of agricultural industrialization and urbanization under normal conditions (Chen and Zhang, 2006). With the agricultural industrialization, the traditional agriculture industry can be transitioned from a dispersed, small scale and extensive operation to regionalization, specialization and intensification. As a result of specialized production, land concentration is necessary, thus CRS can be formed under this condition. In addition, the economic development can provide the farmers more work opportunities in the nearby towns. Local urbanization therefore develops gradually and the farmers can be concentrated in the towns.

CRS can also be advanced through implementing specific policies such as "increasing versus decreasing balance". There are four characteristic approaches to developing CRS through these policies (Wang et al., 2011):

(1) Jiangsu mode: project of building ten thousand hectares of fertile farmland

Background: There are still many problems in rural areas in Jiangsu province, although it has achieved great economic development since 1978. The cost of providing rural infrastructure is high but the utilization efficiency is low due to the dispersed pattern of living and agricultural production. As a result, it is difficult to satisfy the demands of living and economic development in rural areas. Therefore, Jiangsu Province started the project of building ten thousand hectares of fertile farmland in June 2009. It is a systematic project aiming to optimize the pattern of regional land use, concentrate agricultural land and residence and achieve intensive land use. The guidelines include the existing land use planning, town planning, CURDS, new socialist

countryside construction, and “increasing versus decreasing balance” policy. Measures are taken to harness the land in order to increase the areas of farmland and improve the quality while concentrating rural settlement in order to save rural construction land (Jiangsu Provincial Department of Land and Resources, 2008).

Implementation process: Figure 2.5 summarizes the operating procedures of building ten thousand hectares of fertile farmland in Jiangsu Province. The main steps include (1) determining the land to be included in the project, (2) preparing the project planning, (3) submitting applications to the provincial department of land and resources, (4) the department of land and resources checking the application and issuing the permits, (5) the county government then organizing the implementation activities, and (6) the provincial department of land and resources organizing a delivery check according to the planning. Figure 2.5 lists all the precautions needing to be considered in each step. It should be noticed that during the implementation stage, the county government would demolish the rural houses involved in the project. Also, subsidy in the form of money, nursing home, concentrated settlement in nearby towns and CRS in the central village are used to resettle the farmers. After resettlement, the former rural residential land is consolidated into farmland. Moreover, the land can be circulated for modern agricultural development. The CRS is developed as a result of implementing this project.

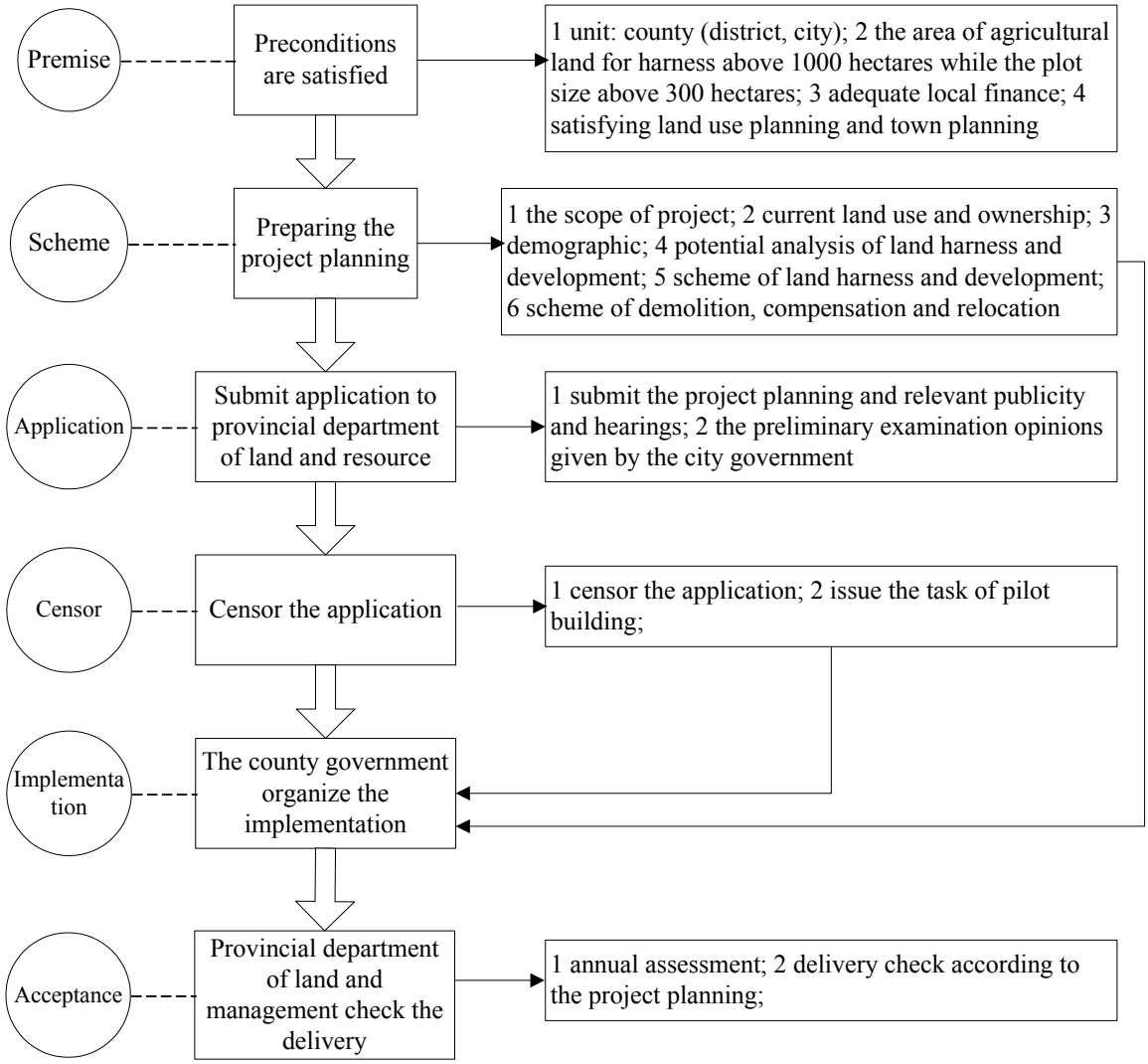


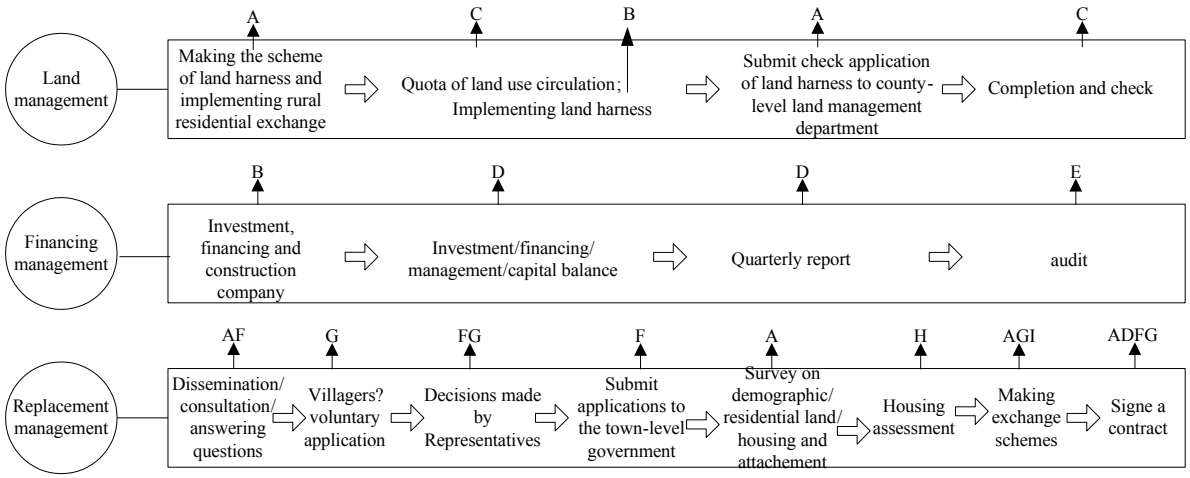
Figure 2.5 Procedures of building ten thousand hectares of fertile farmland in Jiangsu Province

Source: Wang et al. (2011)

(2) Tianjing mode: Exchange houses with rural residential land

Background: There are several problems in the town development in Tianjing, such as small scale, low population density, and lack of practical planning and implementation measures. Meanwhile, there are also some problems in rural areas, including higher per capita rural residential land, low efficiency of land use, and insufficient infrastructure and public services. In order to solve these problems, exchanging house with rural residential land has been used to

build towns and countryside since 2005 in Tianjing. Moreover, "Implementation measures of exchange house with rural residential land in Tianjing" was officially formulated in August 2009. The farmers can obtain certain areas of housing in the towns in exchange for their rural residential land, according to preset standards. The town for the farmers moving in should be suitable for rural economic and social development, industry agglomeration, and living. Meanwhile, the former rural residential land should be reclaimed as farmland and the saved quota of construction land is used for public bidding, the revenue from which is used to make up for the funding gap of constructing the towns.



Note: A~I is the main participant. A- town-level government, B- county-level government, C- county-level land management department, D-investment, financing and construction company, E- audit institution, F- village committee, G- villager, H- housing assessment agency, I- Township People's Congress

Figure 2.6 Procedures of exchange houses with rural residential land in Tianjing

Source: Wang et al. (2011)

Implementation process: Figure 2.6 presents the operating procedures of exchanging houses for rural residential land in Tianjing. Three major procedures including land management, financing management and replacement management are inter-connected. All the involved participants and precautions are shown in Figure 2.6. The voluntary principle was followed in the

implementation process. The farmers moving into the towns are provided with social insurance and work opportunities. The farmers moving into the CRS can keep the rural living and agricultural industrialization is used to solve the problem of larger cultivation radius.

(3) Shandong mode: Developing rural communities in central village

Background: Shandong province has advocated rural communities in central village through the "increasing versus decreasing balance" since 2008. Zhucheng is selected as one of 296 experimental counties developing rural communities at the national level and one of the counties building the new countryside construction and reforming rural community at the provincial level.

Implementation process: Figure 2.7 presents the main steps taken in the process including building rural communities in central villages, building CRS around the rural communities, attracting farmers to move into the CRS, and circulating and concentrating land for industrial development. During this process, 208 rural communities were developed and each rural community covers about five villages and 1,500 households. Gradually, the spatial structure "city-town-rural community" is formed. The function of rural community is to provide public services to the surrounding CRS. As a result, the CRS has been developed and local urbanization is achieved.

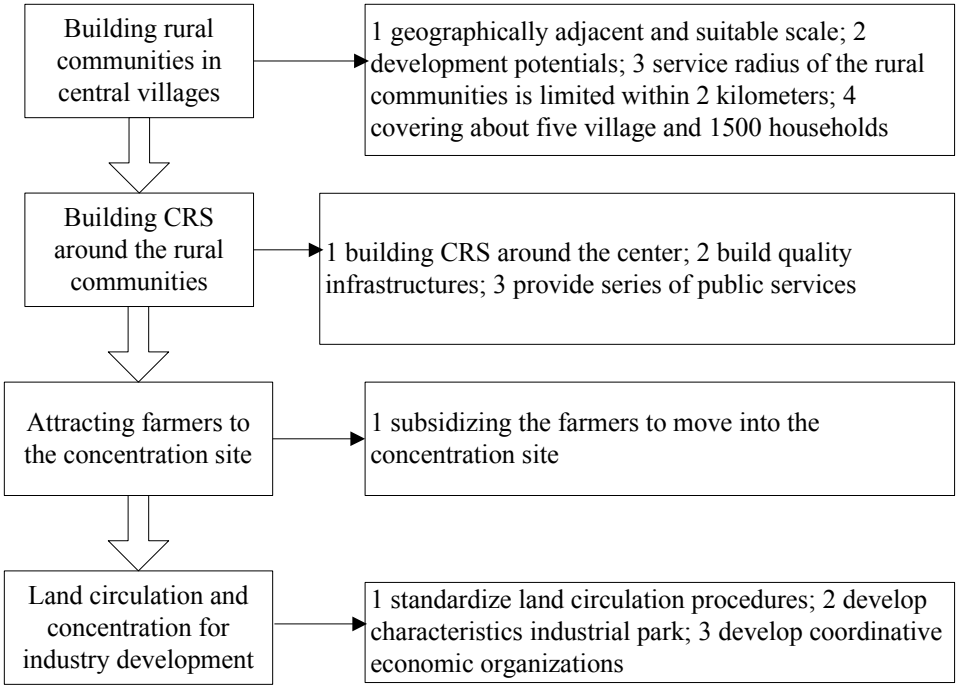


Figure 2.7 Procedures of developing rural communities in central village in Shangdong Province

(4) Chengdu/Chongqing mode: Land ticket transaction

Background: Chengdu and Chongqing were officially approved by the state council as the comprehensive reform experimental zone for urban-rural coordinated development in May 2007. Land exchange institution was therefore established for land ticket transaction and exploring coordinated use of urban and rural land. Regulation was made to specify the transaction boundary, transaction approach, qualifications of participants and right protection.

Implementation process: Figure 2.8 presents the operating procedures of land ticket transaction. The holders of land tickets propose transaction application either by themselves or the agency first. Then the rural residential land should be consolidated into farmland, the quality and quantity of which should be checked. After the qualification investigation, the increased quota

of farmland can be formed as a land ticket for public bidding in a land exchange institution. Once the transaction is successful, the generated revenue can be used to compensate on reclamation of rural residential land, developing CRS, relocation, and rural collectives. Meanwhile, the trade is confirmed and recorded for new construction land planning in urban areas. And finally, the purchaser of the land ticket can use the quota of construction land when a certain amount of farmland is found in urban areas. Land ticket is useful to standardize the exchange procedure and price and break through the administrative boundaries in the "increasing versus decreasing balance" policy. As a result of this procedure, the CRS would be developed.

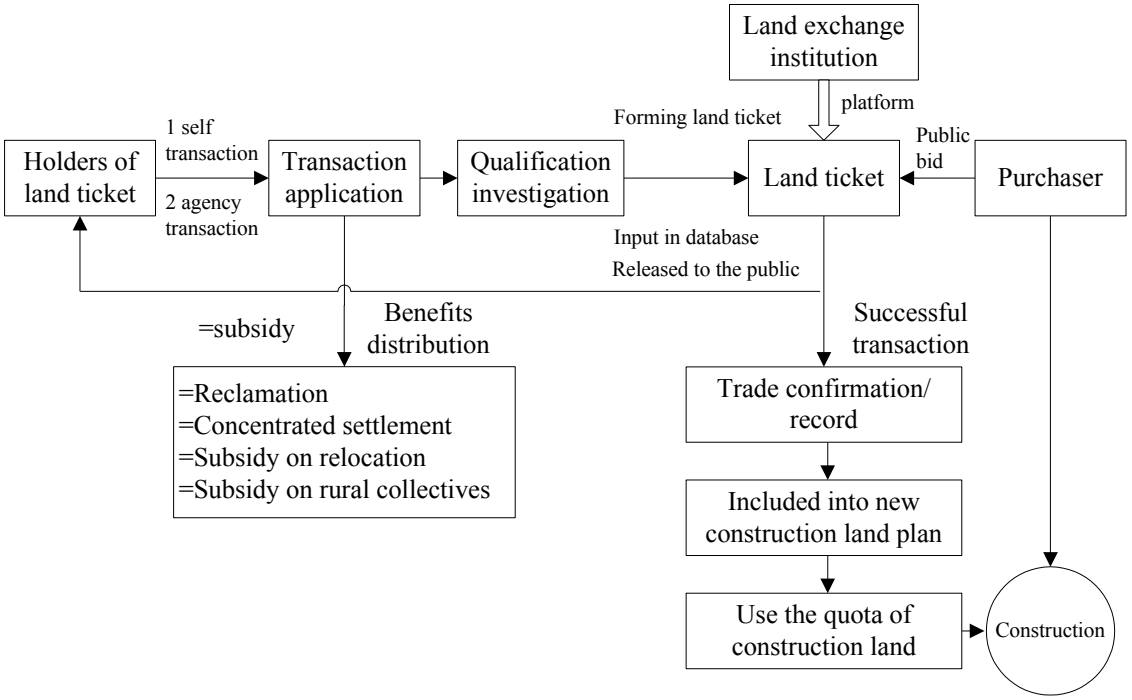


Figure 2.8 Procedures of land ticket transaction in Chengdu/Chongqing

Source: Wang et al. (2011)

2.5 Decision System of Rural Housing Reconstruction under Disaster Conditions

2.5.1 The policies of rural housing reconstruction

The legal system for responding to natural disaster has been basically established through thirty years' efforts. In the past thirty years, some twenty-two laws and regulations were promulgated each year (Zhang et al., 2011). The legal system has defined the responsibilities of each governmental department in pre-disaster prevention, relief during disaster, and post-disaster reconstruction. However, these laws usually focus on emergency response and give few guidelines on rural housing reconstruction at the village level. Table 2.3 summarizes the important laws and regulations concerning rural housing reconstruction in the aftermath of the 5.12 Sichuan Earthquake. These laws and regulations provide general principles, general procedures, common management approaches, and even some specific technical guidance.

Table 2.3 Laws and regulations concerning rural housing reconstruction

No.	Laws/regulations	Issuer	Emphasis	Year
1	Master plan of Wenchuan earthquake recovery and reconstruction	SC	General principles of rural housing reconstruction	2008
2	Guidance on Wenchuan earthquake recovery and reconstruction	SC	General principles of rural housing reconstruction	2008
3	Various Specific planning for Post-Wenchuan Earthquake Reconstruction	NDRC, MOA, MOT	Planning principles of countryside reconstruction, land use, housing reconstruction, environment restoration, and market development	2008
4	Technical guidance on rural housing reconstruction post-Wenchuan earthquake (pilot)	MOHURD	General technical guidance on rural housing reconstruction	2008
5	Sending technical personnel to guide rural housing reconstruction post-Wenchuan earthquake	MOHURD	Solving the problems of insufficient technical personnel	2008
6	Guidance on rural housing	MOHURD	General management approach of	2008

	reconstruction post-Wenchuan earthquake		rural housing reconstruction	
7	State Emergency Plan of Natural Disaster Aids	MCA	General management approach of rural housing reconstruction	2011
8	Work procedures of housing reconstruction	MCA	General work procedures of rural housing reconstruction	2004
9	Work scheme of rural housing reconstruction in Sichuan post-Wenchuan earthquake	SCPPG	General principles and work procedures of rural housing reconstruction	2008
10	Technical guidance on site selection of rural housing reconstruction post-Wenchuan Earthquake in Sichuan Province	SCPPG	Principles of site selection for rural housing reconstruction	2008
11	Seismic Technical regulations of rural housing in Sichuan Province	SCPDHURD	Seismic resistance design of rural housing	2008
12	Technical guidance on building rural housing in Wenchuan Earthquake-stricken areas	SCPDHURD	Technical standard of building rural housing	2008

Note: SC-State Council, MCA-Ministry of Civil Affairs, MOHURD-Ministry of Housing and Urban-Rural Development, SCPPG-Sichuan Provincial People's Government, SCPDHURD-Sichuan Provincial Department of Housing and Urban-rural Development, NDRC-National Development and Reform Commission, MOA-Ministry of Agriculture, MOT-Ministry of Transportation

These laws and regulations concerning natural disaster management are still incomplete and imperfect, although they play a major role in rural housing reconstruction. First, these laws are usually based on specific government departments or disaster events and are short of coordination. Therefore, there will be a series of laws and regulations related to a specific disaster event. For example, there are about 100 laws and regulations for earthquake at the national level, however, two-thirds of these laws were made in response to the 5.12 Sichuan Earthquake. Second, there is a lack of a basic law of disaster management at the national level, which specifies the critical policy, management system, main tasks, responsibilities, involved agencies and participants, and procedures (Yi et al., 2012). Therefore, the activities of disaster mitigation, response and reconstruction generally rely on governmental authority instead of laws.

2.5.2 The operational mechanism of rural housing reconstruction

Operation agency

The operational mechanism of disaster management system in China can be summarized as: "unified leadership, graded response and functional division, based on local government and supplemented by central government" (Yi et al., 2012: 296). The operation mechanism remains the same with housing reconstruction, as post-disaster reconstruction is part of disaster management. Unified leadership implies that the government formulates policies and planning, makes decisions, dictates, oversees and coordinates during the process of disaster management. Graded response means that the central government is responsible for major disasters, the provincial government for large-scale, the municipal government for medium-scale, and county government for minor disasters. Functional division is that relevant departments of the government undertake relevant work of disaster management according to their respective duties. The implementation of disaster management including expenditure mainly relies on local government and is supported by the central government.

At the national level, the National Committee for Disaster Reduction, the State Flood Control and Drought Relief Headquarters, the State Council Earthquake Relief Headquarters, the National Forest Fire Prevention Headquarters and the National Disaster Relief Coordination Office and other agencies responsible for disaster reduction, relief coordination and organization of work are established under the unified leadership of the State Council. These agencies and other ministries such as the ministry of civil affairs, ministry of land and resources, ministry of housing and urban-rural development, and ministry of finance formulate the master plan and

sectional regulations and preferential policies to support rural housing reconstruction. The local governments at all levels also set up similar functions of the coordinating body for rural housing reconstruction. The provincial government usually further makes work schemes to implement the master plan and policies formulated by the national government. The county-level government and relevant departments such as bureau of civil affairs, bureau of land and resources, bureau of housing and urban-rural development, and bureau of finance are usually the agencies to carry out the work schemes and organize various activities to complete rural housing reconstruction. It is emphasized that full responsibility should be borne by the top leader of each level of government and relevant departments during the rural housing reconstruction process.

This management system would result in dispersion of information and resources, information barriers, and low effectiveness and efficiency. In addition, the coordination organization finds it difficult to play a coordinating role due to overlapping functions, limited resources, and exclusive pursuit of departmental interests. Therefore, when a catastrophe occurs, such as the 5.12 Sichuan Earthquake, the central government will directly establish a Comprehensive Disaster Headquarters of the State Council while the standing coordinating organization will be temporarily canceled and still unable to play its due role. Moreover, the local coordination organizations have to accept not only the administrative guidance of the local government but also that of upper coordination organization. The repeated instructions usually affect the timely rescue and reasonable post-disaster reconstruction (Guan and Cheng, 2011).

General principles

General principles can be identified from the formulated laws and regulations concerning rural

housing reconstruction such as “master plan of Wenchuan earthquake recovery and reconstruction”, and “work scheme of rural housing reconstruction in Sichuan post-Wenchuan earthquake”. These principles can be summarized as follows: (1) suiting local conditions: reconstruction in-situ is the first choice unless the location is destroyed by natural disasters; (2) unified planning first: scientific, practicable, and operational planning should be made based on the results of damage assessment; (3) architecture: the architecture and quality of the rural housing should be improved while satisfying the requirements of seismic resistance; (4) function: the rural housing should serve the modern lifestyle while keeping the local characteristics and traditional ethnic style; (5) financial source: a combination of self-financing, governmental subsidy, construction support partners, and social donations; (6) land and environment: the land should be saved and the ecological environment should be protected; (7) organization: the government at all levels in the disaster area should provide a variety of housing designs and technical guidance of construction freely; (8) participation: full respect of the farmers’ willingness; and finally (9) rural housing reconstruction should be combined with new countryside construction after the strategy of new socialist countryside construction was promoted in 2006.

Financial sources

The financial sources for rural housing reconstruction are usually rural victims’ own funds and external funds such as financial compensation, bank loans, social donations and reconstruction support partners. The financial compensation standard would be made by the ministry of civil affairs according to the damage and available financial capability. However, the national subsidy

is limited. In addition, financial compensation is transferred through each level of government, which not only means delays but also hinders forming effective stimulus to reduce risk (Wang, 2010). For example, after the 5.12 Sichuan Earthquake, each household could obtain an average of 20,000 Yuan. The subsidy was further classified according to the number of people and affluence, as shown in Table 2.4. Except for financial compensation, the reconstruction support partners can provide 10,000 Yuan for each household while the Red Cross would grant 15,000 Yuan to selected households on rural housing reconstruction. Therefore, the highest subsidy is only 45,000 Yuan, which is far from the average cost of rural housing reconstruction: 80,000 Yuan in Sichuan. This financial gap presents great difficulties for the rural victims in disadvantaged rural areas.

Table 2.4 Financial compensation on rural housing reconstruction after the 5.12 Sichuan Earthquake (Yuan)

Types of household	1-3 persons/household	4-5 persons/household	6 or above persons/household
General household	16,000	19,000	22,000
Poor household	20,000	23,000	26,000

Operation process

There are four main steps of rural housing reconstruction as shown in Figure 2.9. The first step is to determine the households needing reconstruction. After the damage assessment, the victims should apply for reconstruction by themselves. The village committee would organize discussions on the application, the results of which would be publicly announced to the rural victims. Then the village-level government gathers the confirmed applications and submits them

to the town-level government. The town-level government would examine the applications and further submit them to the county-level civil affairs department for approval. If CRS is adopted, the relevant information should be recorded in the municipal-level and provincial-level civil affairs departments after county-level approval.

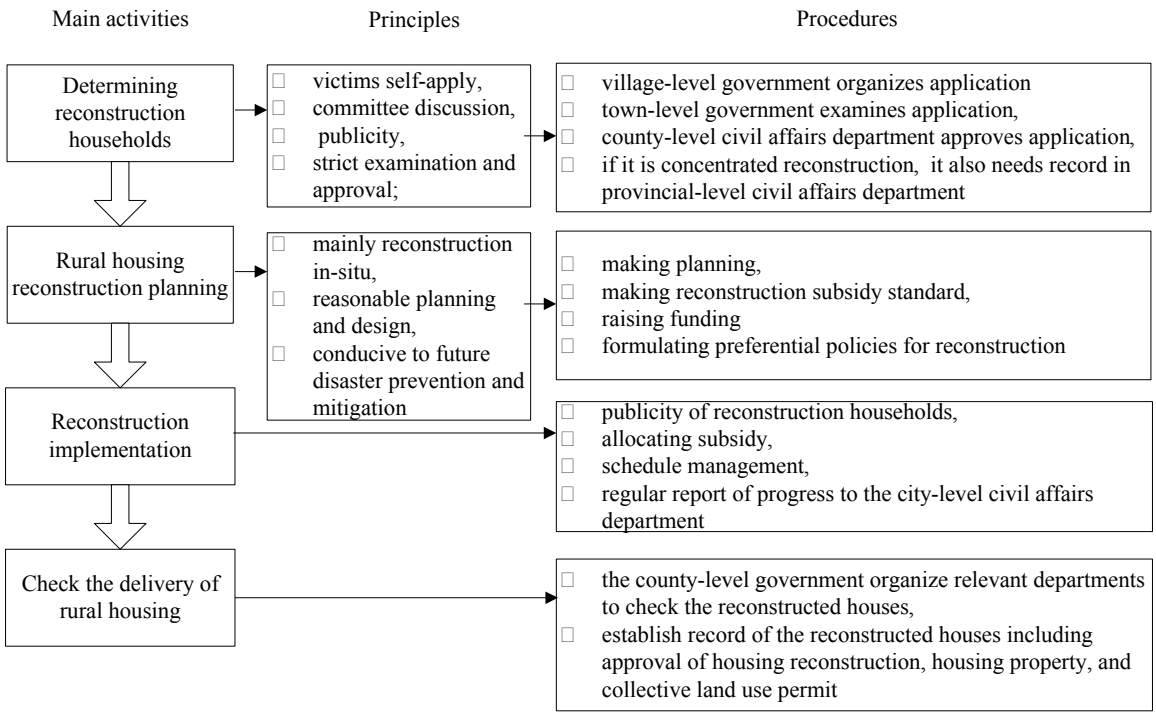


Figure 2.9 Operation procedures of rural housing reconstruction

After identifying the households needing reconstruction, the rural housing planning would be carried out. The planning should specify the reconstruction approach, which is mainly reconstruction in-situ. Moreover, the planning should be reasonable and conducive to future disaster prevention and mitigation. While making plans, the financial compensation standard should be specified. Also, the means of funding raising and preferential policies for rural housing reconstruction would be formulated.

After the planning is confirmed, rural housing reconstruction can be implemented according to the planning. The county-level government should publicize the reconstruction schemes and allocate the financial compensation. Payment by installment is usually taken as a way to promote reconstruction. The county-level government would sign a contract with the town-level government to supervise the reconstruction progress. Regular report of reconstruction progress would be submitted to the municipal-level civil affairs department. Also, relevant departments would conduct quality checks now and then during the reconstruction.

Checks of the delivery of rural housing would be conducted within a month of completing reconstruction. The county-level government would organize relevant departments such as the bureau of civil affairs, bureau of land and resources, bureau of housing and urban-rural development, and bureau of finance to check the quality, property and whether housing is in accordance with the planning and existing laws and regulations. After that, the property right certificate would be issued, which would be further recorded along with approval of the housing reconstruction. The rural housing reconstruction is usually ended at this point.

2.6 Problems in the Exisiting Decision Systems

2.6.1 Problems in the decision systems of CRS development

The decision systems discussed in section 3.1 provide a useful tool for developing CRS under normal conditions. However, through literature review and interview, it is found that there are still some problems in them if strictly applied in developing CRS in post-disaster reconstruction.

Inherent disadvantages in each decision system

The four decision systems have their inherent disadvantages even under normal conditions. For example, Jiangsu province took considerations of increasing fertile farmland, avoiding low quality of consolidated rural residential land, and promoting agricultural industrialization large-scale agricultural production. However, it was complained that compensation on resettlement is not sufficient. The farmers could not bear the cost of purchasing houses in towns while the CRS in central village is not suitable. The practice in Tianjing aimed to advance urbanization but the pace of urbanization was too rapid. Thus, it brought many negative impacts on rural production and living. The practice in Shandong province promoted physical construction in rural areas. However, it separated the farmers' living and production space and thus increased the living cost. The practice in Chengdu and Chongqing innovatively explored the means of rural construction land exchange. Also, the risk of imbalance between occupying farmland and supplementing farmland was mitigated through reclaiming rural residential land first and then exchanging the quota of construction land use. However, the revenue distribution between government, firms and farmers was uneven. Moreover, it undermined farmers' interests for several reasons, such as involuntary participation, insufficient subsidy, and drastic change of rural lifestyle without further support.

Little attention on CRS at the village level

The focus of the decision system is not on CRS at the village level, although CRS is developed as a result of these practices. The government has enough incentives to promote economic development and achieve political achievements with the "increasing versus decreasing

balance" policy. However, CRS is usually difficult to suit the lifestyle of rural living due to overlooking CRS planning and design. For example, CRS is usually far from the contracted land with no space for storing grains and farm tools and feeding livestock. The farmers keeping the rural lifestyle have to bear increased living costs and transport costs of continuing farm work. In addition, the culture, ecological landscape, and social security cannot be adequately considered in CRS without good planning. Moreover, the county-level government rather than the village-level government is the main subject to promote this project. Therefore, the voluntary principle is difficult to follow and the farmers' concerns are hard to take into consideration.

Different context from that under disaster conditions

The four decision systems are established under normal conditions. However, the post-disaster reconstruction environment is chaotic, dynamic, and complex, which is quite different from that under normal conditions (Berke et al., 1993; Alexander, 2004; Birkland, 2006; Davidson et al., 2007). For example, a rush of progress is common to complete housing reconstruction in a short duration as a political task in China. Plus with limited resources and technical personnel, project supervision and quality checks are difficult to carry out. Therefore, these decision systems are difficult to be strictly applied in developing CRS in post-disaster reconstruction.

2.6.2 Problems in the decision systems of rural housing reconstruction

The decision system discussed in section 3.2 provides general principles, procedures and responsibilities of each level of government. However, through literature review and interview, it is found that the decision model could not be directly applied in developing CRS in post-

disaster reconstruction due to the following reasons:

Lack of effective pre-disaster planning at the village level

The National Emergency Plan System was developed by State Council in 2006. According to the regulation, the local government at each level should also have a corresponding emergency plan. It is stressed that pre-disaster planning should occur at each level of government. However, the disaster emergency plan at the lower levels, such as the village level, is usually useless due to low quality, lack of specific response measures, and absence of usable operations. These insufficiencies usually result in unreasonable reconstruction thus sustainability is difficult to ensure in post-disaster reconstruction no matter what reconstruction approach is utilized. In addition, there is no specific pre-disaster planning for developing CRS at the village level. Thus, although several cases of developing CRS were reported as successful, many problems such as inadequate infrastructure, insufficient coordination between industrial planning and developing CRS, and weak basis for future development occurred in the practices that still exist.

Little involvement of NGOs in rural housing reconstruction

In addition to the government, nongovernmental organizations (NGOs) are also encouraged to participate in disaster prevention and mitigation. The 5.12 Sichuan Earthquake provided a chance for NGOs to participate in disaster relief (Huang et al., 2011). But the contributions of NGOs to natural disaster management are limited due to several problems. First, there are currently no operational regulations on how to participate in disaster prevention, mitigation, rescue, and post-disaster reconstruction for NGOs (Yi et al., 2012). Second, the channels for NGOs to participate in post-disaster reconstruction are missing. NGOs commonly take a part in

raising donations and rescue in the emergency response stage but have few impacts on post-disaster reconstruction due to limited financial and human resources (Yuan, 2009). Third, few NGOs have a long term aim of voluntary service in a special field. At present, many NGOs are established according to the governmental needs rather than the social needs. Therefore, most NGOs could not participate in the field where the government pays little attention, like assessment of post-disaster reconstruction, management of new rural communities, or psychological recovery after the emergency response stage. In addition, without the attraction of long-term ideas, most members just take NGOs as a means of living, which blocks their further development.

Lack of disaster mitigation and prevention in rural areas

It is also noticed that the individual is weak in facing natural disasters due to lack of concern and skills at responding to natural disasters. The current laws and regulations only emphasize building emergency management systems from the aspect of government. This generally excludes individuals' role in disaster mitigation and prevention. Therefore, education should be given to improve individuals' abilities to prevent and respond to natural disasters (Barakat et al., 2012). Moreover, the monitoring and early warning systems and emergency plans should be open to the public, which would enable the individuals to understand and participate in emergency plans.

Lack of community management for CRS

As reconstruction in-situ is always the first choice for rural housing reconstruction, the dispersion pattern of rural settlement is kept like that before disaster occurs. The traditional

approach would be adopted by the village committee to conduct routine management. Therefore, the existing decision system of rural housing reconstruction just ends with checking the delivery of rural housing. However, CRS is a new form different from both the traditional dispersed rural settlement and the urban community. Many new problems such as how to adapt to the new lifestyle are generated as a result. An appropriate management approach should be put forward to deal with these problems, which are not included in existing decision systems of rural housing reconstruction.

2.7 Summary of the Chapter

This section has reviewed post-disaster reconstruction and rural settlement patterns. The research on rural settlement patterns aims to measure concentration and dispersion, develop principles for concentrated and dispersed rural settlement, explain the diffusion process of rural settlement and explore the advantages of CRS. Developing CRS is usually purposely conducted under normal conditions. Few studies have explored developing CRS within a village under disaster conditions.

On the other hand, housing reconstruction provides the physical basis for settling down the victims, restarting industry production, and thus facilitating economic recovery and restoring the environmental function. Therefore, this section has reviewed post-disaster reconstruction in terms of housing reconstruction, resourcing, and resettlement versus reconstruction in-situ. The existing research stresses resettlement, which is a useful approach to promote concentration but faces socio-economic challenges such as disrupted social networks, social tensions between relocated and host populations, and employment. It appears, nevertheless, that few studies have

explored the possibility of concentration within a village as a means to promote CRS and achieve sustainable development in post-disaster reconstruction.

This section also reviewed the policy context and decision system of CRS development under normal conditions and rural housing reconstruction in China. The coorindated urban-rural coordinated development strategy and new socialist countryside construction put forward the requirement of developing CRS while the policy of "increasing versus decreasing balance" provided an operational tool to undertake this task even before the 5.12 Sichuan Earthquake in 2008. Four decision systems of developing CRS under normal conditions, namely Jiangsu mode, Tianjing mode, Shandong mode, and Chengdu/Chongqing mode are used to promote CRS under normal conditions. It is found that these decision systems could not be strictly used in developing CRS in post-disaster reconstruction due to their inherent disadvantages and different contexts.

China has developed a natural disaster management system with promulgated laws and regulations, and defined government agencies and social participation. However, it is found that these laws usually focus on emergency response and give few guidelines on rural housing reconstruction at the village level. In addition, the disaster emergency plan at the lower levels, such as the village level, is usually useless due to low quality, lack of specific response measures, and absence of usable operations. Also, this management system would result in dispersion of information and resources, information barriers, and low effectiveness and efficiency of rural housing reconstruction. Moreover, it is found that the channels for NGOs to participate in post-disaster reconstruction are missing while the individual is unprepared to face

natural disasters due to lack of concern and skills in responding to natural disasters. As a result, the existing decision system of rural housing reconstruction could not be directly used in developing CRS in post-disaster reconstruction.

In line with this, the research gap can be addressed as how to develop CRS in post-disaster reconstruction. The reviews in this chapter provide theoretical foundations for further study and help to identify the research gaps addressed in this study. These research gaps therefore lead to the formulation of the research aim and objectives for this research. Therefore, there is an urgent need to establish a decision model for developing CRS in post-disaster reconstruction.

3 RESEARCH METHODOLOGY

This chapter sets forth the research design and methodology adopted in this study. Relevant process, data collection and analysis techniques for each objective are presented in details.

3.1 Research Design

In line with the research objectives and rationale, literature review, content analysis, interview and case study were adopted as the research methods. Figure 3.1 displays the main research questions, research activities, and the corresponding research methodology. The following section would discuss the reason of adopting these methods and the process of realizing relevant objectives.

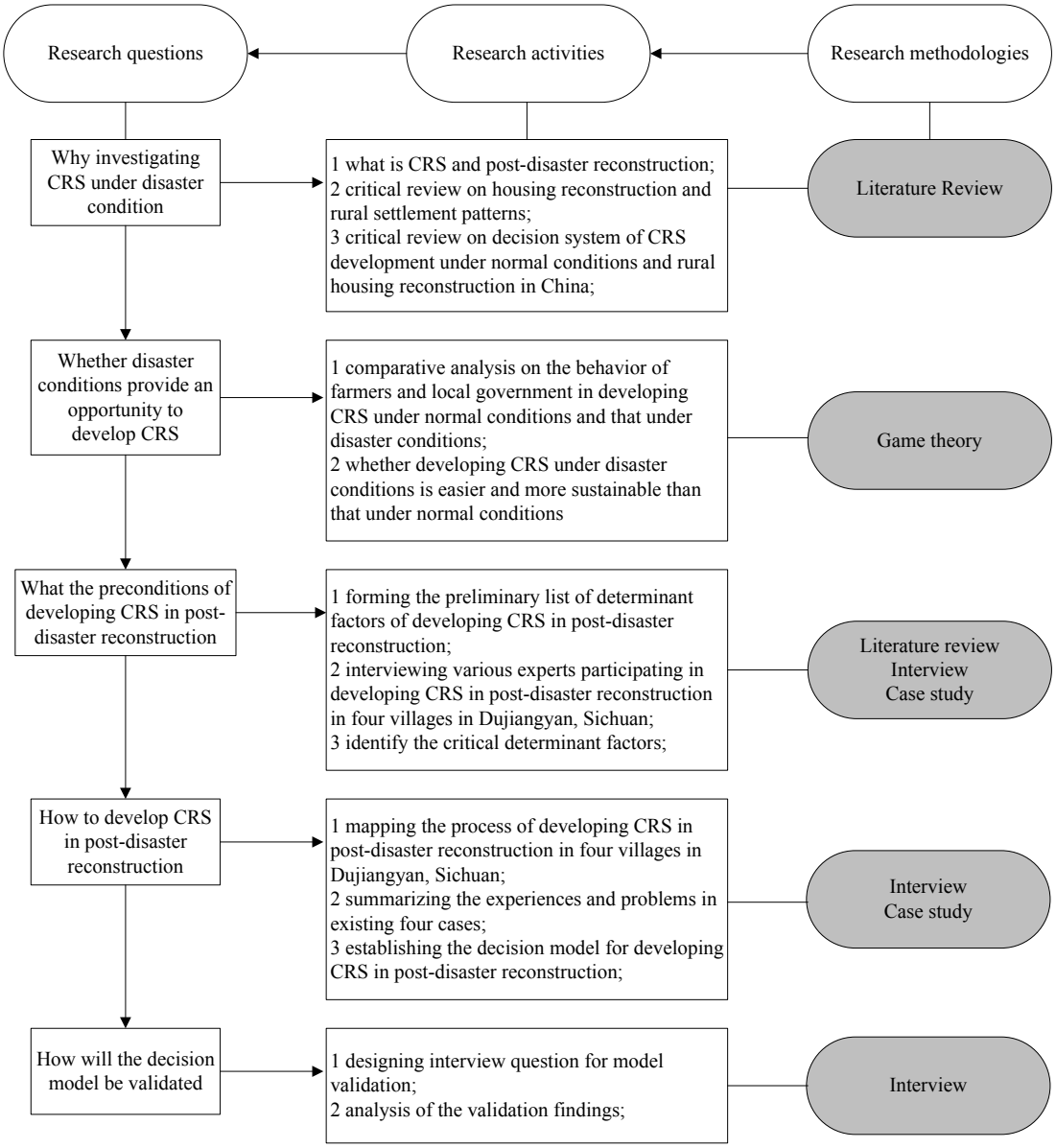


Figure 3.1 Research flow of this study

3.2 Methodology for Each Research Question

3.2.1 Literature review to establish a clear basis of research gap

Studies on post-disaster reconstruction and rural settlement patterns in terms of concentration and dispersion have been critically reviewed to gain an understanding of the two concepts. Keywords including “rural settlement patterns”, “concentrated rural settlement”, “dispersed

rural settlement", "post-disaster reconstruction", "housing reconstruction", "resourcing in post-disaster reconstruction", "resettlement post-disaster" and "reconstruction in-situ post-disaster" were used to search relevant research and reports in established database: Web of Science, EBSCOhost, Emerald Engineering Database, and Google Scholar. Some classic and important books and journal papers were also extracted by examining the reference list in the firstly found literature. Through the review, issues relevant to the classification between concentration and dispersion, general principles of rural settlement patterns, spatial equilibrium theory on rural settlement patterns, advantages of concentrated rural settlement, housing reconstruction, resourcing in post-disaster reconstruction, resettlement versus reconstruction in-situ were summarized. It was found that few studies have explored developing CRS within a village under disaster conditions while those responsible for housing reconstruction after a disaster generally disregard CRS as an optional approach.

In addition, a critical review was undertaken of existing decision systems for CRS development under normal conditions and rural housing reconstruction in China. Keywords including "decision system of CRS development in China", "decision model of CRS development in China", "decision system of rural housing reconstruction in China", "decision model of rural housing reconstruction in China" were used to search relevant research and reports in established database: Web of Science, EBSCOhost, Emerald Engineering Database, and Google Scholar. Due to the nature of this topic, the same keywords were also used to search relevant research and reports in CNKI, which is the famous Chinese bibliographic database. Some classic and important books and journal papers were also extracted by examining the reference

list in the firstly found literature. Through the review, issues relevant to the policy context of CRS development, operating process of CRS development, the policies of rural housing reconstruction, the operational mechanism of rural housing reconstruction, problems of exisiting decision system of CRS development and rural housing reconstruction were summarized. It was found that the exisiting decision system of CRS development and rural housing reconstruction couldnot be directly used for developing CRS in post-disaster reconstruction due to the summarized problems.

The details of the literature review can be found in Chapter 2. The outcome of the reviews and analysis not only highlights the need for an effective decision model that includes the option of developing CRS after a disaster, but it also makes the significance of this study very apparent.

3.2.2 Game theory to investigate whether disaster conditions provide an opportunity to develop CRS

Disaster is appreciated as a "window of opportunity" for resettlement (Pankhurst, 1991). However, the "opportunity" is usually anecdotical without concrete evidence in previous studies (Timms, 2011; Olshansky et al., 2012). As developing CRS was promoted under normal conditions (without disasters) in China through rural residential land exchange, this research activity concerns whether disaster conditions provide an opportunity to develop CRS.

Under both normal and disaster conditions, local government and farmers are involved. Therefore the collective actions taken by the local government and farmers determine the outcomes of developing CRS. Game theory is widely applied to analyze the strategic actions of individual decision makers, where an individual's actions rely upon the choices of others

(Myerson, 1997). Player, strategy, and payoff are the three basic elements in the application of game theory. Player is the individual decision maker participating in the strategic game, who is assumed as a rational man to maximize his interest in the game. Strategy is the action available to the player. Payoff is the possible interest for each combination of strategies taken by the players. The payoffs to the players determine the actions taken in a strategic game. For a typical game analysis, the critical step is to specify these three basic elements and find out the solution to the game, which describes the actions taken by the players and the outcome of the game (Madani, 2010).

Game theory can be adopted to explain or predict the actions taken by the player to maximize their payoffs in conflicts. It has two advantages in analyzing conflicts. Firstly, game theory offers more realistic simulation of players' interest-based behavior (Madani, 2010). It assumes that the players' main concern is to maximize their own interest in the game knowing that the final outcome is the product of all the decisions made, which reflects the human nature in conflict. The self-optimizing attitude of players represented in game theory, often leads to non-cooperative actions even when cooperation is more beneficial to the overall interests. Therefore, stable outcomes of the game predicted by game theory are not necessarily Pareto-optimal (Madani, 2010). Secondly, game theory is able to simulate different aspects of conflict, embody various characteristics of the problem, and predict the possible resolutions in absence of quantitative payoff information. Qualitative knowledge about the players' payoffs, such as how the players rank different outcomes, can be used to resolve the conflict (Madani, 2010). Herein, this enables to handle the socio-economic aspects of conflicts when quantitative information is

not readily available.

Therefore, game theory was used to explain the actions taken by local government and farmers in the process of rural residential land exchange, in which both sides engage in game playing. It is appreciated that the local government is assumed to represent and protect the local people's interest. However, in practice, especially in the current development stage of China, the local government relies on land transactions and acquisitions to generate capital and support urban development and infrastructure provision (Zhang, 2000; Ding, 2007). Thus, there are various conflicts between local government and farmers over land transactions and acquisitions (Ding, 2007; Tang et al., 2008). Therefore, it is feasible to view local government and farmers as "players" in the process of negotiation, and game theory is considered effective to help explain the different actions taken by both sides in the process of rural residential land exchange.

The details of the game analysis can be found in Chapter 4. The outcome of the game analysis shows that disaster does provide an opportunity to develop CRS. The overall benefit of implementing rural residential land exchange under disaster conditions is larger than that under normal conditions from the perspective of either government or farmers. In addition, the implementation of rural residential land exchange under disaster conditions is much more effective as the farmers are more likely to accept the policy of concentrated settlement, which largely reduce the resistance to pushing forward this policy under disaster conditions.

3.2.3 Interview survey and case study to identify CDFs for developing CRS in post-disaster reconstruction

The established methods for identifying CDFs usually develop a preliminary factor list from

literature review first, and then conduct questionnaire survey to find the relative significant value of each factor, and finally select the CDFs based on the results of the survey with certain criteria. In this study, literature review was used to find an initial factor list for developing CRS in post-disaster reconstruction by reviewing the factors favoring CRS and the success/failure factors for resettlement. A pilot study was followed with literature review to refine the CDFs list. Cases of developing CRS after the 5.12 Sichuan Earthquake were identified via web search and field study conducted in September 2011. Interview was used to collect local government officials, planners, and rural victims' opinions on the CDFs list in the case villages. A general set of CDFs was generated by using the intersection of the results given by various experts, which was further verified in a follow-up interview in Feburary 2012.

Pilot study was undertaken to help revisiting the research focus and refining the research questions (Walker, 1997). In this research, it mainly helps to examine whether the initial list of determinant factors is suitable for further interview survey. In this study, a questionnaire survey was sent to thirty experts with rural housing construction experience. The details of the questionnaire can be found in Appendix A. The experts were invited to assess the significance of the initial determinant factors and comment on the research design. The results of the pilot study and the comments from the respondents were used for fine-tuning the preliminary list of determinant factors for the semi-structured interview in the followed step. The results of the pilot study can be found in Chapter 5.

Interview was used to collect the information in the identified villages. Freire and Alarcón (2002) suggested that interview is a useful brainstorming tool for fixing research questions. In addition,

as there are a limited number of experts participating in developing CRS in post-disaster reconstruction in China, there may not be a significantly large sample to justify a questionnaire survey. Moreover, interview is considered as the most suitable approach to conduct research on the issues relating to disaster victims (Oliver-Smith, 1996). This study therefore interviewed the local government officials, planners, and rural victims to identify the CDFs for implementing CRS in post-disaster reconstruction.

Six steps are suggested to follow in the interview although they should be adjusted according to the actual situation. During the interview, it is necessary to appease the interviewee in order not to immerse him in the grief memories of the earthquake. Most importantly, the interview should be stopped if the interviewee is found to be uneasy or the interviewee prefers to end the conversion.

(1) Brief introduction of the research

During this step, the aim of the interview should be clearly explained to the interviewee. In addition, efforts should be spent to attractive the interviewee's interests to help identify CDFs for developing CRS in post-disaster reconstruction.

(2) Collecting background information of the interviewee

Sufficient background information is useful to help judge whether the interviewee's response is believable. The background information of the interviewee can be collected through asking the following questions:

- What is your job title?

- How many years of work experience relevant to rural housing construction do you have?
- How about your education level?
- Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?
- If both, is there any difference especially from the aspect of organization, site selection, layout, housing design, and future development, under the two conditions?
- What is your major responsibility in developing concentrated rural settlement in post-disaster reconstruction?

(3) Collecting background information of the village

It is also important to collect the information of the case villages for case studies. The background information of the case village can be collected through asking the following questions:

- Does this village locate in plain areas or hilly areas?
- How many villagers does this village have right now?
- How much land area does this village have right now?
- How much cultivated land does this village have right now?
- How many households does this village have right now?

- How many labors does this village have right now?
- How many migrant workers does this village have right now?
- What is the supporting industry of this village right now?
- How much per capita income does this village generate before the 5.12 Sichuan Earthquake?
- How many houses were collapsed or damaged during the 5.12 Sichuan Earthquake?
- How much area do the sites for developing CRS occupy?
- What is the percentage of households moving to CRS after the 5.12 Sichuan Earthquake?
- How much per capita income does this village generate after the 5.12 Sichuan Earthquake?
- How much does the living cost increase after concentration?

(4) Assessing the significance of the optional CDFs

The preliminary list of determinant factors, which is the result of the polit study, was presented to the interviewee. The interviewee is asked to assess the significance level of these factors based on his own practical experience. Comments are welcome to deepen the understanding of these factors.

(5) Inviting comments on this research

This step aims to invite the interviewee to comment on the interview process, confirm the

interview results, and put forward suggestions on this research through the following questions:

- Does this interview make you unhappy and therefore the information generated in this process remains questionable?
- Do the results of significance level of the optional factors reflect your true intentions?
- Could I disclose the information relevant to you and the village?
- Do you have any suggestions on the crtical determinant factors of developing CRS in post-disaster reconstruction?

(6) End with thanks

At the end of the interview, efforts should be spent to thank the interviewee's supports and establish some kind of friendship for follow-up interview. Furthermore, snowball technique was used to identify the new interviewee. The interviwer should try to ask him/her to recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for further interview. The interview would be stopped if no new information can be added.

The example of interview to identify CDFs can be found in Appendix B. Through analyzing the information obtained from the interview, the performance of the determinant factors was identified for the four case villages. The concurrence of various CDFs identified by the experts was taken as the final results and a generic set of CDFs was generated and discussed in Chapter 5. In order to validate the results, follow-up interviews with the former interviewees were conducted in February 2012. The critical determinant factors generated from the interviews in

September 2011 were provided to the respondents in the follow-up interviews for verification.

3.2.4 Interview survey and case study to develop the decision model

This research activity is intended to develop a decision model for the local government to use for implementing CRS in post-disaster reconstruction. Interview was used to map the process of developing CRS and the experience and problems in the identified case villages.

Five steps are suggested to follow in the interview although they should be adjusted according to the actual situation. During the interview, it is necessary to appease the interviewee in order not to immerse him in the grief memories of the earthquake. Most importantly, the interview should be stopped if the interviewee is found to be uneasy or the interviewee prefers to end the conversion.

(1) Brief introduction of the research

During this step, the aim of the research should be clearly explained to the interviewee. In addition, efforts should be spent to attractive the interviewee's interests to discuss the process of developing CRS in post-disaster reconstruction.

(2) Collecting background information of the interviewee

The background information of the interviewee can be collected through asking the following questions:

- What is your job title?
- How many years of work experience relevant to rural housing construction do you have?

- How about your education level?

- Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?

- If both, is there any difference especially from the aspect of organization, site selection, layout, housing design, and future development, under the two conditions?

- What is your major responsibility in developing concentrated rural settlement in post-disaster reconstruction?

(3) Mapping the development process and identifying the experience and problems

A sheet is designed to facilitate describe the process of developing CRS in post-disaster reconstruction as shown in Table 3.1. Four stages namely selecting the reconstruction approach, CRS planning, CRS building, and community management after concentration are identified from the public news reports on the reconstruction experience of the case villages. The key point is to get the information of the main activities, participants, the financial resources, experience and problems at each stage during the interview.

Table 3.1 A sheet designed for mapping the process of developing CRS

Stage	Main activities	Participants	Financial resources	Experience/Problems
Selecting the reconstruction approach				
	…			
CRS planning	…			
	…			
CRS building				

	…			
Community management after concentration				
	…			

(4) Inviting comments on this research

This step aims to invite the interviewee to comment on the interview process, confirm the interview results, and put forward suggestions on this research through the following questions:

- Does this interview make you unhappy and therefore the information generated in this process remains questionable?
- Do the identified experience and problems reflect your true intentions?
- Could I disclose the information relevant to you and the village?
- Do you have any suggestions on the process of developing CRS in post-disaster reconstruction?

(5) End with thanks

At the end of the interview, efforts should be spent to thank the interviewee's supports and establish some kind of friendship for follow-up interview. Furthermore, snowball technique was used to identify the new interviewee. The interviwer should try to ask him/her to recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for further interview. The interview would be stopped if no new information can be added.

The example of interview to develop the decision model can be found in Appendix C. Through the information obtained in the interview, the process of developing CRS in the four case

villages was mapped. In addition, the problems and experience were discussed. By integrating the results of case studies and summarized experiences and problems, along with the identified CDFs in Chapter 5, the decision model for CRS was finalized in Chapter 6.

3.2.5 Validation of the decision model

This research activity concerns validating the generic decision model developed in Chapter 6. Model validation is used to demonstrate that the model is a reasonable representation of the actual world. Generally speaking there are three approaches to model validation including expert intuition, real system measurements, and theoretical analysis. Any combination of them may be applied to the model (Hillston, 2003). As the decision model of implementing CRS was established after reconstruction had been completed, it is difficult to observe the outcome of this model. Therefore, interviewing the experts participating in developing CRS, who were not involved in previous studies of investigating the CDFs and developing the decision model, was used to validate this model.

Seven steps are suggested to follow in the interview although they should be adjusted according to the actual situation. During the interview, it is necessary to appease the interviewee in order not immerse him in the grief memories of the earthquake. Most importantly, the interview should be stopped if the interviewee is found to be uneasy or the interviewee prefers to end the conversion.

(1) Brief introduction of the research

During this step, the aim of validation should be clearly explained to the interviewee. In

addition, efforts should be spent to attractive the interviewee's interests to comment on the developed decision model.

(2) Collecting background information of the interviewee

The background information of the interviewee can be collected through asking the following questions:

- What is your job title?
- How many years of work experience relevant to rural housing construction do you have?
- How about your education level?
- Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?
- If both, is there any difference especially from the aspect of organization, site selection, layout, housing design, and future development, under the two conditions?
- What is your major responsibility in developing concentrated rural settlement in post-disaster reconstruction?

(3) Introduction of the established decision model

The established decision model should be presented to the interviewee by showing the relevant Figures. Most importantly, the objective, hidden assumption, and model context should be specified at the beginning. It is necessary to response to the interviewee's questions in order to make him/her understand the decision model whenever they put forward questions during the

introduction process.

(4) Introduction of the performance assessment criteria

The performance assessment criteria are explained to the interviewee for them to assess the decision model during the interview process:

- The objective, scope, and the relevant stakeholders of the model are clear;
- The mentioned process and activities in the model are clear and reasonable;
- The model can improve the efficiency and effectiveness of developing CRS;
- The model provides specific guideline for the local officials to make decisions;
- The model can be applied in other regions of China under disaster conditions;
- The model can be applied in other regions of China under normal conditions; and
- The model has practical and theoretical implications.

(5) Assessing the decision model

The performance of the decision model can be assessed through asking the following questions:

- Whether the assumption of the model is reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.
- Whether the objective of the model is specific and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as

the best.

- Whether the scope of the model is clear and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the decision maker of the model is specific and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the stated activities are clear and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the process of the model is reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the model can improve the effectiveness and efficiency of developing concentrated rural settlement in post-disaster reconstruction? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the model can provide a reference to the decision maker in post-disaster reconstruction? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the model can be applied in other regions of China under disaster conditions? Please give your comments and score the performance of the decision model between 1

and 5 with 5 as the best.

- Whether the model can be applied in other regions of China under normal conditions? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the model has practical implications? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

- Whether the model has theoretical implications? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

(6) Inviting comments on this research

This step aims to invite the interviewee to comment on the interview process, confirm the interview results, and put forward suggestions on this research through the following questions:

- Does this interview make you unhappy and therefore the information generated in this process remains questionable?

- Do the assessment results reflect your true intentions?

- Could I disclose the information relevant to you and the village?

- Do you have any suggestions on improving the decision model?

(7) End with thanks

At the end of the interview, efforts should be spent to thank the interviewee's supports and

establish some kind of friendship for follow-up interview. The interviwer should try to ask him/her to recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for further interview.

The example of interview to validate the decision model can be found in Appendix D. Through the information obtained in the interview, the developed decision model can be validated, the details of which can be found in Chapter 7.

3.3 Summary of the Chapter

This section has presented the research design the relevant methodology adopted to achieve each research objective. Literature review was conducted to analyze previous studies on post-disaster reconstruction, rural settlement patterns in terms of concentration and dispersion, decision system for CRS development in China, and decision system for rural housing reconstruction in China. The outcome of the reviews and analysis highlights the need for an effective decision model for developing CRS after a disaster.

Game theory was adopted to compare the implementation of rural residential land exchange, which is considered as a means of developing CRS under normal conditions and under disaster conditions. This analysis tends to find whether post-disaster reconstruction provide an opportunityto develop CRS in China unlike the ancetoal reports in previous studies.

Interview survey and case studies were adopted to identify the CDFs for developing CRS in post-disaster reconstruction. Literature review was conducted to find the initial list of determinant factors for developing CRS in post-disaster reconstruction. Thirty experts were

surveyed to refine the initial list of determinant factors. As a result of this step, a preliminary list of determinant factors was generated for the semi-structured interview and case studies to identify the CDFs.

Interview survey and case studies were also employed to develop the decision model. Through interview, the real development processes of the four case villages were mapped. In addition, the good experience and problems exisited in the development process were summarized. Based on the mapped process, summarized experience and problems, and the identified CDFs, an effective decision model was developed.

The developed decision model was validated through inviting experts' comments. Six experts, who did not participate in the research of identifying CDFs and developing the decision model, were interviewed to validate the decision model.

4 OPPORTUNITY TO DEVELOP CRS IN POST-DISASTER RECONSTRUCTION

4.1 Introduction

In China, the policy of rural residential land exchange is used as a measure to advocate concentrated rural settlement (CRS), as discussed in Chapter 2. However, under normal conditions, the local government is attracted by generating capital through increasing land leases for construction in urban areas (Ding, 2007). Although the policy of rural residential land exchange was well-intentioned as formulated, it is deformed as a tool for increasing construction land in urban areas by forcibly pushing forward CRS in rural areas. This development-driven practice has resulted in farmers' unwillingness to and resistance in participating in the concentrated settlement scheme. This phenomenon proliferated and caused the awareness of the officers in the central government. As a result, the rural residential land exchange was suspended by the central government in 2010 (MLR, 2010). On the other hand, the farmers suffering natural disasters seem more willing to participate in the land exchange scheme. For example, Tianma Town of Dujiangyan, an area affected seriously by the 5.12 Sichuan Earthquake, adopted the policy of rural residential land exchange, which was accepted by 55% of the rural victims, while an additional 30% of the victims later decided to participate in this scheme due to the benefits demonstrated by the reconstruction (Wu, 2010). This village plus several other villages in Dujiangyan promoting CRS were widely considered as a success of post-disaster reconstruction (Deng, 2010).

Disaster is appreciated as a "window of opportunity" for resettlement; however, few studies

have investigated whether the opportunity is feasible (Pankhurst, 1991; Timms, 2011; Olshansky et al., 2012). There is a clear difference of effectiveness in implementing CRS under two different conditions, namely, normal conditions and disaster conditions. Farmers and local government have different perceptions and objectives under the two different conditions. The understanding of the reasons behind each is critical to prove the opportunity to develop CRS in post-disaster reconstruction.

Research efforts have been devoted to identifying adequate research methods to understand how local government and farmers adopt various measures to protect their interests in the process of rural residential land exchange. The government could take normal means according to the regulation made by the central government if affected farmers accept the exchange. However, farmers usually reject the exchange if the interest gained from acceptance is not attractive to them. On the other hand, it is in the government's interest to introduce CRS and provide land for construction in urban areas. With these interests and objectives, local governments often push forward the exchange policy by special means to force the farmers to live in CRS, and as a disadvantaged group, the farmers have to accept the exchange.

By following the research methodology described in Chapter 3, the analysis for the actions taken by the two sides in the process of rural residential land exchange can be conducted by using a payoff matrix, as shown in Figure 4.1. In the matrix, G_{11}, G_{12}, G_{21}, and G_{22} represent the interest of local government in relevant combinations of strategies while F_{11}, F_{21}, F_{12} and F_{22} represent the interests of the farmers.

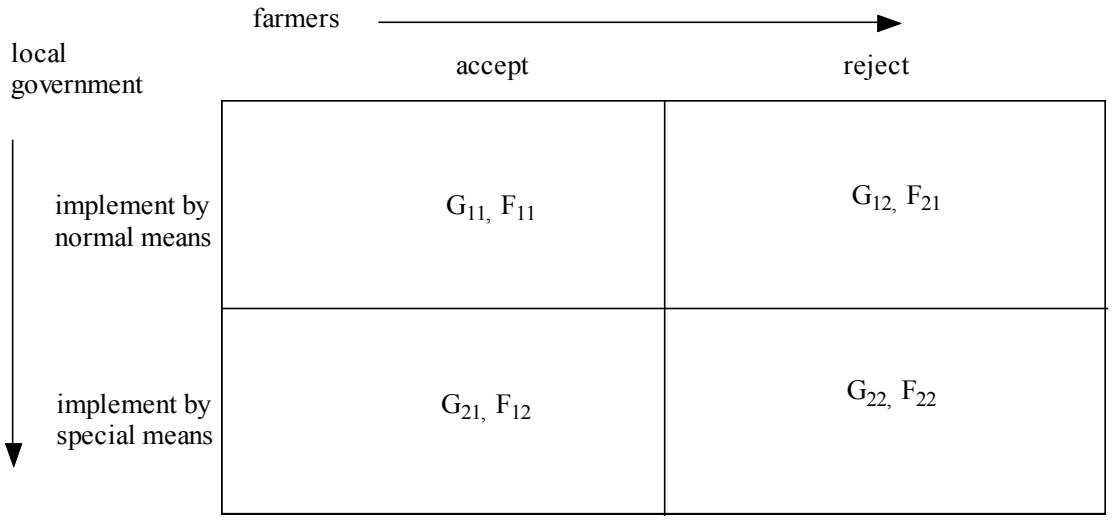


Figure 4.1 The payoff matrix for local government and farmers in the process of developing CRS

To engage in further analysis on the payoff matrix, two scenarios are used: One is the rural residential land exchange under normal conditions, and the other is the rural residential land exchange under disaster conditions. The following section will use the Nash Equilibrium to explain the difference under the two conditions. The analysis will help understand whether disaster conditions provide an effective opportunity for developing CRS by comparing the Nash Equilibriums under the two conditions.

4.2 The Strategy of Stakeholders in Developing CRS under Normal Conditions

For local government, the payoff mainly lies in economic aspects, political achievement, and social consequences. The economic aspect includes the revenue from rural residential land exchange, the cost of removal and reclamation, and the compensation to the farmers (Pu, 2009; Tan, 2010). These variables for characterizing the local government's payoff are described as follows:

- L denotes the unit price of rural residential land exchange, assumed constant when adopting different strategies,
- A denotes the amount of cultivated land that can be saved and used for exchange, which will tell the revenue of rural residential land exchange when it multiplies by L,
- C_r stands for the cost of removing the old rural housing and reclaiming the rural residential land as cultivated land,
- C represents the compensation to the farmers,
- P stands for the political achievement, and
- S stands for the social consequences.

For the farmers, the payoff mainly includes the current interest: compensation, the value of old housing, the cost of purchasing and decorating the new accommodation in the concentrated settlement, the increased living cost in the new settlement, the cost of striving when refusing government policy, and the long term interest, such as the benefits of using infrastructure and quality public services and gaining income from employment, as they may find jobs after moving to concentrated settlement (Pu, 2009; Tan, 2010). The variables used to characterize the payoff of the farmers are listed below:

- C represents the compensation the farmers receive,
- V_o denotes the value of the old house perceived by the farmers,
- C_{nc} stands for the cost of purchasing and decoration in concentrated settlement,
- ΔL represents the increased living cost, such as gas, water, and food,
- C_s stands for the cost of striving borne by the farmer taking the strategy ‘reject’,

- I_{na} implies farmers' income after concentrated settlement,
- I_a implies farmers' income before concentrated settlement, and
- B_c denotes the benefits of concentrated settlement, such as using effective infrastructure and quality public services.

By referring to the general payoff matrix in Figure 1, the payoffs for local government and the farmers under the under normal conditions can be further specified in another matrix as shown in Figure 2, where "*N*" implies under normal conditions. Based on the matrix in Figure 4.2, the following analysis can be conducted to find the Nash Equilibrium under normal conditions.

local government \ farmers	accept	reject
implement by normal means	$G_{11}^N = L_{11}^N A_{11}^N - C_{r11}^N - C_{11}^N + P_{11}^N + S_{11}^N$ $F_{11}^N = C_{11}^N - C_{nc11}^N - \Delta L_{11}^N + I_{na11}^N + B_{c11}^N$	$G_{12}^N = 0$ $F_{21}^N = V_{o21}^N - C_{s21}^N + I_{a21}^N$
implement by special means	$G_{21}^N = L_{21}^N A_{21}^N - C_{r21}^N - C_{21}^N + P_{21}^N + S_{21}^N$ $F_{12}^N = C_{12}^N - C_{nc12}^N - \Delta L_{12}^N + I_{na12}^N + B_{c12}^N$	$G_{22}^N = L_{22}^N A_{22}^N - C_{r22}^N - C_{22}^N + P_{22}^N + S_{22}^N$ $F_{22}^N = C_{22}^N - C_{nc22}^N - \Delta L_{22}^N - C_{s22}^N + I_{na22}^N + B_{c22}^N$

Figure 4.2 The payoff matrix for local government and farmer under normal conditions

4.2.1 Local government' strategy when farmers accept implementing CRS

The local government could only implement the policy of rural residence exchange on a small scale, constrained by the provisional quota and other regulations. However, the government will be able to obtain more cultivated land if special means are taken——in other words, if the value of A_{11}^N is smaller than A_{21}^N. The cost of removing the old houses and reclaiming the residential

land to cultivated land would be larger if the scale of rural residential land exchange is larger. But the benefits from selling land ticket will be sufficient to cover the cost. Furthermore, the local government could reduce the compensation to the farmers when it takes the strategy of 'implement by special means'. That is to say, C_{11}^N would be lager than C_{21}^N. Moreover the political and social impact are almost the same whether the government takes normal or special means if the farmer takes 'accept' strategy. It is evidenced by the fact that there are almost no reports that officials were punished due to the strategy 'implement by special means'. The key information in the above discussion can be summarized as follows:

$$A_{11}^N < A_{21}^N,\ (L_{11}^N A_{11}^N - C_{r11}^N) < (L_{21}^N A_{21}^N - C_{r21}^N),\ C_{11}^N > C_{21}^N,\ (P_{11}^N + S_{11}^N) \approx (P_{21}^N + S_{21}^N)$$

By referring these data to the formula in the matrix of Figure 4.2, we can get the following:

$$L_{11}^N A_{11}^N - C_{r11}^N - C_{11}^N + P_{11}^N + S_{11}^N < L_{21}^N A_{21}^N - C_{r21}^N - C_{21}^N + P_{21}^N + S_{21}^N,$$

or $G_{11}^N < G_{21}^N,$ (Formula 4.1)

Thus, the strategy for local government is to implement by special means when the farmers accept the implementation of CRS through rural residential land exchange.

4.2.2 Local government's strategy when farmers reject implementing CRS

The local government would not push forward rural residential land exchange in the normal way if the farmers reject the exchange scheme, and the payoff of the local government is zero, namely G_{12}^N=0. However, if the local government takes special means to implement the policy, it would obtain revenue from selling land tickets, which can cover the cost of removal,

reclamation, compensation, and the risk of having negative political and social impact. By referring these data to the formula in the matrix of Figure 4.2, we can get the following information:

$$0 < L_{22}^{N} A_{22}^{N} - C_{r22}^{N} - C_{22}^{N} + P_{22}^{N} + S_{22}^{N},$$

$$\text{or } G_{12}^{N} < G_{22}^{N}, \qquad \text{(Formula 4.2)}$$

In other words, the strategy for local government is to implement the rural residential land exchange by special means when the farmers reject the implementation of CRS.

By considering Formula 4.1 and Formula 4.2 collectively, we can see that the strategy for the local government's best interests is 'implementing the rural residential land exchange policy by special means' no matter what action the farmers take under normal conditions.

4.2.3 Farmers' strategy when local government implements CRS by normal means

If the farmer accepts the practice, he would obtain the compensation C_{11}^{N}, but should pay C_{ncl1}^{N} for purchasing and decorating the new house. Usually the compensation cannot cover the settlement cost for a new house, namely $C_{11}^{N} < C_{ncl1}^{N}$. This is echoed by the survey conducted by Zhang and Wang (2008), which is shown in Table 4.1.

Table 4.1 Compensation and cost of purchasing new houses in Sheshan town Shanghai

Family	Removal construction area/ Compensation	Type of house/ Cost	Decoration cost	Balance
A	223 m^2/430,000 RMB	T: 134m^2+83 m^2/ 390,000 RMB	170,000 RMB	-130,000 RMB
B	215 m^2/420,000 RMB	D: 188 m^2/ 410,000 RMB	120,000 RMB	-110,000 RMB
C	232 m^2/450,000 RMB	D: 202 m^2+T: 67 m^2/ 590,000 RMB	190,000 RMB	-330,000 RMB

D	218 m^2/460,000 RMB	M: 223 m^2/ 560,000 RMB	120,000 RMB	-220,000 RMB

Note: T-tier building, D-duplex house, M-multi-family house (Source: Zhang and Wang, 2008)

Moreover, farmers' living cost would increase due to extra expenditure for things like food, gas fee and property management fee (Lang, 2010). Herein, ΔL_{11}^N is positive. Furthermore, the local government is not able to provide employment to all affected farmers, as the pressure of labor markets is increasing with rising population and urbanization (Ding, 2007). Farmers, especially the elders with little other than agricultural work skills, will find they generate less income after they give up their rural residential land. The income increase ($I_{na11}^N - I_{a21}^N$) will be less than the increase in living costs, namely $(I_{na11}^N - I_{a21}^N) < \Delta L_{11}^N$. This relation is evidenced by the survey conducted by Xu et al. (2010), as shown in Table 4.2.

Table 4.2 The earning and living cost for farmers in suburb of Changsha, Hunan Province

	Annual earning per household (RMB)		Annual expenditure per household (RMB)		Construction areas per household (m^2)
	Total	From agriculture	Total	For food	
Before concentration	34, 500	850	18, 500	5, 400	335
After concentration	36, 000	220	21, 300	6, 600	220

Source: Xu et al. (2010)

As for the long term benefit from living in concentrated settlement, a farmer would enjoy the benefit of using better infrastructure and quality public services, while he may also suffer from poor social security, fuzzy self-identity and poor landscape. Therefore a farmer's total welfare will be improved a little, and this can be explained by the data in Table 4.3 (Jia et al., 2009).

Table 4.3 The assessment of welfare in Jiangdu City

	Overall	Economic condition	Social security	Living condition	Community life	Environment	Development chance	Psychology
Before	0.443	0.434	0.406	0.591	0.265	0.952	0.320	0.203
After	0.471	0.482	0.226	0.898	0.206	0.369	0.723	0.726

Source: Jia et al. (2009)

A farmer would usually perceive that the old house is much more valuable than that perceived by the government. It is often overpriced due to the endowment effect when losing the old house (Wu et al., 2008; Kahneman et al., 1991). Moreover, farmers in the suburb areas are reluctant to abandon rural residential land since the land appreciates rapidly (Zhang and Wang, 2008). As a result, the benefit gained from concentrated settlement is perceived less than current settlement and lifestyle. On the other hand, the cost of taking 'reject' attitude against the exchange policy would be very small or even none if the local government takes normal means. In other words, there are the following relations: $B_{c11}^{N} < V_{o21}^{N}$, C_{s21}^{N}=0. The key information in the above discussion can be summarized as follows:

$$C_{11}^{N} < C_{nc11}^{N},\ (I_{na11}^{N} - I_{a21}^{N}) < \Delta L_{11}^{N},\ B_{c11}^{N} < V_{o21}^{N},\ C_{s21}^{N}=0$$

By referring these data to the formula in the matrix of Figure 4.2, we can get the following:

$$C_{11}^{N} - C_{nc11}^{N} - \Delta L_{11}^{N} + I_{na11}^{N} + B_{c11}^{N} < V_{o21}^{N} - C_{s21}^{N} + I_{a21}^{N},$$

or $F_{11}^{N} < F_{21}^{N}$ (Formula 4.3)

Herein, the strategy for farmers is 'reject' when the local government implements rural residential land exchange by normal means.

4.2.4 Farmers' strategy when local government implements CRS by special means

If a farmer takes the strategy of 'reject', he might ask for a higher compensation C_{22}^N. The extra compensation compared to C_{12}^N when the farmer accepts exchange is able to cover the cost of striving C_{s22}^N. So there is the relation: $C_{s22}^N < (C_{22}^N - C_{12}^N)$. However, other payoff elements, including C_{nc}, ΔL, I_{na} and B_c, will remain unchanged whether the farmer accepts or rejects the policy. By referring these data to the formula in the matrix of Figure 4.2, we get the following relationship:

$$C_{12}^N - C_{nc12}^N - \Delta L_{12}^N + I_{na12}^N + B_{c12}^N < C_{22}^N - C_{nc22}^N - \Delta L_{22}^N - C_{s22}^N + I_{na22}^N + B_{c22}^N,$$

or $F_{12}^N < F_{22}^N$ (Formula 4.4)

Thus, the strategy for farmers is 'reject' when the local government implements rural residential land exchange by special means.

By considering Formula 4.3 and Formula 4.4 collectively, we can perceive that the strategy for the farmers' best interests is to 'reject' no matter what action the local government takes under normal conditions.

The above analysis indicates that in the process of implementing CRS through rural residential land exchange policy, the local government will 'implement by special means' while the farmers will 'reject' in order to achieve their best interests. The Nash equilibrium of the game is (implement by special means, reject). This explains why implementing rural residential land exchange by special means is popular in China in recent years. It is considered that the development-driven rural residential land exchange results in unsatisfactory social consequence.

As a result, the policy was suspended by the central government in 2010. However, the benefits of promoting concentrated settlement are well appreciated. It is interesting to examine whether the land exchange scheme is applicable under disaster conditions.

4.3 The Strategy of Stakeholders in Developing CRS under Disaster Conditions

Under disaster conditions, the payoff elements for local government and rural victims are similar to those under normal conditions except C_{nr} which denotes the cost of building a new dispersed house. However, the values of these payoff elements are changed. After a disaster, local government faces different surveillance environment and has various policies backed by central or upper governments while the rural victims usually lost their houses. The actions of local government will be monitored closely by the public and media. The rural victims need to rebuild their houses regardless whether they accept the policy or not. If the policy of rural residential land exchange is implemented under this condition, government and farmers will take different attitudes and actions. The payoffs in this situation can be specified in a matrix as shown in Figure 4.3, where the superscript "D" implies disaster conditions. In order to find out the strategy for each party's best interests, the following analysis is conducted.

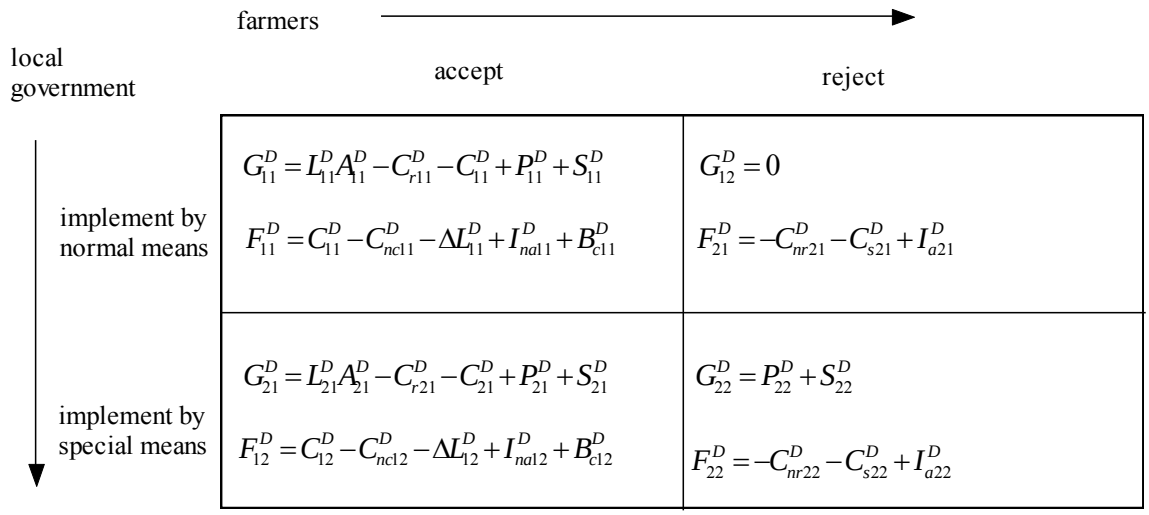


Figure 4.3 The payoff matrix for local government and farmer under disaster conditions

4.3.1 Local government's strategy when farmers accept implementing CRS

The severity of disaster usually brings the local government and rural victims to the close attention of the central government and the media. If local government takes special means, it would be immediately exposed to the public and result in political punishment from the upper government, even if the farmer accepts the special policy. There is a strict audit from the central government and punishment is often reported for the officers who break the law and regulations in the process of post-disaster reconstruction. On the other hand, a series of land, industry and tax favorable policies are usually formulated to promote post-disaster reconstruction. The local government could implement the policy of rural residential land exchange on a comparatively large scale even through proper legal procedures. As a result, the risk of negative political and social impact (P_{21}^D and S_{21}^D) are very high if local government implements the scheme through special means. The increased risk of negative political and social impact $(P_{11}^D + S_{11}^D) - (P_{21}^D + S_{21}^D)$ are even larger than the extra benefits compared to those attained by

normal means, expressed as $(L_{21}^{D}A_{21}^{D}-C_{r21}^{D}-C_{21}^{D})-(L_{11}^{D}A_{11}^{D}-C_{r11}^{D}-C_{11}^{D})$. In other words, $(P_{11}^{D}+S_{11}^{D})-(P_{21}^{D}+S_{21}^{D})>(L_{21}^{D}A_{21}^{D}-C_{r21}^{D}-C_{21}^{D})-(L_{11}^{D}A_{11}^{D}-C_{r11}^{D}-C_{11}^{D})$. By referring these data to the formula in the matrix of Figure 4.3, we can get the following:

$$L_{11}^{D}A_{11}^{D}-C_{r11}^{D}-C_{11}^{D}+P_{11}^{D}+S_{11}^{D}>L_{21}^{D}A_{21}^{D}-C_{r21}^{D}-C_{21}^{D}+P_{21}^{D}+S_{21}^{D},$$

or $G_{11}^{D}>G_{21}^{D}$ (Formula 4.5)

In other words, the strategy for the local government is to implement rural residential land exchange by normal means when the farmers accept the rural residential land exchange policy.

4.3.2 Local government's strategy when farmers reject implementing CRS

The local government would not implement rural residential land exchange in a normal way if the farmers reject the exchange scheme and the payoff of the local government is zero, namely G_{12}^{D}=0. If the local government takes special means to implement the policy, which is against the rural victims' willingness, it would result in conflict and block the process of post-disaster reconstruction. Exposed to the media and the central government, the local government could not push forward the rural residential land exchange by special means, otherwise political punishment from the upper government will be resulted. In other words, the risk of negative political and social impact (P_{22}^{D} and S_{22}^{D}) is very high, namely ($P_{22}^{D}+S_{22}^{D}$)<0. By referring these data to the formula in the matrix of Figure 4.3, we can get the following relationship:

$$0>P_{22}^{D}+S_{22}^{D},$$

or $G_{12}^{D}>G_{22}^{D}$ (Formula 4.6)

In other words, the strategy for the local government is to implement the rural residential land exchange policy by normal means when the farmers reject the implementation of CRS.

By considering Formulae 4.5 and 4.6 collectively, we can see that the strategy for the local government's best interests is implementing the rural residential land exchange by normal means no matter what action the farmers take under disaster conditions.

4.3.3 Farmers' strategy when local government implements CRS by normal means

If the farmers accept the scheme, he would attain compensation C_{11}^{D} and enjoy the benefits of using better infrastructure and quality public services B_{c11}^{D}. No matter whether they accept the policy or not, the farmers need to rebuild the house for settlement. In urgent disaster conditions, where finances and resources are scarce, the compensation C_{11}^{D} could help rebuild the settlement rapidly thus it becomes very attractive to the rural victims. As a result, the current and long term benefits ($(C_{11}^{D} - C_{nc11}^{D} + B_{c11}^{D})$) for rural victims would surpass the increased living cost ΔL_{11}^{D}. In other words, $(C_{11}^{D} - C_{nc11}^{D} + B_{c11}^{D}) > \Delta L_{11}^{D}$. Many rural victims after the 5.12 Sichuan Earthquake were willing to participate in rural residential land exchange during post-disaster reconstruction. For example, it was reported that the average cost of building a new house is 100,000 RMB while the subsidy is only 20,000 RMB per household in Tianma Town of Dujiangyan. However, if participating in rural residential land exchange, the victim family only spent 20,000~40,000 RMB. The remaining costs of housing and infrastructure were covered by the revenue of rural residential land exchange. Therefore, 55% of the rural victims in Tianma Town were reported to take part in this practice willingly (Wu, 2010).

Usually, post-disaster reconstruction would be implemented with a series of matching policies

for improving the local industry, creating more opportunities for employment and expanding the source of income in the long term. Therefore, the income to farmers after the concentrated settlement would be greater than that before. That is to say, $I_{na11}^{D} > I_{a21}^{D}$. For instance, in Tianma Town of Dujiangyan, the cultivated land was rented by Derui Group corporate as a green vegetable base. The rent revenue is about 15,000 RMB per hectare per year, which is more than the traditional agricultural revenue of 4,500~6,000 RMB per hectare per year. Meanwhile, the local farmers could work in the green vegetable base and earn about 600 RMB per month. Furthermore, rural village tours are developed for tourism attraction and become another income source.

Moreover, the cost of taking 'reject' attitude against the exchange policy would be very small or even none if the local government takes normal means. The key information in the above discussion can be summarized as follows:

$(C_{11}^{D} - C_{ncl1}^{D} + B_{c11}^{D}) > \Delta L_{11}^{D}$, $I_{na11}^{D} > I_{a21}^{D}$, and C_{s21}^{D}=0

By referring these data to the formula in the matrix in Figure 4.3, we can get $C_{11}^{D} - C_{ncl1}^{D} - \Delta L_{11}^{D} + I_{na11}^{D} + B_{c11}^{D} > -C_{s21}^{D} + I_{a21}^{D}$ thus there is the following relationship:

$$C_{11}^{D} - C_{ncl1}^{D} - \Delta L_{11}^{D} + I_{na11}^{D} + B_{c11}^{D} > -C_{nr21}^{D} - C_{s21}^{D} + I_{a21}^{D},$$

or $F_{11}^{D} > F_{21}^{D}$ (Formula 4.7)

Herein, the strategy for farmers is 'accept' when the local government implements rural residential land exchange by normal means.

4.3.4 Farmers' strategy when local government implements CRS by special means

If a farmer takes the strategy 'accept' while local government uses special means, he would obtain the payoff F_{12}^{D}. This payoff is less than that when the local government implements the policy by normal means. However, as discussed above, the monitoring from the public shall pressure the local government to improve the compensation otherwise they will receive punishment from the upper government. On the other hand, if the farmer chooses to reject the scheme he could not obtain the urgent compensation and could not enjoy the benefits of using better infrastructure and quality public services. Therefore, there is the following relationship: $C_{12}^{D} + B_{c12}^{D} > -C_{s22}^{D}$. However, other payoff elements, including C_{nc}, ΔL, I_{na}, I_a and C_{nr} will remain unchanged whether the farmer accepts or rejects the policy. Therefore there is the following relationship:

$$C_{12}^{D} - C_{nc12}^{D} - \Delta L_{12}^{D} + I_{na12}^{D} + B_{c12}^{D} > -C_{nr22}^{D} - C_{s22}^{D} + I_{a22}^{D}, \text{ or } F_{12}^{D} > F_{22}^{D} \qquad \text{(Formula 4.8)}$$

Hence, the strategy for farmers is 'accept' when the local government implements rural residential land exchange by special means.

By integrating Formulae 4.7 and 4.8, we can conceive that the farmer's best strategy is to 'accept' no matter what action the local government takes under disaster conditions.

The above analysis indicates that in the process of implementing CRS through rural residential land exchange under disaster conditions, the local government will 'implement by normal means' while the farmers will 'accept' in order to achieve their best interests. The Nash equilibrium of the game is (implement by normal means, accept). The Nash Equilibrium is

different from that under normal conditions. The following section discusses the reasons behind this and explores whether disaster provides an opportunity to develop CRS.

4.4 Discussions

The Nash equilibrium under normal conditions is (implement by special means, reject) while that under disaster conditions is (implement by normal means, accept) for the local government and farmers respectively. The major reasons contributing to the difference can be highlighted as: First, the close monitoring from the public and media in post-disaster reconstruction makes the cost of 'implement by special means' too high to bear for the local government. Compared to normal conditions, the severity of disaster usually would bring the local government and rural victims to the close attention of the central government and the media. If local government does not implement the policy correctly, the local government will face high risk of negative political and social impact. Therefore, under disaster conditions, the local government would normally not implement the rural residential land exchange policy by special means.

Second, with the losses of rural settlement from a natural disaster, the rural victims have to rebuild settlement no matter whether they accept or reject the policy. Under normal conditions, policy implementation leads to the rural housing removed purposely and insufficient compensation. Therefore, farmers usually tend to reject implementing CRS under the current terms. However, in post-disaster reconstruction, as the rural housing has already been destroyed, implementing CRS through rural residential land exchange would provide extra finances for reconstruction. The current interest in compensation could attract the rural victims and fuel the progress of housing reconstruction, especially under the resources scarce condition.

Last, a series of matched favorable policies are usually introduced under disaster conditions. On one hand, the favorable policy will provide the chance for the local government to do what could only be done through special means under normal conditions. Therefore, it makes 'implement by special means' less attractive for the local government in post-disaster reconstruction. On the other hand, the policies for reconstruction are designed to create more employment and broaden the source of income for the rural victims. It alleviates the worries of income after concentrated settlement for the rural victims in the long term. By contrast, under normal conditions, the farmer has not been paid due attention to the income problems, thus making rural residential land exchange less attractive in the long term.

The difference of the Nash equilibrium under normal conditions and disaster conditions results in overall benefits. Assuming the unit land ticket *L* and the saved cultivated land *A* are the same in the two conditions for a particular rural area, comparison of the payoffs for the local government and farmers could be conducted. The local government's payoff is $G_{22}^{D} = L_{22}^{D}A_{22}^{D} - C_{r22}^{D} - C_{22}^{D} + P_{22}^{D} + S_{22}^{D}$ under normal conditions and $G_{11}^{P} = L_{11}^{P}A_{11}^{P} - C_{r11}^{P} - C_{11}^{P} + P_{11}^{P} + S_{11}^{P}$ under disaster conditions. The cost of removal and reclamation C_r and compensation C are considered unchanged. However, the positive political and social impact ($P_{11}^{P} + S_{11}^{P}$) under disaster conditions would exceed the negative political and social impact ($P_{22}^{D} + S_{22}^{D}$) under normal conditions. In other words, $P_{11}^{P} + S_{11}^{P} > P_{22}^{D} + S_{22}^{D}$. Therefore, there is the following relationship:

$$L_{11}^{P}A_{11}^{P} - C_{r11}^{P} - C_{11}^{P} + P_{11}^{P} + S_{11}^{P} > L_{22}^{D}A_{22}^{D} - C_{r22}^{D} - C_{22}^{D} + P_{22}^{D} + S_{22}^{D},$$

or $G_{11}^{P} > G_{22}^{D}$ (Formula 4.9)

The farmers' payoff is $F_{22}^{D} = C_{22}^{D} - C_{nc22}^{D} - \Delta L_{22}^{D} - C_{s22}^{D} + I_{na22}^{D} + B_{c22}^{D}$ under normal conditions while it is $F_{11}^{P} = C_{11}^{P} - C_{nc11}^{P} - \Delta L_{11}^{P} + I_{na11}^{P} + B_{c11}^{P}$ under disaster conditions. As the comparison is for the same area, C_{nc}, ΔL and B_c can be considered the same. However, the more attractive current compensation and long term income source ($C_{11}^{P} + I_{na11}^{P}$) under disaster conditions are perceived to surpass that ($C_{22}^{D} + I_{na22}^{D}$) under normal conditions. In other words, $C_{11}^{P} + I_{na11}^{P} > C_{22}^{D} + I_{na22}^{D}$. Therefore, there is the following relationship:

$$C_{11}^{P} - C_{nc11}^{P} - \Delta L_{11}^{P} + I_{na11}^{P} + B_{c11}^{P} > C_{22}^{D} - C_{nc22}^{D} - \Delta L_{22}^{D} - C_{s22}^{D} + I_{na22}^{D} + B_{c22}^{D},$$

or $F_{11}^{P} > F_{22}^{D}$ (Formula 4.10)

By considering Formulae 4.9 and 4.10 collectively, there is a relationship: $G_{11}^{P} + F_{11}^{P} > G_{22}^{D} + F_{22}^{D}$. That is to say, the overall benefit of implementing rural residential land exchange under disaster conditions is larger than that under normal conditions from the perspective of either government or farmers.

The difference of the Nash equilibrium under the two conditions implies different effectiveness. As shown by Zasloff (1962), the farmer's willingness affected by the economic and social problems is critical for the success of CRS. Under disaster conditions, attracted by the current and long term interest, the farmers are more likely to accept the policy of concentrated settlement, which largely reduce the resistance to pushing forward this policy. As a result, the implementation of rural residential land exchange under disaster conditions is much more effective. This shows that disaster provides the opportunity to develop CRS.

4.5 Summary of the Chapter

Inspired by different results of developing CRS under normal conditions and disaster conditions in China, the research in this chapter supports the hypothesis that disaster provides an opportunity to develop CRS in China. By comparing the difference of the Nash Equilibrium under the two conditions, it was found that the practice of introducing rural residential land exchange policy for CRS development could bring larger overall benefit and more effectiveness under disaster conditions. The government should take disaster as an opportunity to develop CRS in China.

The chapter also contributes to the understanding of why the practice of implementing CRS through rural residential land exchange is different under normal conditions and disaster conditions. However, it remains unknown what preconditions should be available for developing CRS in post-disaster reconstruction, even though this chapter proves the opportunity. The following chapter responds to this concern by exploring the critical determinant factors (CDFs) for developing CRS in post-disaster reconstruction.

5 CRITICAL DETERMINANT FACTORS FOR IMPLEMENTING CRS IN POST-DISASTER RECONSTRUCTION

5.1 Introduction

Although Chapter 4 proves developing concentrated rural settlement (CRS) is much more effective and sustainable, few studies reported developing CRS in post-disaster reconstruction until the reconstruction after the 5.12 Sichuan Earthquake. It appears that there is little study on this issue and a lack of clear understanding of the factors which should be taken into account when developing CRS in post-disaster reconstruction. Therefore, it is the aim of this chapter to find out these critical determinant factors (CDFs) and help understand the preconditions for developing CRS in post-disaster reconstruction by referring to the reconstruction cases after the 5.12 Sichuan Earthquake.

By flashing back to section 3.2.3, various methods including literature review, interview and case study were adopted in this study. An initial list of determinant factors affecting developing CRS was identified through reviewing existing studies. A pilot study was conducted to refine the list of determinant factors. Based on the refined list of determinant factors, interviews with the local government officials, planners, and rural victims of four case villages in Dujiangyan City of Sichuan were conducted to identify the critical factors which determine whether or not to develop CRS. Interviews with different types of participants permit a degree of triangulation between expert opinions, as questions are asked at different levels (Dunford and Li 2011). Moreover, case studies of four villages in Dujiangyan, Chengdu were conducted to deepen the understanding of the interview results. The intersections of various CDFs identified by the

experts are taken as the final results.

5.2 Pilot Study of Determinant Factors

Key words including "concentrated rural settlement", "resettlement successful factors/indicators", and "resettlement failure factors/indicators" were used to search relevant research and reports in established database: Web of Science, EBSCOhost, Emerald Engineering Database, and Google Scholar. As a result of the literature reiview, the initial list of determinant factors for pilot study including 29 factors was generated as shown in Table 5.1.

Table 5.1 The initial list of determinant factors for pilot study

Optional factors		References
Natural endowments	F1-fertile land	Bunce 1982; Short 1992
	F2-vegetation	Bunce 1982; Chen and Zhang 2006
Economic development	F3-urbanization	Bunce 1982; Chen and Zhang 2006; Zhou et al. 2011
	F4-non-primary economic development	Short 1992; Chen and Zhang 2006; Zhou et al. 2011
	F5-agricultural industrialization	Chen and Zhang 2006; Chisholm 2009; Ahmed 2009
	F6-agglomeration effects of infrastructure	Chen and Zhang 2006; Zhou et al. 2011
Farmer's behavior	F7-shift to urban consumption mode	Zhou et al. 2011
	F8- shift to urban works	Zhou et al. 2011
	F9-migration to urban areas	Zhou et al. 2011
Policy	F10-rural land circulation	Chen and Zhang 2006; Zhou et al. 2011
	F11-'increasing versus decreasing balance' policy	Deng 2010
	F12-urban-rural coordinated development strategy	Deng 2010

Culture	F13-cultural conventions	Short 1992; Zhou et al. 2011
	F14-planting modes	Zhou et al. 2011
Organization	F15-clear responsibility of government departments	Young 2004
	F16-dissemination of the reconstruction policies	Lamping 1984; Razani 1984; Oliver-Smith 1986; Dikmen 2006
	F17-victims' participation in the decision-making process	Lamping 1984; Razani 1984; Oliver-Smith 1986; Dikmen 2006
Site selection	F18-short cultivation radius	Bunce 1982; Krugman 1991; Henderson 1997; Dudwick et al. 2011; Zhou et al. 2011
	F19-water availability	Henderson 1997; Dudwick et al. 2011; Zhou et al. 2011
	F20-no secondary disaster	Oliver-Smith 1991
	F21-near employment and social services	UNDRO 1982
	F22-near kin or the old village	Kronenberger 1984; Lamping 1984; UNDRO 1982; Razani 1984
	F23-improved infrastructure	Krugman 1991; Oliver-Smith 1991; Henderson 1997; Dudwick et al. 2011
Layout	F24-culturally constructed ritual spaces required by victims	Razani 1984; Kronenberger 1984
	F25-sufficient space around dwellings for agricultural needs	Lamping 1984; Kronenberger 1984; Oliver-Smith 1986
Housing design	F26-suitable size	Ulubas 1980; Lamping 1984
	F27-good materials and construction	Lamping 1984; Razani 1984; Coburn et al (1984); Ulubas 1980
	F28-privacy needs	Ulubas 1980
Further development	F29-the capability of the community to develop itself	Coburn et al. 1984

By following the methodology described in section 3.2.3, 30 experienced practitioners from government departments, research institutions, and planning institutions who are actively involved in rural housing construction were invited to join the pilot study in April 2011. The

details of the questionnaire for the pilot study can be found in Appendix A. In the first section, the respondents were invited to rate the significance level of 29 factors. In this survey, 1 indicates “insignificant”, 2 “significant”, and 3 “strongly significant”. In the second section, the respondents were asked to fill in some personal information such as “work unit”, “job title”, “work experience”, “education level” and “major responsibility in developing CRS”. Table 5.2 summarizes the information of these 30 experts.

Table 5.2 Personal information of the respondents in the pilot study

Background	Classification	Value	Number of samples	Percentage (%)
Work unit	Government departments	1	8	26.67
	Research institutions	2	8	26.67
	Planning design institutions	3	4	13.33
	Others	4	10	33.33
Job title	Senior professional	1	6	20.00
	Middle level professional	2	10	33.33
	Technical staff	3	8	26.67
	Administrative staff	4	4	13.33
	Others	5	2	6.67
Relevant rural housing construction experience	Below 5 years	1	2	6.67
	5-10 years	2	4	13.33

	10-15 years	3	6	20.00
	15-20 years	4	12	40.00
	Above 20 years	5	6	20.00
Education level	High diploma	1	5	16.67
	Bachelor degree	2	10	33.33
	Master degree or above	3	15	50.00
Experience with CRS development	Direct	1	24	80.00
	Indirect	2	6	20.00
Conditions of developing CRS	Normal conditions	1	6	20.00
	Disaster conditions	2	14	46.67
	Both	3	4	13.33
Major responbility in developing CRS	Housing design	1	1	3.33
	Site selection	2	1	3.33
	Village planning	3	2	6.67
	Building	4	4	13.33
	Policy making	5	3	10.00
	Management and organization	6	4	13.33
	Research	7	3	10.00
	Others	8	6	20.00

Note: only the respondent who has the direct experience with CRS development fill the question of "conditions of developing CRS" and "major responsibility in developing CRS"

It was found that more than half of respondents have the middle-level professional qualification

while 60% of the respondents have more than 15 years of relevant rural housing construction experience. In addition, the respodents being surveyed generally achieved a higher education level with half of them attaining master degree or above. Moreover, 80% of the respondents have the direct experience with CRS development while 46.67% of the respondents have the direct experience with CRS development under disaster conditions. This background information of the respodents reveals that their opinions and comments on the initial list of determinant factors were precious and reliable.

The mean scores obtained from the pilot questionnaire survey can be found in Table 5.3. Among the optional factors, F29-the capability of the community to develop itself was considered as the most crtical determinant factors. That means the farmers should be capable of developing the community themselves after concentration. It is not surprising to find that F20-no secondary disaster is the second critical determinant factors, as avoiding possible disaster is fairly important in selecting sites for concentration. In addition, F16-dissemination of the reconstruction policies is the third critical determinant factors, which is important especially when firstly promoting CRS in post-disaster reconstruction.

Table 5.3 Mean scores of the initial list of determinant factors in the pilot study

Ranking	Factors	Mean	S.D.
1	F29-the capability of the community to develop itself	2.53	0.51
2	F20-no secondary disaster	2.40	0.5
3	F16-dissemination of the reconstruction policies	2.40	0.67
4	F17-victims' participation in the decision-making process	2.37	0.67
5	F27-good materials and construction	2.33	0.66

6	F12-urban-rural coordinated development strategy	2.33	0.71
7	F25-sufficient space around dwellings for agricultural needs	2.30	0.7
8	F4-non-primary economic development	2.27	0.69
9	F24-culturally constructed ritual spaces required by victims	2.23	0.63
10	F7-shift to urban consumption mode	2.23	0.68
11	F22-near kin or the old village	2.20	0.66
12	F5-agricultural industrialization	2.20	0.71
13	F15-clear responsibility of government departments	2.20	0.76
14	F11-'increasing versus decreasing balance' policy	2.17	0.7
15	F21-near employment and social services	2.17	0.75
16	F23-improved infrastructure	2.13	0.68
17	F3-urbanization	2.13	0.73
18	F8- shift to urban works	2.07	0.69
19	F26-suitable size	2.07	0.78
20	F18-short cultivation radius	2.07	0.83
21	F19-water availability	2.03	0.81
22	F14-planting modes	2.00	0.64
23	F13-cultural conventions	2.00	0.74
24	F10-rural land circulation	2.00	0.83
25	F28-privacy needs	2.00	0.83
26	F2-vegetation	1.57	0.77
27	F6-agglomeration effects of infrastructure	1.53	0.78
28	F9-migration to urban areas	1.47	0.68
29	F1-fertile land	1.47	0.73

It also should be noticed that the mean value of four factors including F2-vegetation, F6-agglomeration effects of infrastructure, F9-migration to urban areas and F1-fertile land was far

less than 2. The experts suggest deleting these four factors. The experts thought “vegetation” is too general and the ecological implication of “vegetation” can be found in the factors in the category of site selection. Also, “agglomeration effects of infrastructure” is a result of concentration rather than the determinant factors of concentration. As the farmers moving out rural areas usually do not own the right to participate in village affairs, “migration to urban areas” is not applicable in China to determine CRS development. Moreover, occupying less quality cultivated land is emphasized in CRS development, therefore “fertile land” is also not applicable in China to determine CRS development.

In addition, the surved experts suggested including five factors namely “local financial support”, “reconstruction aids from other provinces”, “rural collective land ownership”, “to know each other well”, and “suitable degree of concentration”. According to their practical experience, “local financial support”, and “reconstruction aids from other provinces” are important for the local government to provide infrastructure and public services in concentration site especially when the financial resource is limited under disaster conditions. “Rural collective land ownership” means that the land owns to the rural collective rather than the farmers. Therefore, under the surpervision of the local government, it is much easier to conduct land adjustment than that of private land during the development process. “To know each other well” implies that there would be few social tenstions and the former social networks can be kept after concentration. Also, the experts thought “suitable degree of concentration” is critical for the farmers to accept the housing in the concentration site. They are less likely to accept a house like the apartment in urban areas, especially if they are accustomed to the dispersed housing.

By following the comments of the experts and the statistical results of the questionnaire survey, the initial list of determinant factors was revised. There are 30 factors in the refined list of determinant factors for further semi-structured interview as shown in Table 5.4.

Table 5.4 The refined list of determinant factors for developing CRS in post-disaster reconstruction

Category	Factor	Reference
Economic development	F1-Urbanization	Bunce 1982; Chen and Zhang 2006; Zhou et al. 2011
	F2-Non-primary economic development	Short 1992; Chen and Zhang 2006; Zhou et al. 2011
	F3-Agricultural industrialization	Chen and Zhang 2006; Chisholm 2009; Ahmed 2009
Farmer's behavior	F4-Shift to urban consumption mode	Zhou et al. 2011
	F5-Shift to urban works	Zhou et al. 2011
Policy	F6-Rural land circulation	Chen and Zhang 2006; Zhou et al. 2011
	F7-'Increasing versus decreasing balance' policy	Deng 2010
	F8-Urban-rural coordinated development strategy	Deng 2010
	F9-Local financial support	Pilot study
	F10-Reconstruction aids from other provinces	Pilot study
	F11-Rural collective land ownership	Pilot study
Culture	F12-Cultural conventions	Short 1992; Zhou et al. 2011
	F13-Planting modes	Zhou et al. 2011
	F14-To know each other well	Pilot study
Organization	F15-Clear responsibility of government departments	Young 2004
	F16-Dissemination of the	Lamping 1984; Razani 1984; Oliver-Smith

	reconstruction policies	1986; Dikmen 2006
	F17-Victims' participation in the decision-making process	Lamping 1984; Razani 1984; Oliver-Smith 1986; Dikmen 2006
Site selection	F18-Short cultivation radius	Bunce 1982; Krugman 1991; Henderson 1997; Dudwick et al. 2011; Zhou et al. 2011
	F19-Water availability	Henderson 1997; Dudwick et al. 2011; Zhou et al. 2011
	F20-No secondary disaster	Oliver-Smith 1991
	F21-Near employment and social services	UNDRO 1982
	F22-Near kin or the old village	Kronenberger 1984; Lamping 1984; UNDRO 1982; Razani 1984
	F23-Improved infrastructure	Krugman 1991; Oliver-Smith 1991; Henderson 1997; Dudwick et al. 2011
Layout	F24-Culturally constructed ritual spaces required by people	Razani 1984; Kronenberger 1984
	F25-Sufficient space around dwellings for agricultural needs	Lamping 1984; Kronenberger 1984; Oliver-Smith 1986
	F26-Suitable degree of concentration	Pilot study
Housing design and construction	F27-Suitable size	Ulubas 1980; Lamping 1984
	F28-Good materials and construction	Lamping 1984; Razani 1984; Coburn et al (1984); Ulubas 1980
	F29-Privacy needs	Ulubas 1980
Further development	F30-The capability of the community to develop itself	Coburn et al. 1984

5.3 Interview and Findings

5.3.1 Case identification

The primary focus of this chapter was to identify CDFs for developing CRS in post-disaster reconstruction. A web search was conducted to find villages that have developed CRS after the 5.12 Sichuan Earthquake. Dujiangyan City has various successful approaches of developing CRS in villages including Luchi, Shiqiao, Xiangrong, Qingjiang, Tai'an, Qipan, Daguan, Huaxi,

Xujiayuanzi, and Shawan. Rather than complete relocation, the CRS was developed within respective villages. It was found that there were seven villages developing CRS in Dujiangyan City including Luchi, Shiqiao, Xiangrong, Qingjiang, Tai'an, Qipan, and Daguan . These seven villages were identified as candidate case studies in this research. A field study in Dujiangyan City, Sichuan Province was therefore conducted in September 2011. The author was able to reach and successfully interview the local government officials, planners, and rural victims from four villages namely Xiangrong, Qingjiang, Shiqiao, and Luchi village. Therefore these four villages were used for further case studies. The location of the four villages can be found in Figure 5.1.

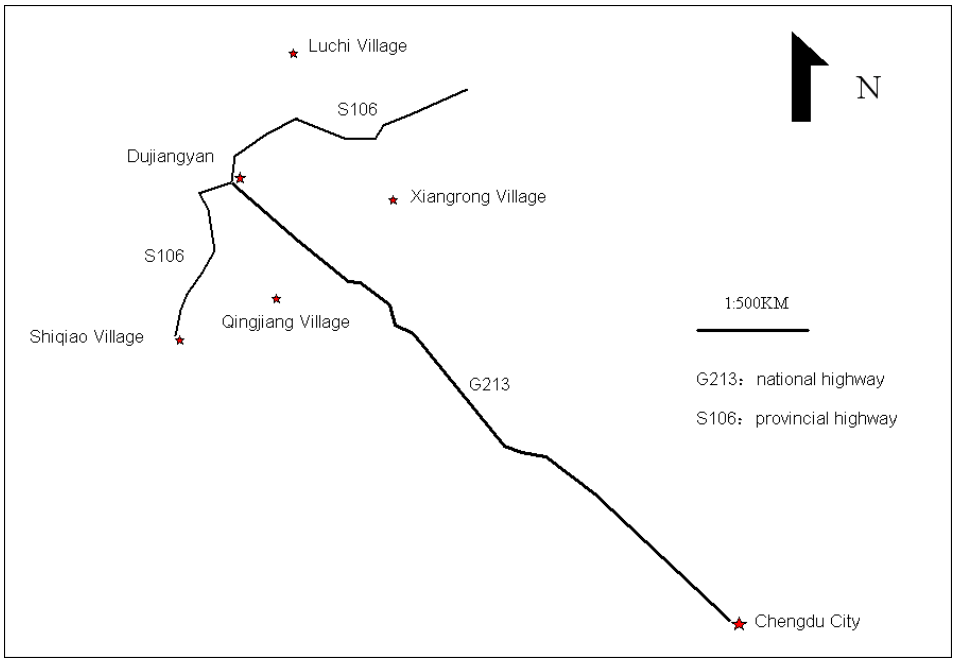


Figure 5.1 The location of the four case villages in Dujiangyan, Sichuan

5.3.2 Interview

Interviewees were identified using the snowball technique, a non-probability sampling method, for obtaining new interviewees from those already interviewed. Further interviews were stopped

when anything new can be added to the knowledge gained from previous interviews. By following the methods described in section 3.2.3, the local government officials, planners and rural victims were invited to assess the importance of candidate factors in terms of insignificance, significance and strong significance. Suggestions of other factors not in the preliminary list could be added by the interviewees. The interview was conducted in Chinese, given that it is the dominant language in the targeted population. Due to the political sensitivity, the people in the disaster-hit areas tend to reject strangers' interviews. But the researchers can speak the native dialect, which helped to reduce the barriers in conducting interviews. Close attention was paid to the minimization of the chance that information would be lost in the translation from Chinese to English.

There were fifteen interviewees in total. For confidential reasons, they were denoted as X1, X2, X3, and X4 (from Xiangrong Village), Q1, Q2, Q3, and Q4 (from Qingjiang Village), S1, S2, S3, and S4 (from Shiqiao Village), L1, L2, and L3 (from Luchi Village). The background information of the interviewees and the case villages was shown in Table 5.5 and Table 5.6. The example of interview to identify CDFs can be found in Appendix B.

Table 5.5 Background information of the interviewees in CDFs identification

Village	Interviewee	Work unit	Job title	Years of relevant work experience	Education level	Major responsibility
Xiangrong	X1	Village level government	Branch secretary	20	Middle school	Organization and management in the whole process
	X2	Village level government	Assistant village head	3	Bachelor	Organization and management in

						the whole process
	X3	Planning institution	Senior Planner	10	Master	Planning
	X4	Others	Farmer	1	High school	Participating in site selection, housing design and building
Qingjiang	Q1	Village level government	Village head	16	High school	Organization and management in the whole process
	Q2	Village level government	Accountant	10	Bachelor	Organization and management in the whole process
	Q3	Planning institution	Senior Planner	8	PhD	Planning
	Q4	Others	Farmer	1	High school	Participating in site selection, housing design and building
Shiqiao	S1	Village level government	Branch secretary	20	High school	Organization and management in the whole process
	S2	Village level government	Village head	15	High school	Organization and management in the whole process
	S3	Planning institution	Senior Planner	12	Master	Planning
	S4	Others	Farmer	1	Middle school	Participating in site selection, housing design, housing allocation
Luchi	L1	Village level government	Village head	11	Bachelor	Organization and management in the whole process
	L2	Planning institution	Senior Planner	13	Master	Planning
	L3	Others	Farmer	1	High school	Participating in site selection, housing design, housing allocation, and community management

Source: from interviews

Table 5.6 Background information of the four cases in this research

Case	A: Xiangrong Village	B: Qingjiang Village	C: Shiqiao Village	D: Luchi Village
Topography	Plain areas	Plain areas	Hilly areas	Hilly areas
Areas of land/cultivated land (Unit: hectare)	315/115.9	352/148.5	537/183.2	328/51
Population/households	1767/635	2776/767	2354 /817	702/220
Labors	1,200	1,800	1,000	540
Percentage of Migrant workers to labors	62%	56%	50%	50%
Per capita income before disaster (Unit: Yuan/person/year) (end of 2007)	5,300	5,200	3,000	4,800
Supporting industry	Vegetable cultivation	Mushrooms, vegetable cultivation	farm tourism, cash crops	actinidia chinensis, tea, and bamboos
collapsed and severely damaged households	433	370	635	210
Areas of the concentration site(Unit: hectare)	5.81	9.07	18.67	2.17
percentage of households moving to CRS after disaster	32%	43%	90%	93%
Per capita income after disaster (Yuan/person/year) (end of 2011)	7,000	7,781	8,900	6,200
Increased living cost after concentration (Yuan/person/year) (end of 2011)	1,000	1,100	1,200	1,000

Source: from interviews

5.3.3 Findings

By summarizing the information generated in the interview process, the findings of identifying CDFs can be shown in Table 5.7. The information in the table shows that the most critical determinant factors include 'increasing versus decreasing balance' policy, urban-rural coordinated development strategy, dissemination of the reconstruction policies, victims' participation in the decision-making process, improved infrastructure, good materials and construction, and the capability of the community to develop itself. The significance of these factors can be elaborated through examining the four cases.

Table 5.7 Comparative evaluations on CDFs for developing CRS in post-disaster reconstruction between the four cases

Optional factors		Case A	Case B	Case C	Case D
Economic development	F1	M	N.A.	N.A.	N.A.
	F2	N.A.	M	M	N.A.
	F3	M	N.A.	M	M
Farmer's behavior	F4	M	N.A.	N.A.	N.A.
	F5	M	N.A.	M	N.A.
Policy	F6	N.A.	N.A.	H	H
	F7	H	H	H	H
	F8	H	H	H	H
	F9	N.A.	N.A.	N.A.	N.A.
	F10	M	M	N.A.	M
	F11	M	H	M	N.A.
Culture	F12	L	L	N.A.	N.A.

	F13	L	N.A.	N.A.	L
	F14	M	H	N.A.	M
Organization	F15	M	N.A.	M	N.A.
	F16	M	M	M	M
	F17	H	H	H	M
Site selection	F18	M	M	N.A.	M
	F19	N.A.	N.A.	N.A.	M
	F20	N.A.	N.A.	N.A.	H
	F21	M	N.A.	M	N.A.
	F22	L	M	N.A.	L
	F23	H	H	H	H
Layout	F24	N.A.	N.A.	M	M
	F25	M	M	N.A.	N.A.
	F26	H	H	H	N.A.
Housing design and construction	F27	N.A.	N.A.	M	N.A.
	F28	M	M	M	M
	F29	N.A.	N.A.	M	L
Further development	F30	H	H	H	H

Note: L: insignificant, M: significant, H: strongly significant, N.A.: not applicable

5.4 Case Study

There were two means, namely unified-planning-self-reconstruction and unified-planning-unified-reconstruction in the four selected villages. Unified planning was adopted for finding the suitable sites for building CRS, ensuring the scientific layout, housing design and construction of the settlement, and maintaining a harmonious relationship with other settlement. For self-reconstruction, the victims consolidated their former rural residential land and rebuilt

the houses with less residential land by themselves in the selected sites. As the area of the rural residential land in the concentration site is smaller than before, many areas of rural construction land were transformed into cultivated land. According to the policy 'increasing versus decreasing balance', the land use rights of the saved areas of construction land in rural areas could be transferred to urban areas, which generated income and supplemented the reconstruction financing. The victims reconstructed the houses by themselves according to the overall planning with governmental subsidies, personal funds, loans and the income from transferring the land use rights of saved rural residential land. Under this context, a single house was preferred in the concentration site. Compared to self-reconstruction, unified-reconstruction granted all the generated income from transferring the land use right of saved rural residential land to the collaborative party. The collaborative party was in charge of building the CRS while the rural victims got the settlement for free. Under this context, a multi-storey house was preferred in the concentration site as the collaborative wanted to save more areas of rural residential land and thus get more incomes. Figure 5.2 illustrates the distribution change of the rural settlement after developing CRS within a village. It is clear that the degree of dispersion would be reduced and it is more effective to provide infrastructure and public services.

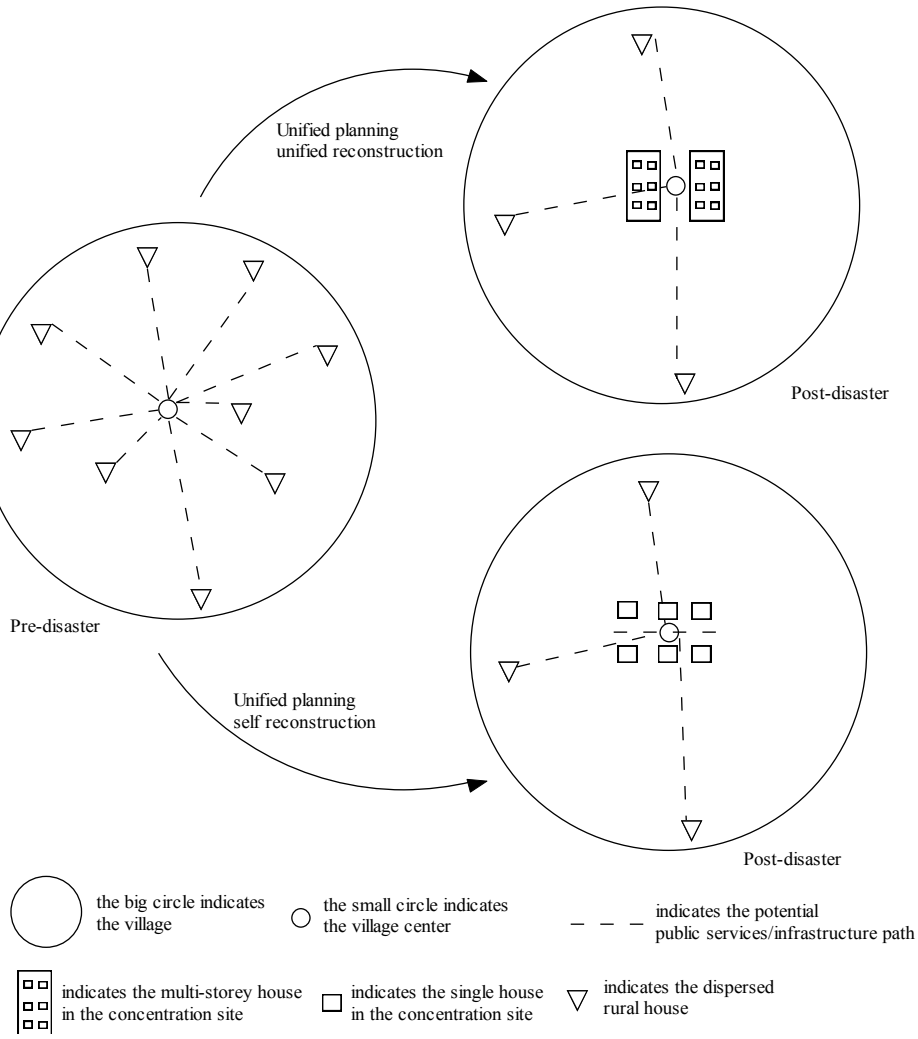


Figure 5.2 Illustration of distribution change of settlement after developing CRS within a village in Dujiangyan

5.4.1 Case A: Xiangrong village

Xiangrong Village is located in Tianma Town, the northeast of Dujiangyan, Chengdu City. Xiangrong Village occupies 315 hectares of land, with 115.9 hectares of farmland. It had 635 households and 1,767 people at the end of 2010. The primary economic activity of Xiangrong Village is vegetable cultivation. As Xiangrong Village is located in Chengdu plain area, the cultivated land is very close to the residence. The cultivation radius is limited and the labor

intensity is comparatively low. Therefore, many labors are able to work in urban areas to find more income sources.

The 5.12 Sichuan Earthquake brought severe losses to Xiangrong Village. According to the interview with the local official of Xiangrong Village, 433 houses were not suitable for living due to severe damage. During the interview, it was found that developing CRS was put on the agenda after a leader of Dujiangyan visited Xiangrong Village. The leader conducted a field study to investigate how to deal with the temporary housing on the forest land in Xiangrong Village. In the process of field study, the leader found it was a big waste to occupy a large amount of cultivated land for permanent housing reconstruction if not considering the forest land built with temporary housing. A principle was therefore suggested that cultivated land should be saved as much as possible through explorative measures. Therefore, the village-level government proposed to concentrate the willing rural victims with less rural residential land in the forest land while consolidating the former rural residential land through rural residential land exchange. A corresponding Village Council and a Board of Supervisors were founded to organize discussions and argumentation among the rural victims. After reaching consensus, three sites, namely Lao Ya Lin, Zeng Jia Yuan Zi, and Xiao Jia Yuan Zi, were selected for developing CRS by considering the needs of saving cultivated land and being close to the provincial highway (Communist Party of China News 2009).

Unified-planning-self-reconstruction was adopted as the rural victims preferred the single house. According to the scheme, the participants consolidated their former rural residential land and rebuilt the houses with less residential land by themselves in the three selected sites. It also

should be noted that the rural victims can choose among the three sites to make their houses as close to their contracted land as possible. The specific location of a house in the selected concentration site was determined by lucky draw. If there is any conflict of interest, the Village Council would guide the involved rural victims to solve the conflicts by themselves. An overall plan, which was the consensus of the rural victims, was taken to ensure the adequacy of the entire layout of CRS. The victims reconstructed the houses by themselves according to the overall plan and determined location. The difference area of former rural residential land and the new rural residential land in the concentration site was considered as the saved rural residential land. The financial income was allocated to the rural victims according to the contribution of saving rural residential land after subtracting the cost of former housing removal and rural residential land reclamation from the total generated revenues in the transferring process. Moreover, allocation step by step was used to push the reconstruction progress.

The CRS had been completed before August 2009. The total area of the concentration site is 5.81 hectares. Due to concentration, about 7.6 hectares of rural residential land was saved and consolidated as cultivated land. The land use right of 7.6 hectares of construction land were transferred to Wenjiang District of Chengdu City according to the 'increasing versus decreasing balance' policy. In the site visit conducted in September 2011, it was found that the CRS was located in the green woodland with beautiful layout. Most households have a beautiful single house with two floors while a few households have only one storey in the concentration site. The infrastructure such as gas, electricity, telephone, road, sanitation, and physical fitness facilities was built and improved greatly compared to those pre-disaster. Figure 5.3 is an

example of the CRS in Zeng Jia Yuan Zi, Xiangrong Village.

(a) the concentrated rural settlement (b) the physical fitness facilities

Figure 5.3 The concentrated rural settlement in Xiangrong Village

The degree of dispersion would be reduced as illustrated by Figure 5.2. The reduced degree can further be calculated through various measures. For example, the measure developed by Zierhoffer is one of the common measures as shown in Formula 5.1 (Mandal, 1989).

$$R = \frac{P \times S}{d} \times K \qquad \text{(Formula 5.1)}$$

where R is the degree of dispersion, P is the average area per dwelling, S is the number of house groups in the commune, which is the number of houses if no houses are grouped, d is the total number of inhabitants, and the constant K is 0.005.

It was found in the interview that 203 households or about 43% took part in this scheme, while others reconstructed in-situ. The average area of rural residential land for the house in the concentration site is 35m^2/person and was 150m^2/person before concentration. That is to say, the value of P and S would be decreased after concentration, while d and K remain unchanged.

Based on this comparison, it is clear that the degree of dispersion has been reduced after developing CRS in post-disaster reconstruction. However, due to political sensitivity, the geographical data could not be accessed, thus it is difficult to specifically calculate how much the dispersion was reduced.

Moreover, it was found that average revenue of each household generated from rural residential land exchange was 60,000 RMB. Taking into account the national subsidy of 20,000 RMB, each household only spent 30,000~40,000 RMB to reconstruct the single house. Most households were satisfied with the improved living environment, infrastructure, public services and neighbors. The social network was further enhanced after concentration. Most households continued farm work but family members are free to find work opportunities in urban areas due to application of mechanics in large-scale agricultural development. Although the average living cost increased 1,000 RMB, the average income increased 1,700 RMB, which is enough to cover the increased living cost as shown in Table 5.6.

5.4.2 Case B: Qingjiang village

Qiangjiang Village is located in Cuiyuehu Town, the southeast of Dujiangyan, Chengdu City. Qingjiang Village occupies 352 hectares of land, with 148.5 hectares of farmland. It had 767 households and 2,776 people at the end of 2010. The primary income source is agricultural cultivation, cultivating landscape plants such as sweet-scented osmanthus tree, and work in urban areas. The per capita income is 5,477 RMB per year.

The 5.12 Sichuan Earthquake brought severe losses to Qingjiang Village. According to the interview with the local officials of Qingjiang Village, 591 houses were not suitable for living

due to severe damage. There was a severe finance shortage for reconstruction, although there were government subsidiaries, reconstruction aid from Shanghai, victims' own capital and bank credit. Furthermore, the geographical location of Qingjiang Village is not so good, presenting difficulty in attracting investment in post-disaster reconstruction. As a result, the government intended to adopt the policy of rural residential land exchange, which can generate income and supplement the reconstruction finance. A corresponding Special Village Affair Board and a Special Supervision Board were founded to organize discussions and argumentation among the rural victims. After reaching consensus, two sites, namely Shui Mo Fang and Qingjiang River, were selected for developing CRS by considering the needs of saving cultivated land and protecting the environment.

Unified-planning-self-reconstruction was employed to deliver CRS. According to the scheme, the participants consolidated their former rural residential land and rebuilt the houses with less residential land by themselves in the two selected sites. The rural victims could choose between the two sites to make their house as close to their contracted land as possible. The specific location of the house in the selected concentration site was determined by pair selection. Pair selection means that the rural victims could select their neighbors and a group location would be determined as a result. The Village Board would mediate the selection if there was any conflict. This measure is used to enhance the social network within the village. An overall plan, which was the consensus of the rural victims, was developed to ensure the adequacy of the entire layout of CRS. The victims reconstructed the houses by themselves according to the overall plan. The revenues generated from rural residential land exchange were evenly allocated to the

participating rural victims. Unlike the proportion allocation principle in Xiangrong Village, the even allocation principle was thoroughly discussed and determined by the Village Board. This principle was useful to avoid social imparity in building CRS although they might have different areas of rural residential land before the disaster occurred. In addition, the revenues were allocated stage by stage to promote the reconstruction progress.

The CRS had been completed before August 2010. The two sites occupy nearly 9 hectares with the construction area as 4.89 hectares. The two sites concentrate 326 households and 1,131 victims. Due to concentration, about 18.7 hectares of rural residential land was saved and consolidated as cultivated land. The average area of rural residential land for the house in the concentration site is $35m^2$/person while it was $150m^2$/person before concentration. It is clear that the degree of dispersion has been reduced after developing CRS in post-disaster reconstruction by following the same logic in Case A.

On the site visit conducted in September 2011, it was found that the CRS was located in the green woodland with beautiful layout. All household have a beautiful single house with two floors in the concentration site. The infrastructure such as gas, electricity, telephone, road, sanitation, and physical fitness facilities was built and improved greatly compared to those pre-disaster. Figure 5.4 is an example of the CRS in Shui Mo Fang, Qingjiang Village.

(a) The layout of the concentrated rural settlement (b) The public space

Figure 5.4 The concentrated rural settlement in Qiingjiang Village

Moreover, it was found that average revenue of each household generated from rural residential land exchange was 60,000 RMB. Taking into account the national subsidy of 20,000 RMB, each household only spent 30,000~40,000 RMB to reconstruct the single house. Most households were satisfied with the improved living environment, infrastructure, public services and neighbors. The social network within was further enhanced after concentration. Most households continued farm work but family members are free to find work opportunities in urban areas due to application of mechanics in large-scale agricultural development. Although the average living cost increased 1,100 RMB, the average income had increased 2,500 RMB, which is enough to cover the increased living cost as shown in Table 5.6.

5.4.3 Case C: Shiqiao village

Shiqiao Village is located in Qingchengshan Town, quite close to the tourism zone of Qingchengshan. Shiqiao Village occupies 537 hectares of land, with 183.2 hectares of farmland. It has 817 households and 2,354 people at the end of 2010. The primary economic activity of

Shiqiao Village is agricultural cultivation and economic crops. As Shiqiao Village is located in hilly areas, the cultivated land is limited generating limited incomes. Therefore, many labors are trapped in working in urban areas to find more income sources or staying in the farmland to survive.

The 5.12 Sichuan Earthquake brought severe losses to Shiqiao Village. According to the interview with the local official of Xiangrong Village, 635 houses were not suitable for living due to severe damage. The triggering reason for developing CRS in Shiqiao Village was a project initiated before the disaster struck. Before the disaster, tourism in Qingchengshan was flourishing but with limited land to expand and support. However, the economic development of Shiqiao Village was poor, although it has a good economic location close to the town of Qingchengshan and the tourist spots of Qingchengshan. Therefore, the village-level government had already discussed with Sun Zone Ltd. to concentrate the farmers to save rural residential land for eco-tourism development and concentrate the farmland for eco-agriculture development before the disaster occurred. The 5.12 Sichuan Earthquake just provided a chance to advance the plan. After the disaster, a corresponding Village Council and a Board of Supervisors were founded to organize discussions and argumentation among the rural victims. The site being close to the provincial highway to the tourism spot of Qingchengshan was selected for developing CRS by considering the needs of saving cultivated land and transportation. Moreover, this site was determined for further development and urbanization due to the good economic location.

Unified-planning-unified-reconstruction was used for delivering CRS in Shiqiao Village.

According to the scheme, the participants consolidated their former rural residential land and all the contracted land should be circulated for eco-agriculture and eco-tourism developed by Sun Zone Ltd. The rural victims can obtain rent and dividends from transferring the land use rights. In addition, the rural victims obtained the house for free according to the standard of 35m^2 per person. An overall plan, which was the consensus of the rural victims, was developed to ensure the adequacy of the entire layout of CRS. The collaboration partner: Sun Zone Estate Ltd., organized building the houses according to the overall plan. After building, the house was allocated to the participants through lucky draw.

The reconstruction was completed before August 2010. It was found in the interview that 480 households or about 90% ook part in this scheme, while others reconstructed in-situ. On the site visit conducted in September 2011, it was found that the CRS was located in the green woodland with beautiful layout. Every household has a beautiful house with three floors in the concentration site. The infrastructure such as gas, electricity, telephone, road, sanitation, and physical fitness facilities was built and improved greatly compared to those pre-disaster. Figure 5.5 is an example of the CRS in Shiqiao Village. The dispersion degree is also reduced through similar analysis in Case A.

(a) layout of concentrated rural settlement (b) The houses in the concentration site

Figure 5.5 The concentrated rural settlement in Shiqiao Village

Moreover, most households were satisfied with the improved living environment, infrastructure, public services and neighbors. The social network within was further enhanced after concentration. Most households chose to find work in urban areas while obtaining the rent and dividends each year. Although the average living cost increased 1,200 RMB, the average income increased 5,900 RMB, which is enough to cover the increased living cost, as shown in Table 5.6.

5.4.4 Case D: Luchi village

Luchi Village is located in the northeast of Dujiangyan, Chengdu City, which is in the mountainous area of Sichuan Province. It occupies 328 hectares of land, with 51.07 hectares of farmland. It had 220 households and 702 people at the end of 2010, with 516 people engaging in agricultural production. The primary economic activity of Luchi Village is cultivation of actinidia chinensis, tea, and bamboos.

The 5.12 Sichuan Earthquake destroyed 95% of the houses and brought severe damage to the infrastructure such as communications, electric, and transportation in Luchi Village. However,

the finance gap for reconstruction is huge, although there are government's subsidiaries, reconstruction aids from Shanghai, personal capital and bank credit. The fact that the rural victims suffered huge losses but had little funds to reconstruct their houses gained great public concern. Therefore, more likely pursuing political achievements, Chengdu bureau of land and resources suggested implementing CRS in Luchi Village through rural residential land exchange and allow the farmers to move into CRS for free. A corresponding Village Council and a Board of Supervisors were founded to organize discussions and argumentation among the rural victims. After reaching consensus, three places, namely Shi Zi Qiao, Dong Lin Liang Zhan, and Dong Lin Meng Zi, were selected for CRS by considering the needs of geological safety, saving cultivated land, and being close to the road. A geological survey was conducted to ensure the safety of the site.

Unified-planning-unified-reconstruction was adopted for delivering CRS in Luchi Village. According to the scheme, the victims consolidated their rural residential land and relocated to the site for CRS. Unified planning, which was the consensus of the rural victims, was used to ensure the entire layout of CRS. Unified reconstruction was undertaken by the Chengdu Bureau of Land and Resources, thus all the rural victims moved to the concentrated settlement for free. Compared to that in Xiangrong Village, the concentration degree was higher in order to save more rural construction land and obtain more extra interests for unified reconstruction.

The CRS had been completed before June 2009. A total of 246 households and 694 people took part in this scheme, while others reconstructed in-situ. On the site visit conducted in September 2011, it was found that the CRS is located along a river. More than ten blocks of four-floor

buildings are built on land of 21.9 Mu areas. The infrastructure such as gas, electricity, telephone, road, sanitation, and physical fitness facilities were built and improved greatly compared to those pre-disaster. The current condition of the CRS in Shi Zi Qiao, Luchi Village is illustrated in Figure 5.6. The dispersion degree is also reduced through similar analysis in Case A.

(a) The layout of concentrated rural settlement (b) the public service center

Figure 5.6 The concentrated rural settlement in Luchi Village

Moreover, it was found that most households were satisfied with the improved living environment, infrastructure, public services and neighbors. The social network was further enhanced after concentration. However, most households continued farm work but the concentration site is a little far from their contracted land, the difficulty of which could not be reduced through mechanics, as Luchi Village is located in a hilly area. In addition, there are no spaces for storing farm tools and grains in the multi-storey building. The rural victims had to build some temporary tents near the contracted land for storing farm tools or feeding poultry. The rural victims therefore had to find more work opportunities in urban areas and had certain

worries for the future after concentration. Although the average living cost increased 1,000 RMB, the average income had increased 1,400 RMB, which was able to cover the increased living cost, as shown in Table 5.6. The local government had been trying to circulate the contracted land for cultivating economic crops by an external company to release the labors and increase the income. The effects of these measures still need observation in the future.

5.4.5 Cases summary

The interview with the local government officials in the four cases showed that governmental guidance played a great role in developing CRS in post-disaster reconstruction. The available government policy (land circulation, 'increasing versus decreasing balance' policy, and urban-rural coordinated development strategy, reconstruction aid from other provinces, rural collective land ownership) is important for them to initiate this scheme. Promoting concentration within the village is critical to reduce social tensions, which convinces the rural victims that they will gain more benefits by participating in this scheme.

Besides, the rural victims' willingness was respected. The government's efforts to involve the rural victims in decision making were important for them to consider concentration settlement as a better alternative. As they were involved in the decision making process, they were assured that the site for concentration was satisfactory (short cultivation radius, near the social services, and improved infrastructure), the layout is attractive (sufficient space for agricultural needs and suitable degree of concentration), and the housing design and construction is according to their preference (good materials and construction). These measures gave them confidence and the hope of what they can get after concentration, thus the concentration scheme received support

from them.

In addition, the economic development is critical for them to adapt to the life after concentration. The plain areas provide good condition for agricultural industrialization, thus making the victims less worried about the future support. In fact, the ability to attaining a better quality of life and being able to afford the increased living cost (further development) are critical for the rural victims to choose the concentration scheme. Some of the family members (who shift to urban consumption mode and work in urban areas) would persuade the whole family to accept CRS and to adapt to the new lifestyle.

5.5 Discussion

The site visit and interviews demonstrated that a generic set of CDFs can be summarized through the interviews and case studies, although CDFs differ between individual cases due to various factors such as natural environment and economic development. Abstracting from the CDFs demonstrated above, it appears that there are three types of CDFs for developing CRS in post-disaster reconstruction. They are governmental guidance, economic development and victims' willingness, as shown in Figure 5.7.

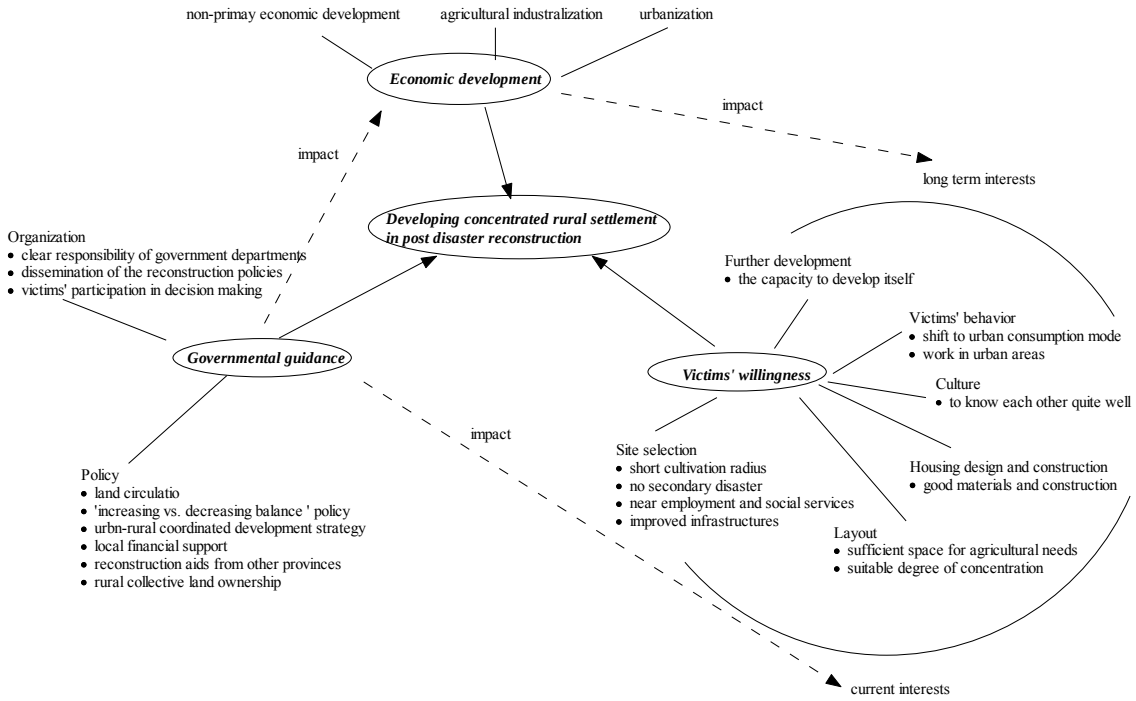


Figure 5.7 A generic set of CDFs for developing CRS in post-disaster reconstruction in China

5.5.1 Governmental guidance

The government plays critical roles in disaster response and reconstruction, especially facing great catastrophes such as the 5.12 Sichuan Earthquake in 2008. Both central government and local government make corresponding laws and regulations e.g. ‘Regulations on Post-Wenchuan Earthquake Rehabilitation and Reconstruction’, and ‘Suggestions of the State Council on the Policies and Measures for Supporting the Post-Wenchuan Earthquake Rehabilitation and Reconstruction’, to implement post-disaster reconstruction (UNDP 2008). Moreover, the government organizes and coordinates the reconstruction efforts including appealing for reconstruction aid from other provinces, named as “partner support”. Each significantly affected county was supported by another province or municipality on a one-to-one basis, as shown in Table 5.8. The external partner was required to commit 1% of its annual local financial revenue

for three years to support reconstruction. Shanghai, one of the richest provinces made a very significant contribution to Dujiangyan reconstruction including the reconstruction in the four case villages (Dunford and Li 2011; Xu and Lu, 2013).

Table 5.8 Support partner arrangements after the 5.12 Sichuan Earthquake in 2008

Supported areas		Supporting areas
Sichuan Province	Wenchuan	Guangdong
	Beichuan	Shandong
	Qingchuan	Zhejiang
	Mianzhu	Jiangsu
	Dujiangyan	Shanghai
	Shifang	Beijing
	Jiangyou	Henan
	Pingwu	Hebei
	Anxian	Liaoning
	Pengzhou	Fujian
	Maoxian	Shanxi
	Lixian	Hunan
	Heishui	Jilin
	Songpan	Anhui
	Xiaojin	Jiangxi
	Hanyuan	Hubei
	Chongzhou	Chongqing
	Jiange	Heilongjiang
Gansu Province	Seriously affected district	Shenzhen
Shanxi Province	Seriously affected district	Tianjin

Source: UNCRD, 2009

In order to improve the infrastructure and living conditions in the rural areas, the government has been taking the opportunity of post-disaster reconstruction to promote CRS. There are three specific policies driving the implementation of CRS. First, the 'increasing versus decreasing balance' policy formulated by the central government to promote CRS was introduced before the 5.12 Sichuan Earthquake occurred (MLR 2008). This policy is a response to the fact that urban construction land is relatively scarce while the use of rural land for construction is disordered and inefficient in recent China, and some rural houses have been abandoned. This

policy allows the allocation of land use through transferring the land use right of construction land from rural areas to urban areas. The interests generated in the land use right transfer process are used to compensate the farmers for consolidating their former rural residential land and help them move into the CRS. Thus the 'increasing versus decreasing balance' policy is attractive for the rural victims especially when the reconstruction finance are limited. It can be found from Table 5.6 that the higher the percentage of collapsed and severely damaged households, the higher the ratio of moving to the CRS. According to the study by Peng et al. (2013), the government has little resistance to promoting CRS in post-disaster reconstruction. Therefore, this policy was adopted effectively in the four case villages under study.

In addition, for narrowing the development gap between urban and rural areas, Chengdu City was selected as one of the experimental zones of urban-rural coordinated development in 2007. The city government introduced the regulation 'suggestions on cultivated land protection and further reform the property system of rural land and rural housing' in 2008. This local policy provides a good mechanism for implementing the 'increasing versus decreasing balance' policy. According to the local regulation, registration of rural collective land and rural residential land was imposed to reform the rural property systems (First Finance Daily 2011). Registering land use right in rural areas aims to maximize land values and support transactions in the market (Xu et al. 2009). Based on the land right registration, land use right of construction land can smoothly transferred from rural areas to urban areas while the rural victims can obtain the interest generated in the process.

Another major policy in promoting CRS in Chinese rural areas is the rural land circulation

policy. This policy was formulated by the central government to increase farm productivity and release surplus labors to seek non-farm work (Zhang 2008). All case villages in this study intend to expand the scale of rural land circulation in order to develop characteristic agriculture, eco-agriculture, and sight-seeing agriculture. This will increase agricultural income while enabling the young labors to obtain non-farm work. This can help increase the income, thus covering the increased living cost after concentration. Furthermore, as the land ownership belongs to the rural collectives, even land adjustment would face few difficulties after several rounds of Village Council discussions, which convinces the rural victims that they will gain more benefits by participating in this scheme.

It is important to note that involving the rural victims in the decision making process is the key for the local government to successfully initiate and organize the concentration scheme. Participation empowers the rural victims to reach consensus on reconstruction and attain community capabilities for further development, which is critical for sustainable development in post-disaster reconstruction (Pearce 2003; Davidson et al. 2007). All case villages established a Village Committee and Supervising Committee to discuss and supervise the implementation of relevant issues, such as reconstruction approach, site selection, layout, and housing design. Sharing decision making process convinces the rural victims of the current interests and the future of CRS. Therefore, the rural victims who participated in the decision making process were more willing to accept the scheme than who were forced.

5.5.2 Economic development

Economic development provides the foundation for the rural victims to cover the increased

living cost after concentration and to sustain further development. Without adequate economic development, developing CRS could only achieve short-term interests such as improved infrastructure and public services but there is a latent danger of poor living in the future. The interviews with planners indicate that developing CRS in less developed areas has raised worries over future development.

Agricultural industrialization is able to expand the scale of agricultural production, develop a better production and management system, and bring value-added processing to the local community through management and technology improvement (Drabenstott 1995). For example, benefiting from the plain areas, Xiangrong Village can develop a vegetable base that exports vegetables to other provinces. Owing to rural land circulation, Luchi Village is able to develop large scale cultivation of actinidia chinensis, tea, and bamboos. At the end of 2011, there are 250 Mu areas of actinidia chinensis, producing 150 tons per year, 700 Mu areas of tea, and 80 Mu areas of bamboos. The actinidia chinensis base is constructed, operated and managed by Qing Niu Corporation according to the standard of demonstrative export bases.

Non-primary economic activities can create more work opportunities, absorb the surplus labors, and expand the income sources for the farmers (Taylor 1988; DeJanvry et al. 2005). For instance, Shiqiao Village plans to develop ecotourism and sightseeing agriculture after concentration. The real estate and infrastructure development near Qingjiang Village attracts the farmers to work nearby. Both agricultural industrialization and non-primary economic activities are able to help people increase income and afford the increased living cost caused by concentrated settlement.

Urbanization not only means moving to cities but also means shifting to the urban living mode (Popkin 1999). Working in urban areas would impact the farmers' consumption modes and living habits, which helps the victims adapt to the new life after concentration. This is evidenced in the interview process with the findings that the family with members working in urban areas is more likely to accept concentration. Furthermore, the urbanization trend results in some abandonment of rural settlement. The practices of developing CRS in post-disaster reconstruction are a kind of response to this trend in two aspects. First, the households abandoning rural settlement can take this opportunity to get some income by reducing the areas of rural residential land and rebuilding a better house in the concentration site. The new house can be used for rent and business, which brings further income. Meanwhile, the saved rural residential land would be consolidated for cultivation. This practice reduces the waste of land and improves the sustainability accordingly. Second, developing CRS for some villages in the suburb of city or town is urbanization (sub-urbanization) itself.

5.5.3 Victims' willingness

Victims' willingness was respected and followed in implementing CRS schemes. The interview with the local government officials in the Huaxi village Puyang Town, which adopted reconstruction in-situ demonstrated that rural victims' unwillingness is the dominant reason for the village to give up implementing CRS. However, the four cases demonstrated that good understandings of the current interest and long term interest generated in implementing CRS can increase the victims' willingness to accept it.

The current interests include extra finance for reconstruction and improved infrastructure, public

services and living conditions. Interests generated from participating in ‘increasing versus decreasing balance’ would help the rural victims to reconstruct the houses. For example, the victims adopting concentration in Xiangrong Village got an average interest of 16,000 Yuan per person, and 20,000 Yuan per person in Qiangjiang Village. With other subsidies, these victims were almost able to reconstruct their houses without credit. The improved infrastructure, public services and living condition are also attractive for the rural victims to accept developing CRS. The professionals from Sun Zone Building Design Company were hired by this village to make plans so that the reconstruction is scientific. The rural victims were involved in making decisions in site selection, layout, and housing design, which makes the planning reasonable; thus, rural victims clearly understand what interests they can obtain. Also, as the rural victims know each other quite well within the village, concentration shall enhances the social network rather than bringing social tensions, which is helpful for countering geographical inertia. As a result, nearly all interviewed farmers enjoy their living conditions after concentration.

In the long term, the rural victims are concerned more about how to afford the increased living cost and how to engage in future development. The main income sources for the rural victims include work in urban areas, the rent generated from rural land circulation, and the income from agricultural planting. From the data shown in Table 5.6, it can be seen that the increased per capita income is enough to cover the increased per capita living cost induced by the concentration lifestyle. Furthermore, all four case villages in this study have made plans to promote agricultural industrialization and non-primary economic activities by using the existing resources, although immediate effects have not been seen. Meanwhile, as a result of establishing

Village Committee and Supervising Committee to make collective decisions and self-management of the concentration site, the social capital can be formed, which is an important feature of a resilient village. In sum, efforts must be devoted to promote the current interest and long term interest of the rural victims in order to attract them to participate in developing CRS.

5.6 Summary of the Chapter

This chapter explores the CDFs for developing CRS in post-disaster reconstruction when making decisions. Interviews with the local government officials, planners and rural victims from four case villages demonstrate that governmental guidance, economic development condition and victims' willingness are three critical aspects for developing CRS in post-disaster reconstruction. Before adopting CRS in post-disaster reconstruction, the local government should consider whether the local economy can support the concentration lifestyle in rural areas, and whether the government has the capacity to make proper guidance and obtain the rural victims' willingness to participate in developing CRS. Governmental guidance can help improve and ensure the current interests of the rural victims while the economic development condition can provide sufficient capacity for improving the long term interests for the affected people. Increasing both current and long term interests can increase the victims' willingness to accept concentrated settlement. The analysis suggests that concentrated settlement without future economic development and rural victims' willingness would bring a latent danger of poor living in the future.

As a natural logic, after identifying the preconditions, it is necessary to investigate how to develop CRS in post-disaster reconstruction in order to ensure the sustainability of post-disaster

reconstruction. The following chapter replies to this question by developing a decision model for implementing CRS in post-disaster reconstruction.

6 AN EFFECTIVE DECISION MODEL FOR IMPLEMENTING CRS IN POST-DISASTER RECONSTRUCTION

6.1 Introduction

Chapter 5 contributed to understanding how to develop concentrated rural settlement (CRS) in post-disaster reconstruction by identifying the preconditions. However, specific measures of how to develop CRS in post-disaster reconstruction remain unknown. By referring to Chapter 2, it is known that existing decision systems of CRS development under normal conditions and rural housing reconstruction have inherent problems and could not be directly applied in developing CRS in post-disaster reconstruction, although these systems do provide good references. Therefore, this chapter aims to fill this gap by establishing a decision model for implementing CRS in post-disaster reconstruction. For this purpose, the implementation of CRS in the villages of Xiangrong, Qingjiang, Shiqiao and Luchi in Dujiangyan, Chengdu City, China was investigated. The free-flow mapping technique was adopted to map the process of developing CRS in post-disaster reconstruction, the result of which was confirmed by the local officials. Finally, the problems and experiences in the mapped processes were discussed. A decision model for developing CRS in post-disaster reconstruction was established based on the experiences and problems found in current reconstruction practices and the identified CDFs in Chapter 5.

6.2 Mapping the Implementation Process of CRS in Case Villages

By following the methods described in section 3.2.4, interview was adopted to find the experiences and problems and collect information of the development process in the four cases.

Fifteen interviewees were involved in this interview. For confidential reasons, they were denoted as X21, X22, X23 (from Xiangrong Village), Q21, Q22, Q23, and Q24 (from Qingjiang Village), S21, S22, S23, and S24 (from Shiqiao Village), L21, L22, L23 and L24 (from Luchi Village). The background information of the interviewees was shown in Table 6.1. The example of interview to identify CDFs can be found in Appendix C.

Table 6.1 Background informaiton of the interviewees in developing decision model

Village	Interviewee	Work unit	Job title	Years of relevant work experience	Education level	Major responsibility
Xiangrong	X21	Village level government	Branch secretary	20	Middle school	Organization and management in the whole process
	X22	Village level government	Assistant village head	3	Bachelor	Organization and management in the whole process
	X23	Planning institution	Senior Planner	10	Master	Planning
Qingjiang	Q21	Village level government	Village head	16	High school	Organization and management in the whole process
	Q22	Village level government	Accountant	10	Bachelor	Organization and management in the whole process
	Q23	Planning institution	Senior Planner	8	PhD	Planning
	Q24	Others	Farmer	1	High school	Participating in site selection, housing design and building
Shiqiao	S21	Village level government	Branch secretary	20	High school	Organization and management in the whole process
	S22	Village level government	Assistant village head	3	Bachelor	Organization and management in

						the whole process
	S23	Planning institution	Senior Planner	12	Master	Planning
	S24	Others	Farmer	1	Middle school	Participating in site selection, housing design, housing allocation
Luchi	L21	Village level government	Branch secretary	15	High school	Organization and management in the whole process
	L22	Village level government	Village head	11	Bachelor	Organization and management in the whole process
	L23	Planning institution	Senior Planner	13	Master	Planning
	L24	Others	Farmer	1	High school	Participating in site selection, housing design, housing allocation, and community management

Source: from interviews

Through analyzing the information generated in the interview, it was found that the process of developing CRS was similar between the villages of Xiangrong and Qingjiang, while the village of Shiqiao was similar to Luchi. These were mapped and presented in Figure 6.1 and Figure 6.2 separately. These mappings are constructed based on the field study and the discussions with governmental officials who were involved in the reconstruction project. In order to present comparative analysis between the four cases, consistent terminologies are used for presenting the mappings.

- Damage assessment: The earthquake relief headquarters established expert groups to assess the extent of damage to the rural houses.

- Determining the reconstruction approach: Whether to develop CRS or to reconstruct in-situ; if to develop CRS, whether adopting unified-planning-self-reconstruction or unified-planning-unified-reconstruction was discussed and determined.

- Site selection: Select the sites for developing CRS within the village.

- Project application: Proposal for developing CRS post-disaster was submitted to the Construction Committee and Standing Committee of Dujiangyan for endorsement.

- Housing planning and design: Respective design company/institutions were hired to plan a course of action in order for the reconstruction to remain reasonable.

- Building CRS: The rural victims respectively selected a construction team and signed the contract to build houses.

- Infrastructure planning: The village planning council of Dujiangyan made infrastructure planning for CRS, which required the village committee's comments and final confirmation.

- Building infrastructure: The construction committee of Dujiangyan entrusted construction teams to build the infrastructure.

- Allocating the houses for unified-planning-unified-reconstruction: The houses were allocated by a lottery draw with official oversight.

- Moving into the CRS: The rural victims moved into the constructed houses in the reconstruction site after completing housing, building infrastructure, and final

decorations and beautification.

- Demolish the former houses and consolidate the former rural residential land: According to China's "increasing versus decreasing balance" policy, the rural victims moving into the CRS must demolish their former houses and consolidate the former rural residential land, which must be used as cultivated land.

- Issue the property right certificate: Property right certificate of the housing and rural residential land in the reconstruction site was issued after the rural victims confirmed the results of survey.

- Daily management: The residents of the concentrated site elected the members of the management committee for the site. The management committee conducted daily management practices accordingly.

- Economic development: Various measures such as land circulation, eco-agriculture, and tourism were considered to promote economic development after concentrating the population

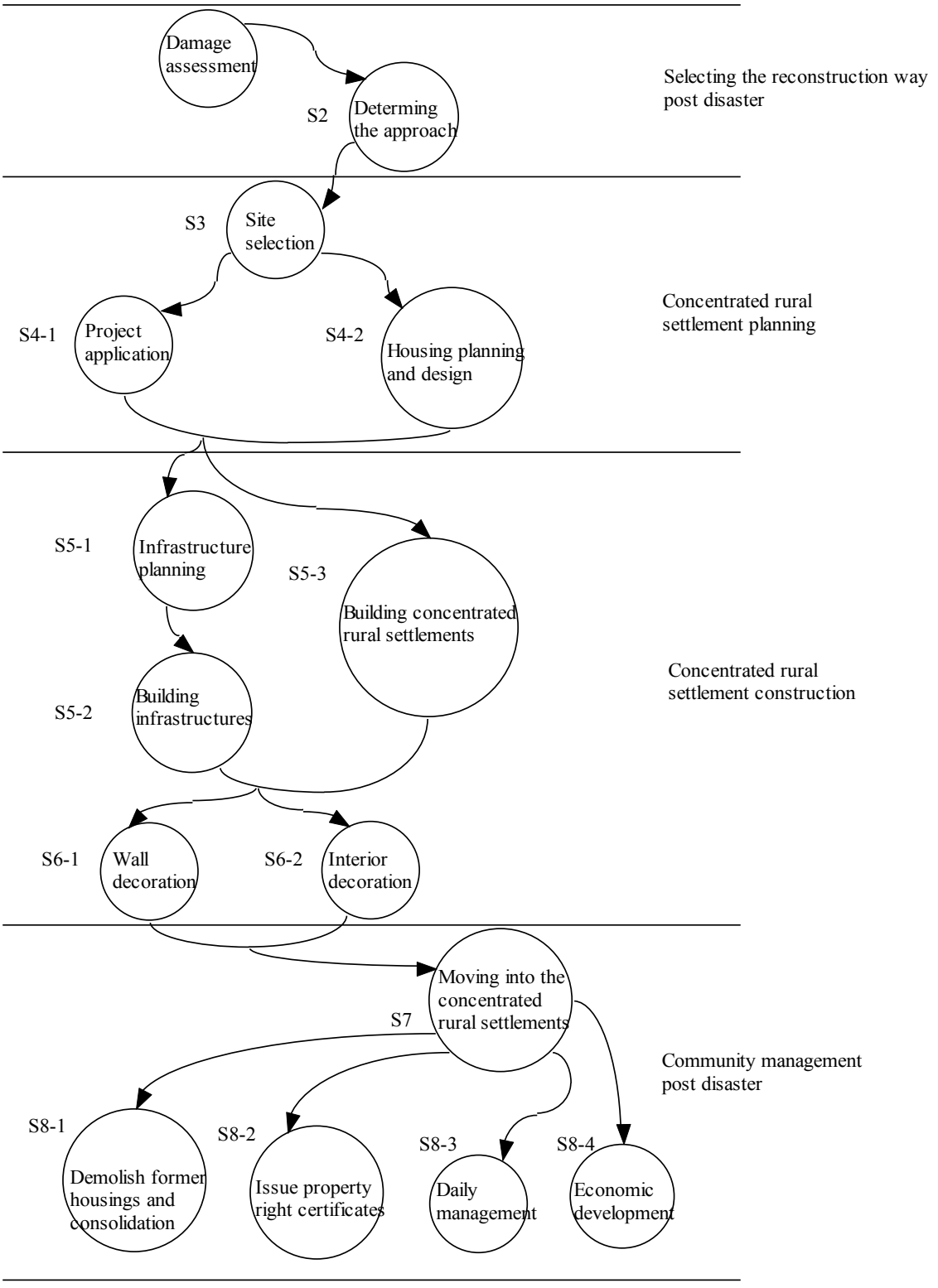


Figure 6.1 The implementation process of developing CRS in post-disaster reconstruction in Xiangrong/Qingjiang Village, Dujiangyan

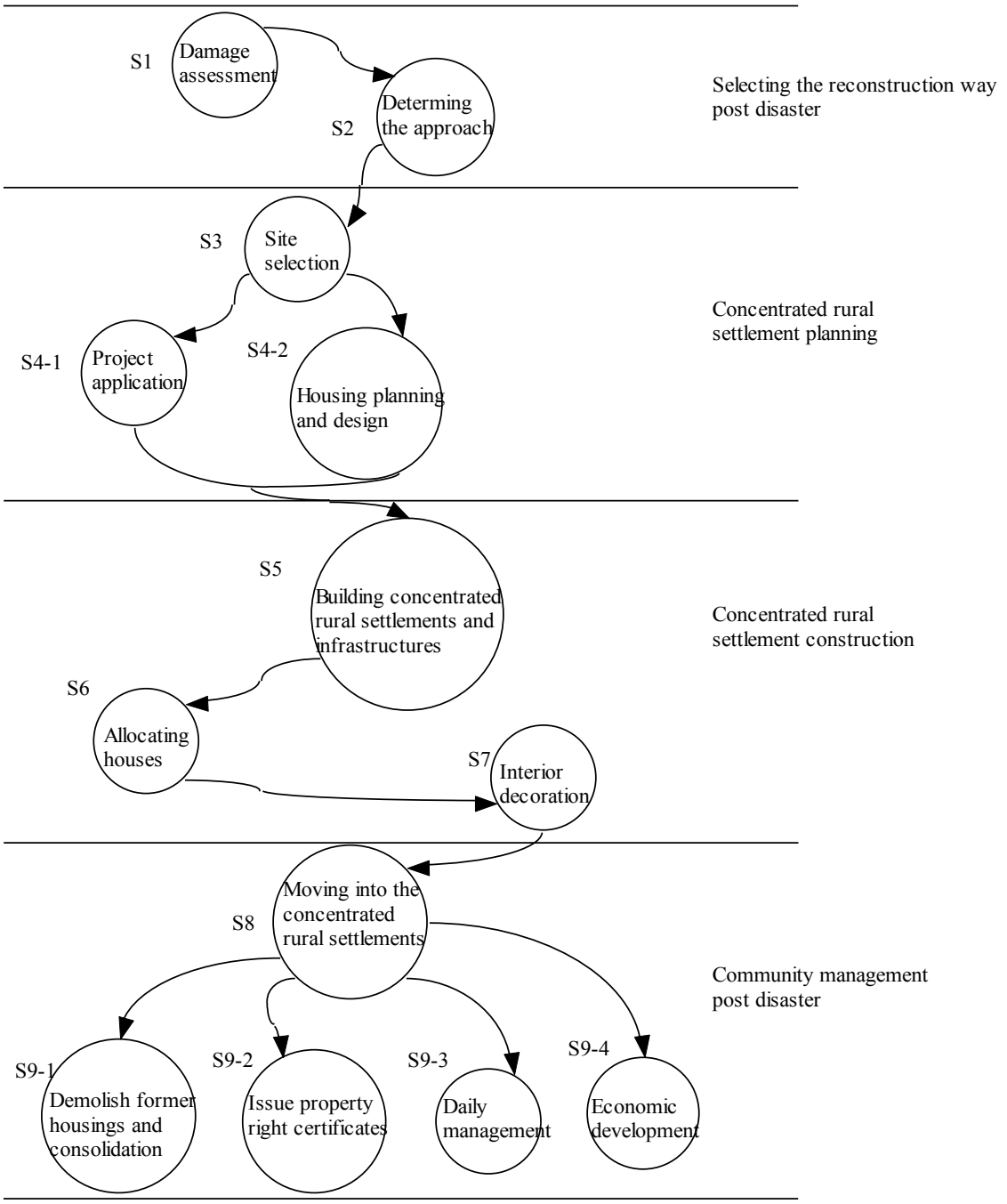


Figure 6.2 The implementation process of developing CRS in post-disaster reconstruction in Shiqiao/Luchi Village, Dujiangyan

The field study and discussions on these development processes further generates a list of problems and experiences in developing CRS in post-disaster reconstruction:

Problem:

P_1=no pre-disaster planning

P_2=undetermined property rights of cultivated land generated from consolidating former rural residential land

P_3=no geographical survey in site selection

P_4=incapability of completing project application before reconstruction

P_5=little supervision on the housing quality

P_6= inadequate assessment due to rush of progress

P_7=inadequate infrastructure

P_8=insufficient financial support on daily management for CRS

P_9=insufficient coordination between industrial planning and developing CRS

P_{10}=weak basis for future development

P_{11}=little attention to environmental impacts

P_{12}=little attention to psychological recovery

P_{13}=few risk-coping mechanisms for CRS

P_{14}=little education for disaster reduction

Experience:

E_1=transparent and consistent policies

E_2=many matched policies to support CRS

E_3=sufficient promotions of CRS to the rural victims

E_4=establishing special village affairs board and special supervision board

E_5=regional coordination of the external features of CRS

E_6=mobilizing the farmers themselves to conduct daily management for CRS

E_7=assessment on degree of damage rather than the economic values of the houses

E_8=CRS suiting local production and lifestyles

E_9=suitable degree of concentration

E_{10}=using local or nearby materials and construction teams

E_{11}=adjustable housing and infrastructure planning

E_{12}=considering future needs of urbanization

The comparative analysis of the problems and experiences of the surveyed practices was conducted between the four cases, and the results are shown in Table 6.2 and Table 6.3. The results are generated from the field study and the discussions with the local officials involved in the four cases.

Table 6.2 The problems existing in the four case villages

Problems	Xiangrong	Qingjiang	Shiqiao	Luchi
P_1	M	M	M	M
P_2	H	H	H	H
P_3	H	N.A.	N.A.	N.A.
P_4	H	H	H	H
P_5	M	M	L	L
P_6	M	M	N.A.	N.A.
P_7	M	N.A.	N.A.	M
P_8	H	H	H	H
P_9	N.A.	N.A.	N.A.	M
P_{10}	N.A.	L	L	M
P_{11}	N.A.	N.A.	N.A.	M
P_{12}	H	H	H	H
P_{13}	N.A.	N.A.	H	H
P_{14}	N.A.	M	N.A.	L

Note: L: insignificant, M: significant, H: strongly significant, N.A.: not applicable

Table 6.3 The experiences existing in the four case villages

Experiences	Xiangrong	Qingjiang	Shiqiao	Luchi
E_1	H	H	H	H
E_2	H	H	H	H
E_3	H	H	H	H
E_4	H	H	H	H
E_5	H	H	H	H
E_6	N.A.	N.A.	M	H
E_7	H	H	H	H
E_8	H	M	N.A.	L
E_9	H	H	L	L
E_{10}	H	H	H	H
E_{11}	H	H	N.A.	N.A.
E_{12}	N.A.	N.A.	H	N.A.

Note: L: insignificant, M: significant, H: strongly significant, N.A.: not applicable

The most important issues for each case mainly lie in available matched policies, successful organization, involving rural victims in decision making, and satisfying rural victims' needs for CRS. These issues are valuable considerations and were included in the decision model. The typical problems existing in most of the surveyed cases included: no pre-disaster planning, incapability of completing project application before reconstruction, little supervision on the

housing quality, insufficient financial support on daily management for CRS, insufficient coordination between industrial planning and developing CRS, little attention to environmental impacts, little attention to psychological recovery, and little education for disaster reduction (Zhang et al., 2011).

Diversified reasons result in the identified problems above. Typically, some critical activities of developing CRS in post-disaster reconstruction are missing. For example, although there were some emergency measures for responding to natural disasters, no pre-disaster planning was available. As a result, no specific guidelines can be provided to instruct the process of developing CRS. The local officials had to explore developing CRS with the rural victims in a rush while listening to the directives of the upper government. The rush of developing CRS without critical guidelines inevitably led to some problems. This problem might be resolved by expanding the pool of systematic studies on decision models for developing CRS in post-disaster reconstruction, which is precisely the aim of this research. In addition, some activities are not so well-designed due to the rush of the project. For example, there is little supervision on the quality of housing and very little assessment on the reconstruction process. This may lead to critical issues if another disaster occurs. Relevant activities should be fine-tuned in the decision model for developing CRS. Moreover, some important features of sustainable development have been given insufficient consideration, including balancing reconstruction efforts with economic, social and environmental benefits; mobilizing the available financial resources and participants; and recycling resources in the reconstruction process. Therefore, the basis for future development may be somewhat weak for some villages. Disaster reduction education and

psychological recovery were not included sufficiently as participants in the reconstruction project; for example, NGOs were not present especially in the stage of post-disaster community management. Also, the environmental impacts were given little to no consideration as resource recycling was overlooked.

6.3 Decision Model for Implementing CRS in Post-disaster Reconstruction

By examining the problems and experiences in developing CRS in the four surveyed villages, we may obtain valuable references for developing a more effective decision model. By incorporating the experiences in these practices, the decision framework for developing CRS in post-disaster reconstruction is shown in Figure 6.3. The main part in this framework is optimizing the process of developing CRS in post-disaster reconstruction (sub-model A) while balancing reconstruction with social, environmental, and economic considerations (sub-model B); then mobilizing the participants and financial resources (sub-model C); and finally recycling resources in post-disaster reconstruction (sub-model D). All are important components in ensuring the sustainability of a post-disaster reconstruction. The following sections briefly introduce these four parts.

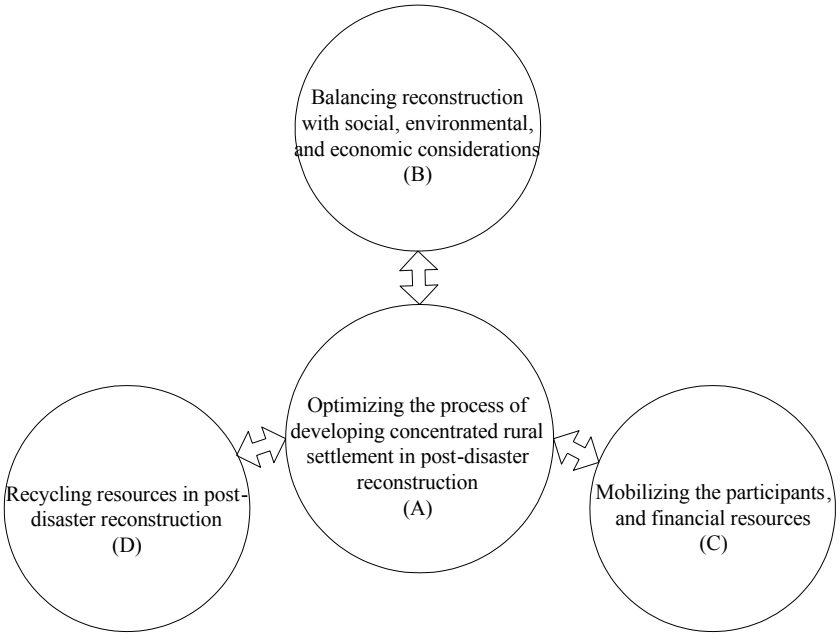


Figure 6.3 The decision framework of implementing CRS in post-disaster reconstruction

6.3.1 Optimizing the process

As the critical stage, sub-model A aims to optimize the process of reconstruction and provide references to the critical activities in each step. As shown in Figure 6.4, there are four sub-stages, namely reconstruction preparedness of CRS (A-1), planning of CRS (A-2), building CRS (A-3), and post-disaster community management of CRS (A-4) in the reconstruction process. Meanwhile a GIS support system (A-5) is introduced to coordinate the efforts of the village-level government and the regional-level government and record any relevant information.

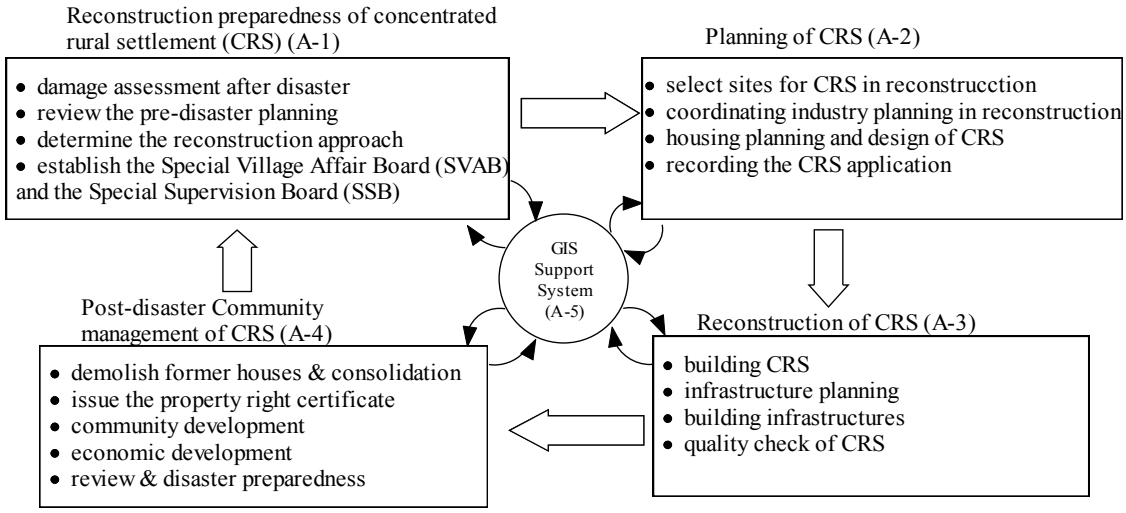


Figure 6.4 Sub-model of optimizing the process of implementing CRS in post-disaster reconstruction (A)

Reconstruction preparedness of CRS (A-1)

Reconstruction preparedness of CRS shall be put on the agenda while the emergency relief, and temporary housing are undertaken. In this stage, the four most important activities, namely damage assessment, reviewing pre-disaster planning, determining whether to concentrate the victims and establishing the Special village affair board (SVAB) and Special Supervision Board (SSB), should be led by the local officials as shown in Figure 6.5. The activities of this stage would target whether concentration and who shall be responsible for organizing and supervising the whole process.

Damage assessment is the basis when determining the proper approach to reconstruction. The principles applied in this step include people orientation and damage assessment rather than the economic values of the houses. As disaster brings a great shock to farmers, people orientation is useful to reduce the resistance to following the reconstruction process. The assessment of

damages is a response to how national subsidies are allocated, based on the degree of damage, and can reduce the suspicion of unfairness. Also, the study found that the higher the percentage of collapsed and severely damaged households, the higher the ratio of moving to the CRS (Peng et al., 2013).

Reviewing pre-disaster planning is a key for timely housing reconstruction, as the timeframe of a disaster offers insufficient time to make proactive plans and hold stakeholder consultations (Wu and Lindell, 2004; Badri et al., 2006). Various critical elements, such as organization, land use, regional coordination, building standards, household preparation, and construction-sector preparation, should be specified in the planning (Wu and Lindell, 2004). In addition, drawing on local resources, meeting local living standards and culture, and selecting a proper location are also necessary (Johnson, 2007). Furthermore, in order to achieve sustainable development, a plan that is flexible, uses minimal energy consumption, is supported by community participation, and produces long term effects should be emphasized (Arslan, 2007; Davidson et al., 2007). The biggest benefit of pre-disaster planning lies in the planning process—not in the written plan itself (Wu and Lindell, 2004). This decision model is a good reference for local governments when designing a pre-disaster plan for CRS.

Determining whether to concentrate the victims is a precondition for developing CRS. Critical factors such as availability of favorable policies, local government organization capacity, economic development conditions, and rural victims' willingness should be considered (Peng et al., 2013). If the geographical location and economic development both provide the basis for concentration and the local government has the capacities of introducing the pros and cons of

CRS and attaining sufficient numbers of rural victims to participate in this scheme, it is possible to develop CRS after disaster strikes. Otherwise, the rural victims can choose reconstruction in-situ. However, even so, the government should also pay attention in guaranteeing the quality of reconstruction.

Establishing the Special village affair board (SVAB) and Special Supervision Board (SSB) is a means to involve rural victims in the decision making process. Members within SVAB and SSB are elected by both the rural victims participating in CRS and the local officials. Participation empowers the rural victims to reach consensus on reconstruction and attain community capabilities for further development, which is critical for sustainable post-disaster reconstruction (Pearce, 2003; Davidson et al., 2007). The first issue on the agenda of SVAB is to choose whether to engage in self-reconstruction or unified-reconstruction, since unified planning is necessary for CRS. The most important principle, no matter what they choose, is to follow the rural victims' preferences. The practical criterion is that if some partner is interested in providing financial support to conduct unified-reconstruction, and the village has the potential of suburbanization or mainly relies on non-primary economic activities, unified-reconstruction is acceptable. A contract is needed to determine the distribution of benefits between the village and the financial backer. Meanwhile, self-reconstruction is suitable for remote villages, which have little potential of suburbanization and still rely on primary economic activities. In addition, SVAB must be responsible for organizing the discussions on site selection, housing allocation, demolishing former rural houses and reclaiming the former rural residential land. SSB must be responsible for supervising the implementation of every decision made by SVAB, supervising

the quality of the houses during reconstruction, and reviewing the timeframe of the CRS project.

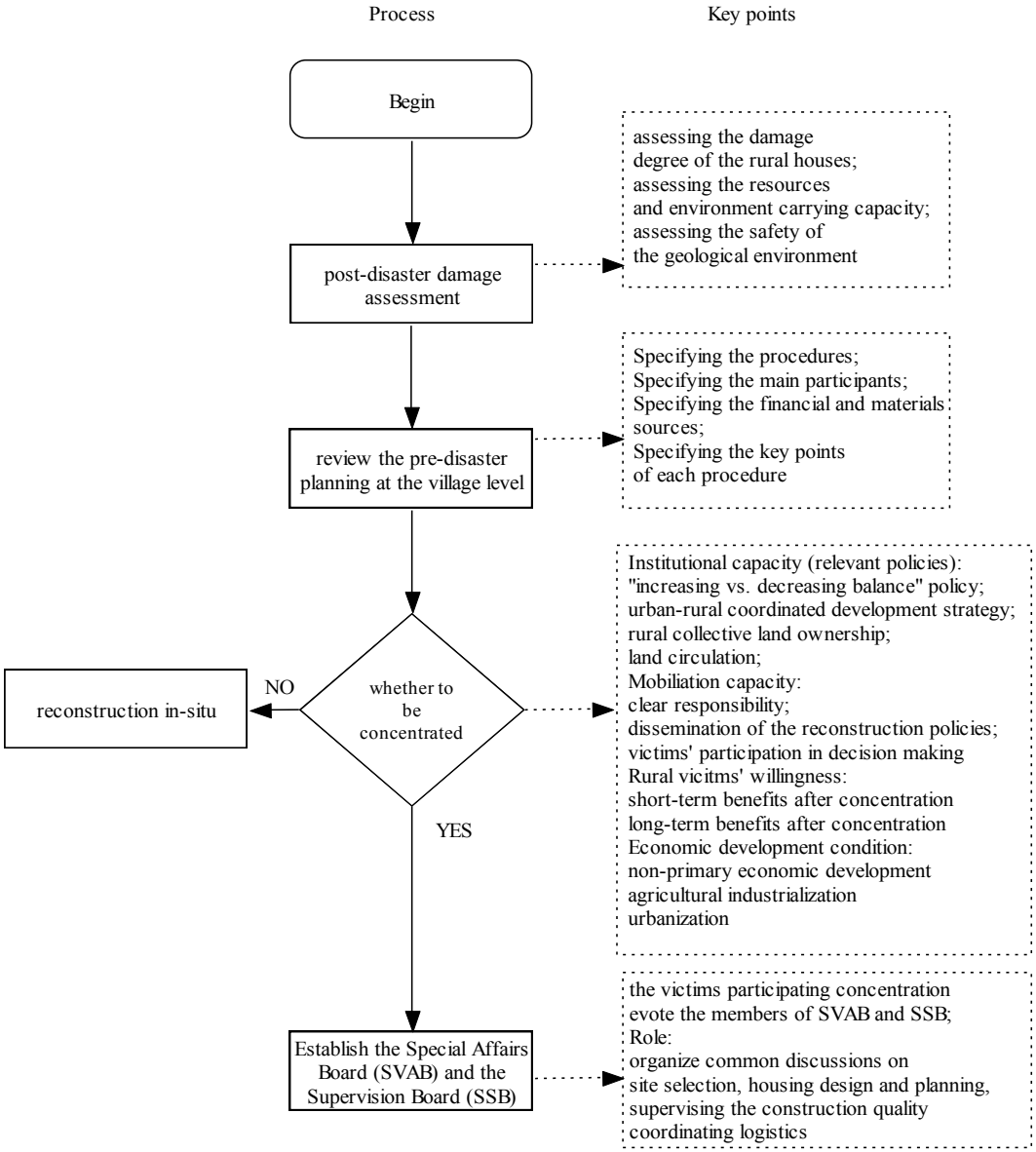


Figure 6.5 The preparedness of implementing CRS in post-disaster reconstruction (A-1)

Planning of CRS (A-2)

After the preparedness, planning of CRS would be started as shown in Figure 6.6. Site selection, housing design/planning and recording the proposals for developing CRS are three main steps to ensure the reasonableness of developing CRS. The activities in this stage shall result in

determined sites for concentration, housing planning schemes, and proposals of developing CRS submitted to upper governmental departments. Each step should be paid due attention as follows:

Site selection is critical for developing CRS after a disaster strikes. The principles for this activity include: (a) safety—no secondary and future disasters; (b) capacity—enough ecological carrying capacity for CRS and relevant infrastructure; (c) proximity to transportation; (d) proximity to the contracted land, especially for those self-reconstruction projects in which the victims prefer maintaining the rural lifestyle. Several sites can be selected to ensure that all rural victims can easily carry on farm work; (e) proximity to urban areas, especially for victims who elected the unified-reconstruction project, and want to abandon the rural life; and (f) occupying farmland as little as possible. By following these principles, the rural victims can usually put forward some clear proposals. By combining the initial options and the experts' professional advice, several sites can be selected as a result. A geographical survey is necessary to finalize the selection.

Housing design and planning the layout of the settlement form the basis for delivering an acceptable CRS. Professional experts/institutions should be employed to design the houses. It is better to have them stay in the villages, where they would be in charge of collecting materials, seeking advice, and following the whole process closely in order to provide flexible revisions. The principles taken into consideration include accommodation to the local living and production ways, leaving room for future demands like garages, and using the local materials as efficiently as possible.

Recording the proposals of developing CRS in the GIS support system is a response to the

embarrassing fact that many projects had begun even before the project application was completed. Many project applications are usually made simultaneously, which is beyond the processing capacity of China's upper government. Therefore, a simplified procedure should be made to confront the chaotic conditions and time constraints after a disaster. A robust GIS support system can be used to judge whether the site selection is feasible or not. Conditional permission can be given to the village to proceed with the reconstruction project after the check. Key points of the project application must be kept in the support system for further review of the construction quality. All the relevant certificates can be prepared in the process of reconstruction and issued after checking the delivery of CRS.

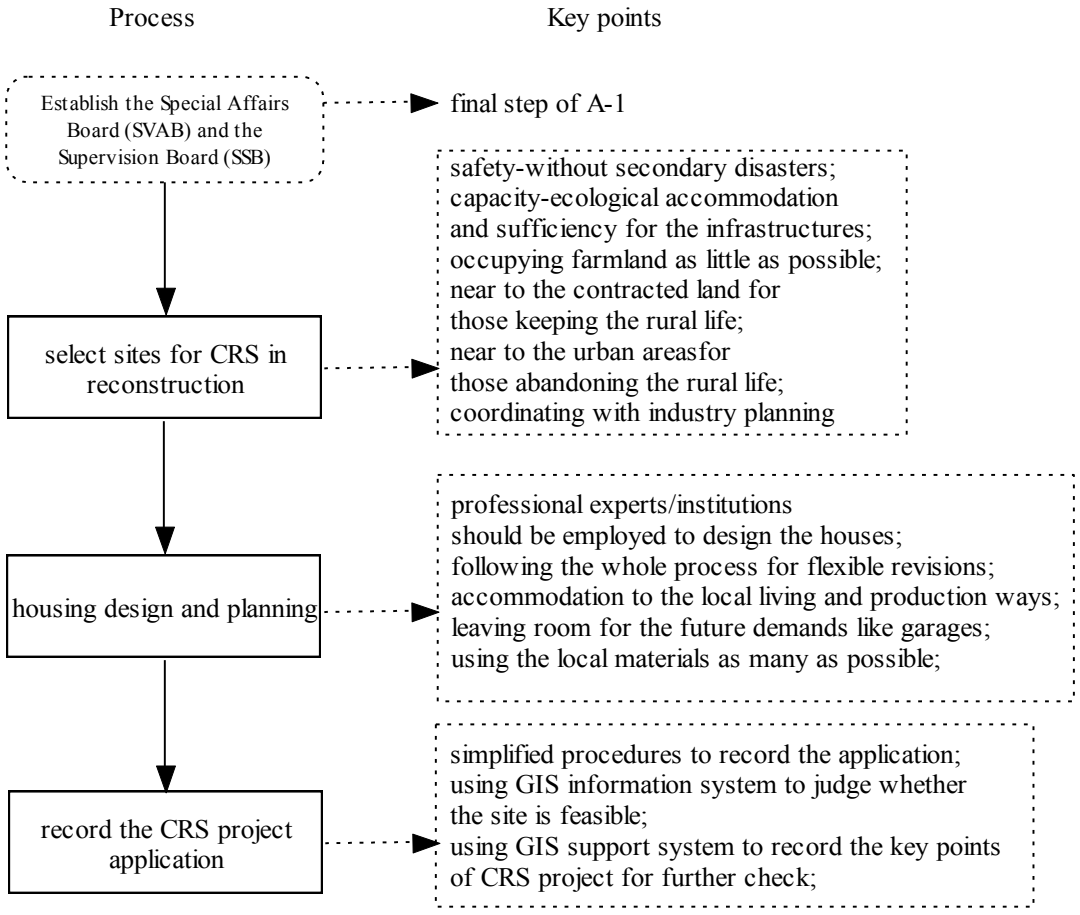


Figure 6.6 CRS planning (A-2)

Building CRS (A-3)

After obtaining the conditional permission, building CRS can be proceed as shown in Figure 6.7. While building CRS, infrastructure planning and design can be undertaken in order to shorten the building time. Quality check of CRS finally can be used to ensure the safety. The activities in this stage mainly result in good quality of built CRS and infrastructure.

Building CRS can begin after obtaining conditional permission. For self-reconstruction, the rural victims sign a contract with the local or external construction teams. The houses must be built according to the selected housing design schemes separately, and both the SVAB and SSB must conduct quality checks throughout the construction process. The financial source for each household would be the income from rural residential land exchange, self-owned capital, and credit. For united-reconstruction, the whole project would be funded by the partner, who could sign a contract with a professional construction company. The concentrated settlement can be constructed according to the determined planning in the abovementioned step. The financial source would be the income from rural residential land exchange and the partner-owned capital. As the whole construction project is taken on by the partner, the rural victims receive no income from rural residential land exchange.

Infrastructure planning and design can be carried out while the CRS is developed, since the construction of the houses takes a longer time. This is useful to reduce the duration of the project. The secret formula is to leave room for infrastructure while construction is in progress. The planning should satisfy the local needs and leave flexibility for future improvement. After the construction committee confirms the infrastructure planning, local construction teams or

construction companies can be hired to construct the infrastructure. It is better to use local materials. However, the supply chain of the relevant materials should be robust to ensure consistent progress. The cost of the infrastructure can be assumed by the local government and the reconstruction support partner.

Quality control of the development of CRS is critical to ensure the safety of those involved in its construction. Although SSB supervises the construction progress and quality now and then, the certification system of commercial houses in the urban areas should be referenced to ensure the quality of houses before the rural victims move in. SVAB could invite the relevant experts (or relevant NGOs) to assume this professional work. The rural victims must confirm the check results before moving forward in the project. For self-reconstruction, the rural victims can move into the CRS after they complete the interior decorating. For unified-reconstruction, the house should be allocated first. All the houses can be numbered, based on the types of rooms, floors and street block for a lucky draw. The first lucky draw can be used to determine the sequence of lucky draws to place the victims into the newly constructed houses. Then the second lucky draw can be used to choose the house according to the chosen drawing sequence. No matter what method is implemented, the detailed rules and procedures should be discussed among the rural victims so that they may reach a consensus and announce it in advance. The official notary should be invited to supervise the whole process in order to ensure equality and fairness. The feeling of equality and fairness is critical for the rural victims to accept the results and complete reconstruction smoothly.

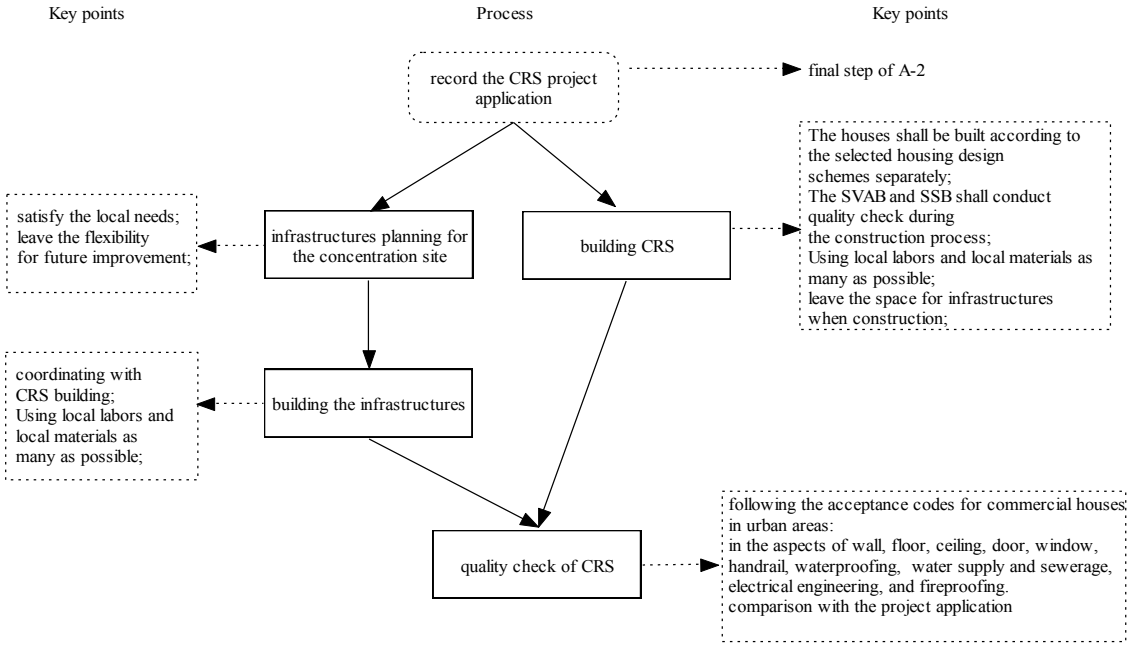


Figure 6.7 Building CRS (A-3)

Post-disaster community management of CRS (A-4)

Post-disaster community management of CRS aims to help the farmers adapt to the new life-style, find their own way to make a living, and learn to respond to future disasters. Six important activities including demolishing former houses and consolidation, issuing the property rights certificate, daily management of CRS, economic development, and disaster preparedness should be conducted as shown in Figure 6.8. The key points of each step are listed as follows:

Demolishing former houses and consolidating the former rural residential land is necessary to complete the scheme of exchanging rural residential land. According to the requirements of 'increasing versus decreasing' policy, the former rural houses should be demolished and the relevant rural residential land should be consolidated to return the construction land to farmable land. SVAB can hire a professional team to handle all the work. The SSB should encourage and supervise the implementation process. The financial source for this activity is the income from

rural residential land exchanges. The allocation of the income for these rural residential land exchanges after consolidation can be used as an incentive to promote this activity. Finally, the land management departments should check and confirm the consolidation.

Issuing the property rights certificate is an indispensible step in confirming the results of the newly developed CRS. After a check on the consolidation of former rural houses is performed, a new property rights certificate for the CRS should be issued by the housing department from the upper government. For the property rights of farmland generated from consolidation, the upper government is better to issue a standard rule. As the right to use the construction has been transferred to urban areas, the contract rights of the farmland can be attributed to the corresponding rural victims while the ownership is still attributed to the rural collectives.

Daily management of CRS is important to achieve social sustainability after reconstruction. A new rural community, which is different from both the traditional rural organization and the urban community, would be formed after concentrating the population. Corresponding measures should be made to support the new rural community. The residents can be mobilized to manage the public affairs by themselves, which is helpful in building social capital. Budgetary allocations from the upper government should be allocated to support daily management. In addition, NGOs can be mobilized to help the residents achieve psychological recovery, deal with the problems that may afflict the old and the young, promote the education of reducing disaster devastation, and accommodate to a new concentrated lifestyle.

Economic development is an important pillar in achieving economic sustainability after concentrating the farmers. Characteristic agriculture, eco-tourism and eco-agriculture can be

promoted by concentrating the farmland, and vocational training should be organized to provide laborers with enough skills to earn income to support their families after they have moved into their new homes in the CRS.

Disaster preparedness is an important measure to take, so that fewer lives will be at stake during the next potential disaster. Pre-disaster planning can be reviewed and improved after the reconstruction project has concluded. For the villages that have no pre-disaster planning experience, this is the chance to start by following the decision model and incorporating their own experiences in developing CRS after a disaster.

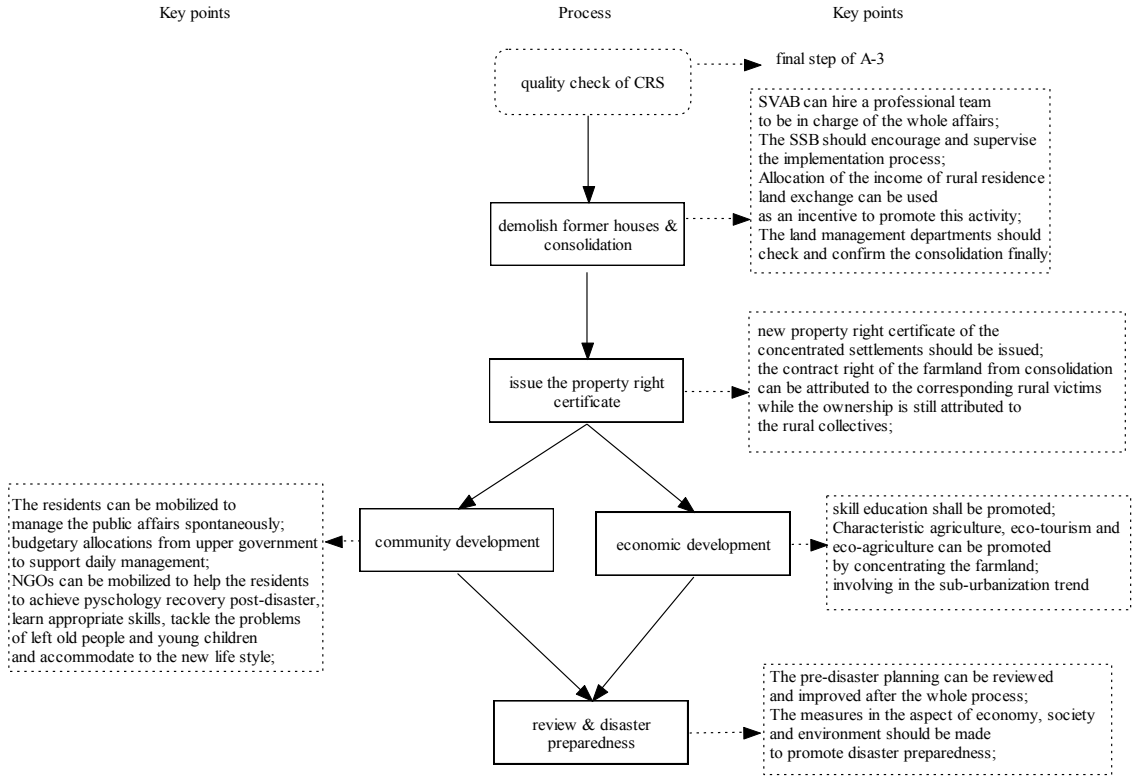


Figure 6.8 Post-disaster community management of CRS (A-4)

The GIS support system (A-5)

The GIS support system is a tool used to record data of geography; demographic, economic and social development; disaster damage; reconstruction proposals and assessment results during the reconstruction process; to conduct relevant analysis; and to manage a developing a CRS in the post-disaster reconstruction at the regional level, as shown in Figure 6.9. Two important analysis components are to assess the resources around the new CRS and its environment's carrying capacity and the safety of the geological environment in establishing a CRS. These critical components are beneficial because they allow a project manager to easily judge whether the site for concentration is feasible. This in-depth analysis can also reduce the project's duration, allowing the victims to reenter society quickly. When supervising the progress and quality of a CRS, the recorded information of a CRS project can be used to check whether the CRS satisfies the objectives in the project application. In addition, the GIS support system can be used to check whether the former houses have been demolished and consolidated in the final stage and can be used to help issue the relevant property rights certificates. Moreover, the GIS support system can be used to coordinate industry planning and CRS development while coordinating the external features of the CRS, which could be diversified at the regional level while unified at the village level.

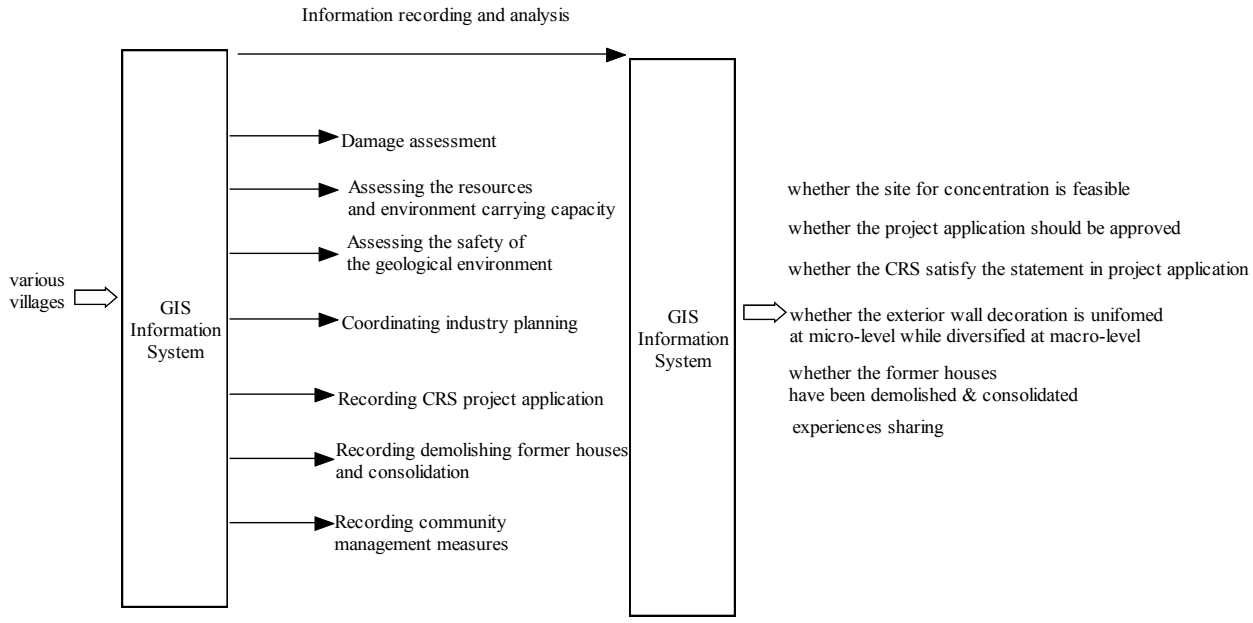


Figure 6.9 The GIS support system (A-5)

6.3.2 Balancing reconstruction with economic, environmental and social benefits

In order to achieve sustainable development, balancing reconstruction with economic, environmental, and social benefits should be closely monitored in the reconstruction process of a CRS. As shown in Figure 6.10, planning coordination, regional coordination, and victims-experts coordination are three critical pillars to support the project's successful completion. Through planning coordination, the construction of the CRS would be connected with industry development after a disaster. On the one hand, the site selection, architecture, and housing design of CRS should favor the industry development such as the eco-tourism and eco-agriculture industries. On the other hand, industry planning should provide non-primary work opportunities for the farmers, which is essential to offer livelihoods after concentrating the population into the CRS. Via regional coordination, industry planning and any relevant CRS planning can be matched with the local environmental resources at the regional level. In

addition, the external features of the CRS could be diversified at the regional level while unified at the village level. Furthermore, coordination between the victims and the experts offer the chance for the victims to make the site selection, decide the housing design, and fulfill the objectives of environmental protection, safety, and economy, while satisfying the cultural and psychological requirements of the rural victims.

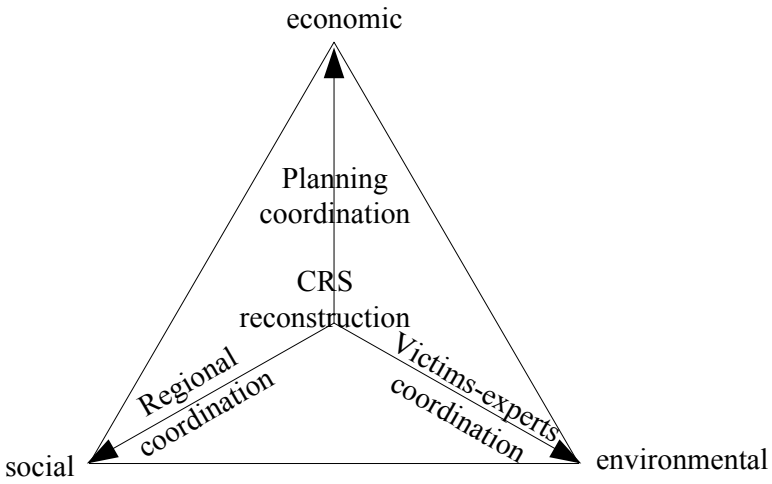


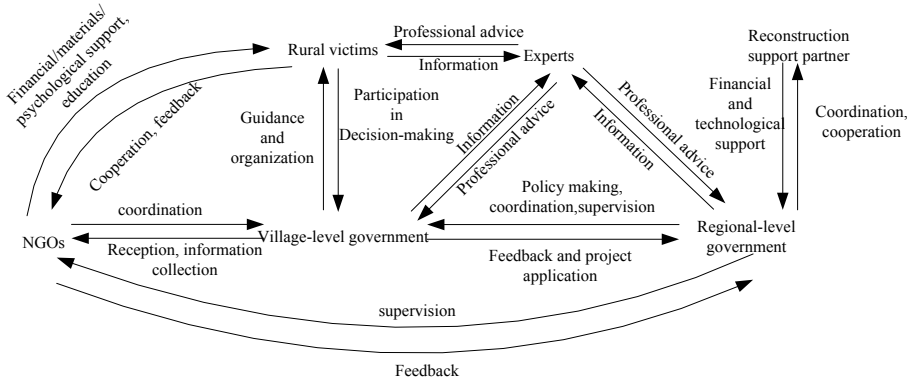
Figure 6.10 Sub-model of balancing reconstruction and social, economical and environmental benefits (B)

6.3.3 Organizing participants and financial resources

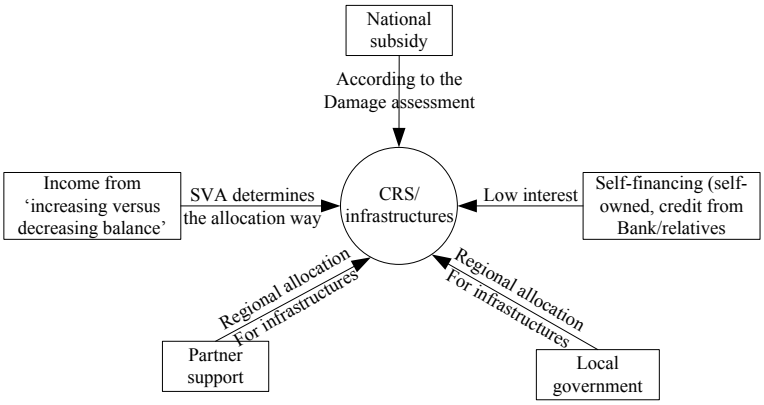
The most involved participants in the development of CRS should be the rural victims, the village-level government, NGOs, the regional-level government, experts, and a reconstruction support partner. Their internal relationships are shown in Figure 6.11 (a). In the central stage of CRS reconstruction, the village-level government should disseminate the schemes of developing CRS by referring to pre-disaster planning, introducing the advantages and disadvantages of concentration, and responding to the rural victims' concerns. This is important to attract rural

victims' participation, and the voluntary principle should be followed in this process. On the other hand, the willing victims must be able to participate in the decision-making process when developing a CRS, such as the site selection, housing design, and quality oversight. The rural victims can provide their needs and any relevant information about the CRS development to NGOs and experts, thus allowing NGOs to provide any necessary emergency aid, along with psychological support and disaster preparedness education after completion of the reconstruction project. This will also enable experts to provide any pertinent professional advice.

The village-level government should also welcome the NGOs and provide information for facilitating recovery. The village-level government should also communicate with the regional-level government, provide feedback about the reconstruction process, conduct a project application for the development of the CRS, and accept their supervision. The regional-level government should enact appropriate policies to support developing CRS, coordinate different planning schemes for different villages at the regional level, and supervise the critical nodes of the reconstruction process, such as project records, housing allocation, and issuing property rights certificates. The regional-level government should also actively communicate with the reconstruction support partner and acquire the financial and technological support for post-disaster reconstruction. Most importantly, the regional government should seek the opportunities to establish long-term cooperation with the reconstruction support partner and push forward the economic/social/environmental development for the region.



(a) The network of the major involved participants



(b) The financial resources

Figure 6.11 Sub-model of organizing participants and financial resources (C)

Specifying the financial sources for developing a sustainable CRS is important, especially when funds are limited after a disaster. As shown in Figure 6.11(b), there are five financial sources, including national subsidies, income from the "increasing versus decreasing balance" policy, self-financing, partner support, and the local government. The national subsidy should be allocated according to the results of the damage assessment, which prioritizes the most severely damaged households. The income from the "increasing versus decreasing balance" policy

should be allocated according to the consensus of SVAB. The existing practices include allocation according to the saved rural residential land, and even allocation among the participants. The most important principle is to reach a consensus and provide a clear dissemination of benefits, thus establishing fairness among the rural victims. Self-financing includes self-owned financial resources and loans from a bank or from relatives (low interest rate). Financing from the local government and a reconstruction support partner would mainly focus on building the relevant infrastructure and providing daily management funding for the site.

6.3.4 Recycling resources in post-disaster reconstruction

Recycling resources is important in achieving the sustainability of a post-disaster reconstruction, especially within the constraints after a disaster. Centered on the CRS development process, recycling efforts should be spent on a temporary housing site (at Stages 1 and 2 of the CRS development), concentrated rural settlement (Stage 3), and a former dispersed housing site (Stage 4), as shown in Figure 6.12. Temporary housing units can be sorted first, followed by dumping all useless and destroyed articles and directly reusing and decomposing construction components such as paneling and walls. For those decomposed parts, some can be reused, some can be recycled, and others can be dumped. If the temporary housing land is suitable for concentration and the rural victims agree to use this site, it can be used for concentrating the victims in the subsequent steps. Otherwise, the temporary housing land should be reclaimed as cultivated land. Correspondingly, the temporary infrastructure can be integrated into the concentration site; otherwise, it should be reclaimed as cultivated land or used for the

agricultural infrastructure.

With regard to the CRS, the construction waste in the building process and the domestic waste in the living process should be collected and sorted, and finally they should be dumped, recycled and reused. As for the former dispersed housing site, the housing units can be reused or recycled for construction in other villages, or be dumped if useless. The housing land should be reclaimed as cultivated land if the "increasing versus decreasing balance" policy is adopted. Meanwhile, it can also be used as construction land (e.g. rural hotels) if the "increasing versus decreasing balance" policy is not adopted. Correspondingly, infrastructure such as road and transportation systems should be reclaimed as cultivated land or be kept for agricultural infrastructure. If possible, they can also be integrated into the construction.

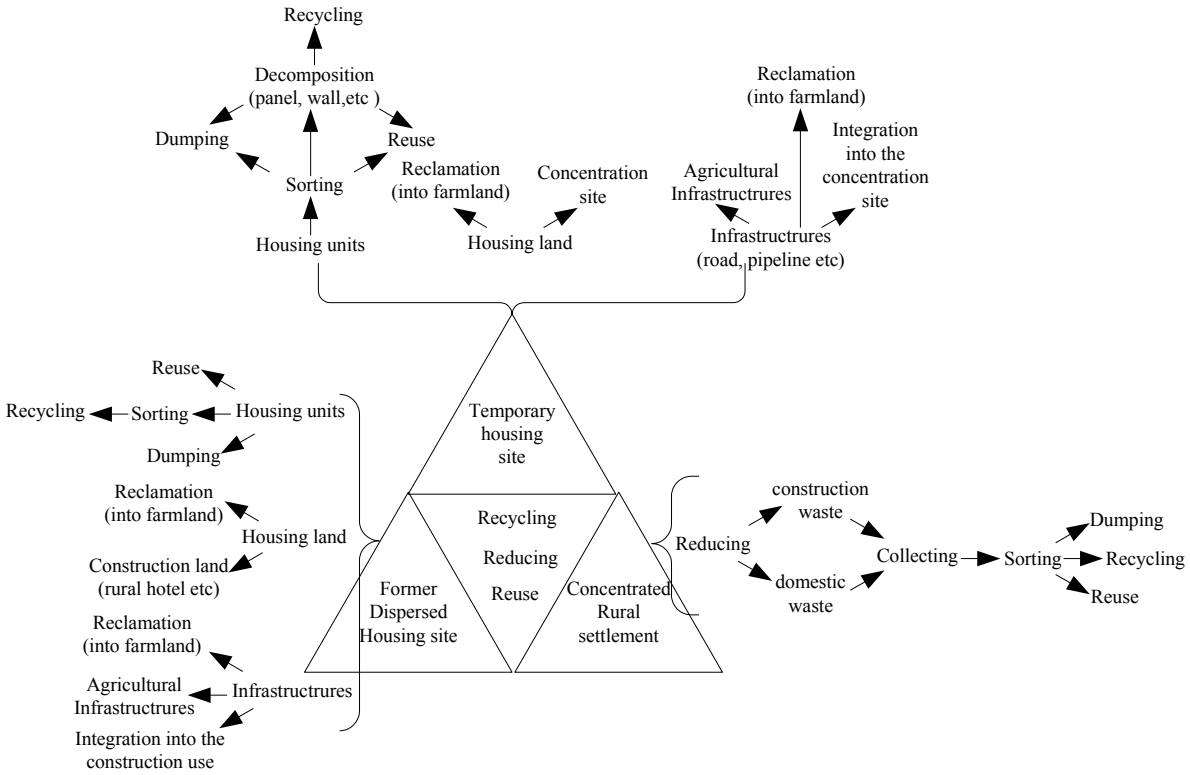


Figure 6.12 Sub-model of recycling resources in post-disaster reconstruction (D)

6.4 Summary of the Chapter

This chapter developed the decision model for implementing CRS in post-disaster reconstruction based on four cases in Dujiangyan. Emphasizing the optimization of the process, this model identifies four stages in the successful development of CRS, outlining specified critical issues at each step. Meanwhile, balancing a reconstruction project with social/economic/environmental benefits, mobilizing participants and financial sources, and recycling resources should be paid enough attention to ensure the sustainability of the CRS. The model allows the local government to improve the effectiveness and efficiency of developing CRS in post-disaster reconstruction by providing specific guidelines. This would also help the local government prepare a pre-disaster plan for developing CRS by following the decision model and involving the local farmers. Moreover, the introduction of a GIS support system would help the regional government manage and coordinate post-disaster reconstruction at the regional level. However whether the decision model is applicable remains unknown. This concern is answered in the next chapter by conducting the model validation via expert view.

7 MODEL VALIDATION

Chapter 6 established a decision model for implementing CRS in post-disaster reconstruction in China in order to achieve sustainable development. However, few understandings have been gained about the practicability of the decision model. An expert's view is a good way to validate the conceptual model, so this study aims to validate this developed decision model through interviews. Semi-structured interviews with six local officials and experts participating in reconstruction after the 5.12 Sichuan Earthquake were conducted. The results demonstrated that the decision model is a useful reference for the local government to develop CRS in post-disaster reconstruction in China. The following sections shall present the entire process of the model validation in detail.

7.1 Introduction

The meaning of model validation varies in the scientific field. For example, Forrester (1961) pinpointed that a model is validated if it accomplishes what is expected of it. Mihram (1972) considered that a model is validated if it is a mimic of the system which it is intended to represent. Schlesinger et al. (1979: 103) defined validation as meaning "substantiation that a computerized model within its domain of applicability possesses a satisfactory range of accuracy consistent with the intended application of the model." O'Keefe et al. (1987) opined that validation implies establishing the appropriate system. Dias and Lopes (2006) point out that model validation is to prove the model efficiency through comparing the model output with field or laboratory data. The variety of definitions demonstrates that validation is context dependent. Some even argue that model validation is useless as models can only be falsified

instead of proven (Bair, 1994; Oreskes, 1998). As a result, Rykiel (1996) emphasized that model validation is is needless if the model aims to systematize knowledge or to develop theory. However, the term "model validation" is usually used as a general term of model assessment allowing the academic community to communicate adequately enough with the semantic debate left behind. Some consensus is reached that the criteria of an "acceptable" model should be defined for testing the model performance (Bellocchi et al., 2010). Therefore, before conducting validation, the model's aim, the performance criteria, and the model context must be provided (Rykiel, 1996).

Various aspects of validation including conceptual validation, logical validation, experimental validation, operational validation, and data validation should be taken into consideration related to the process of developing a model (Landry et al., 1983). Conceptual validation aims to find whether the assumptions and theories behind the conceptual model are relevant to the problem situation. As conceptualization of the problem situation is the basis to develop a model, its validity is therefore critical to avoid undesired consequences. Logical validation concerns whether the formal model properly and exactly delineates the problem as defined in the conceptual model. Logical validity reflects the internal coherence when changing the conceptual model into a formal model. However, the level of logical validity does not reflect the level of conceptual validity, nor vice versa. Experimental validation refers to testing the quality and efficiency of the solution obtained from the formal model. It is useful to find the efficiency of obtaining the solutions. Operational validation targets the quality and applicability of the solutions given by the formal model. This validity indicates the difficulties when the formal

model is put to work. Therefore, it is usually recognized as the ultimate criterion for validating a formal model (Beldring, 2002). Data validation deals with the sufficiency, accuracy, appropriateness, and availability of the data within acceptable cost limits. Data validity is critical for the whole validity of the model.

Existing studies suggest that expert intuition, real system measurements and theoretical analysis are three main approaches to model validation (Hillston, 2003). Multiple techniques are developed to determine whether a specific aspect of model validity has reached a preset benchmark. For example, face validation is used to collect views about the reasonableness and accuracy of the model from people knowledgeable about the model (McCall and Lombardo, 1982). Tracing is used to record the behavior of specific objectives through the model calculations. Internal validation is an approach using stochastic analysis to identify the variability of the model (Gruhl, 1982). Sensitivity analysis intends to measure the effects of changing the value of input parameters on the model behavior and its output (Henderson and Nutt, 1980). Historical validation means to figure out whether the model acts as the real system did by testing the model with part of historical data (Richardson, 1978). Predictive validation is adopted to determine if the system's behavior is the same as the model predictions (Mayer, 1980). Events validation implies comparing the events distribution in the model with that in the system (Cumming et al., 1976). Turing test is employed to verify if relevant experts can distinguish between the real system and model outputs through graphics. Spectral analysis is concerned with evaluating if the the dynamic behavior of the model differs from that of the system (van Horn, 1971). Experimentation is an approach to compare the outputs of the system

and the model by operating variables in both conditions. Convergent validation is comparing the model's predictions with those of experts (Campbel and Fiske, 1959). Furthermore, Rykiel (1996) classified the validation techniques according to the needs of model validation as shown in Figure 7.1, which is a useful guideline for conducting model validation.

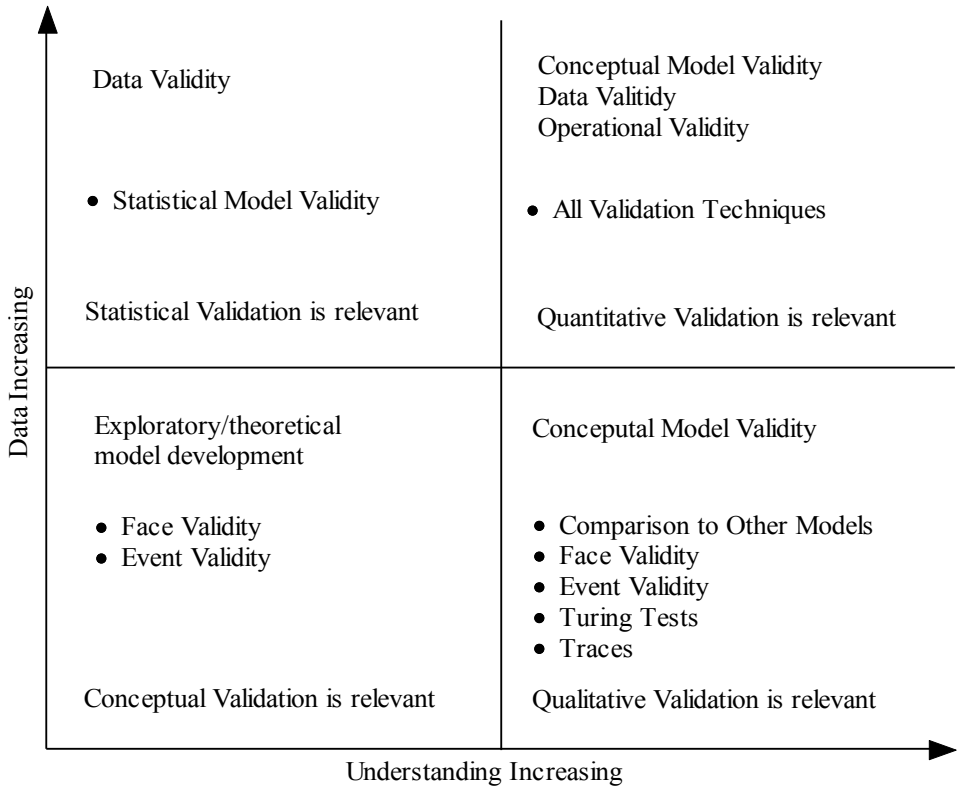


Figure 7.1 Validation techniques for the classified needs of model validation

Source: Rykiel, (1996)

Although the developed decision model for implementing CRS in post-disaster reconstruction is somewhat an explorative study, this study also intends to validate it to see whether it is applicable in the context of China and assess its advantages and disadvantages. In order to fulfill this research aim, expert interview were conducted to validate the decision model. The following sections introduce the research design and the findings accordingly.

7.2 Validation Process

7.2.1 Data collection for validation

The developed decision model in Chapter 6 is a qualitative conceptual model. By referring to the classification shown in Figure 7.1, the model can be validated through face validity, event validity, comparison to other models, Turing validity, and trace validity. However, the last two tests are usually implemented in simulation models, which are not taken into consideration in this study. Interview with the experts with regard to the three types of validity can be adopted to validate the decision model. However, there are no standard procedures or criteria for model validation thus the objective, performance criteria, and model context should be outlined before validation (Rykiel, 1996).

With regard to the decision model for developing CRS in post-disaster reconstruction, its objective is to provide a guideline for the local officials to organize the rural victims to develop CRS in post-disaster reconstruction. The hidden assumption behind the model is the belief that developing CRS is more resilient and sustainable. The model context is post-disaster reconstruction in rural China, with special attention on the reconstruction efforts at the village level. The performance criteria are specified as: (1) the objective, scope, and the relevant stakeholders of the model are clear; (2) the mentioned process and activities in the model are clear and reasonable; (3) the model can improve the efficiency and effectiveness of developing CRS; (4) the model provides specific guideline for the local officials to make decisions; (5) the model can be applied in other regions of China under disaster conditions; (6) the model can be applied in other regions of China under normal conditions; and (7) the model has practical and

theoretical implications. Therefore, according to the objectives of the model mentioned above, twelve questions were designed for interview as shown in Table 7.1.

Table 7.1 The question list of model validation in interview

Group	Factors	Explanation
Face validity	FV1	Whether the assumption of the model is reasonable
	FV2	Whether the objective of the model is specific and reasonable
	FV3	Whether the scope of the model is clear and reasonable
	FV4	Whether the decision maker of the model is specific and reasonable
	FV5	Whether the stated activities are clear and reasonable
	FV6	Whether the process of the model is reasonable
	FV7	Whether the model can improve the effectiveness and efficiency of developing concentrated rural settlement in post-disaster reconstruction
	FV8	Whether the model can provide a reference to the decision maker in post-disaster reconstruction
Event validity	EV1	Whether the model can be applied in other regions of China under disaster conditions
	EV2	Whether the model can be applied in other regions of China under normal conditions
comparison to existing models/practices	CV1	Whether the model has practical implications
	CV2	Whether the model has theoretical implications

By following the methods descried in section 3.2.5, interviews of the experts participating in developing CRS after the 5.12 Sichuan Earthquake were conducted in November 2012. Selection of the interviewees depended on two criteria. First, the experts have participated in developing CRS after the 5.12 Sichuan Earthquake but were not involved in our previous study on developing the decision model. Second, the experts acted as a certain decision maker in their involved position. Six experts were finally identified from the potential experts recommended by the interviewees involved in the previous study. Among them, two experts were local officials in charge of village-level reconstruction in two villages of Mianzhu County, Deyang City (denoted as Int 1 and Int 2), one expert was responsible for the housing planning after

disaster (denoted as Int 3), two experts presided over the land management issues after disaster (denoted as Int 4 and Int 5), and the last expert was a researcher conducting studies on post-disaster reconstruction (denoted as Int 6). The background information of the interviewees was shown in Table 7.2. The example of interview to validate the decision model can be found in Appendix D.

Table 7.2 Background information of the interviewees in model validation

Interviewee	Work unit	Job title	Years of relevant work experience	Education level	Major responsibility
Int1	Village level government	Branch secretary	20	High School	Organization and management in the whole process
Int 2	Village level government	Village head	12	Bachelor	Organization and management in the whole process
Int 3	Planning institution	Senior Planner	13	Master	Planning
Int 4	Provincial government department	Senior professional	16	Master	Land management and transfer
Int5	Municipal government department	Middle level professional	10	Bachelor	Land management and transfer
Int6	Planning institution	Senior professional	8	PhD	Research

Source: from interviews

During the interview process, the decision model and its objective and development process were introduced to the experts. Then the experts were invited to score the performance of the model by answering the questions listed in Table 7.1 (score between 1 and 5, with 5 as the best). Besides assessment based on the designed questions, the experts were also invited to assess the benefits and shortcomings. The interview was conducted in Chinese given that it is the dominant language in the targeted population. Due to political sensitivity, the people in the

disaster-hit areas tend to reject strangers' interviews. But the researchers can speak the native dialect, which helped to reduce the barriers in conducting interviews. Good attention was paid to the minimization of the chance that information would be lost in the translation from Chinese to English. The following section presents the findings and discussions in the validation process.

7.2.2 Validation results

The results of validation are displayed in Table 7.3. It is obvious that the average performance of the decision model is higher than 3, the middle value between 1 and 5. This implies that the decision model is at least satisfactory according to the preset performance criteria. In face validity, all the experts considered the decision model could be a useful tool for the local officials to organize the reconstruction efforts in post-disaster reconstruction. This reflects an awkward reality that few guidelines are available on the issue of developing CRS in post-disaster reconstruction in China. Also, the experts considered that the efficiency and effectiveness of developing CRS can be improved by following the decision model, as the model provides key issues and criteria for decision in each step, improve some steps to save time, and involve more participants in post-disaster community management to ensure the sustainability, especially the socially and economically. In addition, the experts pinpointed that the decision-maker of the model is specific and clear. Therefore, the local officials can make flexible decisions according to the availability of policies, the organization capacity of the local government, the economic condition, and the rural victims' willingness to make decisions about whether CRS should be developed and how to develop. Also, it is useful to involve as many participants as possible to support the building and community management of CRS.

Table 7.3 The results of model validation

Group	Factors	Int1	Int2	Int3	Int4	Int5	Int6	Average
Face validity	FV1	3	3	2	4	4	3	3.17
	FV2	3	4	4	4	3	3	3.50
	FV3	3	3	3	4	4	4	3.50
	FV4	4	4	3	3	5	3	3.67
	FV5	4	4	3	3	4	3	3.50
	FV6	3	3	4	3	4	3	3.33
	FV7	3	3	4	4	4	4	3.67
	FV8	3	4	5	4	4	4	4.00
Event validity	EV1	4	3	4	3	4	4	3.67
	EV2	3	3	2	3	4	3	3.00
comparison to existing models/practices	CV1	3	3	4	4	4	5	3.83
	CV2	4	3	3	3	3	4	3.33

Source: from interviews

In event validity, the experts thought that the decision model could be used in other regions of China under disaster conditions. It is admitted that most important policies mentioned in the model are available in other regions. Therefore, other regions can also determine whether and how to develop CRS in post-disaster reconstruction by following this model. The experts had some doubts as to its applicability under normal conditions, although the model can provide many valuable lessons in developing CRS under normal conditions. The choices of local government and farmers are quite different under normal conditions and disaster conditions, which is evidenced by the findings of Chapter 4. Compared with other models, a consensus was reached that the model provided specific guidelines which was unavailable before, and that the implementation process was at least as good as the existing practices. Most thought the model was an improvement over existing practices.

The key points in each step of CRS development, GIS support system, balancing model, and resource recycling model were the functions they thought very useful. Having a process model

with key points allows the local officials to pay attention to precautions in each step. The framework of the GIS support system provides a tool to manage the reconstruction information at the regional level, conduct regional coordination, balance, and speed up reconstruction progress accordingly. The balancing model and the resource recycling model specify the important concerns and offer detailed measures to achieve them during reconstruction. It was also agreed that the model would lend a tool for them to prepare a pre-disaster planning, make the local officials' job easier, and avoid some disadvantages if they had it when pushing CRS in post-disaster reconstruction.

Although the functions of the model are well-designed, there were also some reservations about its implementation. Potential problems lie in that some criteria are qualitative without a specific threshold to make decisions. This resulted from the difficulties of gaining enough data to develop a quantitative model. However, this was somewhat offset by the fact that the decision in reality usually depends on several critical qualitative criteria listed in the model.

7.3 Summary of the Chapter

Model validation is irreplaceable to discover whether the model achieves its objective and reaches the preset performance criteria. Therefore, this chapter exerted great effort to validate the decision model established in Chapter 6. The results of validation showed that the model would be useful as a decision tool. It would allow the local government to improve the effectiveness and efficiency of developing CRS in post-disaster reconstruction by providing specific guidelines. This would also help the local government prepare a pre-disaster planning for developing CRS by following the decision model and involving the local farmers. Finally,

the introduction of GIS support system would help the regional government manage and coordinate post-disaster reconstruction at the regional level. In addition, it was also found that some criteria in the decision model are qualitative without a specific threshold to make decisions. Future efforts can therefore be spent to quantify these criteria and the decision model.

8 CONCLUSIONS

This chapter presents the summary of findings and conclusions of this research, and describes its contributions to the body of knowledge related to rural housing reconstruction in the aftermath of disasters. Recommendations for future research are also put forward.

8.1 Summary of Findings and Conclusions

This section summarizes the major research findings by referring to the research objectives established in Chapter 1. The overall aim of this study was to discover how to effectively develop CRS in post-disaster reconstruction in China. The objectives were to:

- Investigate the opportunity to develop CRS in post-disaster reconstruction in China;
- Examine the critical determinant factors (CDFs) for implementing CRS in the aftermath of a natural disaster in China;
- Establish a effective decision model for implementing CRS in China; and
- Validate the decision model.

By successfully accomplishing the above research objectivities, the following major conclusions have been drawn.

(1) Proving opportunity to develop CRS in post-disaster reconstruction

Different actions are taken for developing CRS through the “increasing versus decreasing balance” policy, which is also called rural residential land exchange, under normal conditions compared to disaster conditions. To find the reasons behind this, the opportunity to develop

CRS in post-disaster reconstruction in China was investigated. Game theory was adopted to explain the actions taken by local government and farmers in the process of developing CRS, in which both sides engage in game playing. The local government's action is to implement the policy to maximize their own interest, either by normal means (according to the policy) or by special means (violating the policy). On the other hand, the farmer's action is to accept or reject the implementation of rural residential land exchange.

A static full information game was analyzed to identify the Nash Equilibrium under two different conditions. The results suggest that the local government tends to implement the "increasing versus decreasing balance" policy by special means and the farmers are prone to reject the scheme under normal conditions. Conversely, the local government is likely to implement the policy by normal means and the farmers incline to accept the scheme under disaster conditions. Three reasons for the results are identified from the analysis as follows: firstly, the close monitoring from the public and media in post-disaster reconstruction makes the cost of 'implement by special means' too high to bear for the local government. Secondly, with the losses of rural settlement from a natural disaster, the rural victims have to rebuild settlement no matter whether they accept or reject the policy. Lastly, a series of matched favorable policies are usually introduced under disaster conditions.

By comparing the Nash Equilibrium under two different conditions, it was found that the practice of introducing the "increasing versus decreasing balance" policy for developing CRS could bring larger overall benefits and more effectiveness under disaster conditions. This shows that developing CRS in post-disaster reconstruction in China is possible. The government could

use reconstruction after a disaster, such as an earthquake, as an opportunity for developing CRS in China.

(2) Identifying CDFs for implementing CRS in post-disaster reconstruction

Various methods including content analysis and interviews were adopted to identify the CDFs for developing CRS in post-disaster reconstruction. A preliminary list of determinant factors affecting developing CRS was identified through examining existing studies using content analysis. Based on the preliminary list of factors, interviews with local government officials, planners, and rural victims of four case villages in Dujiangyan City of Sichuan were conducted to identify the critical factors that determine whether or not to develop CRS.

The site visit and interviews demonstrated that the CDFs mainly include the "increasing versus decreasing balance" policy, urban-rural coordinated development strategy, dissemination of the reconstruction policies, victims' participation in the decision-making process, improved infrastructure, good materials and construction, and the capability of the community to develop itself. Furthermore, a generic set of CDFs was summarized through the interviews and case studies, even though CDFs differ between individual cases due to various factors such as natural environment and economic development. The generic set of CDFs is composed of three main aspects: governmental guidance, economic development and victims' willingness.

The local government plays a critical leading role in developing CRS in post-disaster reconstruction by making relevant policies and organizing the reconstruction activities. Various policies such as "Regulations on Post-Wenchuan Earthquake Rehabilitation and

Reconstruction" and, "increasing versus decreasing balance", as well as the rural land circulation policy are available. Also, the pros and cons of CRS were disseminated to the rural victims for considerations. It is important to note that involving the rural victims in the decision making process is the key for the local government to successfully initiate and organize the concentration scheme.

Economic development provides a foundation for rural victims of a disaster to cover the increased living cost after concentration and to sustain further development. Agricultural industrialization, non-primary economic activities and urbanization are three beneficial conditions for developing CRS in post-disaster reconstruction. Both agricultural industrialization and non-primary economic activities are able to help people increase income to afford the increased living cost caused by concentrated settlement. Working in urban areas would impact farmers' consumption modes and living habits, which helps the victims adapt to the new life after concentration. Furthermore, developing CRS for some villages in the suburb of a city or town is urbanization (sub-urbanization) itself.

The victims' willingness to participate is critical to implementing a CRS scheme. Good understandings of the current interest and long term interest generated in implementing CRS can increase the victims' willingness to accept it. The current interests include extra finance for reconstruction, and improved infrastructure, public services and living condition. In the long term, rural victims are concerned more about how to afford the increased living cost and how to engage in future development.

(3) Development of decision model for implementing CRS in post-disaster reconstruction

As few studies have been conducted on establishing a decision model for developing CRS in post-disaster reconstruction, implementing CRS first required an explorative investigation of real cases. For this purpose, the implementation of CRS in four villages in Dujiangyan, Chengdu City, China was investigated. The free-flow mapping technique was adopted to map the process of developing CRS in post-disaster reconstruction, which was confirmed by local officials. Finally, the problems and experiences in the mapped processes were discussed. A decision model for implementing CRS in post-disaster reconstruction was established based on the experiences and problems found in current reconstruction practices and the traditional models' existing principles.

By incorporating all the proficiencies embodied in the aforementioned practices, the decision framework of developing CRS in post-disaster reconstruction was established. The central part is optimizing the process of developing CRS in post-disaster reconstruction (sub-model A) meanwhile balancing reconstruction with social, environmental, and economic considerations (sub-model B), mobilizing the participants, and financial resources (sub-model C), and recycling resources in post-disaster reconstruction (sub-model D) are also important components to ensure the sustainability of a post-disaster reconstruction.

As the critical part, sub-model A aims to optimize the process of reconstruction and provide specific references to each step. There are four sub-stages, namely reconstruction preparedness of CRS (A-1), planning of CRS (A-2), building CRS (A-3), and post-disaster community management of CRS (A-4) in the reconstruction process. Meanwhile a geographic information

system (GIS) support system (A-0) is introduced to coordinate the efforts of the village-level government and the regional-level government, and record any relevant information.

In order to achieve sustainable development, sub-model B balances reconstruction with economic, environmental, and social considerations. Planning coordination, regional coordination, and victims-experts coordination are put forward as three critical pillars to support the project's successful completion.

Sub-model C is assumed to specify the inter-relationships of main participants and the financial sources in order to provide better management in the resource-limited conditions after disaster. The most involved participants in the development of CRS after a natural disaster should be: the rural victims, the village-level government, NGOs, the regional-level government, experts, and a reconstruction support partner. Their internal relationships are mapped while their works undertaken are specified. Five financial sources, including national subsidies, income from the "increasing versus decreasing balance" policy, self-financing, partner support, and the local government are identified. The relevant access channels and allocation approach have also been introduced for reference.

Sub-model D is designed to recycle resources in order to save land and materials for better sustainability of post-disaster reconstruction. Centered on the CRS development process, recycling efforts should be spent on a temporary housing site (at Stage 1 and 2 of the CRS development), concentrated rural settlement (Stage 3), and a former dispersed housing site (Stage 4). Measures are put forward to recycle the housing units, land and infrastructure by following the principlesof "recycling, reuse, and reduction".

(4) Model validation

Interview with the experts with regard to face validity, event validity, and comparison with other models was adopted to validate the decision model. According to the objectives of the model, twelve questions were designed for the three types of validity. Selection of the interviewees depended on two criteria. First, the experts must have participated in developing CRS after the 5.12 Sichuan Earthquake but were not involved in developing the decision model. Second, the experts must have acted as a decision maker in his or her position. Six experts were identified, among who, two experts were local officials, one expert was responsible for the housing planning after disaster, two experts presided over the land management issues after disaster, and the last expert was a researcher conducting studies on post-disaster reconstruction.

During the interview process, the decision model, and its objective and development process were introduced to the experts. The experts were then invited to score the performance of the model by answering the pre-designed questions. Apart from assessment based on the designed questions, the experts were also invited to pinpoint the benefits and shortcomings.

All the experts claimed that they could comprehend the model and that the process was reasonable reflecting that in the real world. They showed great interest in the key points throughout the process and paid special attention to balancing the reconstruction with social/economic/environmental considerations, mobilizing participants and financial resources, and recycling resources. a consensus was reached that the model provided specific guidelines which was unavailable before, and that the implementation process was at least as good as the existing practices. Most thought the model was an improvement over existing practices.

The key points in each step of CRS development, the GIS support system, the balancing model, and the resource recycling model were the functions that the experts thought were very useful. Having a process model with key points allows local officials to identify any necessary precautions in each step. The framework of the GIS support system provides a tool to manage the reconstruction information at the regional level, conduct regional coordination and balance, and speed up reconstruction accordingly. The balancing model and the resource recycling model specify the important concerns and offer detailed measures to achieve progress during reconstruction. The experts also agreed that the model would be a useful tool for them to prepare a pre-disaster planning agenda, make the local officials' job easier, and avoid some pitfalls of the reconstruction process.

Although the experts agreed that the functions of the model are well-designed, they did have some reservations about the implementation of the model. They felt that potential problems lie in the fact that many criteria are qualitative without a specific reference for making decisions. This resulted in difficulty in gaining enough data to develop a quantitative model. However, this was somewhat offset by the fact that in reality decisions usually depend on several critical qualitative criteria listed in the model.

8.2 Contributions to Knowledge

This study contributes to a theoretical understanding of why the practice of rural residential land exchange is different under normal conditions from that under disaster conditions in China. The major reasons contributing to the difference can be highlighted as: close monitoring from the public and media in post-disaster reconstruction makes the cost of 'implement by special means'

too high to bear for the local government; with the loss of rural settlement from a disaster, the rural victims have to rebuild settlement whether or not they accept or reject the policy; and a series of matched favorable policies are usually introduced under disaster conditions. This understanding can facilitate the central government to improve the rural residential land exchange policy in order to achieve positive results even under normal conditions.

This study also contributes to a theoretical understanding of critical determinant factors for developing CRS in post-disaster reconstruction when making decisions. Before developing CRS, the local government should consider whether the local economy can support the concentration lifestyle in rural areas, and whether the government has the capacity to provide proper guidance and garner the farmers' willingness to participate. Governmental guidance can help to improve the process and assure interests of the rural victims while the economic development can provide sufficient capacity for improving the long term interests of disaster victims. Increasing both current and long-term interests can increase the victims' willingness to accept concentrated settlement.

This study provides Chinese village-level government with knowledge for developing CRS in post-disaster reconstruction through a decision model. Emphasizing the optimization of the process, this model identifies four stages in the successful development of CRS, outlining specified critical issues at each step. Meanwhile, in order to ensure the sustainability of the CRS, due attention must be paid to balancing a reconstruction project with social/economic/environmental benefits, mobilizing participants and financial sources, and recycling resources. The model allows the local government to improve the effectiveness and

efficiency of developing CRS in post-disaster reconstruction by providing specific guidelines. This would also help the local government prepare a pre-disaster plan for developing CRS by following the decision model and involving local farmers. Moreover, the introduction of a GIS support system would help the regional government manage and coordinate post-disaster reconstruction at the regional level.

In addition, this study enriches the knowledge of housing reconstruction in the aftermath of disasters with particular reference to China. Whilst there is a huge body of knowledge available on the subject of housing reconstruction in post-disaster reconstruction, theories on how to achieve sustainable housing reconstruction in rural areas are rare. This research provides the option of developing CRS within a village, which is argued to be more sustainable and resilient, as an alternative to reconstruction in-situ and resettlement. CRS not only reduces rural disadvantages and alleviates the imbalance of welfare distribution between urban and rural areas, but it also contributes to achieving sustainable development by saving land consumption and serving as a growth-engine and stabilizer of urbanization and economic potential through linking rural and urban areas.

8.3 Limitations and Recommendations for Future Research

The limitations of this study concern largely with data availability and the limitation of time. Firstly, data collection was very difficulty due to political sensitivity. Thus, the analysis tools in this study are mainly qualitative methods such as content analysis, case study and interview. No quantitative model or quantitative criteria are developed as not enough data could be accessed. Secondly, the decision model is developed at the village-level, although the GIS support system

is designed for coordinating at the regional level. It could provide references to local government officials when organizing reconstruction efforts. However, due to limited time and the research objectives, the analysis in this study was not extended to reconstruction at the regional level. The final limitation was the fact that all four case studies were situated in Dujiangyan, Chengdu City.

To address the above limitations, the following areas are recommended for future research: (1) A study to identify CDFs for developing CRS in post-disaster reconstruction can be conducted in other developing countries to add knowledge on the subject of housing reconstruction in the aftermath of natural disasters. Relevant data can be collected through international co-operation. Comparison of the set of CDFs in different countries is useful to identify the different concerns and provide chances of learning from others' good experience. (2) Further research should aim to develop a decision model at the regional level, which can enhance the understandings of CRS on a larger scale and help regional governments to actively organize and coordinate reconstruction efforts at regional level. A concrete GIS support system can be developed to combine the research at the village level and that at the regional level. (3) A study could be conducted to quantify the CDFs and decision criteria for a decision model. Questionnaire survey and Structural Equation Modeling (SEM) are suggested to quantify the CDFs and identify the inter-relationships of these factors. Suitable methods such as multi-criteria assessment, linear programming can be used to develop quantitative decision criteria for each step of the decision model.

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APPENDICES

Appendix A Structured questionnaire for Pilot Study of Identifying CDFs

Cover Letter

Dear Sir/Madam,

Survey from Developing Concentrated Rural Settlement in Post Disaster Reconstruction Research Group (DCRSPDRRG)

Please take several minutes of your precious time to complete the enclosed questionnaire.

We are an independent research team at the Hong Kong Polytechnic University. Currently, we are conducting a research project of the captioned title. 5.12 Sichuan Earthquake brought huge damages to our country. Post disaster reconstruction is a necessary step adopted to restore the normal life and cure hurt. Typically, rural settlement is reconstructed in-situ, which is criticized for suffering possible secondary disaster and wasting the opportunities to improve the infrastructure and public services in rural areas. However, in post 5.12 Sichuan earthquake reconstruction, several cases of developing concentrated rural settlement (CRS), which is considered to be sustainable post disaster reconstruction, have been successful model of post disaster reconstruction. What are the key factors for developing concentrated rural settlement that should be strengthened especially in post disaster reconstruction?

The research group has found 29 optional factors for developing concentrated rural settlement in post-disaster reconstruction through literature review. The objective of this survey is to refine these factors for further survey.

There is no commercial or political sponsorship in this academic research. Your response will remain strictly confidential. If you can provide your contact information in your reply, we would be most happy to share our findings with you (subject to sufficient returns).

Your kind assistance would be most appreciated. Please complete the questionnaire and send it back to us by using either email or the attached self-addressed envelope within 1 month of receipt. If you have any questions, please feel free to contact me at Tel No (+852) 2766 5872 or email:1090

Looking forward to receiving your early reply,

Yours faithfully,

Yi Peng

Instructions

Please indicate the degree of significance of the following optional factors critical for developing concentrated rural settlement (CRS) in post disaster reconstruction to your own practical experience. Among them, ① indicates "insignificant"; ② "significant"; ③ "strongly significant". In addition, you are welcomed to add other critical factors which are important but not in the list based on your professional knowledge.

Section I: initial list of determinant factors for developing CRS in post-disaster reconstruction

Optional factors		Significance level		
Natural endowments	F1-fertile land	①	②	③
	F2-vegetation	①	②	③
Economic development	F3-urbanization	①	②	③
	F4-non-primary economic development	①	②	③
	F5-agricultural industrialization	①	②	③
	F6-agglomeration effects of infrastructure	①	②	③
Farmer's behavior	F7-shift to urban consumption mode	①	②	③
	F8- shift to urban works	①	②	③
	F9-migration to urban areas	①	②	③
Policy	F10-rural land circulation	①	②	③
	F11-'increasing versus decreasing balance' policy	①	②	③

	F12-urban-rural coordinated development strategy	①	②	③
Culture	F13-cultural conventions	①	②	③
	F14-planting modes	①	②	③
Organization	F15-clear responsibility of government departments	①	②	③
	F16-dissemination of the reconstruction policies	①	②	③
	F17-victims' participation in the decision-making process	①	②	③
Site selection	F18-short cultivation radius	①	②	③
	F19-water availability	①	②	③
	F20-no secondary disaster	①	②	③
	F21-near employment and social services	①	②	③
	F22-near kin or the old village	①	②	③
	F23-improved infrastructure	①	②	③
Layout	F24-culturally constructed ritual spaces required by victims	①	②	③
	F25-sufficient space around dwellings for agricultural needs	①	②	③
Housing design	F26-suitable size	①	②	③
	F27-good materials and construction	①	②	③
	F28-privacy needs	①	②	③
Further development	F29-the capability of the community to develop itself	①	②	③

Other critical factors based on your professional knowledge		①	②	③
		①	②	③
		①	②	③
		①	②	③
		①	②	③

Note: 'increasing versus decreasing balance' policy is short for "The balance between the increase of construction land in urban areas and the decrease of that in rural areas"

Section II: personal information

1. Work unit

①Government department, ②Research institution, ③Planning design institution, ④Others

2. Job title

①Senior professional, ②Middle level professional, ③Technical staff, ④Administrative staff, ⑤Others

3. Relevant rural housing construction experience

①Below 5 years, ②5-10 years, ③10-15 years, ④15-20 years, ⑤Above 20 years

4. Education level

①High diploma, ②Bachelor degree, ③Master degree or above

5. Whether you have direct or indirect experience of CRS development

①Direct, ②Indirect (If "Direct", please go through the following questions; otherwise please go to the end of the questionniare)

6. Whether you have involved in CRS development under normal conditions (without disasters), or disaster conditions or both

①Normal conditions, ②Disaster conditions, ③Both

7. What is your major responsibility in developing CRS

①Housing design, ②Site selection, ③Village planning, ④Building, ⑤Policy making, ⑥Management and organization, ⑦Research, ⑧Others

8. Do you have any comments on this pilot study with regards to the research process, research content? If any, would you please write down in the blank area?

<The End>

Thank you so much again for your kind assistance to complete this questionnaire. Please send the questionnaire to pengyihz@

If you are interested in this study, please leave your email, we would send a report to you after completing the study.

Your email: _____

Thank you for your contribution!

Appendix B Example of Semi-structured Interview to Identify CDFs of Developing CRS

Time: 09:00 a.m. ~ 11:00 a.m.

Date: 28 September 2011

Place: Xiangrong Village, Dujiangyan, Chengdu, Sichuan Province, China

Interviwer: PENG Yi (P for short)

Interviewee: The branch secretary, who managed and organized CRS development in the whole process (named X1 in Chapter 5)

Interview record:

P: Dear <Title> <First Name> <Last Name>, I am Peng Yi, a member of an independent research team at the Hong Kong Polytechnic University. Currently, we are conducting a research project of "Decision model for developing concentrated rural settlement in post-disaster reconstruction: A China study". The 5.12 Sichuan Earthquake brought huge damages to our country. Post disaster reconstruction is a necessary step adopted to restore the normal life and cure hurt. Typically, rural settlement is reconstructed in-situ, which is criticized for suffering possible secondary disaster and wasting the opportunities to improve the infrastructure and public services in rural areas. However, in post 5.12 Sichuan earthquake reconstruction, several cases of developing concentrated rural settlement, which is considered to be sustainable post disaster reconstruction, have been successful model of post disaster reconstruction.

The objective of this interview is to identify the critical determinant factors for developing concentrated rural settlement in post disaster reconstruction. Would you please take several minutes of your precious time to complete the interview? There is no commercial or political sponsorship in this academic research. Your response will remain strictly confidential.

We believe that the findings from this survey will help the local government and NGOs to gain more understandings on developing concentrated rural settlement. With such understanding, the local government and NGOs can make reasonable decisions to develop concentrated rural settlement, thus achieve sustainable post disaster reconstruction.

Would you like to accept the interview and continue the talk? You can stop this interview if you feel uneasy at any time.

X1: Surely, please go ahead.

P: Could I know some background information about you and your village for better analysis? Like "What is your job title?", "How many years of work experience relevant to rural housing construction do you have?" and "How about your education level?"

X1: No problem. I am the branch secretary of this village. I have monitored the village affairs for about 20 years including rural housing construction in the village. I graduated from middle school, and managed some business outside and came back to do this job in 1990s.

P: Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?

X1: This is the first time to promote concentrated rural settlement (CRS) just after the 5.12 Sichuan Earthquake.

P: What is your major responbility in developing CRS in post-disaster reconstruction

X1: I was in charge of the whole organization and management affairs at the village level, such as dissemination of the reconstruction policies, organizing the rural victims to discuss the reconstruction approach, submitting reconstruction proposal to the upper government, allocating the financial subsidy.

P: Could I also learn something about the village, like "Does this village locate in plain areas or hilly areas?", "How many villagers does this village have right now?", "How many households does this village have right now?"

X1: You may have noticed that our village locates in plain areas. There are 315 hectares of land with 115.9 hectares of cultivated land.

P: Then how many housholds and people does this village have?

X1: There are 635 households and 1767 people right now.

P: How many labors does this village have and How many work in the urban areas?

X1: There are 1200 labors whose age is between 18 and 50. There are about 62% working in urban areas including those working annually and seansonly.

P: What is the supporting industry of this village right now?

X1: We mainly rely on vegetable cultivation. Our vegetable would be transported to nearby metropolis like Chengdu, Chongqing and Guiyang.

P: How much per capita income does this village generate before the 5.12 Sichuan Earthquake?

X1: It was about 5,300 Yuan per year at the end of 2007.

P: How many houses were collapsed or damaged during the 5.12 Sichuan Earthquake?

X1: There were about 433 households.

P: What is the percentage of households moving to CRS after the 5.12 Sichuan Earthquake?

X1: We had three concentration sites with 384 households in total.

P: Three concentration sites? Then how much area do the sites for developing CRS occupy?

X1: Yeah, three. The land area is about 87.15 Mu (* Mu is the commonly used unit of land area in rural China, where 1 hectare=15 Mu).

P: How much per capita income does this village generate after the 5.12 Sichuan Earthquake?

X1: It was about 7,000 Yuan per year in our initial survey.

P: We can expect that their living cost would be increased, do you have any ideas about that?

X1: Yeah, they have to pay for the gas, cable and increased usage of power. The increased living cost is about 1000 Yuan per person per year according to our survey.

P: Thanks for your kind information sharing. Actually, I found there were many news reports promoting the successful reconstruction experience of your village. Do you feel proud of that?

X1: Thanks to good policies. We just did what we have to do. Most rural victims like the better housing and infrastructure.

P: Could we discuss something about the critical determinant factors for developing CRS in post-disaster reconstruction in order to systematically summarize the good experience of your village.

X1: Surely.

P: I had a preliminary list of determinant factors, which was refined by some experts. Could you have a look at it and make some comments on it according to the experience of your village.

X1: Let me have a look.

X1: “Urbanization” and “agricultural industralization” is significant for our case. You may know that our village locates in plain area, we mainly use machines for planting. Therefore, many labors can be released from the land to work in urban areas. This good condition means that there are few difficulities for them to continue farmwork if the farmers are concentrated. Also, the village is quite clost to the Town with good transportation, the urbanization trend provides many work opportunities and the potential of digesting the vegetable production. “Non-primay economic development” was not considered as our village mainly relies on planting.

P: you mean “non-primay economic development” insignificant?

X1: No, it was just not considered in our case.

X1: “Shift to urban consumption mode” and “shift to urban works” are significant. As I introduced before, many labors work in urban areas. They are accotusmoed to the urban

consumption mode gradually. They all like the better housing and equipments in the concentration site.

P: understand that.

X1: “Incresing versus decreasing balance” policy and “Urban-rural coordinated development” strategy are strongly significant. “Increasing versus decreasing balance” policy is very useful for transferring the land use right from rural areas to urban areas. The generated revenues in this process are greatly appreaciated in housing reconstruction. In other words, developing CRS was just a result of promoting this policy in post-disaster reconstruction. As a requirement of “Urban-rural coordinated development”, land titling and property right certificate issuing had been conducted before the earthquake. This work made land adjustment, transfer and transaction much easier in the process of developing CRS.

X1: Also, “reconstruction aids from other provinces” and “rural collective land ownership” are significant. As our town does not have enough financial resource, the reconstruction aids from Shanghai made us much easier to build infrastructure like the road, pipeline and cable in the village. “Rural collective land ownership” means that the land owns to the rural collective rather than the farmers. Therefore, under the surpervision of the local government, it is much easier to conduct land adjustment than that of private land during the development process. The only concern is how to make the farmers feel fair during this adjustment process.

P: Then how about “rural land circulation” and “local financial support”?

X1: They may be important. But we did not consider these two factors in our case.

P: How about the cultural issues?

X1: “To know each other well” is significant. The good relationship before concentration would keep the social network and make them live better compared to strangers. This was reflected by the fact that some rural victims would like to build houses close to their relatives.

X1: For the cultural conventions and planting modes, I think it is insignificant. As we share the same culture but you can find both dispersion and concentration in China. Also, plannting mode did not determine whether we can be concentrated.

P: Got that. Then how about the governmental organization during the process?

X1: “Victims’ participation in the decision-making process” is strongly signifincant. All the important issues, such as whether concentration or not, site selection, housing design were discussed and determined by the rural victims. This is helpful to make the rural victims accept CRS in a fair and effective way. Also, “clear responbility of government departments” and “dissemination of the reconstruction policies” are significant. The rural victims need the clear and complete information to make decisions. In addition, they could figure out the future life after concentration if they know what they were doing.

P: You mean that the rural victims are more likely to accept concentration if they can clearly find their benefits in the development process?

X1: Yes. Like that the farmers felt happy when they knew that the three concentration sites would be close to the provincial highway. Also, they liked CRS because they knew they could enjoy better infrastructure like natural gas and network.

P: So do you mean “improved infrastructure” is significant?

X1: Actually strongly significant. It made the rural victims more likely to participate in this scheme.

P: Then should the concentration site be near employment and public servies.

X1: That may be necessary. The increased work opportunity and better access to public services made the rual victims be less worried about their future life after concentration. That is also why we chose the site being close to the provincial highway, which make the farmers easy to find work in the Tianma town or enjoy the public services in the town.

P: So how about other issues, like water availability?

X1: Basically, I think water availability is important for both dispersion and concentration. But it does not matter in our decision as the water resource in Dujiangyan is rich and there are water supply companies to supply water as the pipeline is easy to be built along with the provincial highway.

P: So do you consider secondary disaster when selecting the sites for concentration?

X1: For “secondary disaster”, I should admit that we did not conduct geological survey for the three concentration sites as we tended to speed up the reconstruction progress especially under some political burden. But you may know that our village locates in plain area, so we usually would not encounter the secondary disaster like mudslides resulted by earthquake.

P: I may understand the tight reconstruction timetable. Wish there is no disaster again in the village. So do you consider the farmers’ needs of continuing farmwork when selecting the sites?

X1: Definitely. That is why we had three sites for concentrating the rual victims. We let the rural vicitims chose among the three sites as close to their contracted land as possible. This arrangement would reduce their cost of continuing farmwork. All the rural victims welcomed and accepted.

P: That means “short cultivation radius” is significant, is that right?

X1: Yes.

P: So if carrying on farmwork is necessary, should you also consider space for agricultural needs in the newly constructed house or the concentration site?

X1: Definitely. As most households still have farmwork to do after concentration, there are some public areas around the dwelling for them to dry grains or store farm tools. Also, the housing design considers the agricultural needs and leave one or two rooms for the farmers to store the grain or farm tools.

P: That is to say “sufficient space around dwellings for agricultural needs” is also significant?

X1: Yes, in our case.

P: If being close to contracted land is important, should the concentration site also be close to the old village or where the kin lives?

X1: That is not necessary. You may know that our village has gone through the collective era. Usually the villagers know each other well and would help each other when necessary. So whether the concentration site is near the kin is not so important.

P: You just mentioned collectivism, something relevant to culture. So do you think there should be some culturally constructed ritual spaces in the concentration site?

X1: Our village did not consider this issue when implementing CRS as the rural victims did not express their willingness in the consultance.

P: So do you think that is insignificant?

X1: I am not sure. But it is not applicable in our village. The farmers are still satisfied even until now.

P: So should the concentration should be as high as possible to save land and attain the reveues generated in the process of rural residential land exchange?

X1: Not that way. You may find that we built single house with sufficient space between houses when you passed by the concentration site. In the consultancy, we found that the farmers did not the style of urban apartments. Although the area of residential land was reduced when compared to that before concentration, the construction area is almost the same as two or three floors were built in the concentration site. Maybe the single house with small residential land is a good buffer for the farmers to shift from dispersion to urban concentration.

P: You said that the construction area is almost unchanged?

X1: Yes. Before reconstruction, the farmers usually lived in bungalow. But in the concentration site, they usually built a single house with two or three floors. Even though the area of rural residential land is smaller, the construction area with more floors is larger or at least unchanged.

P: So that means the size of the house does not matter?

X1: It may matter in some other way. But I think the importance of the size is not so clear especially if you investigate this issue from the aspect of construction area.

P: How about privacy needs. I read some reports and found it is important especially in the western countries when they promote concentration.

X1: I am not quite sure about this. But the farmers know each other quite well and we built single house with sufficient space between houses. I think the privacy issue plays certain role in urban apartment rather than that of single house in rual areas.

P: We had talked much more about the psychological or cultural issue. So back to the physical reconstruction does “good materials and construction” play some role in developing CRS?

X1: Surely. The rural victims expected a better living environment of the concentrated rural settlement. So if the quality of the house is not so good, I think the rural victims would be sad and even do something extreme to resist the new houses. The resistance may result in political punishment. That’s why our rural collective also organized a special team to supervise the reconstruction progress and helped check the quality of construction during the reconstruction process, even the farmers decided to reconstruct the house by them.

P: I understand that. Until now, we had discussed the factors relevant to economic development, farmers’ behavior, policy, organization, site selection, layout, housing design and contruction. So do you think these are enough to ensure the success?

X1: No. As shown in your factor list, the capability of the community to develop itself is very important. The living cost would be increased after concentration, therefore the farmers should find some way to sustain the life. The living standard should be improved or at least remains at the same level of that before concentration. So the village collective had tried to provide more training course for the villagers to learn some skills to find work in urban areas. Also, we established the vegetable base to promote the vegetable business as a whole. In addition, we tried to circulate some land to do vegetable business with outside enterprises. Also, we tried to provide helps to manage the concentration site with the financial support from upper government.

P: So do you think these measures take effective?

X1: It works in some way. The increased income can cover the increased living cost as we discussed before. It still needs time to observe the long term effect. We should also continue to promote the community development and economic development after concentration.

P: So do you have any idea about how to do community development and economic development for the concentration site?

X1: Not so clear. It still needs time.

P: Thank you indeed for your kind sharing. I would complete the interview if you can help confirm some relevant information.

P: Does this interview make you unhappy and therefore the information generated in this

process remains questionable?

X1: I felt happy to discuss this issue with you.

P: Do the results of significance level of the optional factors reflect your true intentions?

X1: Yes, definitely.

P: Could I disclose the information relevant to you and the village?

X1: As there were already some new reports about the village, you can use the relevant information in your research. For my background information, it can be used in some way if I can not be directly identified.

P: Thank you indeed. Do you have any suggestions on the crtical determinant factors of developing CRS in post-disaster reconstruction?

X1: Nothing special. It would be greatly appreciated that if you can help promote the reconstruction experience of our village.

P: Thank you indeed for your precious time and kind sharing. Could you please recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for my further interview?

X1: Surely. That is my pleasure. You can find our assistant village head, who is a graduate of the university.

P: Thank you indeed.

Appendix C Example of Semi-structured Interview to Map the Process of Developing CRS

Time: 10:00 a.m. ~ 11:00 a.m.

Date: 20 February 2012

Place: Qingjiang Village, Dujiangyan, Chengdu, Sichuan Province, China

Interviwer: PENG Yi (P for short)

Interviewee: the village head, who managed and organized CRS development in the whole process (named Q21 in Chapter 6)

Interview record:

P: Dear <Title> <First Name> <Last Name>, I am Peng Yi, a member of an independent research team at the Hong Kong Polytechnic University. Currently, we are conducting a research project of "Decision model for developing concentrated rural settlement in post-disaster reconstruction: A China study". The 5.12 Sichuan Earthquake brought huge damages to our country. Post disaster reconstruction is a necessary step adopted to restore the normal life and cure hurt. Typically, rural settlement is reconstructed in-situ, which is criticized for suffering possible secondary disaster and wasting the opportunities to improve the infrastructure and public services in rural areas. However, in post 5.12 Sichuan Earthquake reconstruction, several cases of developing concentrated rural settlement, which is considered to be sustainable post disaster reconstruction, have been successful model of post disaster reconstruction.

The objective of this interview is to map process of developing CRS after the 5.12 Sichuan Earthquake and identify the good experience and problems during the process. Would you please take several minutes of your precious time to complete the interview? There is no commercial or political sponsorship in this academic research. Your response will remain strictly confidential.

We believe that the findings from this survey will help the local government and NGOs to gain more understandings on how to develop concentrated rural settlement. With such understanding, the local government and NGOs can make reasonable decisions to develop concentrated rural settlement, thus achieve sustainable post disaster reconstruction.

Would you like to accept the interview and continue the talk? You can stop this interview if you feel uneasy at any time.

P: Could I know some background information about you and your village for better analysis? Like "What is your job title?", "How many years of work experience relevant to rural housing construction do you have?" and "How about your education level?"

Q21: No problem. I am the head of this village. I have monitored the village affairs for about 16 years including rural housing construction in the village. I graduated from high school.

P: Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?

Q21: This is the first time to promote concentrated rural settlement (CRS) just after the 5.12 Sichuan Earthquake.

P: What is your major responbility in developing CRS in post-disaster reconstruction

Q21: I was in charge of the whole organization and management affairs at the village level, such as dissemination of the reconstruction policies, organizing the rural victims to discuss the reconstruction approach, submitting reconstruction proposal to the upper government, allocating the financial subsidy.

P: Could I also learn something about the village, like "Does this village locate in plain areas or hilly areas?", "How many villagers does this village have right now?", "How many households does this village have right now?"

Q21: You may have noticed that our village locates in plain areas. There are 352 hectares of land with 148.5 hectares of cultivated land.

P: Then how many housholds and people does this village have?

Q21: There are 767 households and 2776 people right now.

P: How many labors does this village have and how many work in the urban areas?

Q21: There are 1800 labors whose age is between 18 and 50. There are about 56% working in urban areas including those working annually and seansonly.

P: What is the supporting industry of this village right now?

Q21: We mainly rely on vegetable cultivation and mushrooms. Some housholds are also cultivating ornamental plants.

P: How much per capita income does this village generate before the 5.12 Sichuan Earthquake?

Q21: It was about 5200 Yuan per year at the end of 2007.

P: How many houses were collapsed or damaged during the 5.12 Sichuan Earthquake?

Q21: There were about 370 households and 591 houses were not suitable for living due to severe damage.

P: What is the percentage of households moving to CRS after the 5.12 Sichuan Earthquake?

Q21: We had two concentration sites with 330 households in total.

P: Two concentration sites? Then how much area do the sites for developing CRS occupy?

Q21: Yeah, two. The land area is about 135Mu (* Mu is the commonly used unit of land area in rural China, where 1 hectare=15 Mu) wile the construction area is more than 73 Mu.

P: How much per capita income does this village generate after the 5.12 Sichuan Earthquake?

Q21: It was about 7781 Yuan per year in our initial survey.

P: We can expect that their living cost would be increased, do you have any ideas about that?

Q21: Yeah, they have to pay for the gas, cable and increased usage of power. The increased living cost is about 1100 Yuan per person per year according to our survey.

P: Thanks for your kind information sharing. Actually, I found there were many news reports promoting the successful reconstruction experience of your village. Do you feel proud of that?

Q21: Thanks to good policies. We just did what we have to do. Most rural victims like the better housing and infrastructure.

P: Could we talk something about the development process.

Q21: Surely.

P: What did you do before determining developing CRS?

Q21: Damage assessment was conducted. The upper government sent an expert team to assess the housing damage. There were about 370 households and 591 houses were not suitable for living due to severe damage.

P: So is there anything we should pay attention to in damage assessment?

Q21: The experts just assessed the degree of damage rather than the economic value of the house. I thought it was useful to ensure fairness especially when allocating financial subsidy from the upper government.

P: So is there any relationship between the damage and CRS development.

Q21: Surely. There was a severe finance shortage for reconstruction, although there were government subsidiaries, reconstruction aid from Shanghai, victims' own capital and bank credit. Furthermore, the geographical location of Qingjiang Village is not so good, presenting difficulty in attracting investment in post-disaster reconstruction. As a result, the government intended to adopt the policy of rural residential land exchange, which can generate income and supplement the reconstruction finance.

P: So the village-level government decided that?

Q21: Not exactly. We just put forward this option. A corresponding Special Village Affair Board and a Special Supervision Board were founded to organize discussions and argumentation among the rural victims. So you can know we just had 330 households moving into CRS while others prefer reconstruction in-situ. Also, the rural victims decided unified-planning-self-reconstruction rather than unified-planning-unified-reconstruction, as they preferred single house.

P: So the Special Village Affair Board was in charge of the whole issue?

Q21: Yeah, we may put forward some ideas about CRS and let Special Village Affair Board to discuss and make decisions finally. We also had a Special Supervision Board to monitor the whole process. We worked together.

P: Then what did you do after deciding to develop CRS.

Q21: The Special Village Affair Board organized discussions to find the site for concentration.

P: So what did you consider in the discussion?

Q21: There were three principles: proximity to the contracted land, occupying cultivated land as little as possible, and no secondary disaster. After reaching consensus, two sites, namely Shui Mo Fang and Qingjiang River, were selected for developing CRS. Unified-planning-self-reconstruction was employed to deliver CRS. According to the scheme, the participants consolidated their former rural residential land and rebuilt the houses with less residential land by themselves in the two selected sites. The rural victims could choose between the two sites to make their house as close to their contracted land as possible.

P: So did any professional team help you to select the sites for concentration?

Q21: Yeah, geological survey was conducted to ensure the safety of the site.

P: How about after determing the sites?

Q21: We took two steps at the same time. The village-level government organized the proposal application while a professional team was hired to make housing planning and design. An initial proposal was submitted to the upper government for endorsement.

P: Was the endorsement rapid?

Q21: No. You can figure out that the upper government was very busy after a huge disaster. Actually we had begun reconstruction before obtaining the endorsement and relevant departments' approval.

P: But why not simplify the procedures since it is difficult to complete it?

Q21: Disaster is an unusual condition, so the big reason is that the government has few preparedness for this condition.

P: I see. So how did you do housing planning?

Q21: A professional institution in Dujiangyan was employed to design the houses. A planner stayed in the village to collect relevant materials for his colleagues to make the planning. Also, he helped to seek the rural victims' advice when there was an initial planning scheme ready.

P: You mean that the rural victims could choose theire housing design scheme?

Q21: Yes, they put forward their comments on the housing planning scheme and the professional institution made changes accordingly, which is easy to ensure the reasonable design while satisfying the rural vicitims' needs. An overall plan, which was the consensus of the rural victims, was developed to ensure the adequacy of the entire layout of CRS.

P: So was there any special consideration in the housing planning?

Q21: The principles taken into consideration include accommodation to the local living and production ways, leaving room for future demands like garages, and using the local materials as efficiently as possible.

P: We just discussed the layout design. So how did the rural victims choose the specific location of the house in the selected concentration site?

Q21: It was determined by pair selection. Pair selection means that the rural victims could select their neighbors and a group location would be determined as a result. The Village Board would mediate the selection if there was any conflict. This measure was useful to enhance the social

network within the village.

P: What about infrasture planning?

Q21: It was carried while building CRS.

P: Is it feasible?

Q21: Yeah we made infrastructure planning at the initial stage of building. You know the house may need some time to build. It is possible if we can complete infrastructure planning and building before completing housing reconstruction. We can leave room for infrastructure while construction is in progress. So we can shorten the duration compared to the way of completing all planning first and then building house and infrastructure.

P: So what do you consider in infrastructure planning and building?

Q21: The planning should satisfy the local needs and leave flexibility for future improvement. After the construction committee confirms the infrastructure planning, a local construction team was hired to construct the infrastructure.

P: How about after that?

Q21: After completing building the houses, wall decoration design was unified by the Planning Committee of Dujiangyan. It was useful to make the whole layout of the concentration site beautiful.

P: I can see that when I entered into the village. It is really beautiful.

Q21: Thanks for your kind words.

P: So the rual victims moved to CRS after that?

Q21: Yes, The CRS had been completed before August 2010. Most of them felt happy about CRS and moved into the new house when it was available.

P: What else did you do after moving into the CRS?

Q21: The former houses were demolished and the former rural residential land was consolidated in order to complete the scheme of exchanging rural residential land. According to the requirements of ‘increasing versus decreasing’ policy, the former rural houses should be demolished and the relevant rural residential land should be consolidated to return the construction land to farmable land. Our village hired a professional team to handle all the work. Finally, the land management departments checked and confirm the consolidation before issuing the property right certificate.

P: Is there any resistance?

Q21: Not too much. We allocated the left revenues after they completed demolish and consolidation. Due to concentration, about 18.7 hectares of rural residential land was saved and consolidated as cultivated land.

P: Is there any other affairs?

Q21: After a check on the consolidation of former rural houses is performed, a new property rights certificate for the CRS should be issued by the housing department from the upper government. The contract rights of the farmland can be attributed to the corresponding rural victims while the ownership is still attributed to the rural collectives.

P: How do you manage CRS as it is different from both the former rural settlement and urban settlement?

Q21: The residents managed the public affairs by themselves. Budgetary allocations from the upper government are allocated to support daily management.

P: So do you do something special to help the farmers adapt to the new lifestyle.

Q21: Not too much. That depends on the household.

P: How about economic development after concentration? Do you consider this issue?

Q21: So the village collective had tried to provide more training course for the villagers to learn some skills to find work in urban areas. The real estate and infrastructure development near Qingjiang Village attracts the farmers to work nearby.

P: Do you think that is enough?

Q21: Not enough. We are still trying to find some way to survive.

P: Thank you indeed for your kind sharing. I would complete the interview if you can help confirm some relevant information.

P: Does this interview make you unhappy and therefore the information generated in this process remains questionable?

X1: I felt happy to discuss this issue with you.

P: Do the results of significance level of the optional factors reflect your true intentions?

X1: Yes, definitely.

P: Could I disclose the information relevant to you and the village?

X1: As there were already some new reports about the village, you can use the relevant information in your research. For my background information, it can be used in some way if I can not be directly identified.

P: Thank you indeed. Do you have any suggestions on the crtical determinant factors of developing CRS in post-disaster reconstruction?

X1: Nothing special. It would be greatly appreciated that if you can help promote the reconstruction experience of our village.

P: Thank you indeed for your precious time and kind sharing. Could you please recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for my further interview?

X1: Surely. That is my pleasure. You can find our accountant, who is a graduate of the university.

P: Thank you indeed.

Appendix D Example of Semi-structured Interview to Validate the Decision Model

Time: 15:00 a.m. ~ 16:00 a.m.

Date: 21 November 2012

Place: Chengdu, Sichuan Province, China

Interviwer: PENG Yi (P for short)

Interviewee: An expert participated in village planning during post-disaster reconstruction (named Int3 in Chapter 7)

Interview record:

P: Dear <Title> <First Name> <Last Name>, I am Peng Yi, a member of an independent research team at the Hong Kong Polytechnic University. Currently, we are conducting a research project of "Decision model for developing concentrated rural settlement in post-disaster reconstruction: A China study". The 5.12 Sichuan Earthquake brought huge damages to our country. Post disaster reconstruction is a necessary step adopted to restore the normal life and cure hurt. Typically, rural settlement is reconstructed in-situ, which is criticized for suffering possible secondary disaster and wasting the opportunities to improve the infrastructure and public services in rural areas. However, in post 5.12 Sichuan Earthquake reconstruction, several cases of developing concentrated rural settlement, which is considered to be sustainable post disaster reconstruction, have been successful model of post disaster reconstruction.

A decision model for developing CRS has been established by our research team. The objective of this interview is to validate the established decision model. Would you please take several minutes of your precious time to complete the interview? There is no commercial or political sponsorship in this academic research. Your response will remain strictly confidential.

We believe that the findings from this survey will help us improve the decision model. With such understanding, the decision model can be used for local government and NGOs to make reasonable decisions, thus achieve sustainable post disaster reconstruction.

Would you like to accept the interview and continue the talk? You can stop this interview if you feel uneasy at any time.

Int3: Surely. Post-disaster reconstruction is an important issue in current China. It is my pleasure that I can have some discussions with the academics.

P: Could I know some background information about you for facilitating analysis? Like "What is your job title?", "How many years of work experience relevant to rural housing construction do you have?" and "How about your education level?"

Int3: No problem. I am a senior planner in the Village Planning Institution of Sichuan Province.

I have participated in village planning for about 13 years. I had a master degree of planning.

P: Do you involve in developing concentrated rural settlement under normal conditions or disaster conditions?

Int3: This is the first time to promote concentrated rural settlement (CRS) just after the 5.12 Sichuan Earthquake. I participated in the village planning including some concentrated rural settlement planning in the post-disaster reconstruction.

P: What is your major responbility in developing CRS in post-disaster reconstruction

Int3: I was in charge of CRS planning, such as layout design, housing design, and infrastructure planning.

P: Planning? So you knew something about the reconstruction process of CRS.

Int3: Yes. I stayed in one village to facilitate CRS planning and experienced the whole process from planning to construction.

P: Do you think the process is perfect?

Int3: Although there are many good experiences, there is still some room for improvement. Like there is no pre-disaster planning about the CRS development, so time was wasted to explore every potential rather than following some guidelines.

P: Yes, in my interview with the experts participating in developing CRS in some villages of Dujiangyan, I found no specific guidelines can be provided to instruct the process of developing CRS. The local officials had to explore developing CRS with the rural victims in a rush while listening to the directives of the upper government. The rush of developing CRS without critical guidelines inevitably led to some problems.

Int3: Yes, that may be a big problem.

P: Actually. Through mapping the CRS development process and analyzing the relevant experience and problems of the four case villages in Dujiangyan, we established a decision model to guide how to develop CRS in post-disaster reconstruction. Would you like to have a look at it shown in pictures?

Int3: Surely.

P: The main part in this decision model is optimizing the process of developing CRS in post-disaster reconstruction (sub-model A) while balancing reconstruction with social, environmental, and economic considerations (sub-model B); then mobilizing the participants and financial resources (sub-model C); and finally recycling resources in post-disaster reconstruction (sub-model D).

Int3: So do you have four parts in the model?

P: Yes, but the main concern is how to optimize the development process. Sub-model A aims to optimize the process of reconstruction and provide references to the critical activities in each step. There are four sub-stages, namely reconstruction preparedness of CRS (A-1), planning of CRS (A-2), building CRS (A-3), and post-disaster community management of CRS (A-4) in the reconstruction process. Please take some time to look at the decision model. You can ask me when you have any question.

Int3: That is interesting. So what is your objective as you just showed me the pictures while there are few words on them.

P: Its objective is to provide a guideline for the local officials to organize the rural victims to develop CRS in post-disaster reconstruction.

Int3: So do you mean CRS is worthwhile to investigate and develop?

P: Yes, the hidden assumption behind the model is the belief that developing CRS is more resilient and sustainable.

Int3: And you invesitageted it at the micro level? I found that you involves a little regional issues.

P: Yes, the model context is post-disaster reconstruction in rural China, with special attention on the reconstruction efforts at the village level, as few studies developed housing reconstruction model at the village level.

Int3: I see.

P: So do you understand the model?

Int3: Almost.

P: Thanks. Maybe we can have some time to assess it. Before starting the assessment, I may give you the assessment criteria including

- the objective, scope, and the relevant stakeholders of the model are clear;
- the mentioned process and activities in the model are clear and reasonable;
- the model can improve the efficiency and effectiveness of developing CRS;
- the model provides specific guideline for the local officials to make decisions;
- the model can be applied in other regions of China under disaster conditions;
- the model can be applied in other regions of China under normal conditions; and
- the model has practical and theoretical implications.

P: Do you also understand the assessment criteria?

Int3: Yes.

P: So whether the assumption of the model is reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I may just give 2 for this issue. You said that the hidden assumption behind the model is the belief that developing CRS is more resilient and sustainable. This may be right, but I think everything depends. You know that the increased damage caused by natural disasters may be a direct result of urbanization concentrating more people to urban areas. So it needs more efforts to prove whether CRS is more resilient and sustainable.

P: I agree with you that everything depends on the context. Let me explain more about the assumption to you. Exsiting experiences from urban areas demonstrates that concentration have both advantages and disadvantages in light of vulnerability to disasters. On the one hand, concentration contributes to vulnerability through various factors such as increasing concentration of energy or energy transportation routes, by the likelihood of disease transmission, via the mix of and possible synergy between hazards, and by means of limited escape. On the other hand, concentration with good urban management brings diversity, market efficiency, jobs, quality public services, improved infrastructures, and health improvement, which can help the individual and society prevent or reduce the negative impacts of disasters, and enhance recovery from. However, regardless of the advantages of concentration, it is still not wise to ascribe vulnerability to concentration alone as vulnerability was complicated with the social, cultural, demographic and economic conditions.

Against the dispersion pattern of settlement, this study argues that developing concentrated rural settlement is able to increase the resilience of rural villages and to provide a basis for sustainable development post disaster. Compared to the concentrated urban area, the dispersed rural area face serious threats attributable to various factors such as lack of sufficient infrastructures, lack of information facilities about disasters, lack of social capital, socio-economic inequality, and poverty. However, developing concentrated rural settlement allows sufficient infrastructures, better public services, poverty alleviation and building social capital. These benefits would help the rural areas to confront the largest challenges in light of vulnerability while the rural areas face fewer disadvantages than the urban areas do as the density of concentrated rural settlement would not be as high as that of urban areas. Furthermore, concentrated settlement pattern serves as growth-engines and stabilizers of urbanization and economic growth through linking rural and urban areas, which would provide a basis of sustainable development post disaster.

Int3: I got that. Hope you can also do some research to prove this or find the critical threshold for concentration or dispersion.

P: Surely. I will do this if I can get more samples about CRS. So whether the objective of the model is specific and reasonable? Please give your comments and score the performance of the

decision model between 1 and 5 with 5 as the best.

Int3: I can give 4. You have explained exactly and clearly about the decision model, providing a guideline for the local officials to organize the rural victims to develop CRS in post-disaster reconstruction for better outcomes.

P: Then whether the scope of the model is clear and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: 3. The scope of the model is clear as you confined it within the village. But I think it would be more reasonable if you can alo include the regional level.

P: Yeah, I have considered this necessity and have left an interface of combining CRS development at the village level and regional level in the GIS support system.

Int3: Hope you can realize this objective in future.

P: Thanks for your suggestions. So do you think the decision maker of the model is specific and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: 3. You have provided keypoints for each step and further analyzed the main participants' relationships and possible actions. That is fine enough.

P: You just mentioned the keypoints of each step. So do you think the stated activities are clear and reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I may give 3. It is clear enough as the keypoints may help the decision maker to find what they should pay attention to during the process. However, it could be better if you can provide some quantitative criteria for making decisions.

P: Definitely. That is also what I want. But I could not attained large sample of data to extract information for finding the quantitative criteria due to time limit and political sensitivity. Also, in practice, some qualitative criteria are useful enough to guide the decision maker as the cost may be high to quantitify everything.

Int3: I know that would be quite difficult. This is just for your reference.

P: Thank you indeed. Then do you think the process of the model is reasonable? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I may give 4. Especially sub-model A tried to optimize the process of CRS development. It considers the needs of speeding up reconstruction process, then suggest conducting infrastructure planning and building CRS simultaneously. It also put forward to shorten the process of proposal application. The support system would be useful to help check this. Rather

than just focusing on the speed, the model also point out the necessity of guaranting the quality with practical measures. The process is good.

P: Thanks. Do you think the model can improve the effectiveness and efficiency of developing concentrated rural settlement in post-disaster reconstruction? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: 4. The decision model not only optimizes the development process by considerting the needs of speeding up reconstruction and quality guarantee, but also put forwards other three sub-models like resource recycling to support the process. The effectiveness and sustainability would be improved as a result. In addition, the detailed process with keypoints in each step as a reminder would help the local officials make decisions as soon as possible. The efficiency would also be improved.

P: Thank you indeed. So do you think the model can provide a reference to the decision maker in post-disaster reconstruction? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: 5. Due to merits I just mentioned before, I think it is quite useful for the decision maker to make relevant decisions in post-disaster reconstruction.

P: As you thought it is good for a reference. Do you think the model can be applied in other regions of China under disaster conditions? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I may give 4. You know that our country almost share the same institutional arrangements although there may be some differences in natural environment and economice development. But I think the decision model is applicable in post-disaster reconstruction if the requirements stated in your model could be satisfied.

P: Yeah. Then do you think the model can be applied in other regions of China under normal conditions? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I can only give 2. It may not be suitable for that under normal conditions, although the model can provide many valuable lessons in developing CRS under normal conditions. The local government and farmers may have different choices resulted by different conditions and different interest demands.

P: Yeah, the farmers have to build their houses no matter he participates in CRS development or not, but if he does, he may attain extra revenues for housing reconstruction, which was greatly appreciated in my case studies.

P: So do you think the model has practical implications? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: I consider giving 4 for this aspect. As there is no systematic guideline for the local officials to develop CRS in post-disaster reconstruction, this decision model helps a lot. It would lend a tool for them to prepare a pre-disaster planning, make the local officials' job easier, and avoid some disadvantages if they had it when pushing CRS in post-disaster reconstruction.

P: Then how about the theoretical implications? Please give your comments and score the performance of the decision model between 1 and 5 with 5 as the best.

Int3: May be 3. The model provides specific guidelines which was unavailable before, and that the implementation process was an improvement over existing practices.

P: Thank you indeed for your kind sharing. I would complete the interview if you can help confirm some relevant information.

P: Does this interview make you unhappy and therefore the information generated in this process remains questionable?

Int3: I felt happy to discuss this issue with you.

P: Do the results of significance level of the optional factors reflect your true intentions?

Int3: yes, definitely.

P: Could I disclose the information relevant to you and the village?

Int3: It can be used in some way if I can not be directly identified. I must say that what I just said are just my views rather than representing the institution that I am working in.

P: Thank you indeed. Do you have any suggestions on the crtical determinant factors of developing CRS in post-disaster reconstruction?

Int3: Nothing special. It would be greatly appreciated that if you can help promote the reconstruction experience of our village.

P: Thank you indeed for your precious time and kind sharing. Could you please recommend another interviewee with good experience of developing CRS in post-disaster reconstruction for my further interview?

Int3: That is my pleasure. Sorry my colleagues are busy with some important affairs. It may not be so good to interview them. Would you please find another time or other people?

P: Thank you all the same.