Study on the Sustainable Renewal of Poor Rural Communities of Southwest China

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ABSTRACT

Cities and counties in China experience unbalanced development as well as vulnerable economies and environments despite the rapid country-level progress. These poor villages thus face the enormous challenge of sustainable development. The government's attempt of improving the situation through its "urban–rural integration" policy to promote the development of rural areas has helped achieve short-term objectives in building construction and some other aspects. However, this policy is a disaster for long-term development in rural areas. Specifically, only 5% of the rural areas in Southwest China, especially those located near cities, are suitable to the government's policy; the remaining 95% of villages, especially those in remote areas, need to find their own ways to realize sustainable development.

This study combines the theories of sustainable development in China and other countries and proposes the use of the "endogenous development" concept to meet the development needs of poor rural areas. Under this model, the villagers can use the modified "traditional ways" to improve their housing conditions (i.e., space, materials, daylighting, and ventilation), public health circumstances, and financial and cultural situations. This study tests the theory using two case studies of the Yangliu and Ma'anqiao reconstruction projects and provides strategies for the sustainable renewal of poor rural areas of Southwest China.

Keywords: *sustainable renewal, Endogenous development, poor rural communities, Southwest China*

1. INTRODUCTION

The Chinese government invests in and provides preferential policies for rural areas. However, several of these policies are unsuitable for Southwest China, a multi-ethnic area with a considerably diverse and complex natural environment, which remains undeveloped despite the country's rapid development. This study combines the sustainable development theories in China and other countries to introduce the concept of "endogenous development" that could solve the problem. The study likewise establishes a sustainable development framework for poor rural areas in Southwest China.

2. BACKGROUND AND PROBLEMS

The scope of the study includes Sichuan, Yunnan, Guizhou, and Chongqing in Southwest China (Figure 1). These four provinces have a total land area of 1,134,400 square kilometers (Wan, 2013). Southwest China is home to ethnic groups and minority nationalities, many of whom have a low educational level. This mountainous area with complex topography and bad transportation is frequented by natural disasters; such characteristics seriously impede the development of both its society and its economy.

2.1 Poverty Problems

The mountainous Southwest China has inconvenient transportation and low land-use efficiency. Its productivity level is relatively backward, and its agricultural structure is unbalanced. The villagers lack the ability to abandon the traditional agricultural model. Therefore, an increasing number of villagers go to large cities to seek jobs to feed their families; this phenomenon has caused villages to become empty and lifeless. The per capita net income of rural households of Southwest China is less than the average level of China (Figure 2).

Figure 1: the scope of Southwest China

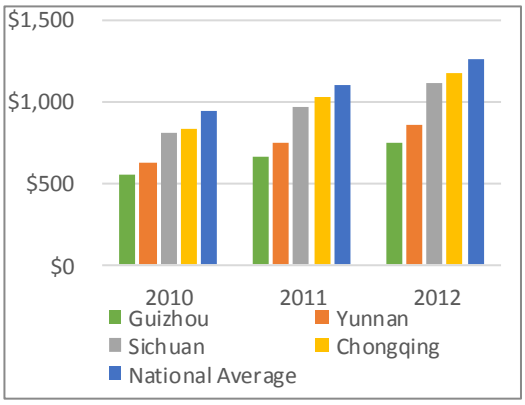

Figure 2: Per capita net income of rural households by region in China

2.2 Environmental Problems

Villagers cannot determine an appropriate method for waste management in poor rural areas because of deficient knowledge on public health. As a result, solid and liquid wastes pollute land and water resources. The so-called solid white waste pollutes both soil and water. Non-treated waste can produce toxic substances that attend to the top of the food chain. This environmental problem seriously damages the liver and the nervous system of humans (Zhang & Yu, 2007).

2.3 Public Health Problems

Lack of consideration for health issues is a common problem across the poor rural areas in Southwest China. Villagers do not fully understand the importance of health, and this situation adversely affects people's health and lives. For instance, burning firewood is the principal source of indoor air pollution; high indoor levels of PM10 in rural areas lead to several diseases, such as upper respiratory tract infection and asthma (Guo, 2005). Moreover, dry latrines that are extensively used in poor rural areas typically cause infectious diseases and zoonoses (Hu, 2009).

2.4 Building Renewal Problems

Various architectural forms follow unique regional conditions, such as those in the rural areas of Southwest China. However, traditional architecture lacks systematic ecological strategies and has technical problems with regard to anti-seismic design. At present, rural communities lack proper infrastructure and public service facilities; therefore, a suitable strategy for building renewal must be developed by comprehensively considering community planning and building design.

2.5 Government Policy Problems

Several important policies for rural development have been implemented in China, such as the 11th Five-Year Plan, which puts forward new countryside construction in 2005, and the Third Plenary Session of the 18th Central Committee, which emphasizes urban–rural integration as the fundamental

solution to rural issues in China. However, these policies insufficiently focus on poor rural areas with complex topography and deficient transportation and have thus failed to produce the desired effects.

3. A SUITABLE MODEL FOR RURAL DEVELOPMENT

Cities and counties of Southwest China have unbalanced development and extremely sensitive economic, environmental, and public health situations. Therefore, these areas face an enormous challenge in terms of sustainable development. The government has implemented the urban–rural policy to promote the development of rural areas and thus improve their situation. This policy is a means for officers to achieve the short-term objective in building construction and other aspects. However, this policy is a disaster for long-term development of rural areas because only 5% of villages, especially those counties near cities, are suitable for urban–rural integration; the remaining 95% of villages, especially those in remote areas, should determine their own means of realizing sustainable development (Qiu, 2007). Thus, endogenous development may be the appropriate model for poor rural areas in Southwest China.

Endogenous development entails "respect for the cultural identity, [wherein] people have the right to own their culture. . . . Humans are the power [and] also the purpose of development. In form, development should be generated internally; in purpose, development should serve the people" (Huang, 1988). Compared with the old rural development model, the theory of endogenous development is defined by three key points (Table 1): first, the shift in emphasis from inward investment to endogenous development, which promotes the development of resources found within the region instead of attracting investment from external sources; second, the shift in delivery mode for rural development from a top–down to a bottom–up approach; and third, the shift in the structure of rural development policy from sectoral modernization to a territory-based integrated rural development (Michael, 2011).

Table 1. Features of the modernization paradigm and the new rural development paradigm

Modernization	New rural development paradigm
Inward investment	Endogenous development
Top-down planning	Bottom-up innovation
Sectoral modernization	Territorially based integrated development
Financial capital	Social capital
Exploitation and control of nature	Sustainable development
Transport infrastructure	Information infrastructure
Production	Consumption
Industrialization	Small-scale niche industries

4. STRATEGIES FOR RENEWING POOR RURAL COMMUNITIES

Sustainability comprises three dimensions, namely, environment, economic, and social dimensions. Social sustainable development covers several issues, such as peace, security, social justice, and human settlement. A sustainable social environment focuses on health and education, and sustainable societies provide high levels of health and wellbeing to their members (Jeremy, 2003). The strategies for renewing poor rural communities are expounded in this paper from the social, environmental, and economic aspects according to the practical application.

4.1 Fully Respect the Autonomy of Villagers

In 2005, the Central Committee of the Communist Party officially launched the "construction of a new socialist countryside" policy as "a major historic task [that] relates to the Chinese modernization process in the future" (Xinhua News Agency, 2005). The local government has used unified management, as well as unified planning and designs, to merge smaller villages or to move them to another site. A "rural house standard atlas" was used for reference in building apartments, which were not easily changed according to the opinions and the difficult-to-meet needs of villagers. However, the endogenous development model suggests that designers actively listen to the villagers' viewpoint and

follow their actual needs. Furthermore, in this model, the completed construction is evaluated through value orientation of villager groups. This approach provides an effective way to enhance public participation in architectural design and to improve the design quality of new residential communities.

4.2 Provide More Public Space

In the traditional development model, the local government prefers to support the construction of infrastructure, such as roads and bridges, and a "village center" serves as a venue for village leaders to hold their meetings. In endogenous development, more attention is paid to communication infrastructure than physical infrastructure. However, very few public spaces in most rural communities of Southwest China are available for interflow or for educating villagers of all ages.

4.3 Make Use of Local Material and Resource

In the pursuit of rapid economic development, the traditional development model often overlooks the effect of development on the environment. By contrast, endogenous development finds ways to increase the value of natural resources in rural areas through prescriptions. For instance, a regional climate analysis is conducted prior to the architectural design to find the most suitable passive design to minimize energy consumption of buildings. Local natural materials should be used during construction. Furthermore, construction wastes generated during the project should be recycled. Natural energy sources, such as solar energy and wind energy, are good alternatives to non-renewable energy sources. Architectural strategies that follow local conditions can reduce the negative effect of construction and development on the environment.

4.4 Develop Traditional Construction Techniques

Large-scale intensive house construction is difficult in poor rural areas with a complicated mountainous terrain. This terrain results in traffic inconvenience, which means that the transportation cost of industrial construction materials will be high. Meanwhile, low education level villagers are not easy to accept the specialized construction techniques. Traditional construction techniques have an irreplaceable regional advantage in rural areas. Thus, architects should investigate local traditional techniques and combine them with modern technology by using the "high science and low technology" concept for innovation and improvement, while preserving the technical mastery of the farmers.

4.5 Villagers Participation and Cooperative Construction

Local villagers are the main targets and movers of efforts toward the renewal of rural communities. During the period of house construction, villagers help each other by way of "labor exchange" and exert effort to build their own homes. Participation and cooperation enhance the cohesion of villagers; such relationship can be used as motivation for people to remain on their own lands and not fall for labor migration. On that basis, the semi-self-construction system and regional cooperatives were also established.

4.6 Proper Economic Strategies

The use of indigenous technology and local materials greatly reduces the purchasing and transportation costs in projects for the renewal of rural communities. The participation of the local workforce not only improves labor skills but also maximizes the value of labor because it encourages "labor exchange" and "volunteer work." Therefore, local resources are effectively utilized by the most appropriate configuration in this region.

4.7 Environment-Friendly Strategies

The effect of the rural community development process on the environment should be reduced. Household wastes and those generated from production should be properly classified, and small-scale

landfills should be available for the disposal of such garbage. Sewage needs treatment before being discharged to rivers so that the water could be fit for everyday household use after sedimentation and purification processes. These strategies will help improve the ecological carrying capacity of the environment.

4.8 Public Health Strategies

Implementing ecological toilets and separating livestock are important aspects of public health strategies. In Southwest China, animals and humans share very limited land, especially in residential areas, because of economic and land conditions. By optimizing the residential design, rational space can be designed to separate animals from humans in rural communities. In addition, the establishment of eco-toilets will eliminate the "dirty and messy" status of traditional toilets and will significantly improve public health. People's awareness of public health could also be enhanced by the promotion and popularization of related knowledge.

Generally speaking, the sustainable renewal of poor rural communities of Southwest China could follow the below steps:

1. Before the start of the design process, local climate, culture, and traditional techniques should be analyzed systematically.

2. During the design period, the practical needs of the villagers should be considered. Local materials and resource should be used, and traditional techniques should be improved by the "high science and low technology" concept.

3. During the construction period, villagers should participate and learn the modified techniques, which will be the ways to make their living.

4. After the construction period, the modified techniques and the renewal model should be publicized and promoted to improve the endogenous development of these areas.

5. CASE STUDY

5.1 RECONSTRUCTION OF YANGLIU VILLAGE

Yangliu Village has suffered a major geological damage in the 5/12 Wenchuan earthquake in 2008 when more than 85% of the rural houses were damaged. To avoid further geological damage, the village government decided to relocate the entire village to an open area near the Minjiang River. Architect Hsieh Ying-chun and his team carried out the overall planning and architectural design for the new site based on traditional customs and lifestyle. The construction work was successfully completed with good use of "collaborative construction" (Figure 3) and sustainable ecological strategies. The cost of per square meter is less than brick-concrete building in the same region (Figure 4).

Figure 3: collaborative construction

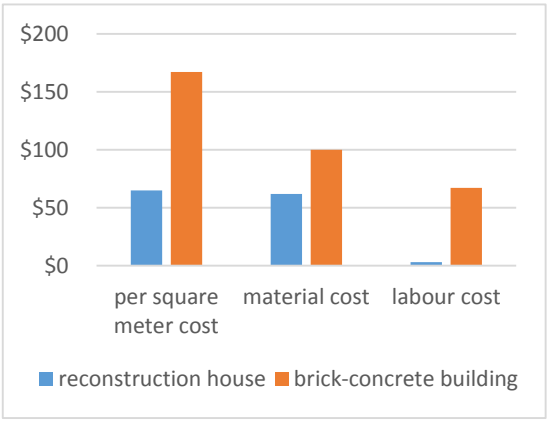

Figure 4: cost comparison of reconstruction house and brick-concrete building

The framework in the reconstruction of houses mainly used cold-formed steel, which has good seismic performance. The entire framework was connected by bolts, and the villagers were able to build it themselves after a one-time demonstration. The walls were filled according to traditional ways by using local materials. The houses looked identical because of the recycled old materials (Figure 5).

The framework has these other features:

1. Large-scale standardized production. The period of construction was short, which was very suitable for reconstruction;

2. Direct molding of the framework depending on the level of construction skills. This feature was suitable for villagers who built houses by themselves.

3. The openness of the structure. Villagers could easily add a room to the original building because of structural flexibility.

4. Similarity of this architectural framework to the traditional "through type timber frame." Such similarity helped steer the reconstruction of houses toward having the same spatial form as that of traditional houses.

Figure 5: framework of reconstruction house Figure 6: a double-sided hot-dip galvanized network

Architect Hsieh Ying-chun was also concerned about a building's energy efficiency and sustainable development. Given that Maoxian is in the hot-summer-and-cold-winter area, the thermal performance of a building during winter should be considered. The main envelope of a house is composed of three layers of exterior walls: the first layer is made of local stone, which has strong local characteristics; the second layer is a double-sided hot-dip galvanized network with concrete-filled gap to effectively reduce the weight of the wall and to increase the strength of the structure to resist horizontal forces (Figure 6); and the third layer mainly uses insulating form board with grass soil, which is likewise used in the main structure of the roof. In this way, the house has good thermal performance. Compared with traditional houses, the roof and three layers of exterior walls can save 45.61% and 39.45% of construction energy consumption, respectively (Du, 2010).

Furthermore, the lesser energy consumption of cold-formed steel compared with clay bricks and the local availability of stones lead to effective control of CO_2 emissions.

5.2 Ma'anqiao Reconstruction Project

Ma'anqiao is a small and poor village located in the impoverished mountainous area of Southwest China, in the southernmost side of Sichuan Province near the Jinsha River and close to Yunnan Province. An earthquake in August 2008 severely damaged most of the village houses. Rebuilding materials (e.g., bricks) are too expensive for the villagers and are also difficult to be transported across the river. The remote location, poor accessibility, and resource limitations hampered the rebuilding efforts of the villagers. Considering that many other remote villages in Southwest China are similarly situated as Ma'anqiao, the challenge for development workers and rebuilders was "how to make use of local materials to create an anti-seismic, comfortable, and cheap [but sustainable] house." The post-earthquake village reconstruction project in Ma'anqiao Village is the first comprehensive village

demonstration project in the poor rural areas of Southwest China after the 2008 Wenchuan earthquake. Professor Edward Ng of the Chinese University of Hong Kong and his team from the Wuzhiqiao Foundation worked on the project for three years.

Before the initiation of the design work, the team conducted a series of survey and investigation in the village, communicated with the villagers to define the key problems, and conducted research to find an appropriate solution (Figure 7). This project provided several designs suitable to the needs of different family sizes. Villagers could choose the appropriate design according to their own needs.

The old rammed earth building has poor seismic performance because the building's foundation is not solid enough, and the tensile strength of mud wall is insufficient. After a series of investigations, the team invented and proposed a series of anti-seismic designs and strategies. Timber frame inside the mud wall became an important part of an effective anti-seismic design, and a building's foundation with appropriate size and correct cement mortar enhanced the integrity of houses. Bamboo strips, which are embedded into the mud wall, can bond the frame with the walls; some concrete belts were added into the wall to improve structural integrity and to avoid vertical cracking. Light lime and cement were added into the mud to strengthen the wall. Ramming tools were improved to pound the mud better by fitting them with iron heads (Wan, 2013). The resulting anti-seismic rammed earth building could satisfy the demand of seismic fortification in the area (Figure 8). The cost of per square meter is $32 which is only 20% of brick-concrete building in nearby village.

Figure 7: communicate with villagers

Figure 8: build a demostration rammed earth house

The traditional rammed earth houses in this village were ill ventilated and dark. Therefore, windows of proper sizes and cross ventilation were provided to improve daylight and natural ventilation (Figure 9). Biogas has since then been used to turn waste into fuel for lighting and cooking. Water cellars were built to supply clean water from the nearby spring instead of people directly collecting "dirty" water from the river. In addition, storm water was naturally channeled to the land.

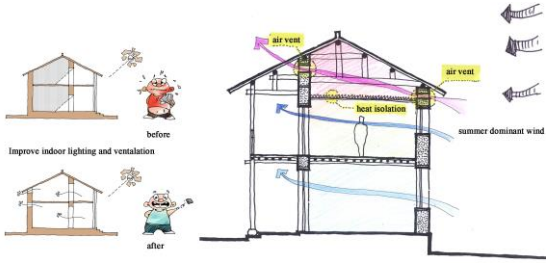

Figure 9: improve indoor lighting and ventilation

Figure 10: the round yard of village center

After the rural houses have been reconstructed for basic living needs, a village center with a clinic,

reading room, kindergarten school, shops, and other facilities was built to provide public space and to make its facilities available to the villagers. The village center could also function as an ethnic cultural exhibition center and was built in a round yard because Dai and Yi people prefer dancing together in a circle to celebrate festivals or for entertainment (Figure 10). This yard has become a public communication space and could maintain the minority culture of the village.

As in the Yangliu Village, the villagers of Ma'anqiao were employed in the reconstruction process. Given the effective, economical, and easy-to-learn anti-seismic strategies, the villagers were able to build their homes by themselves without hiring a contractor and without using complex technology. The occupied houses were also inexpensive and easy to build and repair. In this way, the villagers built anti-seismic rammed earth houses and learned an economical way to make their living. The idea of the project was to transfer knowledge and skills during the construction process rather than merely teaching the villagers using drawings.

5.3 Discussion

The case studies show that both of reconstruction projects fully respected the traditional cultures and the autonomy of villagers and also made rational use of local materials and local technology to rebuild the rural communities. The concept "collaborative construction" not only provided an opportunity for the local labor force to learn new skills but also reduced the economic pressure on house construction. The two cases also considered the reduction of environmental and ecological damage in the entire process. Case 2, in particular, was an overall reconstruction project of a community, and its supporting facilities (i.e., construction of village center, setting up ecological toilets, and promoting public health awareness) have good social effects. The sustainable practices of Village level (ie. the orientation of houses should respect to climate, rain water harvesting system and water supply etc) and settlement level are also important aspects for this study. Due to the space constraints, the related strategies will be discussed in the further study.

6. CONCLUSION

Endogenous development emphasizes the concept of sustainability and focuses on the importance of humans living in rural areas. Endogenous development suggests a self-sufficient, regional characteristics-based model that is suitable to the situation of poor rural communities in Southwest China, which have poor transportation and backward economy. This model can also reduce the communities' dependence on inward investment by emphasizing the use of local resource and traditional core values. The discussed strategies could provide a systemic way to further study sustainable renewal in the poor rural communities of Southwest China.

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