

The Infiltration Interface Structure of Suburban Landscape in Bimen Township, Anji, Zhejiang Province, China

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Abstract: Coordinating and promoting urban and rural-space development has been a new round of institutional change in the Province of Zhejiang since 2004. And this plan was fully implemented, which showed that the isolation between the urban and rural areas had gradually diminished. Meanwhile, an interaction that is dynamic, flexible and lasting is formed, and is embodied in change of landscape morphological structure in the surrounding villages. Bimen village locating at the intersect area of Anji Township, Huzhou and Yuhang District was the case. Recognized as ‘Bamboo village’ with flourishing bamboo industry, Bimen has witnessed the blooming process of interaction with urban areas in ecology, economy, technology and culture. However, there were challenges of agriculture and manufacture recession and population loss as well. This study focused on Bimen village’s adaptation to the resource exchange with cities, and put forward the infiltration model simulating the transformative process based on theory of landscape ecology and infiltration mechanism. By introducing the infiltration model, industrial upgrading and several patterns were proposed in the reformation design, such as adjusting the industrial structure, upgrading the local special bamboo crafting traditions, releasing space for activities, and establishing infrastructures on the interface. The new agriculture mode will strengthen the interface by orienting the Third Party Platform (i.e. Internet oriented platform) upon the old dynamic basis and will bring new vitality for economy development in Bimen village.

1. Introduction

In the progress of urbanization, according to Wang, Z. and Wang, T. (2014), there is a trend can be observed: to speed up the capital flow and popularity return, some of the emerging rural industries gradually change into urban industrial development model [1]. On the other hand, Smith, N. R. (2014) has mentioned that the urban industry's expansion happening in the suburb area leads to the suburb area's industrial transformation and upgrading [2]. This study defines the interaction of multiple industries in suburban area as its industrial transformation. Under the influence of industrial transformation, the rural

spatial pattern is also constantly changing, resulting in ecological and life further upgrading [3], which is the focus of this paper.

According to landscape ecology, when the density of a media reaches a critical point, permeate can suddenly travel through the media material from one end to the other end [4]. With the development of urbanization between urban and rural areas, industry and space have produced economic, social, ecological and spatial infiltration phenomenon, which can prevent the industry or space from fragmentation [5]. The impact is also regarded as constant dynamic process [6]. In conclusion, the focus of infiltration research will be on media and osmosis.

A critical valve phenomenon is the case where an event or process (i.e. dependent variable) suddenly enters into another state when the influencing factor or environmental condition (i.e. independent variable) reaches a certain degree (i.e. threshold). It is often a process from variable to qualitative change, from one state to another different state. Urbanization rate of 70% in the ‘Three Stages of Urbanization’ principle is at the second or third stage of urbanization threshold. As for domestic cities where urbanization rate reaches more than 70%, the suburban villages have played critical roles in the process of urbanization, and that is why they do not appear with reverse growth as the western cities did in the past.

2. Bimen Village

Bimen village is located in Anji County, Huzhou, in the northwest of Zhejiang Province. The north of it is Shangshu Township and Lingfeng scenic area, and the east of it is Tianhuangping Township (Figure 1-2). In the meanwhile, Bimen Village is in the outskirts of the infiltration interface, and its spatial pattern has also undergone significant changes with upgrading of industry.

Through filed research, data was collected on villagers’ living and working condition in Bimen by visiting house-by-house, addressing several questions emerged in the galloping development of bamboo industry.

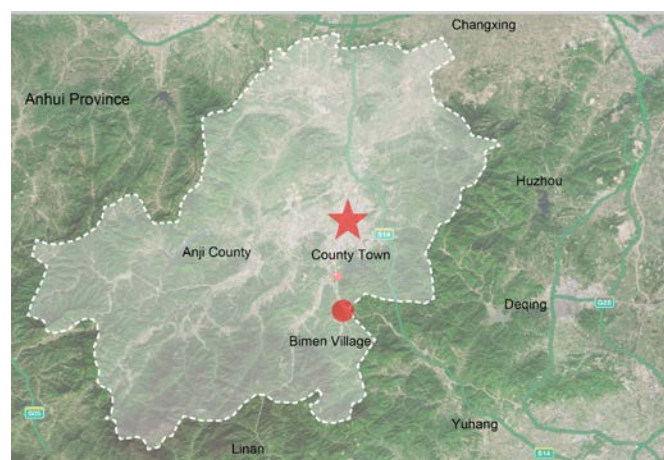


Figure 1: Location of Anji County in Zhejiang Province



Figure 2: Location of Bimen Village in Anji County

2.1. Agriculture Recession

Bimen village has vast farmlands, and is also rich in land types such as arable land, woodland, bamboo forest, dry land, grassland and garden. While part of the lands have been taken over for the No.04 Provincial Rd, overall land texture in Bimen village remains intact and large, reaching 892 acres, and per capita farmland is about 0.52 acres. At present, more farms are occupied growing grapes, strawberries, and vegetables, the rest of which cultivate rice. Since 'leisure agriculture' gradually takes the place of traditional agriculture, picking activities and entertainment were introduced into the farms, threatening the previous farming activities on the field.

2.2. Manufacture Decay.

The prevailing industry of Bimen village is closely around bamboo craft processing. In the 1990s, with the deepening of reforming and opening up, some Taiwan business entity came to invest Bimen village for its great potential. At the same time, villagers started to seize the booming opportunity. They stood on the basis of traditional agriculture, and take advantages of bamboo resources of the village, and vigorously transformed the low yield forest into high yield abundant forest. During the highly sustainable processing of bamboo resources, villagers gradually generated a specific pattern as 'one village, one type of product' for local entrepreneurship. Since then, local economy was mainly supported by bamboo products' manufacturing, processing, sales, and Crop cultivation. The main profitable commercial products include bamboo mats and other fine bamboo handicrafts, which it's 2014 annual output value reached 350 million Yuan. Until now, the village has developed 13 large-scale enterprises, more than 130 family plants, and encouraged 98% of the labor force in the village to be engaged in the family industry. In short, the manufacture industry had been the main reason for the flourishing of Bimen village since 1990s, on account that it not only supported the bamboo industry, but also drove the village economy and other rapid and coordinated development, and it helped to form a "support farmers' economy" pattern. Nevertheless the challenge came soon in 2016, when the low-prize bamboo products became less

satisfying and less competitive in the global market affected by Internet. Meanwhile, lower price of bamboo raw material and labors helped Hunan Province take the majority of market share (Figure 3-4).



Figure 3: Bamboo manufacture



Figure 4: Drying processing

3. Model of Infiltration Interface in Bimen Village

3.1. Infiltration Motivation

Decadency of bamboo industry became one of the drives. The village has taken bamboo industry as major industry for a long time. However, the products manufacture is at downstream of the industry such as bamboo mats, bamboo brooms and bamboo chopsticks. With the gradual decrease of market demand, bamboo industry started facing the dilemma. A large number of small family workshops were closed during the period (Figure 5-6). Specially influenced by global financial crisis in 2008, there was a sharp decrease in market share of Anji County and that in profits because of domestic competition with Fujian, Jiangxi and Hunan Provinces. Under this background, Bimen village begins to focus on technical innovation from 2016. It intends to upgrade the quality of bamboo products and extend the chain of bamboo industry. And it copes with the dilemma through several approaches like simultaneous development of internal and external market in order to transform and upgrade local enterprises in bamboo processing.



Figure 5: Outdated family workshops



Figure 6: Old factories

Contradiction in internal village between production space and residential space was the second drive. Most villagers in Bimen village were involved in processing and manufacturing bamboo products in 1990s. And they had added new production facilities in their own yards one after another, which were independent workshops for temporary or permanent use. Some villagers took the first floor of the housing as the workshop, while some villagers reconstructed their forecourts into the workshops by adding new awnings. The addition and illegal constructions now are one of the manifestations of outdated bamboo industry. It has destructed the whole view of the village and life quality of villagers to a certain extent. Therefore, many villagers expect to adjust their production types through industrial reform. And their higher demands for living environment are promoting the upgrading of residential space in the village.

The third drive was that urban tourists, when they began to crowd into rural areas due to the rising of rural tourism. Affected by the economic circle of Yangtze River Delta and Tianhuangping scenic region, the Second Industry that originally relied on bamboo production in Bimen village was not able to meet the demand of local residents, especially after suffering from the depression. In this circumstance, people paid more attention to the great potential of tourism. Bimen village is close to Lingfeng Temple, Tianhuangping area and the Bamboo Expo Garden, and is the only corridor connecting the scenic spots with cities like Hangzhou, Shanghai and Nanjing, where gathering potential tourists who are ready to participate in carnival. The development of “the 2.5 Industry” and tertiary Industry in the village was also supported by that the administrative region of Bimen village has been put under Lingfeng Street so that there will be driving effect by means of the tourism development in Lingfeng tourist area (Figure 7).



Figure 7: Tourism development resource in Lingfeng area

3.2. Infiltration Media

The infiltration media is in the model of “One Line, One Belt and Double Corridors”.

“One Line” is the No.04 Provincial Highway through the village. It closely connects Bimen village with Anji County in the north and Hangzhou in the south. It enables Bimen village to be the only way to the urban district of Anji and Lingfeng tourist area from south to north. And it is the primary external transportation vein of Bimen village. It not only creates favorable conditions for the delivery of bamboo products, but also makes it convenient for tourists to experience and go sightseeing. Therefore, No. 04 Provincial Highway is one of the major mediums in the industrial infiltration between the surrounding cities and Bimen village.

“One Belt” indicates the Port Creek as the branch of Huxi River running through five natural villages. The stream connects the green ecological corridor on both sides, forming a landscape belt. There are a series of slow walking systems and green open space on the waterfront of landscape belt accessible to the villages, attracting villagers and tourists to the river. Therefore, Port Creek is also the main media for ecological and space infiltration.

“Double Corridors” represent the two view corridors in the east-west direction. There are neither buildings nor structures on the view corridors so that the infiltration between mountains and the vision between people and mountain will be ensured. Through the way, the two view corridors have been the main channels for landscape infiltration to increase the echo of dwellings on both sides (Figure 8).

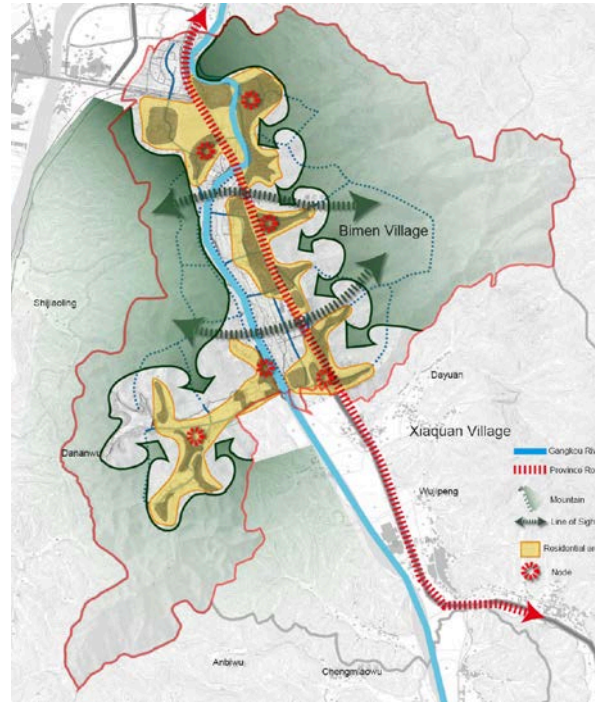


Figure 8: Penetration media of “one line, one belt and two galleries” of Bimen village

3.3. Infiltration Mechanism

The infiltration in Bimen village includes industrial and space permeation. Industrial infiltration is presented in the coordinate development in Primary, Secondary and Tertiary Industries. It is the process of upgrading of bamboo industry, agricultural intelligence and arts, influenced by urban expansion. It reflects in new industrial forms, such as leisure agriculture, tourism agriculture, maker space and creative industrial parks. Space infiltration is to release space in the village and produce smart growth under the impact of industrial transformation, and to maintain the disheveled living environment in good order (Figure 9).

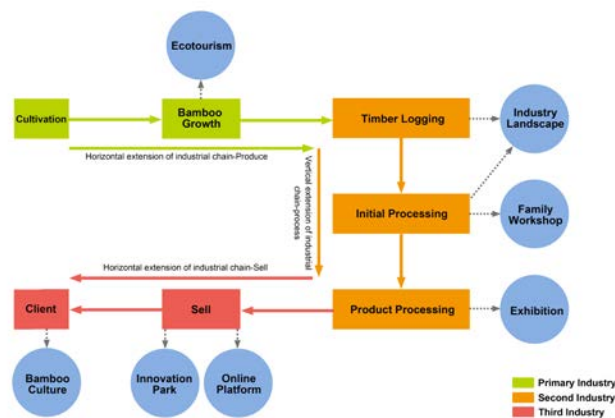


Figure 9: Three linkages of bamboo industry

3.3.1. Industry Transformation

Industrial infiltration is reflected in product upgrading. It is mainly embodied with quality improvement of traditional products and reinforcement of brand building, with promotion of industrial competitiveness and market attraction. Therefore, it can transform the bamboo products from traditional types to dominant and emerging types gradually. For example, large factories can develop bamboo floor, bamboo fiber, while small workshops is suitable for bamboo handicrafts.

Secondly, industrial infiltration is reflected in platform upgrading, by implementing strategy of upgrading industrial cluster. Specific method is to establish demonstration zones for bamboo industry and micro theme parks. Leading enterprises can drive small and middle processing sheds and family workshops.

Thirdly, industrial infiltration is reflected in introduction of the Internet. The main method is to establish an E-Commerce system, and encourage enterprises in bamboo industry to register websites or web pages for online marketing on the Internet and support companies to establish on-line platforms running from procurement of raw materials to product sales in accordance with requirements of supply chain.

Finally, industrial infiltration is extraction of bamboo culture, which indicates to exploit the landscape element in production process in current bamboo industry. For example, as for the unique space or yards for sun-treatment of bamboo products, transform those industrial processes into landscapes, for forming earth landscape and expressing local industrial culture. In addition, people can develop catering, home stays and museums under the theme of bamboo element to provide auxiliary service in tourism for potential tourists.

3.3.2. Space Infiltration

Space infiltration is regarded as “releasing space in the village”. After evaluation, remove the abandoned buildings accordingly, by tearing down the illegal working sheds and cleaning up the yards that have blocked the laneways. Therefore, it will release the occupied space within the village and replace it with well-designed sites for public activities, social interaction and green space.

It is also explained as ‘smart growth’ of the village. It indicates to adopt the tactics of periodical planning and reformation in the industrial and space planning in Bimen village. In short-term planning, the strategy is to stress the essentials, to forge the regions and to renovate key industries to set up construction models for the whole village. In long-term planning, the aim is to make integral lifting and to promote industrial transformation.

4. Landscape Pattern Formed by Infiltration

4.1. Industrial Pattern

Industrial infiltration provides the landscape pattern in Bimen village a layout in gradual change. Industrial upgrading has mixed diversified bamboo culture together, collected small-scale workshops and established the platform of high-quality cooperation in Bimen village. In industrial permeation, people preserve factories in good condition for reconstruction and remove abandoned buildings selectively so that all the emerging industries in the past will be well settled according to their potential.

This action will clean up the polluting area for residence and will release more space for public activities to enhance the quality for villagers' living. Through the adjustment, there will be a gradient affecting color change representing industrial strength from south to north, on the five natural villages of Bimen village in ribbon pattern, including Qingshan village, Central village of Bimen, Huxikou, Huangmukou and Yanjingwu (Figure 10).



Figure 10: Total industrial gradient format of Bimen village

The Secondary Industry in Bimen will continue the current status, including handicraft industry and processing industry. The intensity of development varies from strength to weakness when it is from north to south along the village. For Qingshan village, the northernmost natural village, developing integrated bamboo industry can improve industrial quality and add value. For Central village of Bimen and Huangmukou village, in the middle, they can develop small experiential family workshops. In Huxikou and Yanjingwu, the southernmost villages, it is possible to minimize industrial elements and change scattered industrial remains into new leisure landscapes.

The Tertiary Industry of tourism gradually strengthens from north to south along the village. Qingshan village forges pleasant waterfront landscapes. Central village of Bimen and Huangmukou village develops experiential agriculture based on land resources [7]. In Huxikou and Yanjingwu with the best conditions in scenery, they can make full use of excellent natural landscapes and quiet climate to promote tourism for home stays and leisure entertainment (Figure 11).

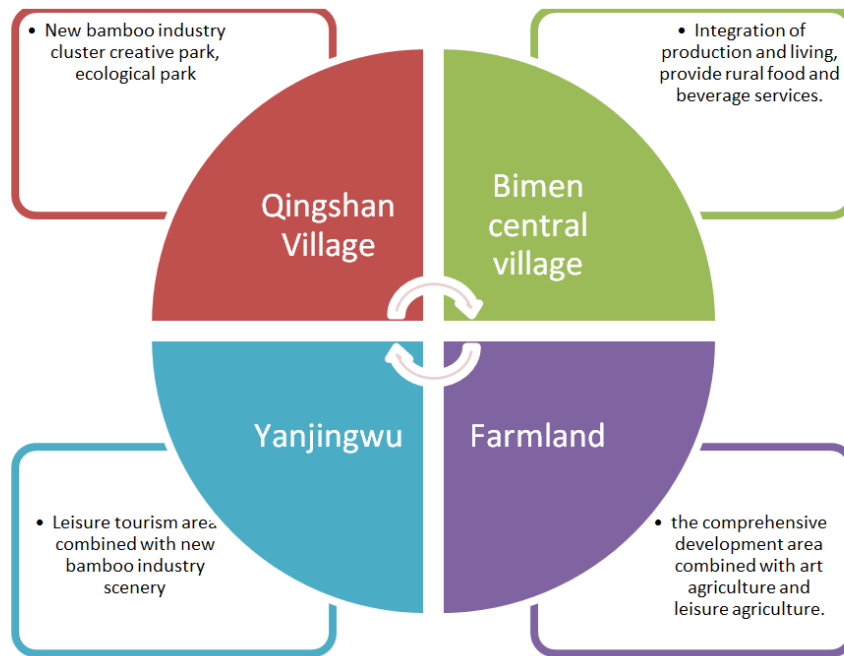


Figure 11: Four industrial gradient patterns of four regions in Bimen

4.2. Art Farmland

The land for scale agriculture in ribbon pattern is one of the characteristics in Bimen village, which is also the space carrier for Primary Industry. In industrial and space infiltration, scale agriculture can be developed into art agriculture so that the farmland can transform into art pattern. For example, there are vast areas of farmland in the west of Central village and Huangmukou village. It brings opportunity to establish an experiential base for art agriculture in combination with earth landscape, agricultural planting and recreation, following the natural texture of the village (Figure 12). Art farmland will focus on vegetable planting and agriculture in earth landscape, including functional projects in exhibition of modern planting and sun-cure of bamboo filament, experience in free farming, agricultural education, sales of agricultural specialties and waterfront recreation. All above can satisfy the demands of tourists for various experiences in picking, planting and entertaining. In conclusion, it will facilitate the organic fusion in deep recreation and agriculture experience.



Figure 12: Art farmland pattern and farming experience in Bimen village

The art farmland, as a unique landscape layout, has been a method to increase industrial benefits in many cases of rural construction. For example, by creating experiential parks for strawberries and grapes, tourists can fully taste the rural life and try the freshest fruits so that the added value of fruits will be increased (Figure 13). The village can also breed bamboo chicken in bamboo forests to develop animal farming in high quality as well as enable tourists to participate in experience activities like chicken capturing.



Figure 13: Strawberry experiment gardens

Combination of art farmland and the Internet can be developed into the infiltration beyond space restrictions. Based on Agriculture 3.0, it can sell healthy and safe crops to urban groups in middle class and attract customers to take leisure tourism in the village [8]. The tourists can also experience the picking and planting of crops by themselves. Through the interaction, it can realize “ecological agriculture in socialization” with extensive participation of citizens and villagers (Figure 14).

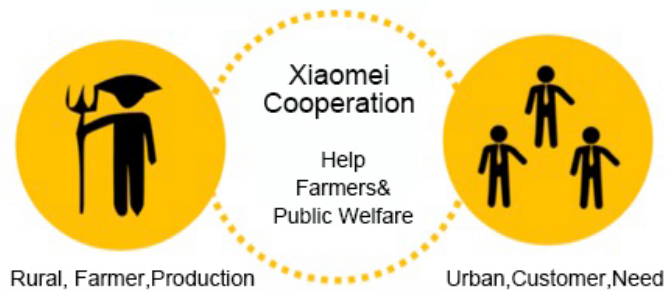


Figure 14: XiaoMei Cooperation as a Third Platform in reforming rural industry

4.3. Residents Develop along with Industry Chain

Bamboo industry in Bimen village attracts production factors in the village to permeate into industrial nodes. And it changes the connection direction between industrial structures and then changes the space layout of industries.

Firstly, industrial patches are distributed closely to industrial nodes, which can form moderate concentration of industrial clusters and markets. Proper enterprise aggregation and business acquisition will play an active role in market development. It will enlarge operation scale, refine product structure and improve utilization rate of service facilities.

After that, dwellings begin to transfer to the neighborhood of industrial nodes, which causes the expansion of residential space. Therefore, the closer the node is to industries, the more concentrated the residential spot is. The phenomenon is relatively obvious in Bimen village.

5. Project Practice – Design for Dynamic Adaptability

The project is on an ecological Leisure Park in Correlation with Mountains and Rivers.

There is a wasteland in nearly one acre by the river in Qingshan village, in the north of Bimen village. The site is idle after removal of illegal buildings. So the design intends to make full use of the superiority in surrounded mountains, port creek through the belt and embellished pastoral land to reconstruct the open space into an ecological leisure park with dynamic adaptability. Through environment improvement, the park can provide basic functions of recreation and fitness. In long-term planning, the target is to expand the site into a comprehensive waterfront park in multiple functions, and create a park in harmonious coexistence of mountains, rivers, farmland and humans.

Under the opportunity of the project "Co-governance of Five Waters" in rural areas in China, the focus is on environment remediation and establishing the foundation in harmonious development of ecology, production and life. Meanwhile, the park can provide the basic needs of daily recreation and hydrophilic entertainment, including fitness facilities, an open square and a small mountain park, so as to achieve the infiltration toward the riverside and the harmony between human and nature (Figure 15).



Figure 15: Aerial view of the waterfront park

The dynamic adaptability of the waterfront park is reflected in:

Sustainable materials. Bamboo was used to establish structures in the park, which can meet the industrial excess demand in five-year planning. Bamboo is the most fertile product in Bimen village, for it is cheap and easy to gather. When it comes to culture norm, the theme parks of bamboo express the culture extracted from bamboo industry thus it can play a role in promoting local traditional culture. More importantly, as the lifetime of bamboo is from five to ten years, the update cycle well synchronizes with the planning period in industrial development, which can maximize the usability of natural resources.

Dynamic public activities. According to the characteristics of fluctuation in port creek, the hydrophilic platform can be designed into dynamic space. That is “water enters and human retreats while water retreats and human enters” (Figure 16-17). It means when the river submerges the first-floor platform by the river, tourists can enjoy the scenery safely on the second-floor platform. When the water is retreated, tourists can get close to water and play on the first-floor platform. The dynamics makes hydrophilic activities of people match the law of fluctuation. And the riverside space can also be fully utilized.



Figure 16: Water level falls and people come.



Figure 17: Water level rises and people leave.

6. Conclusion

Based on landscape ecology and infiltration theory, this article puts forward the model of village infiltration as a pattern in industrial transformation and upgrading. Under the impetus of industrial penetration, villagers' living and working spaces have also undergone tremendous changes [9]. For example, the integration of working space and living space, the increase of illegal structures, the contradiction between living space and tourism development, and so on. Although the local government proposed the strategy of village transformation and upgrading for these issues, only the demolition, the introduction of foreign industries, the encouragement of the development of tourism and other activities with little effect and lack of concern for the living space of villagers [10]. The role of designer becomes a bridge between government and villagers. Through field investigation, construction quality inspection, interviewing villagers and other research, combined with landscape ecology and economic infiltration theory, we transformed villagers' needs into design strategies and formed infiltration models. The spatial transformation under the guidance of the infiltration model is a theory-based design process, such as the reform of home workshops, the activation and reconstruction of abandoned factories, and the dynamic flood control landscape design, which can pay attention to the micro-environment of villagers and promote the government's relevant Support for updating work. Future research directions will explore ways to generalize this infiltration model from Bimen village, a predominantly bamboo-based processing industry, to villages of a particular industry type, such as tourism-based and agriculture-based villages.

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