Practical Exploration of New Urbanization in China—A Case Study of Shichuan River (urban section) Comprehensive Improvement Project

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Abstract. The “New Urbanization” strategy is an important practice of development of New Era Socialism with Chinese Characteristics, a key action of constructing a modern nation, and a powerful support of implementing the strategy of rural revitalization and regional coordinated development. This study explored the land comprehensive development mode and watercourse treatment engineering technology during urbanization using comprehensive improvement project of Shichuan River (urban section) as an example. Under the actual situation of an increasingly dense population and more stringent resource and environment regulation, new urbanization in the future should aim at a “resource-saving and environment-friendly” society and treat urbanization at the county level as an important step of future urbanization in China.

Key words: New urbanization, Treatment mode, Shichuan River, Comprehensive improvement

1. Introduction
During the 70 years after the foundation of People’s Republic of China, the urbanization experienced a slow-growth phase before the inauguration of the Reform and Opening-up policy and a rapid-growth phase thereafter. The thriving economy of China in early days is attributed to traditional urbanization. However, since the new normal of economic development, the lagging citizenization of the migrant rural workers resulted in a great discrepancy between the apparent and actual urbanization rate. Urbanization of land was faster than urbanization of people. Inappropriate spatial distribution, scale, and structure of cities and towns caused discordant concentration of industry and population. Salient issues such as disorderly development of urban spaces, excessive concentration of population, an appreciation of construction and a neglect of subsequent management, a sharp decrease of urban green space, and environmental problems existed. This development mode cannot keep pace with the development of the times. New urbanization, which is the powerful driving force for healthy and sustainable development of future economy, is the correct path for expediting transformation and
upgrade of industrial structure, solving the wealth disparities between the urban and the rural areas, and promoting coordinated regional development.

2. Partition of Urbanization in China

The strategy of New Urbanization in China is raised by the party and state leaders based on the deep recognition of current situation of urbanization in our country and correct judgement of future development trend, characteristics, and challenges of urbanization during the important period of entering the decisive phase for building a moderately prosperous society in all aspects, economic restructuring and upgradation, and expediting socialist modernization [1]. According to current definition of urbanization and its principles of development [2]-[8], new-type urbanization is referred to as sustainable urbanization that is people oriented. It takes the scientific outlook on development as the guiding ideology, the holistic and integrated approach as the principle of development, and the scientific and technological innovation as the impetus of development. New urbanization aims for stable and efficient economy, social peace and harmony, clean and friendly environment, and economical and intensive use of resources, which leads to coordinated development of metropolitan, intermediate, and small cities and small towns, integration of rural and urban regions, and mutual promotion and progress. The essence of new urbanization lies in continuously improvement of the quality and connotation of urbanization.

Initiation of urbanization in China lags far behind European and American countries. Urbanization in China demonstrated distinguished characteristics from other counties due to differed social systems and domestic situations [9]. The U.S. urban geographer, Ray M. Northam proposed a curve shaping “S” after his empirical studies on many countries and cities, which is illustrated in Fig. 1 [10]. Based on this curve as well as realistic circumstances in our country, urbanization in China is divided into 5 phases, including restoring development, fluctuated development, stable development, rapid development, and new urbanization [2] (Table 1).
Table 1. The 5 phases of urbanization in China.

| Phase                  | Time       | Urbanization rate | Total growth rate | Growth rate per year |
|------------------------|------------|-------------------|-------------------|----------------------|
| Restoring development  | 1949-1957  | 10.6-15.9         | 5.3               | 0.66                 |
| Fluctuated development | 1958-1977  | 16.1-17.8         | 1.7               | 0.09                 |
| Stable development     | 1978-1995  | 17.9-29.0         | 11.1              | 0.65                 |
| Rapid development      | 1996-2013  | 30.9-53.7         | 22.8              | 1.34                 |
| New urbanization       | 2014-now   | 54.8-             | --                | --                   |

3. Construction Path and Governance Mode of New Urbanization in China

The path of new urbanization is urbanization with the Chinese characteristics and is determined by the fundamental situation of our country. As empirical achievements summarized by the long-term practice in China, new urbanization includes turning rural population into urban population as well as making rural population move to the municipality towns and work there [11]-[15]. Therefore, new urbanization in our country is comprised of two aspects, “metropolitanization” and “county-level urbanization”. Rational distribution of metropolitan cities and small towns and strengthening the guidance in planning could help to change the situation of “pseudo-urbanization” in certain regions of China.

From the perspective of current practices across the whole country, each of the two modes has its own representation. For example, Chongqing and Chengdu used “metropolitanization” as the main path and propel urbanization through city capacity expansion. In contrast, Jiangsu, Guangdong, and Wenzhou adopted “county-level urbanization” as the main path and propel urbanization through expedite construction of small towns in rural area [16]. Based on the consequences of development impact, Chengdu mode and Wenzhou mode have the greatest impact and are representations of the two different paths of urbanization in China. Each mode has its own unique characteristics. Chengdu mode focuses more on integrated management of urban and rural areas during urbanization, whereas Wenzhou mode focuses more on governance at the grass-root level during urbanization of the rural area.

4. Practical Exploration of New Urbanization—A Case Study of Shichuan River (urban section) Comprehensive Improvement Project

Fuping county, which has convenient transportation network, is conveniently located in the transition area of the Guanzhong Plain and the Shanbei Plateau in central Shaanxi province and belongs to the gully region of the Weibei Loess Plateau.

The total area of Fuping county is 1242 km2 and the total population is 0.81 million. The Shichuan River almost always runs dry except for the flood season before the implementation of the improvement project. Since the elevation of Fuping county is higher in the north and west relative to the south and east, massive amount of municipal sewage water is thus discharged into the watercourse through the major spillways in the southern part of the county. This causes severe environmental damage in the surrounding area and the residents here live a filthy life [17].
4.1. Project Design and Implementation

4.1.1. General Exploration. Geology. Fuping county is located in the middle section of Weihe Basin and is primarily covered by loose sedimentary rocks from the quaternary period. Bedrock from pre-Quaternary period is only observed in the north hill and cut gully region of the Loess Plateau. Geomorphology where the project was conducted is the flat terrace region of the Loess Plateau. The soil type is loess, which is favorable for constructing common industrial and civilian buildings.

Hydrology. The Shichuan river is an important branch of the Weihe river. The total length, total area of the watershed, and averaged gradient of the riverbed is 137 km, 4154 km², and 6.0‰, respectively. Development and utilization of water resources for the Shichuan river dates back to 2200 years ago. Due to construction of reservoir in the upstream area and thus interception of water flow, the Shichuan river becomes a seasonal river since 1970s.

4.1.2. Watercourse Engineering. The Shichuan river in the urban section is contaminated primarily by point source pollution. To intercept sewage in the watercourse, pollution discharge channels were constructed, and sewage was thus directed to the downstream area and treated in a newly-built wastewater treatment plant. This way, water pollution caused by directly discharged sewage was reduced and the environmental quality in the surrounding area was improved. Meanwhile, the reclaimed water after treatment can be used for fire control and afforestation, resulting in a new mode of sustainable utilization of urban water resource as “Tapping new sources-Purification-Utilization-Discharge-Recycle” [18].

Watercourse aeration. A rubber dam was constructed, therefore, watercourse aeration was improved through water fall and close-to-natural treatment of vertical section following the dam. In the backwater area, aeration was manually achieved by designing landscape fountains. This way oxygen concentration in water was increased and thus anaerobic conditions were suppressed. In addition, water circulation could improve air humidity and dedusting effect, reduce air temperature, and subsequently mitigate the urban heat island effect. Circulating fountain water could bring bottom water layer with less phytoplankton to the surface, hence, content of phytoplankton in the surface water was reduced.

Decontamination through hydrophyte. Emergent, floating, and submerged aquatic plants were planted in the watercourse to restore the vegetation and natural wetland along the riverbank and to improve purification capability of the water body. Methodology of thin sheet flow and contact was employed to further improve the purification capability according to the principle of biofilm self-purification. Aquatic plants also provided favorable conditions for microbial growth in the river sediment, and thus enriched biodiversity of the aquatic environment.

Creation of ecological revetment. Ecological revetment refers to as restored natural riverbank or artificial revetment that has the permeability of natural riverbank. Two water diversion channels, including introduction of water from the Jinghe river in Sanyuan county, Xianyang City through the Jinghui canal, and getting discharged water from the Taoqupo reservoir regularly, were designed to continuously supply clean water and thus mitigate local water pollution. In addition, ~30000 fish fingerlings were released to the river. Earth filling for the damming project was a total of 2.3 million cubic meter. This ensured adequate water exchange between the riverbank and the water body. Water purification was also achieved through the self-regulation function of adsorption, filtration, and purification in the plant and soil system following applying the land treatment techniques along the riverbank.

4.1.3. Soil Body Reconstitution. Indigenous soil body of watercourse inside the Shichuan river has been severely contaminated due to sewage and wastewater discharge, trash dumping, and excessive usage of chemical fertilizers in the surrounding area. Therefore, contaminated soil body of the watercourse was reconstituted using both the physical and organic techniques.
The physical techniques. During land levelling, trash in the original watercourse was cleaned and river sediment was dredged. Contaminated surface soil in the surrounding area was first exfoliated and then clean soil from the outside was backfilled. This way, the degree of contamination effectively reduced.

The organic techniques. Plant and microbiological technology could effectively improve soil environment. On the basis of physical reconstitution, woody trees, shrubs, and turf grass was planted along the riverbank. This way, certain chemicals could be enriched in plant tissues and/or degraded by plant rhizosphere microbes, subsequently achieving soil body reconstitution.

4.1.4. Auxiliary Project. During the later period of comprehensive treatment project for the Shichuan river, auxiliary projects was implemented primarily including landscapes, roads, gardening, and ecological management.

Landscape design. This project included afforestation, plant and water system landscaping, creation of scenic route and bridge, water body shaping, sculptures, landscape lightings, landscape designs for residential communities, public environment signages, and murals.

Road construction. Binhe road on the north riverbank and Difang road on the south riverbank are both located on the control line of 1/50-year frequency flood. Binhe road is 2.16 km long and 24.5 m wide with a 14 m motorway, a 7 m sidewalk to the north, and a 3.5 m sidewalk to the south. Difang road is 2.23 km long and 10 m wide with a 6 m motorway, a 3m sidewalk to the north, and 1 m hardened belt to the south.

Gardening. Gardening in the project area included planting of border trees, shrubs and turf grass and construction of landscape designs such as rockery, veranda, easel, pond, and fountain within street greening.

4.2. Function of Comprehensive Ecological Treatment

Watercourse is an important natural geographic element in the land engineering system. Its significance for ecological construction has gained extensive attention. Application of the watercourse ecological function has also been gradually introduced to the construction of ecological project. Morphological diversity of watercourse is an important foundation for maintaining diversity of the river biocenosis. Besides effectively providing habitat for plants and animals, implementation of the comprehensive ecological treatment in the project area also acted as the flowing path for energy, materials, and creatures, regulated water flow and regional climate, purified and/or the environmental contaminants, and provided close-to-nature places for leisure and entertainment of residents.

To explore comprehensive land development mode and watercourse treatment engineering technology during urbanization, the Shichaun river watershed in Fuping county, Shaanxi province, which has representative geographic position, climate, hydrology, and transportation in the area, was chosen as the site for a demonstration project. Comprehensive development of the watercourse and land using techniques of general exploration, watercourse treatment (physical and organic), and organic reconstitution of soil body were performed. Through implementation of watercourse engineering, landscape design, ecological treatment, and rapid in-situ analysis of soil and water samples, overall quality of the climate, environment, and water as well as nutrient supply for the soil body in the area were significantly improved. Former watercourse filled with flowing smelly wastewater was turned into modernized wetland park, leading to an improved watercourse and ecoenvironment quality. Therefore, technology and engineering mode used in this project may be adopted by other regions with similar conditions.

5. Challenges Faced by New Urbanization in China

The core principles of new urbanization contain many components and could be summarized as development towards good life of people with effective balance between the people and the land. Promoting urbanization for people is a core value of new urbanization and should follow the guidance of high-quality development principles [19]. In the face of the current situation of increasing
population and tightening resources and environment restriction, how should we arrange spaces for production, livelihood, and ecology, and thus achieve a safe, convenient, comfortable, livable, beautiful, and orderly spatial arrangement to the uttermost level needs to be answered.

Integration of urbanization with ecological civilization, intensive and economical use of land, water, and energy resources, reinforcement of environmental protection and ecological remediation are indispensable premises for securing healthy urbanization in China [20]. The rapid and large-scale development of urbanization in the past decade is accompanied by continual occupation of massive land, resulting in salient environmental issues such as depletion of cultivated farmland, overall shortage of water supply, water crisis in local areas, severe environmental pollution, and overwhelmed infrastructure. Developing a series of industrial and municipal concentration area, especially the metropolitan area, requires functional support of ecological service for a broader range. Hence, implementation of “resource-saving and environment-friendly” urbanization should be greatly emphasized in the future.

As the largest developing country globally, one of the outstanding characteristics in China is the extensive rural area and massive rural population. It is a long-term strategy and the most suitable choice to propel the urbanization actively and well-advisedly and to employ great endeavor on constructing the extensive rural area[21]. From a long-term perspective, it is essential to establish a hierarchical system of urban settlement with “Metropolitan and Megacity-Intermediate city-Small city-Rural new community” as a framework. Urbanization at the county level would be an important section of future urbanization in China as intermediate and small cities and small towns play a pivotal role in integrated development of urban and rural areas.

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