

Soil-Water Comprehensive Treatment Theory of Urban Fringe

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Abstract

Urban fringe is an active expanding belt, the environment of the urban fringe is complex and frangible. Previous studies have focused on the landscape spatial pattern changes, the spatial-temporal variability of soil pollutants and the land management and policy issues, etc., but it is lack of the theory and practice study of land & water comprehensive remediation in urban fringe areas. This article is taking the Shichuan River as an example. And establish a new concept of comprehensive remediation with soil purification as the key, and with water treatment as the link, meanwhile it will keep clear water with pure land. Form land organic rearrangement theory for different types of land utilization.

Keywords

Land-water; Treatment Theory; Urban Fringe.

1. Introduction

The urban fringe is the ecosystem transition zone between urban and rural. The landscape types and land use are heterogeneity and diversity¹. The urban fringe is an important area for the creation of urban ecological landscape. Natural resources such as river, farmland and woodland are the main components of the urban fringe². Due to the coexistence of urbanization and suburbanization, urban fringe is mostly the blind areas in urban management and planning³. The environment of the urban fringe is complex and frangible. With the acceleration of industrialization and urbanization, the urban fringe has become the primary space for urban expansion. In addition, the intense human activities have created a high risk of potentially toxic element. Urban fringe is the high-incidence areas of idle rural residential land (IRRL), The transfer of rural labor, nonagriculturalization of the industrial structure and the mode of production and lifestyle caused by urbanization and industrialization are the major driving forces, and the lagging village planning and imperfect land use system increased the risk of IRRL at the management level⁴.

With the development of urban, the contradiction between the scarcity of land supply and the growth of social demand for land has been intensified, and the competition for land use has become increasingly acute. The collision between industrial and ecological land has continued to expand, However, the urban fringe is one of the typical areas that reflect these contradictions⁵. The urban fringe is the area where land use changes and develops rapidly. One of the urgent problems to solve is that how to ensure the national or regional ecological security, and accelerate the process of urbanization and industrialization, further to maintain the dynamic balance of the total amount of industrial land and the steady development of ecological environment construction. The idle space in the urban fringe provides a new opportunity for

the reconstruction of the urban and rural ecology. Through reasonable restoration and optimization, the idle space can supplement and upgrade the urban ecological system, and improve the quality of water and soil, then form precious resources for special protected habitats¹. China proposes the recommendation of changing the idle, polluted and ecologically damaged land into ecological land in the "National New Urbanization Plan (2014-2020)" in 2014⁶. The specific content includes delimiting the ecological area reasonably, expanding the urban ecological space, increasing the area of forests, lakes, and wetlands, and converting rural wasteland, contaminated land and industrial or mining land into ecological land. The suggestion will play a positive role in the healthy development of urban fringe. Comprehensive land & water consolidation in China is expected to be both a tool and a platform for a developmental policy that aims to promote rural vitalization through the integration of urban-rural development.

2. Study Area

Shichuan River, a branch of Wei River, originated in Bei Mountain of Jiaoping and Yaoqu County, Yaozhou District, Tongchuan City. It flows from northwest to Southeast. Shichuan River in Fuping area is as long as 36.4 kilometer with the discharge area 132.4 square kilometer. It is abundant of fine sand and cobblestone and be called "Stone River". Shichuan River means "Stone River".

After 1970s, due to building of reservoir in upstream, the flow was cutoff. Shichuan River dried up gradually and became a seasonal river finally. Quarrying and sand dredging made river bed extremely uneven. Construction waste and household garbage was disposed in river channel. Meanwhile, sewage discharge from urban area and factories was accumulated in river channel. All of these made river smelly and full of mosquitoes and flies. The plants and fishes in river channel became extinct gradually. The serious degradation of ecological environment made surrounding residents suffer a lot.

In order to recover the ecological environment of Shichuan River, in July, 2013, contracted by Shaanxi Provincial Land Engineering Construction Group Co., LTD, the urban area of Shichuan River started to be improved with length of 2.2 kilometer. Land consolidation in the corporation-leading mode could avoid the insufficient shelterbelt planting, low annual output value of farmland and grain production capacity, low increase rate of agricultural labor production, and low land reclamation efficiency, which were main features led by governments in China (Yang et al., 2020). After comprehensive survey and investigation in 2013, we found the pollution range of river channel was large and the area of pollution was big. Moreover, the sources of pollution were complex which can be divided into types as below:

2.1. Water Pollution

With development of agriculture and cultivating technics, the amount of using chemical fertilizer and pesticides increases. There were large quantities of farm around Shichuan River. The chemicals infiltrated into soil to pollute river. Thus fishes died and aquatic biological structure changed. Large amount of living sewage from Fuping County discharged into channel. Meanwhile, the serious polluting factories in upstream, which were lack of proper sewage treatment equipment, discharged waste water into river directly without treatment. Shichuan River became a drainage ditch with polluted water, mosquitoes and flies, and terrible stink. Due to the poor environmental awareness of the residents, living garbage and construction waste disposed into river channel. Not only river channel was blocked, but also rotted wastes polluted environment.

2.2. Soil Pollution

Shichuan River is close to the South Ring Road and Pinyang Road of Fuping County. Emission and dust from large number of vehicles infiltrated into soil. This can harm and affect crop, and soil physical and chemical properties. The living garbage and construction waste accumulated in river channel not only occupied large amount of land, but also carried the pollutants, such as heavy metal, organic compounds, acid, alkali, salt, harmful microbe, to infiltrate into soil resulting in pollution in different extent. The living sewage and industrial waste water discharged into river without treatment. And then surrounding farmers used pollute water for irrigation. Thus the heavy metal and other harmful substance accumulated in soil, which resulted in serious problems. The animal manure from livestock farm was used as fertilizer. The parasites, pathogenic bacteria, and diseases can pollute soil which can harm human health through water and crops.

2.3. Air Pollution

Industrial waste water and living swage from urban area consists of materials with terrible stink. This terrible stink influenced human physical and psychological health. There is large amount of organic matter in swage which can dissolve oxygen of water after getting in river. When consuming amount of oxygen in water is greater than supplying amount from air above water, the creatures in water will die extensively. In water lacking of oxygen, dissociation of organic matter would produce sulfureted hydrogen, ammonia gas, and other substance with bad smell. Burning away refuses by residents can produce contaminants such as sulfur dioxide, suspended particulate matter, and oxynitride. These gases is greatly harmful for human health, which causes many diseases of respiratory system. Besides, garbage burning can generate dioxin, a kind of toxic substance, which may result in abortion or fetal malformation if the pregnant live in air with certain dioxin for certain time. It cannot be ignored that refuses burning result in atmospheric pollution. Large amount of sulfur toxic gas, dust, fine particle matter produced in burning can rise with wind, which result in content of sulfur dioxide and suspended particulate matter in air exceed standard. Thus the acid rain and flowing dust pollution occur again and again.

Above all, it is apparent that the polluted situations are just like trap cycles that associate with each other and become worse and worse, which lead to adverse effect of surrounding living environment and ecological environment.

3. Construction Theory

At present, the lack of theoretical guidance⁸ in the process of comprehensive land & water remediation has led to the separate consideration of land and water, in fact, they must be considered as a whole. Based on the principle of integrated protection and restoration of landscapes, forests, fields, lakes and grasses⁹, we have established a new concept of comprehensive land & water remediation with soil purification as the key technique, and water treatment as the link, meanwhile it will keep clear water with pure land. And have formed land & water rearrangement theory for different types of land including targets, measures and method. The theory has proposed the land organic rearrangement with the goal of increasing production capacity, improving human living environment and recovering ecological service functions. The target of the theory used soil particle and structure reconstruction, soil profile hierarchical reconstruction, land biochemical reconstruction, biological nutrition protection, and river bottom consolidation and pollution purification as the measures. Specifically, farm land, with a cultivated layer of more than 20 cm, must be constructed with organic soil characterized by water, fertilizer, gas and heat coordination, humification, biochemical and agglomeration. Residential land is constructed with healthy organic soil that is beneficial to the

survival of living organisms (healthy respiratory system for humans and land). And ecological land must be constructed with organic soil adapted to the function of biological reproduction and survival in different regional environment. The three types of land must be no pollution within 200 cm. And water must be flowing and clear by river bottom consolidation, dam storage and water pollution treatment. However, Other theory mainly focus on certain types of land remediation. For example, Cheng et al⁹ proposed that farm land remediation should be divided into 4 stages: pollution investigation-effect evaluation and plan optimization-pollution detection-land quality evaluation. Obeng et al¹⁰ examines how contemporary land consolidation activities in Sub-Saharan Africa contribute to the achievement of the SDGs, specifically ending poverty, ending hunger, and developing sustainable cities and settlements through land tenure security, food security, and rural development initiatives at country level. The established new theory of land organic rearrangement is based on target demand, with obvious quality indicators and different methods, and it can realize the key technique of soil purification and guide the design of comprehensive land & water remediation plans, quality control and project implementation.

4. Conclusion

Land in urban fringe area is the primary source for the development of urban and rural, but cannot be considered separately in the procession of comprehensive remediation in Urban Fringe area. And establish a new concept of comprehensive remediation with soil purification as the key, and with water treatment as the link, meanwhile it will keep clear water with pure land. Form land organic rearrangement theory for different types of land aimed at increasing production capacity, improving human living environment and recovering ecological service functions.

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