Study on Farmland Water Network Protection from the Perspective of Ecological Infrastructure

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Abstract. The traditional farmland water network is a stable production, ecological structure and sustainable ecological infrastructure. In this study, the author analysed the farmland water network pattern in suburbs of Chengdu from the perspective of landscape ecology. From the perspective of patch corridor graphic relationship, the characteristics of farmland water network landscape pattern’s changes of two time nodes, before and after, urban and rural planning were compared. Summarize the impact of the process of urbanization on the existing ecological infrastructure. Discuss the protection and utilization of farmland water network in Chengdu suburbs. identifying the spatial pattern of the ecological base of the key lines, and optimizing and improving the base of the existing farmland water network are the key ways to realize the effective protection and utilization of the farmland water network.

1 Front

1.1 Background
Nowadays, every city in China is experiencing the process of rapid urbanization, which is more irrational expansion and expansion, which also leads to the disorderly spread of urban boundaries and creates new harm to the urban fringe. Chengdu city is experiencing: the suburbs is changing into city, the natural environment is being transformed into the man-made, rural change into the outskirts of the city and then become a city. The natural environment is being replaced by human structures step by step. The ecological infrastructure of the village has been destroyed. It includes all kinds of eco productive land within the village, such as natural or artificial forest land, farmland, grassland, river wetlands, coastal beaches, villages built in a variety of green spaces and water. It is not only the material basis for the survival and development of the village residents, but also the material basis for the normal operation of the city.[1] In a way, the various environmental problems which the city is facing are the result of the original natural texture and the separation of natural processes from the city. Therefore, in the process of urban development, it is necessary to limit its expansion and destruction. A series of protective measures, such as restriction measures, to strengthen the control of space, protect natural resources and achieve orderly development.

The abundant water environment of Chengdu lays a solid foundation for "the land of abundance". The water network in Chengdu is dense and orderly. In the Committee of local chronicles compilation of Chengdu city "- in Chengdu city - water conservancy annals" also have a more complete record about Origin of river systems. The Dujiangyan city’s water conservancy project not only effectively avoids the scourge of Minjiang River water, but also more importantly constructs the network water system together.[2] Farmland depends on this network of water systems, and gradually forms the layout of farmland and water network. The farmland water network, as a production ecological
complex structure, shapes the unique agricultural form, regional landscape and cultural mark of Chengdu plain. [3] After thousands of years of natural and artificial interaction formed the unique network of water system. It constitutes a pattern of farmland water network which is closely related to production and life.

1.2 Research Situation at Home and Abroad
Among the domestic scholars, Wang Yuncai takes the suburbs of Beijing as an example. On the basis of the study of the use of landscape and the destruction of landscape ecology and the quantitative evaluation of landscape behavior compatibility, this paper discusses the laws of landscape development and recreation landscape planning in urban suburbs, regional planning of recreation landscape and planning of rural recreational landscape. And put forward the construction of perfect recreational landscape system and specific measures of landscape ecological protection in Beijing suburbs.[4] Zhou Jiandong discusses the necessity of introducing ecological planning and design in the construction of waterfront green space in large and medium cities in China from the angle of theoretical research. The basic principles of urban waterfront green space planning and design are put forward. And the method of dealing with the landscape elements of waterfront green space is put forward.[5] In addition, Xiao Duning and Yu Kongjian have made some achievements in the study of ecological recreation landscape.

Among foreign scholars, Bryant pointed out that the primary function of open space in urban suburbs is to meet the needs of active or passive recreation and recreation, then agricultural production, the protection of resources, and the prevention of disasters.[6] Zetter studied the location of the open space in the countryside, and considered that providing recreation and recreation is the goal of the open space construction in the suburbs.[7] Brotherton believe that the suburbs of green building to protect the fragile and precious British rural areas have a positive effect, to meet the demand of recreation and suburban nature reserve role, also pointed out the need to prevent the deterioration of the environment in the scenic area construction and maintenance process.[8]

1.3 Research Method
Spatial pattern analysis method is adopted in this paper. It is a Pattern analysis method which mainly to be used to study the relationship between landscape structure characteristics and spatial allocation and solve spatial problems. The analysis of landscape structure or spatial patterns generally includes the following steps: Get landscape data (Such as field investigation, remote sensing and image processing, etc.) Then the data were extracted by patch-corridor. Finally, select the appropriate pattern of research methods for analysis and explain the results of the analysis. In this study, the Dujiangyan’s riverside is analyzed. Mainly extract and calculate the Patch-corridor landscape pattern. In this study, the spatial patterns of the study areas were compared and analyzed, and the existing problems were found out.

2 Research Contents
2.1 Research Area Overview
The research area is located in Chengdu, Dujiangyan city. The village covers an area of 1.91 square kilometers (1910644m2), with a population of more than 10000, of whom more than 2000 are natives. It’s next to Chengdu. Using the LANDSAT and TM satellite images of 1987 and 2000, the expansion of Chengdu and its surrounding towns was studied. It is found that between the three ring road and the Beltway, urban sprawl mainly occurs in the southwest and northwest, and mainly extends along the road. Remote sensing image processing and image study area after phase superposition analysis. In 2000, as shown in Figure 1, The village and its vicinity are less affected by urbanization. It is a traditional agricultural production area. Then, compared with the satellite chart of 2002, in 2002, the village retains typical rural features of the Chengdu area-- Farmland texture clear, river corridor tightknit, rural settlements distribution and orderly, vegetation mainly along the canals and settlements surrounding the distribution of Homestead. It belongs to the typical layout model of field-water-forest-house. Under the influence of farmland water network, it is a traditional and common landscape pattern in Chengdu area. As shown in Figure 2, it is a stable environment for agricultural
production and rural life.

By comparing the satellite maps of each year, between 2002 and 2014, the natural features of the study area have changed dramatically in the urban and rural development. The land of agricultural production was transformed into the mixed type of industrial and agricultural land, and the types of vegetation changed from original crops to economic seedlings, and the original land landscape pattern in Chengdu was undergoing rapid destruction. According to the above analysis of the formation and evolution of Chengdu suburban landscape pattern, and Comparison of satellite images between 2002 and 2014. During the period of 2002, the landscape development of the village was in the third stage of the landscape evolution process of Chengdu suburban farming area, and the steady state of the traditional agricultural landscape pattern was maintained between the late stage and the fourth stage.

2.2 Data Sources
Using Google Earth satellite map - Chengdu suburb of Chengdu city in September 2002 and November 2014 shooting of the village's satellite map, picture download range: E103°58'46", N30°47'20" and E104°1'12", N30°46'11". Finally, the geometric correction is carried out according to the present situation, topographic map and series plan of the greenbelt around the city of Chengdu.

2.3 Characteristics of regional landscape pattern change in 2002 and 2014
In 2002, the overall landscape of the village, features are as follows: (1) The whole area is based on farming land, and the spatial distribution of farmland is relatively complete. (2) Among them, there are forest-house patches, canals-rivers corridors. The space is obviously concentrated around the house and along the channel. (3) The type of Patch -corridor is less. There are 5 main groups: network of rivers, farmland, woodland, homestead and road. Farmland patches are the dominant landscape patches in the area (about 102.5 hectares). It's accounts for 53.7% of the entire village area. It constitutes a complete base of agricultural landscape. Toft-forest land distributed homogeneously. An organic whole is formed under the series of channel systems.

2.4 Farmland-Water Network Landscape Pattern Variation Characteristics
From 2002 and 2014, the village land map shows that over 12 years, land types have become more. Increased plaque types mainly by changing the original farmland patches. As can be seen in figures 3, field patches decreased significantly. The average patch area of farmland also changed greatly. It decreased from 1.83 to 0.48. With the development of urbanization, patch types increased in 14 years, such as nurseries, factories and so on.
Figure 4 Farmland Water Network Pattern in 2002&2014

From the farmland water network pattern of 2002 and 2014, it can be seen that the agricultural irrigation canal pattern changes little, and there are some changes in the local area, and the water network length increases by nearly 1800 meters. Between 2002 and 2014, the total area of the patch of farmland in the village was greatly reduced. The present farmland patches are fragmented and the trend is serious. The patch area of farmland became smaller and large areas of farmland were replaced by rural homestead, township enterprises, factories, nurseries, wasteland and other forms of land. Among them, the changes of farmland on the north and south sides of the Beltway expressway are quite different. On the north side, because of the traffic inconvenience and the speed of the Beltway, the large area of farmland can be better preserved, while the southern area has a large area of farmland, and the farmland patches are fragmented.

There are more and more human disturbance factors in the suburban farmland landscape, meanwhile, there is lack of reasonable landscape design and management. It results in the continuity among the elements in the landscape pattern of Suburban Farmland. Therefore, the fragmentation of landscape patterns also leads to the decline of their ecological functions. Mainly in two aspects: (1) The increase of artificial disturbance patches leads to the fragmentation of farmland patches and ecological patches. Increase in Township processing plants, Lead that a large number of fertile farmland and ecological forest land have been occupied. The original farmland water network texture has been greatly destroyed. Farmland is split, resulting in reduced productivity and production on a large scale. (2) Reduced corridor connectivity: Industrial waste water discharged from local and upstream processing enterprises is discharged into agricultural canals, resulting in serious water pollution in the region and even affecting groundwater. On the other hand, the decrease of farmland area and the decrease of agricultural utilization lead to the decrease of irrigation effect of the original farming water network.

2.5 Basic Pattern of Farming Water Network

Through the study of the water network morphology in the suburbs of modern times, (The graphical record is shown in Figure 5.) five basic forms of water network in Chengdu are found:

Figure 5 Basic Pattern of Farming Water Network in Suburbs of Chengdu

3 Findings

For a long time, human farming and the industrialization of modern society have changed the water network landscape system in rural areas. Through studying the composition and evolution process of
farmland - water network pattern in Chengdu plain, the spirit of place is analyzed. Combined with landscape ecology, the landscape pattern of farmland water network in Chengdu plain was analyzed macroscopically. Draw the following conclusions:

(1) Through the analysis of the rural landscape pattern in two periods before and after the overall planning of urban and rural areas, the evolution of suburban spatial morphology can be simply divided into two stages:① Water network leading stage: The water network system and the elements of the countryside show a state of being generated by water and changed by water. Human activities are dependent on the ecological pattern of the existing water network system. The ecological network system of water network, farmland and forest land is stable. Human activity interferes with it less. The life, the production process and the natural ecological environment are in a good coupling state. ② Leading stage of road network: With the development of urbanization, especially urban and rural development, the traditional farming areas are rapidly becoming urban suburbs, and the information exchange and interaction between rural and urban areas are increasing. The role of the road network in the suburban spatial morphology changes, and the agricultural space begins to differentiate. The traditional "water based" lifestyle begins to change into "road dependence". Along with the network especially the roadway extension and expansion, further differentiation of suburban space. Large tracts of farmland were converted into industrial land. The pollution of water area and the decrease of irrigation canal function lead to the decrease of farmland productivity. Under the influence of this vicious cycle, the water network gradually lost its multiple functions of production, life and ecology. The suburban space followed built to replace the way built by the water. The road network dominates the suburban spatial morphology.

(2) From the angle of regional sustainable development, the village field interference makes the patch corridor broken degree increased, decreased productivity, agricultural land gradually abandoned, farming water lost its function as a corridor, part of the canal had been abandoned, the groundwater level decreased year by year, the water quality is getting worse, the local living production and life are greatly affected. The suburban landscape has lost its regional scenery. Human settlements need to be changed urgently. The farmland water network pattern needs to be protected and renewed.

4 Summary
Farmland and water network are the key factors in the open space of the suburbs of Chengdu. They are formed in the farming civilization and are the cultural heritage of modern farming water. Through qualitative research on farmland and water network, micro level shows that they are facing important problems: (1) The production function of farmland is degraded. Farmland is occupied by other industrial lands. (2) The water pollution in the farming water network is serious, and the local drains suffer great damage. From the macro level, Patch corridor map change and landscape index evaluation can sensitively describe the change trend of farmland water network pattern. It is of great significance for the basic ecological framework of urban suburban land, the demarcation line of production protection and the ecological protection line, to guide the rational layout of construction space. It is beneficial to the ecological control and ecological development of suburban farming water network area.

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