# Study on the Evolution and Influencing Factors of Ruralism-ecology Spatial Pattern in QinLing Mountains: A Case Study of YangXian County

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**ABSTRACT**
A sound ecological environment is a necessary prerequisite for maintaining global ecological security and building a beautiful China. And geographical probe method based on GIS spatial analysis technology, the use of geospatial data cloud, editing, and statistical yearbook data from 1985 to 2015 native, the county in the qinling area ruralism-ecology spatial pattern and influence factors were analyzed, and the results show that: (1) ruralism-ecology space while retain the original form, obvious regional differences. The area of forest land, water area and urban and rural land increased obviously, the cultivated land and grassland decreased, and the unused land increased slowly. (2) The production space and ecological space show a decreasing trend, while the living space shows an increasing trend. There is an interaction between the ecological space and the living space. (3) Population density, land reclamation rate and vegetation coverage rate are the human-land relationship factors of the ruralism-ecology spatial pattern. The coordinated development of ruralism-ecology space in Qinling Mountains is conducive to easing the contradiction between man and land and providing reference for rational utilization of land resources.

***Keywords:*** *Qinling region; ruralism-ecology space; Geographic detector; Land transfer matrix; Yangxian County*

## 1. INTRODUCTION

In the context of rural revitalization and new rural construction, the study of "production, ecology, and life" in the countryside has become an area of widespread concern [1]. Among them, ecological space, as an important part of urban and rural development, has become a hot topic of discussion in academic circles [2-3]. With the rapid development of global urbanization and modernization, the ruralism-ecology space has become the focus of attention in various countries [4-7]. The term "vernacular" was first derived from Latin, and its meaning has been extended since then due to the needs of various disciplines [8]. Through the development and changes of different social forms, "vernacular landscape" has become the result of the relationship between people and nature, which is the adaptation of local people to the spatial pattern of nature and land in order to live. The long-term changes in the contradiction of human-land relationship have shifted the research from rural areas to urban areas, and urban-rural integration has led to the gradual expansion of non-agricultural areas, fragmentation of agricultural areas and ecological spaces, and the sustainable and coordinated development of urban health and ecological environment has attracted much attention [9]. The traditional urban-rural dualism can hardly meet the real development needs, and the ruralism-ecology space, as a special functional territorial space type, is of great significance to promote new urbanization [10]. In the 1940s and 1950s, the term "Satoyama" was first used in Japan to refer to the natural landscape of the countryside, which existed as a place for people to maintain their livelihood. Satoyama is an ecological space that connects people and nature because it is located in the overlap between the city and nature [11]. The Risan concept has influenced the development of rural communities in various countries and provided new ideas for the transformation of national space. The Baltimore metropolitan area in Washington, D.C., USA alleviates the environmental problems caused by urban

expansion by maintaining an urban ecological space with a certain area of forest and farmland [12]. The United Kingdom, as the first urbanized country in the world, still has a green landscape in the countryside during industrialization and urbanization, and protects the green space to some extent [13]. Germany's ecological compensation mechanism adopts the ecological account system, which uses the dynamic balance of ecological indicators to achieve the green development of human and natural environment [14].

The attention of our scholars began in the 1980s, and on the basis of the experience of other countries, relevant research suitable for the development of vernacular was also carried out. The term ruralism-ecology space in China refers to a special type of territorial space with rustic and ecological functions, mainly with production, living and ecological functions, and spatial forms specifically manifested as agricultural land, villages, mountains and lakes, forests and grasslands. Rural spatial changes involve complex processes such as rural territorial economic structure [15-16], social form [17] and spatial layout evolution [18-19]. As an important territory for socio-economic development, rural space plays a fundamental role in the process of urban-rural integration. Along with urban outward expansion and suburban urbanization emerge ecological spaces that are distinct from towns and villages [20-21]. Ecological space research involves the process of identification and classification, the evaluation and optimal layout of the quantitative and spatial distribution of patterns[22].

The construction of ecological civilization in the Qinling region directly affects the economic and social development of the north and south regions. It has become a key problem that needs to be solved urgently. Therefore, this paper takes Yangxian County, a typical representative of the Qinling Mountains, as an example, and uses GIS spatial analysis to analyze the characteristics of spatial and temporal quantitative changes and structural evolution of land use in Yangxian County, and uses geographic probes to investigate the degree of influence of human-land relationship factors on the ruralism-ecology space. On the basis of understanding the development of ruralism-ecology space, it provides some reference for the optimization of rural structure layout, and also for the steady and healthy development of urban-rural integration and territorial spatial planning.

## 2. RESEARCH METHODS AND CASE AREA INTRODUCTION

### *2.1 Case area introduction*

Yang County is located in the southwest of Shaanxi Province, northeast of Hanzhong City, the eastern edge of the Hanzhong Basin, north of the Qinling Mountains, south of the Ba Mountain. The geographical coordinates are 107°11′-108°33′ East longitude and 33°02′-33°43′ North latitude. Yang County has 16 towns and 10 townships, with a total area of nearly 3200km2 [23]. As a model county for green development in southern Shaanxi, Yangxian is an important water-conserving area for the national South-North Water Diversion Project and the Han-Jiwei Project of Shaanxi Province, and its forest coverage rate reaches 68.9%, which is regarded as one of the best ecological regions on earth at the same latitude, with the reputation of "the ancient Yangzhou" and "the Pearl of Han It is known as the "ancient Yangzhou" and the "Pearl of Han".

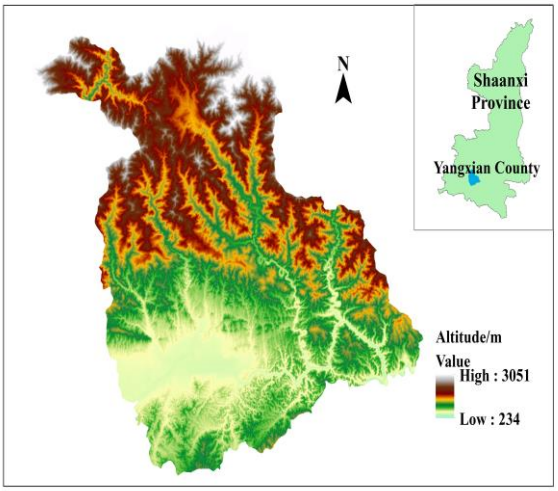


**Fig. 1** Research location map

### *2.2 Data source*

The basic data used in this study were obtained from the Yangxian Chronicle, the Statistical Bulletin of National Economic and Social Development of Yangxian County and the statistical indicators of Yangxian County Bureau of Statistics, and some indicator data were calculated from the collation of relevant basic data. The Landsat images, DEM, and land use data used in the study are from the geospatial data cloud with a spatial resolution of 30m, including 4 periods of images in 2005, and 2015.

### *2.3 research method*

The article reveals the influencing factors of land use change by means of factor detection and interaction detection in the geographical detector; meanwhile, the internal transfer of land use types in the study area can be analyzed by means of the land use transfer matrix. Based on the theory of human-earth relationship and sustainable development, 6 indicators were selected to construct the rustic-ecological spatial functionality evaluation index system in accordance with the principles of comprehensiveness, scientificity and operability from three dimensions: living function, production function

and ecological function by combining the five major systems of habitat environment, including habitation system, support system, human system, and social system (Table 1).

**Tab.1** Function evaluation index system of ruralism-ecology space

| Target layer | Normative Level | Meteic level | Indicators weights | Indicators attributes |
|---|---|---|---|---|
| ruralism-ecology space functions | Life functions$U_1$ ( 0.333 ) | $X_1$population density($\mathbf{person}/km^2$) | 0.205 | – |
| | | $X_2$disposable income of famers(yuan) | 0.197 | + |
| | Production functions$U_2$ ( 0.333 ) | $X_3$grain yield($kg/hm^2$) | 0.228 | + |
| | | $X_4$land reclamation rate(%) | 0.222 | + |
| | Ecological function$U_3$ ( 0.333 ) | $X_5$vegetation verge (%) | 0.267 | + |
| | | $X_6$arable land per capita ($m^2/\mathbf{people}$) | 0.271 | + |

## 3. RESULTS AND ANALYSIS

### *3.1Analysis of spatio-temporal differentiation of uralism-ecology space*

#### *3.1.1 Analysis of changes in uralism-ecology space over time*

The changes of land use types in Yangxian County in each period are as follows: urban and rural land use increased at a positive rate between 2005 and 2015, and the trend of changes in all other land use types was obvious. Among them, arable land and grassland show a decreasing trend, while forest land and urban and rural land use show an increasing trend. This change trend obviously reflects the transformation between rural-ecological space, the increase in the amount of forest land produces the expansion of ecological space area, and there is some transformation relationship between arable land, grassland and urban-rural land, which leads to the mutual change of area and function between living space and production space(Table 2).

**Tab.2** The detection results of functional index factors of ruralism-ecology space

| Detector factors | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ |
|---|---|---|---|---|---|---|
| $X_1$ | 0.687 | 0.911 | | | | |
| $X_2$ | | 0.022 | | | | |
| $X_3$ | | | 0.041 | 0.921 | | |
| $X_4$ | | | | 0.396 | | |
| $X_5$ | | | | | 0.343 | 0.965 |
| $X_6$ | | | | | | 0.022 |

#### *3.1.2 uralism-ecology space land transfer matrix analysis*

The spatial overlay analysis module was used in ArcGIS to calculate the land use change transfer matrix from 2005 to 2015.The land use change in Yang County between 2005 and 2015 shows that the change in area of each land type is ranked from largest to smallest: grassland > urban and rural land > watershed > forest land > unused land > cropland. Among them, the area of

forest land, water area, urban and rural land and unused land increased, and the area of cropland and grassland decreased. The overall trend of urban and rural land area in this period is rapid expansion, with an increase of 8.306（$km^2$） , and the other land types that match the development of urban and rural land also increase to some extent(Table 3).

**Tab.3** Transfer matrix of land use change in Yangxian County from 2005 to 2015

| | | 2005 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Type of land use | Cultivated land | Forest land | grassland | watershed | Urban and rural land | Unused land | Total（$km^2$） |
| 2015 | Cultivated land | 872.950 | 1.244 | 19.045 | 0.860 | 0.101 | 0.001 | 894.202 |
| | Forest land | 1.282 | 940.664 | 5.029 | 0.011 | 0.007 | 0.001 | 946.994 |
| | grassland | 9.541 | 1.973 | 1255.180 | 0.069 | 0.021 | 0.089 | 1266.874 |
| | watershed | 2.435 | 0.398 | 1.984 | 32.132 | 0.005 | — | 36.955 |
| | Urban and rural land | 8.193 | 0.027 | 0.213 | 0.006 | 28.482 | — | 36.922 |
| | Unused land | 0.633 | 0.134 | 0.477 | 0.001 | 0.001 | 0.506 | 1.749 |
| | total（$km^2$） | 895.034 | 944.441 | 1281.928 | 33.080 | 28.616 | 0.596 | 3183.696 |

## *3.2 Analysis of uralism-ecology space influence factors*

The uralism-ecology space is a comprehensive spatial-territorial system that integrates production function, living function and ecological function. For the analysis of the influence factors of the rustic-ecological space of Yang County, the factor detection and interaction detection methods were used to analyze the three sub-functions of the criterion layer and six influence factors of the indicator layer selected for the functionality of the rustic-ecological space of Yang County in 2015, in order to explore the effect of the role between the functional indicator system of the rustic-ecological space of Yang County （Table 4）.

**Tab.4** The detection results of functional index factors of ruralism-ecology space

| Detector factors | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ |
|---|---|---|---|---|---|---|
| $X_1$ | 0.687 | 0.911 | | | | |
| $X_2$ | | 0.022 | | | | |
| $X_3$ | | | 0.041 | 0.921 | | |
| $X_4$ | | | | 0.396 | | |
| $X_5$ | | | | | 0.343 | 0.965 |
| $X_6$ | | | | | | 0.022 |

### *3.2.1 Analysis of uralism-ecology functional indicator layer analysis*

According to the results of the detection of functional indicators of rural-ecological space (Table 4), from the interpretation of the single influence of the indicator layer on the criterion layer, the influence of the living-type indicator layer on the living function is ranked as X1>X2. The results show that the population density has the strongest influence on the living function, and there is

consistency between the living function and the population density indicators. The production index layer has the strongest influence on the production function: X4>X3, indicating that the production function is most strongly influenced by the land settlement rate index, and the ratio of grain yield, total fixed investment, economic density and secondary and tertiary industries are all close to 0.02 to 0.05, showing a strong consistency with the production function. The ecological indicator layer has the strongest consistency with the ecological function in the following order: X5>X6, and the results show that the vegetation cover has the strongest consistency with the ecological function. From the explanation of the interaction influence of the indicator layer on the criterion layer, the factor explanatory power of the indicator two-by-two interaction on the criterion layer is obviously enhanced. After the two-by-two interaction of living, production and ecological indicators, it was found that the degree of factor explanatory power on living, production and ecological functions after the interaction showed an increasing trend.

### *3.2.2 Uralism-ecology spatial function guideline layer analysis*

Based on the results of the functional criterion layer of the rural-ecological space （ Table 5 ） , the explanatory power of the criterion layer on the target layer is: U3 >U1 >U2, among the three indicators of the criterion layer, the one with the greatest influence on the rural-ecological space is the ecological function, whose factor explanatory power is 0.306, indicating that the ecological function plays a crucial role in the change of the rural-ecological space of Yangxian County. The factor explanatory power of the production function is relatively weak at 0.256. As can be seen from Table 4, the factor explanatory power of the detection factor increases significantly after two interactions, and the factor explanatory power of the living function, production function and ecological function is relatively similar after two interactions. The explanatory power of the factors after the interaction of the two probing factors is significantly enhanced, and the explanatory power of the factors after the interaction of the living function, the production function and the ecological function is closer to each other, and all three are consistent with the target layer, and the changes of the rustic-ecological space are mutually constrained and influenced by multiple dimensions, and the explanatory power of the factors after the interaction of any two functions is much higher than the explanatory power of the factors of one function.

**Tab.5**production, living and ecological function detection results

| Detector factors | $U_1$ | $U_2$ | $U_3$ |
|---|---|---|---|
| $U_1$ | 0.268 | | |
| $U_2$ | 0.885 | 0.256 | |
| $U_3$ | 0.897 | 0.877 | 0.306 |

## 4. CONCLUSION

As an important national ecological barrier area, the stability and construction of the ruralism-ecology space in the Qinling region plays an important role in guaranteeing the improvement of the ecological environment in the north and south of the country. In the study of the spatial and temporal evolution of the rustic-ecological space in the Qinling region, we analyzed the living, production and ecological functions of the ruralism-ecology space by using the factor detection and interaction detection of geographic detectors, combined with the changes of land use quantity and structure, and came to the following main conclusions:

(1) The original texture of the ruralism-ecology space in the Qinling region during 1985-2015 still maintains its original form, showing obvious differences between different regions and significant regional characteristics ;

(2) Through changes in the number and structure of different land types, with production space and ecological space decreasing and living space tending to increase, and the area of shrinking ecological space is consistent with the area of expanding living space;

(3) The formation of the ruralism-ecology spatial pattern in the Qinling region is the result of the joint action of living, production and ecological functions, and ecological functions become the dominant factors of ruralism-ecology spatial changes, among which population density, land settlement rate and vegetation cover become the dominant factors affecting living space, production space and ecological space. The new human-land relationship factor will play an increasingly important role in the evolution of the ruralism-ecology spatial pattern.

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