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Driving Analysis of Spatiotemporal Change of Land Use in Production-Living-Ecology Space in Shendong Mining Area

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ABSTRACT. *Land is the carrier of human survival and development. With the development and utilization of land resources, the types of land resources have changed significantly. In order to more clearly analyze the temporal and spatial change of land resources in Shendong mining area, we classified the land types into four types, namely ecological space (Eco), ecological production space (E-P), production ecological space (P-E) and production and living space (P-L). The changes of land use types also reflect the direction of resource development and protection in Shendong area. Based on the land use transfer matrix, correlation coefficient and principal component analysis, this paper analyzes the spatial and temporal changes of land resources in Shendong coal mining area from 1980 to 2015. It is found that the single ecological space scope in this area has been reduced, while the ecological leading production land range is large, and the ecological land scope with production as the main purpose is also decreasing. Because Shendong coal mine area belongs to the town layout form of combining production and living, although the space accounts for a small area of the total land, with the development of production, the space of this land increases sharply. Combined with correlation analysis and principal component analysis, we conclude that the main driving factors driving the transformation of land use types in Shendong mining area are the financial policy, the level of science and technology and the growth of non-agricultural industry.*

KEYWORDS: *production-living-ecology space; land use type exchange; Shendong Mining Area*

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1. Introduction

Driven by social and economic changes and innovation, the transformation process of regional land use form corresponding to the transformation of social and economic development stage in a period of time is called land use transformation [1,2], in which human interference plays a decisive role. With the rapid development of regional economy and the rapid progress of urbanization, many negative effects such as human settlements, climate and ecology are increasing day by day, which is reflected in the impact of land use change on ecological environment and global change. Research shows that global climate change, biodiversity and soil erosion are directly related to land use change. Therefore, the study of land use has been gradually incorporated into the study of global change, mainly including the marginal effect of the link between forests and deforested areas, habitat fragmentation and habitat destruction. This change is closely related to land use.

Research on land use transformation and corresponding ecological effects has attracted global attention, and has become a hot issue in Applied Ecology, ecological economics, geography and other disciplines [3-6]. The important performance of land use transformation is to realize the form transformation of land use function by reorganizing the quantity and space between the limited land resources. According to the ecological, production and living purposes of land types are being more and more attention and called "three living space"[7-9]. Combining with land cover change and "three generation space", dividing the dominant function of land use, and studying the combination of regional land function transformation and regional economic development is the direction of land use transformation [1,10].

2. Materials and Methods

2.1 Study Area

The study area is located at the intersection of the southern Ordos City in Inner Mongolia and the northernmost part of Yulin City, Shaanxi Province (Fig 1). The total area of coal field is 31000 km^2, and the proven coal reserves are 223.6 billion tons. Among them, the mining area is 3481km^2, and the geological reserves of coal are 35.4 billion tons. Shendong area belongs to continental temperate semi-arid monsoon climate. The annual average temperature is 6.2 ℃, the extreme minimum temperature is - 31.4 ℃, the extreme maximum temperature is 36.6 ℃, the frost-free period is 130-140 days, and the annual rainfall is 340-420mm. The study area belongs to the transition zone from the Loess Plateau to the sandstorm area of the Ordos Plateau. The terrain is low in the southeast and high in the northwest, low in the north and south, and high in the central part. The altitude is between 800-1385m. The gully is crisscross and the soil erosion is serious [11].

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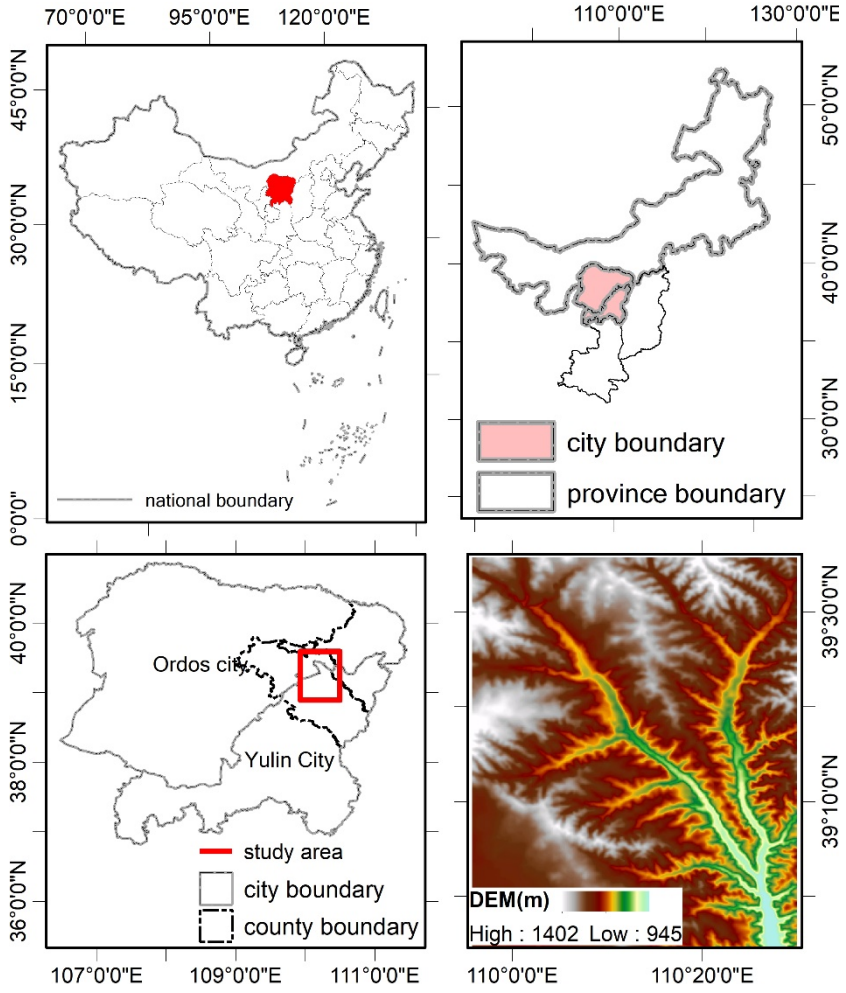

Fig 1. The location of the mining areas.

2.2. Data and Processing

The remote sensing monitoring data of land use in Shendong area are from the resource and environment data center of Chinese Academy of Sciences(http://www.resdc.cn)The data set includes six issues in 1980, 1995, 2000, 2005, 2010 and 2015. The data production and production are based on the Landsat TM / ETM Remote Sensing Images of each period as the main data source, and then generated by manual visual interpretation. We use the intersect module of arcgis10.2 and the PivotTable function of Excel to establish the land type transfer matrix of six

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periods of remote sensing images from the end of 1980, 1995, 2000, 2005, 2010 and 2015.

2.3. Methods

2.3.1 Land Use Transfer Matrix

The land use transfer matrix can be obtained from the quantitative description of system state and state transition by system analysis. Generally, in the land use transfer matrix, the column represents the land use type at t_1, and the row represents the land use type at t_2. k_{pq} represents the percentage of total land area converted from land type P to land type Q in T_1-T_2 period; k_{pq} represents the percentage of stable area of p land use types in t_1-t_2 period. k_{p+} represents the percentage of total area of $_Q$ land use types at T_2 point. k_{+q} represents the percentage of total area of land type $_q$ at point t_1. k_{+q} - k_{qq} is the increase percentage of land type $_Q$ area in t_1-t_2 period, and k_{p+} - k_{pp} is the decrease percentage of land type $_P$ area in t_1-t_2 period. The mathematical form of transfer matrix is as follows (Table 1):

Table 1 land use transfer matrix

		t_2				K_{p+}
		A_1	A_2	...	A_n	
t_1	A_1	Q_{11}	Q_{12}	...	Q_{1n}	K_{1+}
	A_2	Q_{21}	Q_{22}	...	Q_{2n}	K_{2+}
	...	...	...	...	....	...
	A_n	Q_{n1}	Q_{n2}	...	Q_{nn}	K_{n+}
K_{+q}		K_{+1}	K_{+2}	...	K_{+n}	

2.3.2 Land Use Type Division

There are six kinds of land use types in Shendong coal mining area, which are grassland, urban and rural, industrial and mining land, construction land, cultivated land, woodland, water area and unused land.

Grassland is mainly formed naturally or under the encouragement of the government, the residents plant grass for the development of animal husbandry. In addition, a part of the waste disposal sites, and industrial sites of production and construction projects were restored by planting grass to increase the grassland area.

Urban and rural land, industrial and mining land and construction land are collectively referred to as construction land. Urban construction land is mostly concentrated on both sides of the Ulan Mulun river. Daliuta and lijiapun are the main urban areas of the mining area because of their rapid development, close connection, integration trend and high degree of urbanization. The situation of village construction land is that there are more natural villages and the internal structure of the village is loose. Generally, the cultivated land is close to the residential area, so the

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site selection of residential area is random. Industrial and mining land mainly refers to the open-pit coal mine and factory enterprise land in the mining area. Most of the factories and enterprises are small in scale or mixed with village construction land and scattered.

The crops planted in cultivated land are mainly corn, potatoes and other grains. Due to the limitation of planting conditions and policies, local farmers began to return farmland to grassland and grassland. Most of the cultivated land is located in the river, in the ditch, on the catchment surface of the valley or around the artificial reservoir. The cultivated land is distributed in patches with different sizes and irregular shapes, reflecting the traditional small-scale farming mode.

Willow and poplar are mainly planted in woodland. As a kind of artificially planted trees, most poplar trees have the phenomenon of top tip death due to the climate and environmental problems, forming small old trees, which is difficult to improve the ecological environment. *Salix matsudana* in the planning area is mainly distributed in the live chicken rabbit minefield, which plays a certain protective role.

The reason for the change of water area is that in recent years, the state attaches great importance to water conservancy projects, increases investment, and compensations for soil and water loss are spent on treatment projects, such as silt dam construction, small-scale water conservancy facilities construction and river regulation project, which increases the water area.

The unused land is the main form of land use in the mining area. Although the wasteland has some desertification, it is not a desert without grass. In the area with less man-made destruction, the surface is rarely exposed, which can basically meet the requirements of soil and water conservation and wind and sand fixation. Generally speaking, although the amount of wasteland is relatively large, there are not many bare lands in the mining area.

2.4 Classification of Production-Living-Ecology Space

According to the three functions of land ecology, production and life, the classification system of production-living-ecology space divides all the land types in the current land use classification into four categories.

(1) Ecological land refers to the land which is relatively less used by human beings and can directly or indirectly improve the ecological environment. It includes: ① land with ecological regulation function: grassland, glacier, wetland, etc.; ② land with ecological accommodation function: bare land, sandy land, saline alkali land, etc.

(2) Ecological production land refers to the land with ecological and agricultural production functions, but the ecological function is greater than the production function. Including: ① forest land, ② grassland, ③ aquaculture water surface.

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(3) Productive ecological land refers to the land which takes the acquisition of agricultural products as the main purpose and has ecological functions at the same time. Including: ① cultivated land, ② garden.

(4) Land for living and production refers to land types for other production and living purposes. In addition to agricultural production, this kind of land is all or partially covered by structures and buildings, and production and living functions are crossed together, which is generally difficult to distinguish, so it is called production and living land.

2.4.1 Correlation Coefficient

Correlation analysis is mainly used to study the relationship between quantitative data, that is, whether there is a relationship between indicators, whether the relationship is close. Correlation analysis uses correlation coefficient to represent the relationship between indicators. Correlation coefficient is the first statistical index designed by the statistician Karl Pearson. It is a measure of the degree of linear correlation between variables. It is generally expressed by the letter R. Correlation coefficient is used to reflect the close degree of correlation between variables (table 2).

Table 2 Correlation discrimination

Correlation Coefficient (R)	Correlation Coefficient Squared(R^2)	Relationship Degree
>0.70	>0.49	H
0.40-0.70	0.16-0.49	M
0.20-0.40	0.04-0.16	L
<0.20	<0.04	N

2.4.2 Principal Component Analysis

The idea of principal component analysis (PCA) is to reduce the dimension, convert multiple variables into a small number of comprehensive variables with little or no loss of information, and the principal components are not correlated with each other. When we use principal component analysis to study difficult problems, we often only need to consider a small number of variables and lose too much information. This method can quickly grasp the main contradictions, reflect the law of internal variable factors of things, simplify the research steps, and greatly speed up the analysis speed [12-14].

In order to eliminate the dimensional influence of these data and make different data characteristics have the same scale, we select the indicators of national economic statistics in Shendong area, and do the "0-1" standardized processing on the data, and get the data with standard deviation of 1 and mean value of 0, which obey the standard normal distribution. It can be more accurate to determine the influencing factors in the later stage. According to the calculation results of SPSS14.0 software, the

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corresponding correlation matrix coefficient, cumulative contribution value and contribution value are obtained, so as to determine the main influence factors driving the "three generation space" change in Shendong mining area.

3. Results

3.1 Overall Change of Land Use Type

Based on the analysis of land use in Shendong area from 1980 to 1995, 1995-2000, 2000-2005, 2005-2010 and 2010-2015 (figure 2), it is found that grassland, cultivated land and unused land account for a large proportion in Shendong area. In the past 25 years, the grassland area increased first and then decreased, and the overall result increased by 3.4%; among all the land types of construction land, the proportion area increased continuously, from 0.3% to 2.55%; the unused land showed a downward trend, decreased by 5%, and the reduced part was mainly grassland.

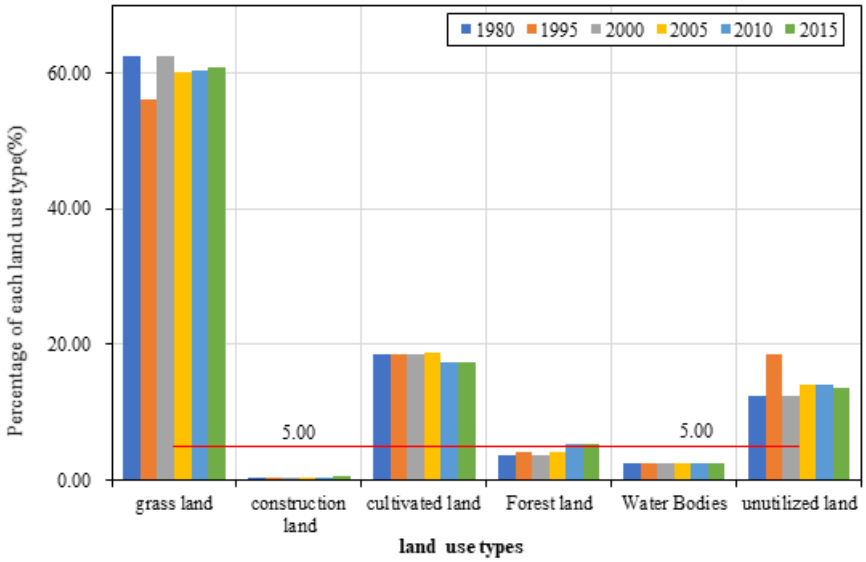

Figure 2 Change chart of proportion of various land use types to total area in Shendong mining area from 1980 to 2015

3.2 Spatial Pattern Structure Analysis of Production-Living-Ecology Space

From 1980 to 2015, the spatial pattern of Production-living-ecology space in Shendong area changed. After making the table of the spatial change of Production-living-ecology space, ArcGIS10.2 software and the existing data are used to make the spatial change diagram of Production-living-ecology space. Summarize

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the chart, comprehensively analyze the information reflected, and finally draw a conclusion.

The changes of four land use types in Shendong area showed regular changes (Fig. 3 (a) - (d)). The single eco land decreased, and the production oriented ecological land also showed a decreasing trend, while the scale of ecological production land increased. Although P-L land accounted for a small part of the total area of the region, it changed dramatically, and increased significantly since 2000. At the same time, we analyze the change from specific to year.

From 1980 to 1995, the production ecological space and ecological space changed the most, while the living production space and ecological production space changed little. From 1980 to 1995, 3.88% of production ecological space evolved into ecological space, 0.68% into ecological production space, only 0.01% into living and production space; living and production space remained stable; 2.37% of ecological space changed into production ecological space, 0.51% into ecological production space; 0.98% of production ecological space changed into production ecological space and 0.55% into ecological space Between.

From 1995 to 2000, the production ecological space and ecological space changed the most, while the living production space and ecological production space changed little. During this period, 0.78% of the production ecological space became ecological space, 0.86% became ecological production space; the living and production space basically kept the original pattern, with little change; 2.56% of ecological space became ecological production space, 0.4% became ecological production space; 0.58% of ecological production space changed into production ecological space and 0.37% became ecological space. In general, the production ecological space and ecological production space area increased in this period, while the ecological space area decreased significantly.

From 2000 to 2005, the biggest change is the production ecological space, ecological space, ecological production space. Among them, 1.08% of production ecological space became ecological space, 0.36% became production ecological space; 1.34% of ecological production space became production ecological space, 0.64% became ecological space.

From 2005 to 2010, the biggest changes were in production ecological space and ecological space. Among them, 0.32% of production ecological space became ecological space; 0.27% of ecological space became production ecological space; 0.04% of ecological production space became production ecological space, and 0.02% became ecological space.

From 2010 to 2015, the biggest changes were in the production ecological space, living and production space and ecological space, and the ecological production space changed little. Among them, 0.27% of production ecological space evolved into ecological space, 0.15% into ecological production space, only 0.01% into living production space; 0.75% of living and production space evolved into production ecological space, 0.96% into ecological space, 0.19% into ecological production space; 0.36% into production ecological space and 0.16% into ecological production

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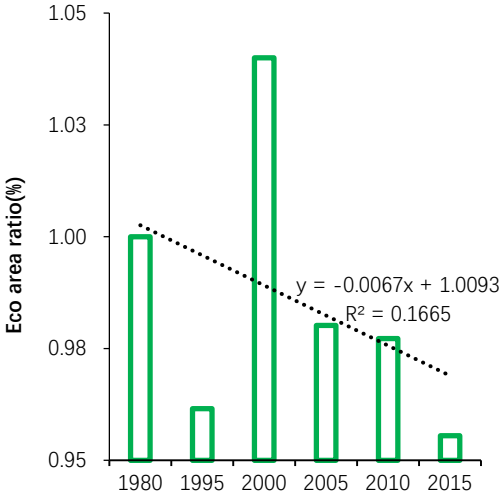
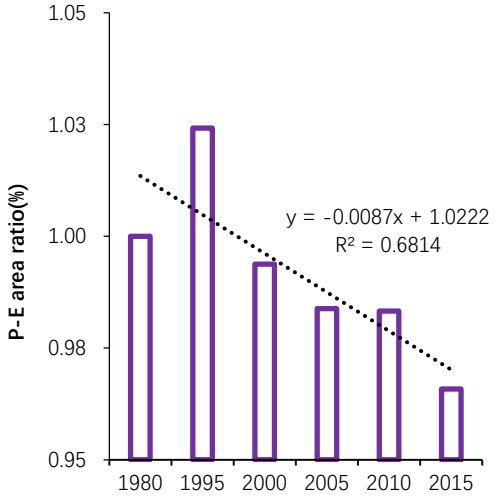
space; 0.19% of ecological production space evolved into production ecological space, and 0.14% evolved into ecological space.



(a) Eco land use type change



(b) P-E land use type change

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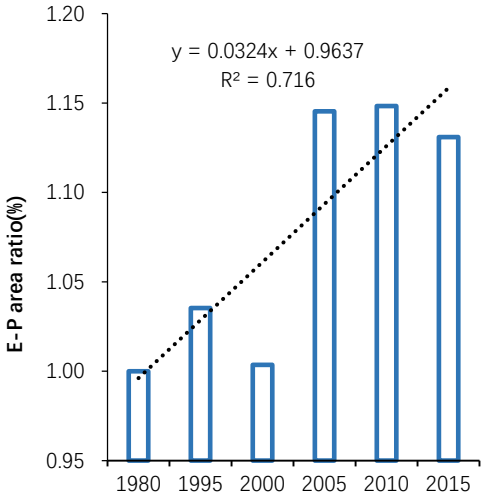
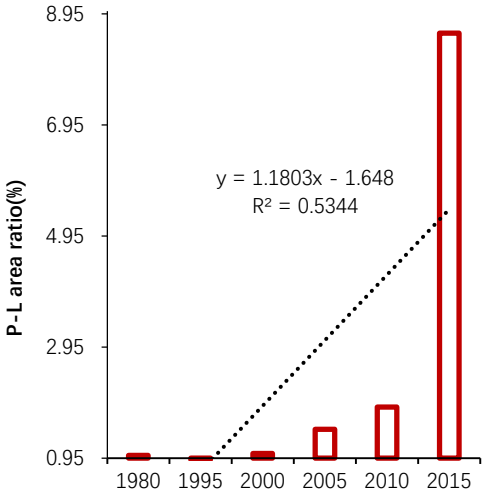


(c) E-P land use type change



(d) P-L land use type change

Figure 3 Changes of four land use types in Shendong mining area from 1980 to 2015

3.3 Correlation Coefficient Analysis

Through the data collection and processing, this paper will select 20 indicators in Shendong area for correlation coefficient analysis (table 3). These indicators cover the population, society, science and technology, commodities, economy, agriculture and

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other factors, with scientific and comprehensive data. According to the natural, economic and social characteristics of Shendong area, and facilitate better correlation analysis and research, the 20 indicators are re classified into three categories: population factors, economic factors and agricultural factors. The data of correlation coefficient analysis are all from the statistical data of land and statistics departments, which have strong reliability and can be used for analysis.

Table 3 analysis factors of correlation coefficient

Factor	Index	Unit	Code
Population factor	total population	ten thousand people	B_1
	Number of primary school teachers	people	B_2
	Number of primary school students	people	B_3
	Number of secondary school teachers	people	B_4
	Number of middle school students	people	B_5
	hygienic personnel	people	B_6
	beds in health institutions	Number	B_7
Economic factors	primary industry	RMB100mn	B_8
	the secondary industry	RMB100mn	B_9
	the service sector	RMB100mn	B_{10}
	Per capita GDP	element	B_{11}
	Investment in fixed assets of the whole society	Ten thousand yuan	B_{12}
	Local fiscal revenue	Ten thousand yuan	B_{13}
	Local fiscal expenditure	Ten thousand yuan	B_{14}
	Total retail sales of consumer goods	Ten thousand yuan	B_{15}
	Per capita net income of rural residents	element	B_{16}
	Per capita disposable income of urban residents	element	B_{17}
	Total output value of agriculture	Ten thousand yuan	B_{18}
Agricultural factors	Common cultivated land area	hectare	B_{19}
	grain yield	ton	B_{20}

It can be concluded that the factors that have a greater impact on farmland, woodland and water area of ejinholo are roughly the same, including the area of commonly used cultivated land (B_{19}) and the number of full-time teachers in ordinary middle schools (B_4); the number of health institutions (B_6) and the number of beds (B_7) of health institutions have a greater impact on urban and rural, industrial and mining, and residential land)The primary industry (B_8) and the total output value of agriculture, forestry, animal husbandry and fishery (B_{18}) have a greater impact on the unused land.(figure 4)

The main factors affecting the cultivated land in Shendong aera are the number of full-time teachers in ordinary primary schools (B_2) and the per capita disposable income of urban residents (B_{17}); the main factors affecting forest land are the number of teachers and students in ordinary primary schools (B_2, B_3) and grain production (B20); the factors affecting grassland are the per capita GDP (B11); the number of teachers of primary and secondary school students (B_2, B_4) affects the water area; The factors that affect the land use of urban and rural areas, industrial and mining areas and residents are the local fiscal expenditure (B_{14}) and the total output value of agriculture, forestry, animal husbandry and fishery (B18); the factors affecting the

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unused land are the number of students in ordinary middle schools (B_5) and the investment in fixed assets of the whole society (B_{12}).

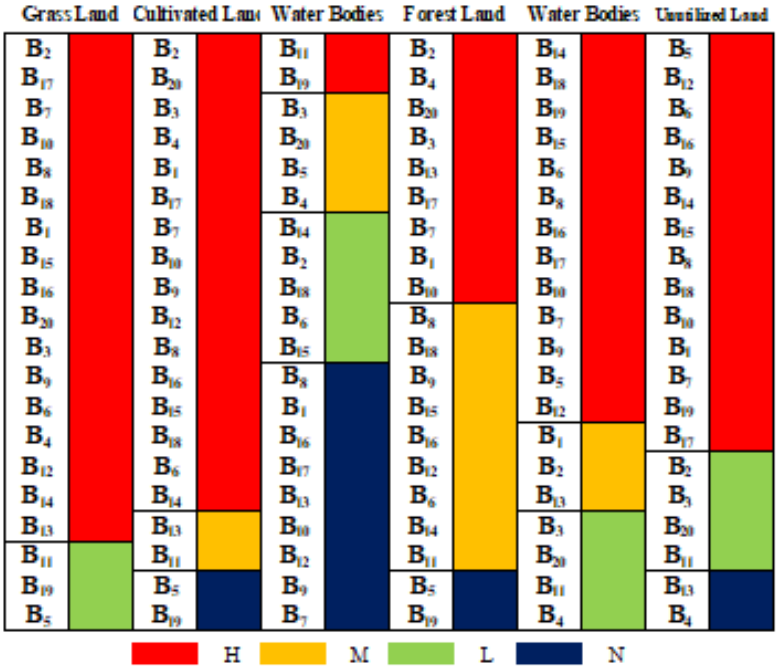

Figure 4 correlation coefficient analysis of Shendong Mining Area

Based on the correlation coefficient analysis of the two regions, it is concluded that in Shendong area, the factors affecting cultivated land, forest land and water area land can be summarized as population factors, while the factors affecting grassland, urban and rural areas, industrial and mining land, residential land and unused land can be summarized as economic factors. According to the above land use transfer matrix analysis, from 1980 to 2015, the main land types changed in Shendong were grassland, urban and rural, industrial and mining, residential land and unused land. Combined with the local social and economic conditions, the correlation coefficient can be more clearly reflected in the final analysis results.

3.4 Principal Component Analysis

According to the actual situation of Shendong area, the main component analysis of Shendong mining area is carried out by using SPSS software with 20 factors combined with table 13. The specific analysis results are as follows:

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Table 4 factor score table of Shendong Mining Area

Code	Factor		Code	Factor	
	1	2		1	2
B_1	0.987	-0.078	B_{11}	-0.629	-0.767
B_2	0.944	0.325	B_{12}	0.335	0.896
B_3	0.984	0.026	B_{13}	0.982	0.186
B_4	0.997	0.069	B_{14}	0.995	0.062
B_5	1	-0.026	B_{15}	0.954	-0.291
B_6	0.996	0.078	B_{16}	0.342	-0.897
B_7	0.971	0.065	B_{17}	0.486	0.858
B_8	0.996	-0.054	B_{18}	-0.569	0.816
B_9	0.994	0.113	B_{19}	0.932	-0.291
B_{10}	0.935	-0.166	B_{20}	0.783	-0.596

Principal component analysis shows that the first principal component accounts for a large proportion in the tertiary industry, per capita GDP and local fiscal expenditure. Generally speaking, the influence of economic factors is greater. The second principal component is the grain yield, the number of full-time teachers and the number of students in ordinary middle school, which has a greater impact on the second principal component. According to the principal component analysis, it can be concluded that the main factors affecting the regional development of Shendong region are the tertiary industry, local fiscal revenue, local fiscal expenditure and other indicators. Generally speaking, the economic and demographic factors dominate the development of Shendong region, and the rest such as agriculture account for a relatively small proportion.

4. Conclusion

Based on the land use transfer matrix and spatial analysis of Production-living-ecology space from 1980 to 2015, the spatial-temporal pattern and evolution characteristics of Production-living-ecology space in Shendong area are preliminarily explored. According to the three living space classification, it can be seen that the area of production ecological space is reduced, the area of living and production space is increased, the area of ecological space is reduced, and the area of ecological production space is increased. According to the classification of land use transfer matrix, it can be seen that grassland, urban and rural, industrial and mining, residential land and unused land area change most obviously. Although the grassland area fluctuates, the overall trend is increasing; the urban and rural, industrial and mining land and residential land continue to increase; the unused land shows a decreasing trend.

From the end of 1980 to 2015, the transformation of the three birth systems in Shendong region is mainly affected by population, economy and other factors. The most important factor is the proportion of local fiscal expenditure and per capita GDP. This shows that Shendong is affected by its own resource conditions and economic development, pays more attention to economic development, and has less

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development in agriculture, while the industrial structure supported by mineral resources is changing the transformation between the three systems in Shendong area.

To sum up, although Shendong mainly takes the route of resource development, it has also begun to pay attention to ecological development in recent years. It can be seen from the land use transfer matrix and Production-living-ecology space that the ecological development trend of Shendong area will gradually improve in the future. Affected by the national policy and people's awareness of environmental protection, the areas with resource development have gradually realized the importance of transformation. While economic development, they pay more attention to environmental protection. Environment is the premise of economic development. Therefore, under the macro background of rapid economic development, it is also necessary to cherish the use of land resources, reasonable planning, and promote the balance of various ecological systems in order to achieve sustainable development.

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Conflicts of Interest: The authors declare no conflict of interest.

References

[1] Guo, Y.N.; Chen, G.Q.; Mo, R.G.; Wang, M.; Bao, Y.Y. Benefit Evaluation of Water and Soil Conservation Measures in Shendong Based on Particle Swarm Optimization and the Analytic Hierarchy Process. *Water* 2020, *12*.

[2] Kun; Yang; Xiuming; Wang; Peng; Zhao; Xucheng; Liu; Yuhuan; Zhang. In *The Study of Driving Forces of Land Use Transformation in the Pearl River Delta during 1990 to 2010*, 2018.

[3] Marsland III, R.; Cui, W.; Goldford, J.; Sanchez, A.; Korolev, K.; Mehta, P. Available energy fluxes drive a transition in the diversity, stability, and functional structure of microbial communities. 2018.

[4] Zhong, Z.; Han, X.; Xu, Y.; Zhang, W.; Fu, S.; Liu, W.; Ren, C.; Yang, G.; Ren, G. Effects of land use change on organic carbon dynamics associated with soil aggregate fractions on the Loess Plateau, China. *Land Degradation & Development* 2019.

[5] Suo, A.N.; Li, J.C.; Wang, T.M.; Ge, J.P. Effects of land use changes on river basin soil and water loss in loess plateau. *Journal of Hydraulic Engineering* 2008, *39*,767.

[6] Wang, J.; Yang, L.; Wei, W.; Chen, L. Effects of landscape patterns on soil and water loss in the hilly area of loess plateau in China: landscape-level and comparison at multiscale. *Acta Ecologica Sinica* 2011.

[7] Yang, Y.; Bao, W.; Liu, Y. Coupling coordination analysis of rural production-living-ecological space in the Beijing-Tianjin-Hebei region. *Ecological Indicators* 2020, *117*.

ISSN 2706-655X Vol.2, Issue 3: 16-30, DOI: 10.25236/IJFET.2020.020302

[8] Shu-hui, Y.; Wei, D.; You-xin, X.; Xia, Z.; Hao-lin, X. Evaluation of the production-living-ecology space function suitability of Pingshan County in the Taihang mountainous area, China. *Journal of Mountain Science* 2020, *17*,2562.

[9] WAN, J.; LI, Y.; ZENG, J.; DENG, W. In *A Sustainable Land-use Practice in Huanjiang Karst Mountainous County from Holistic Production,Living and Ecology Perspective*, Beijing China, 2019; Beijing China, p 4.

[10] Wang, F.; Mu, X.; Li, R.; Fleskens, L.; Stringer, L.C.; Ritsema, C.J. Co-evolution of soil and water conservation policy and human-environment linkages in the Yellow River Basin since 1949. *Science of the Total Environment* 2015, *508*,166.

[11] Guo, Y.; Mo, R.; Wang, M.; Bao, Y.; Chen, G. Benefit evaluation of water and soil conservation measures in Shendong based on particle swarm optim. *Water* 2020, *12*.

[12] Zeng, S.; Ma, J.; Ren, Y.; Liu, G.J.; Zhang, Q.; Chen, F. Assessing the Spatial Distribution of Soil PAHs and their Relationship with Anthropogenic Activities at a National Scale. *Int J Environ Res Public Health* 2019, *16*.

[13] Omwene, P.I.; Oncel, M.S.; Celen, M.; Kobya, M. Heavy metal pollution and spatial distribution in surface sediments of Mustafakemalpasa stream located in the world's largest borate basin (Turkey). *Chemosphere* 2018, *208*,782.

[14] Dolezalova Weissmannova, H.; Mihocova, S.; Chovanec, P.; Pavlovsky, J. Potential Ecological Risk and Human Health Risk Assessment of Heavy Metal Pollution in Industrial Affected Soils by Coal Mining and Metallurgy in Ostrava, Czech Republic. *Int J Environ Res Public Health* 2019, *16*.