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Ar Horqin Banner Analysis of Land Use Changes and Sustainable Use

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Abstract

Using the paper, this passage analyzes the land use status of 2011 and other related data from 2011 to 2015.The results showed that the area of cultivated land,village,small towns and mining land increased in 2011 to 2015; the land area for garden land, forest land, grassland , water area and water conservancy facilities continued to decrease; while the land area for the land use for communication and transportation purposes and unused land fluctuated. this passage reveals the problems of land desertification, grassland degradation, extensive land exploitation and cultivated land reduction, and discusses all of these.

Keywords

Land Use; Sustainable Land Use; Ar Horqin Banner.

1. Introduction

Sustainable development is the most fundamental strategic goal of the development of cities in various countries and regions, however, the current fierce human-land contradiction has severely restricted the sustainable development of land, so there is an urgent need for a research about land use dynamic analysis and sustainable use analysis to alleviate the severe land use problems, in order to finally achieve the limited sustainable use of land resources.The study of the sustainable use of regional land in Ar Horqin Banner can help to understand the status of land use in this region, analyze the restrictive factors affecting the sustainable use of regional land, promote the methods and measures about the sustainable use of land, and put forward relevant suggestions to improve the utilization rate of regional land resources and promote sustainable development.

2. Data Sources and Research Methods

2.1. Data Sources

The data used in the institute were obtained from Chifeng Yearbook[1] and Statistical Yearbook of Ar Horqin Banner[2] (2011 to 2015) and the land use change data of Ar Horqin Banner from 2011 to 2015.Due to the changes of land use in the research area, in order to facilitate calculation and comparison, all the land use types are land use classification, including cultivated land, garden plot, forest land, grassland, land used for village,small town, industrial and mining purposes, land used for communication and transportation purposes, water area and water conservancy facilities, and unused land. The specific data are such as: Table 1.

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Table 1. Current Status of Land Use in 2011-2015

	2011	2012	2013	2014	2015
Cropland	132704.1	133163.39	133129.69	133072.35	133816.18
Garden plot	1002.2	1002.12	1002.1	991.34	991.34
Forest land	320032.01	319984.66	319970.57	319943.27	319904.31
Grassland	773318.73	773001.54	772951.39	772898.16	772552.41
Land used for village, small towns, industrial and mining purposes	22240.07	22146	22217.8	22349.2	22406.47
Land used for communication and transportation purposes	9497.28	9489.44	9489.2	9489.01	9491.11
Water area and water conservancy facilities	21226.94	21221.4	21221.38	21221.3	21219.82
Unused land	43960.89	43973.67	44000.09	44017.59	43600.58

Unit: hm^2.

2.2. Research Technique

2.2.1. Analysis of Land Use Change Rate of Ar Horqin Banner

In the land use analysis, the land use change rate[3] can be expressed as a single land use type dynamic attitude, which can effectively compare the regional differences of the land use change. The specific calculation formula is as follows:

$$K = \frac{Ub - Ua}{Ua} \times \frac{1}{T} \times 100\% \quad (1)$$

In, K indicates the rate of change of a land use type during the study period; the area of a land utilization type at the beginning of the Ua study; Ub represents the area of a land use type at the end of the study; and T indicates the study period. Table 2 is used to analyze the current land use data in 2011,2013 and 2015.

Table 2. Annual change rate of land use in Region

	2011-2015	2011-2013	2013-2015
Cropland	0.84	0.32	0.52
Garden plot	-1.08	-0.01	-1.07
Forest land	-0.04	-0.02	-0.02
Grassland	-0.10	-0.05	-0.05
Land used for village, small towns, industrial and mining purposes	0.75	-0.10	0.85
Land used for communication and transportation purposes	-0.06	-0.09	0.02
Water area and water conservancy facilities	-0.03	-0.03	-0.01
Unused land	-0.82	0.09	-0.91

Unit: %.

2.2.2. Analysis of the Change Amplitude of Land Use

The amplitude of land use change[4] can enable us to understand the overall situation of land use changes in the research area and the change of regional land use structure. Using the formula of the change amplitude we can get a result. And there is the formula of land use structure in the table below:

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$$R = \frac{Zib - Zia}{Zia} \times 100\% \quad (2)$$

Formula: R is the range of change of a certain type during the study period; Zia is the initial area of a land type study; and Zib is the area at the end of a land type study. Table 3 can be obtained with the above formula.

Table 3. Units of land use change in Ar Horqin Banner from 2011-2015

	Cropland	Garden plot	Forest land	Grassland	Land used for village, small towns, industrial and mining purposes	Land used for communication and transportation	Water area and water conservancy facilities	Unused land
amplitude of variation	0.84	-1.08	-0.04	-0.1	0.75	-0.06	-0.03	-0.82

Unit: %.

2.2.3. Analysis of Land Sustainable Utilization Indicators of Ar Horqin Banner

There are many restrictive factors and promoting factors affecting land use changes, In conducting an analysis of the sustainable use of land in the Ar Horqin Banner, referring to the evaluation index system of Chen Baoming[5], and combining all kinds of literature and the relevant experience of previous experts and scholars, this paper selects nine of the key indicators from the regional land sustainability evaluation index system to analyze the land sustainability of Ar Horqin Banner. They are the output value index of agricultural land, the output value index of construction land, grain production index, desertification management index, water area protection index, forest stability index, grassland stability index, land GDP index, and per capita cultivated land index.

Table 4. Changes in land use indicators of Ar Horqin Banner from 2011-2015

Code layer	Factor layer	Elements layer	2011	2012	2013	2014	2015
Productbility	Agricultural land output value index	Value value of the primary industry (ten thousand yuan)	139084	156708	174683	181437	184620
		Agricultural land area (hm^2)	1227057.04	1227151.71	1227053.75	1226905.12	1227264.24
		Production value of agricultural land per unit area (ten thousand yuan / hm^2)	0.11	0.13	0.14	0.15	0.15
	output value index of construction land	The added value of the secondary and tertiary industries (ten thousand yuan)	600805	760936	826220	831291	905443
		Construction land area (hm^2)	52964.29	52856.84	52928.38	53059.51	53117.4
		Production value of construction land per	11.34	14.4	15.61	15.67	17.05

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		unit area (ten thousand yuan / hm^2)					
	Grain production index	Total grain output (kg)	335000000	500000000	510200000	510500000	513500000
		Farmland area (hm^2)	132704.1	133163.39	133129.69	133072.35	133816.18
		Grain production value per unit area (kg / hm^2)	2524.41	3754.79	3832.35	3836.26	3837.35
Protectiveness	Sand governance index	Sandy area (hm^2)	22242.52	22242.52	22242.52	22242.52	22241.24
		gross area (hm^2)	1323982.22	1323982.22	1323982.22	1323982.22	1323982.22
		Sandland change rate (%)	1.68	1.68	1.68	1.68	1.68
	Water protection index	Water area (hm^2)	19759.09	19754.46	19754.46	19754.42	19754.18
		gross area (hm^2)	1323982.22	1323982.22	1323982.22	1323982.22	1323982.22
		Water area change rate is (%)	1.49	1.49	1.49	1.49	1.49
Stability	Forest stability index	Woodland area (hm^2)	320032.01	319984.66	319970.57	319943.27	319904.31
		gross area (hm^2)	1323982.22	1323982.22	1323982.22	1323982.22	1323982.22
		Rate of change in forest cover, (%)	24.17	24.17	24.17	24.17	24.16
	Grass-based stability index	Grass area (hm^2)	773318.73	773001.54	772951.39	772898.16	772552.41
		gross area (hm^2)	1323982.22	1323982.22	1323982.22	1323982.22	1323982.22
		Grass change rate (%)	58.41	58.38	58.38	58.38	58.35
Economic vigor	The Land GDP Index	Regional GDP (ten thousand Yuan)	739889	917644	1000903	1012728	1090063
		gross area (hm^2)	1323982.22	1323982.22	1323982.22	1323982.22	1323982.22
		Gross land product per unit area (ten thousand yuan / hm^2)	0.56	0.69	0.76	0.76	0.82
Acceptability	Per capital arable land index	agricultural acreage (m^2)	1327041000	1331633900	1331296900	1330723500	1338161800
		Total population number (person)	300000	299600	300100	301300	299000
		Per capital cultivated land area (m^2 / person)	4423.47	4444.71	4436.18	4416.61	4475.46

3. Analysis of Land Use Dynamics

3.1. Analysis of the Land Use Status of Ar Horqin Banner

As shown in Table 1, in 2015.The cultivated land area is 133816.18hm^2, accounting for 10.11% of the total land area of the whole area; Garden garden area is 991.348hm^2, accounting for 0.07%

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of the total land area of the whole area; Forest land area of 319904.31hm^2, Composes for 24.16% of the total land area of the whole area; Grassland area is 772552.41hm^2, accounting for 58.35% of the total land area of the whole area; Town, village and industrial and mining land area is 22406.47hm^2,accounting for 1.69% of the total land area of the whole area; Land used for communication and transportation purposes area is 9491.11hm^2, accounting for 0.72% of the total land area of the whole area; Water area and water conservancy facilities land area is 21219.82hm^2, accounting for 1.6% of the total land area of the whole area; Unused land area is 43600.58hm^2, It accounts for 3.29% of the total land area of the wholearea. Above all, the grassland area is the largest, it can be seen that Ar Horqin Banner is a typical pastoral area.

3.2. Analysis of Land Use Changes in Ar Horqin Banner

As can be seen from Table 1, the cultivated land area of Ar Horqin Banner is on the rise, which increased by 1112.08hm^2 from 2011 to 2015.From 2011 to 2012, the cropland area increased slowly and from 2012 to 2014, these are mainly due to the national ecological return to farmland policy and agricultural structure adjustment. From 2014 to 2015, the cultivated land area increased significantly, due to the development of new land renovation projects.

The garden area of Ar Horqin Banner showed a downward trend, reducing 10.86hm^2 from 2011 to 2015.In particular, from 2013 to 2014, the area of the garden area was greatly reduced. Due to the establishment of the "northern green barrier" in the autonomous region, some of the gardens were planted into non-economic tree species, such as camphor pine.

The grassland area showed a slow decline, reducing 127.7hm^2 from 2011 to 2015.The main reason is land desertification and soil erosion.

The grassland area showed a declining trend, with 766.32hm^2 reduced from 2011 to 2015.Grassland is the basis of the production and development of animal husbandry. Ar Horqin Banner is a typical pastoral area in northern China. On the one hand, overgrazing makes the unreasonable grassland utilization leading to the reduction of grassland area; on the unused hand, grassland degradation and land desertification are the reasons for the decrease of grassland area.

The area of land used for villages, small towns and industrial and mining purposes in Ar Horqin Banner was on the upward trend. From 2011 to 2015, the area of land used for villages, small towns and industrial and mining purposes increased by 166.4hm^2.In particular, the rising trend from 2012 to 2015, there are two main reasons for the fast: First, the flag vigorously responded to the national urbanization policy, the expansion of urban infrastructure scale, the expansion of village extension boundary; second, due to the rapid development of the economy, the large number of new enterprises make the large increase of industrial and mining land area.

The land used for communication and transportation purposes area of Ar Horqin Banner generally showed a slow decline, reduced by 6.17hm^2 from 2011 to 2015.The main reason is that the new rural construction has been merged and reorganized for rural roads, so that the area of transportation land is slightly reduced.

The land area of water area and water conservancy facilities showed a downward trend, from 2011 to 2015, the land area of water area and water conservancy facilities decreased by 7.12hm^2.The main reasons are the deterioration of the ecological environment and the aggravation of soil erosion, which makes for a small reduction in the water area.

The number of unused land used in Ar Horqin Banner generally declined, with unused land areas decreasing by 360.31hm^2 from 2011 to 2015.

3.3. Analysis of Land Use Change Rate in Ar Horqin Banner

As can be seen from Table 2, from 2011 to 2015, garden land, forest land, grassland, land used for communication and transportation purposes, water area and water conservancy facilities,unused land constantly decreased, especially the garden land which decreased the

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fastest and decreased by 1.08%, grassland and unused land area decreased by 0.10% and 0.82%, respectively, the land area for forest land, water area and water conservancy facilities decreased slowly, which decreased by 0.04% and 0.03% respectively.The area of cultivated land, land used for village, small towns and industrial and mining purposes has increased by 0.84% and 0.75%, respectively.

From 2011 to 2013, the area of garden land, forest land, grassland, land used for village, small towns and industrial and mining purposes, land used for communication and transportation purposes, water area and water conservancy facilities all decreased in different degree, the area of town village, transportation land, water and water conservancy facilities decreased rapidly by 0.10% and 0.09%, garden plot, forest land, grassland, water area and water conservancy facilities reduced slowly by0.01%, 0,0.02%, 0.05% and 0.03% respectively. Increasing cultivated land and unused land area, the largest change rate is 0.32%; the change rate of unused land area is 0.09%.

Between 2013 and 2015, the area of cultivated land, land used for village, small towns and industrial and mining purposes, land used for communication and transportation purposes continued to increase, especially land used for village, small towns and industrial and mining purposes increased by 0.85%; the cultivated area increased by 0.52% and and used for communication and transportation purposes changed a little by 0.02%.Garden land, forest land, grassland, water area and water conservancy facilities are reduced, with the fastest reduction rate of 1.07%, unused land area reduce slowly by,0.91%; forest land, grassland, water area and water conservancy facilities reduce slowly by 0.02%, 0.05% and 0.01% respectively.

3.4. Analysis of the Variation Amplitude of Land Use

As can be seen in Table 3, the largest change in land use in Ar Horqin Banner from 2011 to 2015 is the garden land area of-1.08%, cultivated land, land used for village, small towns and industrial and mining purposes, unused land changed by 0.84%, 0.75%, -0.82%, forest land, grassland, land used for communication and transportation purposes, water area and water conservancy facilities, changed by -0.04%, -0.1%, -0.06% and-0.03%.

4. Analysis of Land Use Sustainability Indicators

4.1. Agricultural Land Output Value Index

The output value index of agricultural land is calculated through the ratio of the added value of the primary industry (10,000 yuan) and the area of agricultural land (hm^2) to obtain the production value of agricultural land (10,000 yuan / hm^2), and obtains the results shown in Table 4:

As can be seen from Table 4, the annual agricultural land output value index from 2011 to 2015 was 0.11,0.13,0.14,0.15 and 0.15 respectively; among them, the highest agricultural land output value index was 2014 and 2015 and the lowest agricultural land output value index was 0.11 in 2011. From 2011 to 2015, the agricultural land output value index generally increased by 0.04, showing an upward trend, among which saw little change from 2014 to 2015.

4.2. Output Value Index of Construction Land

The output value index of construction land is calculated through the ratio of the added value (10,000 yuan) and the construction land area (hm^2) to obtain the production value of unit area (10,000 yuan / hm^2), and obtains the results shown in Table 4:

As can be seen from Table 4, the annual output value index of construction land from 2011 to 2015 was 11.34,14.4,15.61,15.67 and 17.05, respectively; among which, the highest construction land output value index in 2015 was 17.05, and the lowest construction land

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output value index in 2011 was 11.34. From 2011 to 2015, the construction land output value index of Ar Horqin Banner generally increased by 5.71, showing a steady rising trend.

4.3. Grain Production Index

The grain production index is calculated from the ratio of total grain output (kg) to cultivated land area (hm^2) to obtain the grain production value (kg / hm^2), and the results are shown in Table 4:

As can be seen from Table 4, the annual grain production index of 2011 was 2524.1,3754.79,3832.35,3837.35,3836 and 3837.35 respectively; the highest grain production index in 2015 was 3837.35 and the lowest in 2,24.41 was 2524 in 2011. From 2011 to 2015,1312.14, a steady upward trend, with 1230.38 in 2011.1 2.

4.4. Sand Governance Index

Sand treatment refers to which is calculated from the ratio of the sand area (hm^2) to the total area (hm^2), with the results shown in Table 4:

As can be seen from Table 4, the annual desertification governance index of Ar Horqin Banner from 2011 to 2015 was 1.68,1.68,1.68,1.68 and 1.68 respectively, so the desertification governance index remained basically unchanged from 2011 to 2015.

4.5. Water Protection Index

The water protection index is calculated by the ratio of the water area (hm^2) to the total area (h m ^{2}), with the results shown in Table 4:

As can be seen from Table 4, the annual water protection index from 2011 to 2015 was 1.49,1.49,1.49,1.49 and 1.49, respectively, so the water area were basically stable from 2011 to 2015.

4.6. Forest Stability Index

The forest stability index is calculated by the ratio of forest land area (hm^2) to total area (hm^2) to obtain the rate of forest cover change (m%), with the results in Table 4:

As can be seen from Table 4, the annual forest stability index from 2011 to 2015 was 24.17,24.17,24.17,24.17 and 24.16, respectively. Overall, the forest stability index decreased by 0.01 from 2011 to 2015, showing a slow decline trend, among which the forest stability index from 2011 to 2014 remained basically unchanged.

4.7. Grass-based Stability Index

The grassland stability index is calculated from the ratio of the grassland area (hm^2) to the total area (hm ^{2}), with the results shown in Table 4:

As can be seen from Table 4, the annual grassland stability index from 2011 to 2015 was 58.41,58.38,58.38,58.38 and 58.35, respectively. Overall, the grassland stability index decreased by 0.06 from 2011 to 2015, showing a slow decline trend, among which the forest stability index from 2012 to 2014 remained basically unchanged.

4.8. The Land GDP Index

The land GDP index is calculated through the ratio of the regional GDP (10,000 yuan) to the total area (hm^2) to obtain the gross total product of land per unit area (10,000 yuan / hm^2), and the results are shown in Table 4:

As can be seen from Table 4, the annual land GDP index of Ar Horqin Banner was 0.56,0.69,0.76,0.76 and 0.82 in 2011 to 2015 respectively; the highest land GDP index was 0.82 in 2015 and the lowest land GDP index was 0.56 in 2011. The qi land GDP index from 2011 to 2015 increased by 0.26, showing an upward trend, among which the land GDP index from 2013 to 2014 remained basically unchanged.

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4.9. Per Capita Arable Land Index

The per capita cultivated land index is calculated by the ratio of cultivated land area (m^2) to the total population area (m^2 / person), with the results shown in Table 4:

As can be seen from Table 4, the annual per capital cultivated land index in 2011 to 2015 was 4423.47,4444.71,4436.18,4416.61 and 4475.46 respectively; among which the highest per capita farmland index in A 015 was 4475.46 in 2015 and the lowest was 416.61 in 2014. From 2011 to 2015, the flag land GDP index overall increased by 51.99, showing an upward trend, among which the per capita cultivated land index from 2012 to 2014 showed a significant decrease of 28.1.

5. Conclusion

Under the guidance of sustainable development theory and on the basis of land sustainable use evaluation, this paper analyzes the status of land use from 2011 to 2015, and the following conclusions are drawn as described above:

(1) From the analysis of land utilization status, it can be seen that between 2011 and 2015, garden land, forest land, grassland, land used for communication and transportation purposes, water area and water conservancy facilities land and unused land area were constantly decreasing; the area of cultivated land, land used for village, small towns and industrial and mining purposes were constantly increasing. In terms of the change rate of land use, the fastest change rate of garden land is 1.08%; the change rate of unused land, cultivated land, land used for village, small towns and industrial and mining purposes is relatively fast by 0.82%, 0.84% and 0.75% respectively; and the smallest change rate of land for forest land, water area and water conservancy facilities is 0.04% and 0.03% respectively. In terms of land use, the garden land changed the most by-1.08%; cultivated land, land used for village, small towns and industrial and mining purposes, unused land areas changed by 0.84%, 0.75% and-0.82%; forest land, grassland, land used for communication and transportation purposes, water area and water conservancy facilities changed by -0.04%, -0.10%, -0.06% and-0.03% respectively. In a word, which changed most were cultivated land, garden plot, land used for village, small towns and industrial and mining purposes, unused land. The large positive change rate of cultivated land shows the food security and sustainable use of land; the area of garden land also changed a lot,considering its small total area, it would only have little influence on the sustainable land use; the positive change rate in urban villages and industrial and mining land would lead to the inevitable development of urban population, that is why rural land should control its scale, and land development should be reasonable.

(2) It can be seen from the analysis of sustainable land sustainable use: Ar Horqin Banner from 2011 to 2015, The output value index of agricultural land, construction land output value index, grain production index, land GDP index, and per capital cultivated land index have all increased, increasing from 0.01 to 0.15,11.34 to 17.05,2524.41 to 3837.35,0.56 to 0.82,4423.47 to 4475.46, respectively; From 2011 to 2015, water protection index, the sandy land governance index and forest stability index all remained basically unchanged, which were 1.8,1.49, and 24.16; The Ar Horqin Banner grass stability index has decreased, reducing from 58.41 to 58.35. Among the indicators, only the construction land output value index is negatively related to the land sustainable use, but it has little impact on the land sustainable use; although the grassland stability index has decreased, it has only decreased by 0.06, with little change, which has little impact on the sustainable use of the land. Among the other indicators, the sand management index, the forest stability index are basically unchanged.

(3) Therefore, according to the above conclusions, the land use sustainability of Ar Horqin Banner is generally good, and all kinds of land areas are relatively stable. However, there are still problems that are not conducive to the sustainable use of land, such as land desertification

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and the expansion of urban construction scale. To achieve the sustainable use of land, Ar Horqin Banner should "adhere to the green development, improve the ecological environment", revolve around the construction of ecological security barrier, promote the forestry ecological construction, and reasonably control the scale of construction land.

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