Postprint: Land Use and Oasis Dynamics in Xinjiang Over the Past 40 Years

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Abstract

This study utilizes Landsat MSS/TM/OLI and CBERS remote sensing imagery data from 1972–2015 to obtain spatiotemporal land use data for Xinjiang over the past 40 years, and comprehensively analyzes the dynamic changes and driving factors of land use and its oases in Xinjiang. The results indicate that: land in Xinjiang has been continuously reclaimed and the area of cropland has been expanding, having reached a considerable quantitative scale; land reclamation and abandonment have become the most important characteristics of land use change in Xinjiang and even in the arid regions of northwestern China, with the ratio of cropland abandonment to land reclamation decreasing period by period and land use efficiency continuously improving; urban construction land has continued to expand; over the past 40 years, oasis area has gradually expanded, with its areal proportion increasing from 8.18% to 9.93%; the area and proportion of artificial oases have also gradually increased, with more than half of the current oasis area being artificial oases. Climate warming and humidification, as well as policy, population, socio-economic, and technological factors have become the driving factors behind land use changes in Xinjiang. This paper also proposes that while focusing on quantitative changes in land, further research should be conducted on quality changes and assessment of land development.

Full Text

Dynamic Changes of Land Use and Oasis in Xinjiang Over the Past 40 Years

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Abstract: This study conducted a comprehensive analysis of the dynamic changes and their causes in land use and oasis in Xinjiang based on spatiotemporal data of land use obtained from remotely sensed Landsat MSS/TM/OLI and CBERS data over the past 40 years from 1972 to 2015. The results indicated that the cultivation area in Xinjiang had been constantly expanding as a result of land reclamation, which had reached a considerable quantity; the land reclamation and some of the cultivated land left uncultivated became the most important feature of the land use in Xinjiang and even in northwest arid area of China. The ratio of the land left uncultivated against the land reclaimed was gradually being decreased, translating into a continuously improving efficiency of land use; the construction land of urban residents has been expanded continuously. The area of oasis has gradually been expanded with its occupation rate being increased from 8.18% to 9.93%. The area of artificial oasis and its proportion have also been increased gradually. At present, more than half of the oasis area is the artificial oasis. The warm and wet climate changes, as well as the policies, population, social economy, science and technology and other factors have become the motivation of the change of land use in Xinjiang. This paper also puts forward the research on the quality change and evaluation of land development while paying attention to the change of land quantity.

Keywords: land use; oasis; dynamic change; Xinjiang

1. Introduction

Over the past 40 years, the cultivated land area in Xinjiang has undergone significant changes, with a total increase of 315.34×10 hm^2, accounting for 54.29% of the total cultivated land. The area of newly reclaimed land in different periods was 5.22×10 hm^2, 65.09×10 hm^2, 96.24×10 hm^2, 56.88×10 hm^2, and 91.91×10 hm^2 respectively. The ratio of abandoned land to reclaimed land has been decreasing, indicating improving land use efficiency.

2. Data and Methods

2.1 Data Sources

The study utilized remote sensing images from Landsat MSS/TM/OLI and CBERS satellites. The data covered five periods: the 1970s, 1990s, 2000-2005, 2005-2010, and 2010-2015. All images were processed using ArcGIS software for geometric correction, registration, and classification.

3. Results

3.1 Land Use Changes

The area of cultivated land in Xinjiang increased by 315.34×10 hm^2 over the 40-year period, representing a 54.29% growth. The expansion of artificial oasis was particularly notable, with its proportion increasing from 8.18% to 9.93%.

The occupation rate of oasis increased from 43.62% in the 1970s to 57.86% in 2015.

3.2 Land Reclamation and Abandonment

The ratio of abandoned land to reclaimed land showed a decreasing trend, indicating improved land use efficiency. During 2010-2015, the abandonment rate was only 13.87%, while the reclamation efficiency reached 99.59%.

3.3 Oasis Expansion

The oasis area expanded continuously, with significant changes in its structure. The proportion of artificial oasis increased substantially, now accounting for more than half of the total oasis area. The occupation rate of oasis increased from 8.18% to 9.93% over the study period.

4. Discussion

The expansion of cultivated land and oasis in Xinjiang was driven by multiple factors including climate change (warming and wetting trends), policy interventions, population growth, socioeconomic development, and technological advancement. The continuous improvement in land use efficiency, evidenced by the decreasing abandonment-to-reclamation ratio, reflects better land management practices.

5. Conclusion

Over the past 40 years, Xinjiang has experienced significant land use changes characterized by continuous expansion of cultivated land and oasis. The increasing proportion of artificial oasis and improving land use efficiency are notable trends. Future research should focus on both quantitative and qualitative changes in land development to ensure sustainable land use in this arid region.

Table 1 Remote sensing images used in the study

Period	Sensor	Resolution/m	Coverage
1970s	Landsat MSS	30, 19.5	1972-1978
1990s	Landsat TM, CBERS	30, 19.5	1990s
2000-2005	Landsat TM, CBERS	30, 19.5	2000-2005
2005-2010	Landsat TM, CBERS	30, 19.5	2005-2010
2010-2015	Landsat TM, CBERS	30, 19.5	2010-2015

Table 2 Percentage of cultivated land reclamation in Xinjiang during the last 40 years

Period	Reclamation rate (%)
1970s-1990s	94.63
1990s-2000	92.18
2000-2005	90.81
2005-2010	87.25
2010-2015	77.76

Table 3 Percentage of urban and rural, industrial, mining and residential land in Xinjiang during the last 40 years

Period	Urban/rural (%)	Industrial/mining (%)	Residential (%)
1970s-1990s	36.52	0.14	18.61
1990s-2000	30.08	0.00	19.46
2000-2005	23.08	0.07	35.84
2005-2010	6.68	0.30	70.84
2010-2015	31.76	0.00	37.73

Table 4 Situation of abandoned land reclamation in Xinjiang during the last 40 years

Period	Abandoned (10 hm^2)	Reclaimed (10 hm^2)	Abandonment rate (%)	Reclamation efficiency (%)
1970s-1990s	929.86	821.84	92.98	82.18
1990s-2000	800.39	997.03	80.04	99.70
2000-2005	600.37	1054.04	60.04	105.40
2005-2010	62.61	15.08	6.26	1.51
2010-2015	76.00	12.78	7.60	1.28

Table 5 Area occupation ratio and structure change of oasis in different periods of Xinjiang

Period	Natural oasis (%)	Artificial oasis (%)
1970s	43.62	56.38
1990s	42.86	57.14
2000	46.82	53.18

Period	Natural oasis (%)	Artificial oasis (%)
2005	51.00	49.00
2010	53.75	46.25
2015	57.86	42.14

References

[5] Liu Jiyuan, Kuang Wenhui, Zhang Zengxiang, et al. Spatiotemporal characteristics, patterns and causes of land use changes in China since the late 1980s[J]. Acta Geographica Sinica, 2014, 69(1): 3-14.

[7] Zhang Baiping, Zhang Xueqin, Zheng Du. Arid northwest China cannot be regarded as the farmland reserve base[J]. Arid Zone Research, 2010, 27(1): 1-5.

[8] Liu Jiyuan. Macro investigation and dynamic research on remote sensing of resources and environment in China[M]. Beijing: China Science and Technology Press, 1996: 353.

[11] Chen Xi, Luo Geping. Researches and progress of oasis ecology in arid areas[J]. Arid Land Geography, 2008, 31(4): 488-495.

[12] Zhang Ying, Ti Yi, Zhang Shouyu, et al. Study on the change of spatio-temporal LUCC in oasis-desert ecotone[J]. Research of Environmental Sciences, 2006, 19(6): 100-105.

[15] Xinjiang Comprehensive Investigation Team of the Chinese Academy of Sciences. Soil geography in Xinjiang[M]. Beijing: Science Press, 1965: 471.

[16] Li Qihu, Chen Y, Shen Y, et al. Spatial and temporal trends of climate change in Xinjiang, China[J]. Journal of Geographical Sciences, 2011, 21(6): 1007-1018.

[17] Ding Jianli, Zhang Ying, Ti Yi. Study on the expansion of both cultivated and construction land in Xinjiang since the late 1980s[J]. Arid Land Geography, 2017, 40(1): 188-196.

Note: Figure translations are in progress. See original paper for figures.