

Spatial Patterns and Characteristics of Land Cover Change in Xinjiang over the 40 Years of Reform and Opening-up: Postprint

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Abstract

Over the 40 a since the reform and opening-up, Xinjiang has experienced tremendous changes in land use and land cover. While generating substantial socioeconomic benefits, these changes have also given rise to numerous ecological and environmental problems. To provide a basis for future territorial spatial planning regarding land use, water resource development, and sustainable socioeconomic development in Xinjiang, we employed a zoned and hierarchical decision tree method and a change detection method based on vector similarity to complete a 1:100,000 vector dataset of land cover for Xinjiang for the years 2015, 2010, 2000, 1990, and 1975. This accurately retrieved the process of land cover change in Xinjiang over the past 40 a (the 40 a of reform and opening-up), and analyzed the relationship between land cover changes in Xinjiang and the national reform and opening-up policies. The influence of national policy intensity and orientation on land cover changes was elaborated through four stages: land reclamation (1975–1990), agricultural resource development (1990–2000), Western Development Strategy (2000–2010), and paired assistance to Xinjiang (2010–2015). The analysis reveals that land cover changes in Xinjiang have begun transitioning from a high-speed development model focused on cropland reclamation and artificial surface expansion to a sustainable development direction that balances ecological civilization construction. Changes in major land cover types have also shifted from rapid development to being basically controllable. Over the past 40 a, Xinjiang's cropland area has increased by 128% (50,414.02 km²), with newly added cropland distributed spatially according to patterns that follow the characteristics of water and soil resource allocation. Artificial surfaces (construction, transportation, and industrial/mining land) have increased by 197% (7,497.11 km²), with growth accelerating notably after 2000 and increasing substantially in southern Xinjiang after 2010. Forest area showed a decreasing trend before 1990, but an increasing trend thereafter, with newly

added forests widely distributed within the natural forest closure and protection areas and Natural Forest Protection Program implementation zones across the region. Wetland area decreased significantly before 1990, remained stable from 1990–2000, and showed an increasing trend after 2000. Grassland and other land types have exhibited a continuous decreasing trend.

Full Text

Preamble

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Arid Land Geography (ChinaXiv Cooperative Journal)

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Abstract: Since China' s economic reform and opening-up 40 years ago, land use and land cover in Xinjiang have undergone tremendous changes. While generating great socio-economic benefits, many ecological and environmental issues have also arisen. To provide a basis for future land use planning, water resources development, and sustainable socio-economic development in Xinjiang, this study employed a partitioned and layered decision tree method combined with vector similarity change detection to complete Xinjiang Land Cover 1:100,000 vector datasets for 2015, 2010, 2000, 1990, and 1975. The evolution of Xinjiang' s land cover over the past 40 years was analyzed across four distinct policy periods: reclamation (1975–1990), agricultural resource development (1990–2000), western development (2000–2010), and counterpart assistance to Xinjiang (2010–2015). The analysis reveals that Xinjiang' s land cover change has begun to shift from a high-speed development model to sustainable development integrated with ecological civilization construction. Major land type changes have also transitioned from rapid development to basic controllability. Over the past 40 years, cultivated land area increased by 128% (50,414.02 km²), with new cultivated land distributed according to water and land resource availability. Artificial surfaces (construction, transportation, industrial, and mining land) increased by 197% (7,497.11 km²), with growth accelerating significantly after 2000 and particularly rapid expansion in southern Xinjiang after 2010. Forest area showed a decreasing trend before 1990 but increased thereafter, with new forestland widely distributed in natural forest enclosure areas and within the implementation zones of the Xinjiang Natural Forest Protection Project. Wetland area decreased significantly before 1990, remained stable from 1990 to 2000,

and showed an increasing trend after 2000. Grassland and other land types continued to decrease.

Keywords: Xinjiang; land cover; spatio-temporal pattern; sustainable development

1.2 Data Processing and Accuracy Assessment

ArcGIS software was used for data processing and analysis. The overall classification accuracy for the 40-year land cover dataset exceeded 93% [1]. The classification system followed the China Land Cover Classification System based on carbon budget [19]. Landsat TM, OLI, and MSS images were employed as primary data sources, with 30m spatial resolution imagery covering over 70% of the study area. For regions lacking satellite data, 1:100,000 topographic maps from 1975, 1990, 2000, and 2010 were used as supplementary references. The ChinaCover land cover dataset served as validation data, with additional field surveys conducted in 2015 to verify classification accuracy.

3. Dynamics of Land Cover Change Over 40 Years

Statistical analysis of five land cover datasets reveals significant spatio-temporal changes in Xinjiang from 1975 to 2015. Cultivated land showed continuous expansion, increasing by 50,414.02 km², while artificial surfaces grew by 7,497.11 km². Conversely, forestland and wetland areas decreased by 35,591.07 km² and 9,499.33 km² respectively.

The 40-year period can be divided into four stages with distinct characteristics [Figure 5: see original paper]. During 1975–1990, cultivated land expansion was moderate, with an increase of 12,432.31 km². The 1990–2000 period marked accelerated agricultural development, adding 14,219.75 km² of cultivated land, primarily converted from grassland and unused land. The western development phase (2000–2010) saw the most dramatic changes, with cultivated land increasing by 16,548.37 km² and artificial surfaces expanding rapidly. During the counterpart assistance period (2010–2015), cultivated land continued to grow by 7,213.60 km², while ecological restoration efforts led to increased forest and wetland areas.

4.3 Cultivated Land Change Patterns

Cultivated land changes in Xinjiang over the past 40 years reflect distinct policy impacts and resource constraints. Spatial analysis reveals that 92% of new cultivated land was converted from grassland and unused land, distributed pri-

marily in oasis areas with available water resources. The Tarim River basin and northern Xinjiang plains experienced the most significant expansions.

From 1975–1990, cultivated land increased by 12,432.31 km², mainly through reclamation of grassland in state-run farms. During 1990–2000, the “Four-Around” campaign (reclaiming land around villages, rivers, roads, and barren hills) drove a 14,219.75 km² increase, though this was partially offset by 6,467.08 km² of cultivated land abandonment due to water shortages and salinization. The 2000–2010 western development period added 16,548.37 km², often through conversion of forest and wetland margins. Since 2010, cultivated land growth has slowed but continues in southern Xinjiang through water-saving irrigation projects.

The spatial distribution of cultivated land change correlates strongly with water resource availability and policy implementation intensity. Areas with stable water supply show continuous expansion, while water-stressed regions exhibit fluctuating patterns of reclamation and abandonment. This pattern underscores the critical role of water resource management in sustainable land use planning in arid regions.

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