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Analysis of Spatial and Temporal Variations of Cropland Cover in Korea Based on GlobeLand30

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Abstract: Based on the GlobeLand30 data set, this study conducted an in-depth analysis of the distribution of cropland and its temporal and spatial change characteristics in South Korea from 2010 to 2020, and drew the corresponding conclusions: (1) most of the cropland in South Korea is concentrated in the western region with relatively low elevation and gentle slope; (2) in terms of temporal change, the amount of change in the area of cropland in 2010 -(2) In terms of temporal change, the amount of change in the area of cultivated land in Korea from 2010 to 2020 is significant, and the rate of change is equally significant. (3) In terms of spatial change, there is a very significant decreasing trend, with the decrease in area characterized by “more in the west and less in the east”.

1. Introduction

Arable land, as the land for crop cultivation, consists of natural elements and other components. With the advancement of the breadth and depth of the exploitation and utilization of arable land by human production and living activities, the traits of arable land are manifested in various aspects such as space and time [1]. It is of great practical significance to analyze the spatial and temporal changes of arable land in Korea.

2. Overview of the study area and data sources

2.1 Overview of the study area

The Republic of Korea, is located between 34 °-38 °N and 126 °-130 °E, with a diverse topography of low mountains, plains, and hills, high in the east and low in the west, a temperate monsoon climate, and a population concentrated around the capital (Figure 1).

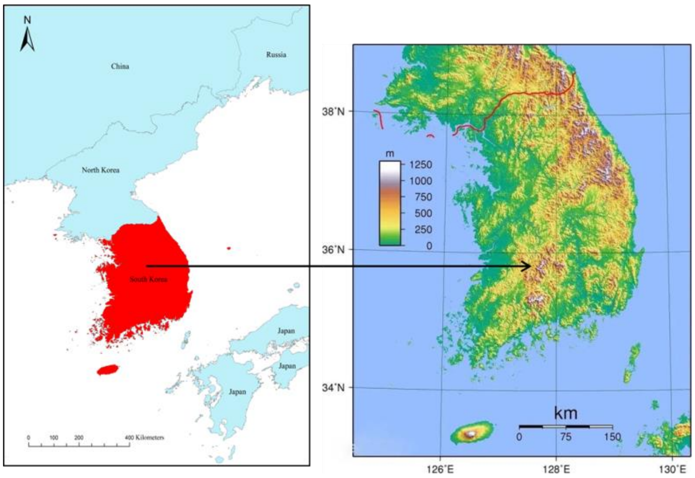

Figure 1: General Situation

2.2 Data sources

In this study, land use data for 2010 and 2020 were obtained from the official website of GlobeLand30 product. The dataset covers a rich variety of land use types, including cropland, forest, grassland, shrubland, wetland, water bodies, man-made surfaces, bare land, and marine areas [2].

3. Patterns and changes in spatial and temporal distribution of surface cropland cover in Korea

3.1 Overall pattern of other surface cover types in Korea

Based on the GlobeLand30 ground cover data, ArcGIS mapping was utilized to obtain the spatial distribution map of ground cover in Korea in 2010 and 2020 as shown in Figure 2. From Figure 2, it can be seen that some of the feature types have a more obvious geographical spatial concentration in space. Among them, the areas and proportions of various types of ground cover in Korea in 2010 and 2020 are shown in Table 1.

Table 1: Surface coverage area and proportion of various types in South Korea in 2010 and 2020

vintages	parameters	plow land	deforestation	grasslands	shrubland	wetlands	body of water	artificial surface	bare ground
2010	Area/km2	32839.64	55789.84	4534.56	51.38	225.02	1501.41	3550.42	0.30
	percentage	33.34%	56.64%	4.60%	0.05%	0.23%	1.52%	3.60%	0.00031%
2020	Area/km2	26818.19	59235.91	4049.26	40.24	155.85	1546.14	6496.02	138.09
	percentage	27.23%	60.15%	4.11%	0.04%	0.16%	1.57%	6.60%	0.14%

The land cover types in Korea in 2020 were dominated by forests and croplands, with the total area of the two accounting for 87.38% of the total land area, while shrublands, wetlands, and bare ground were smaller, with the combined area of the three accounting for less than 0.40% of the total land area. In terms of the distribution characteristics of each category, the man-made land surface is concentrated in the Gyeongin Industrial Zone centered on Seoul Special City and the Southeast Coastal Industrial Zone centered on Busan and along the highways connecting the two areas, while the man-made land surface is also concentrated in major wide-area cities, and it has a point-like layout on the whole of Korea's land area, and Jejudo Province has a semi-annular layout, which is closely related to the topographical characteristics of Jejudo, which is high in the middle and low in the surrounding areas. Forests are widely distributed throughout the administrative regions of Korea, generally more in the east than in the west. Water bodies, wetlands, and grasslands are scattered throughout the country.

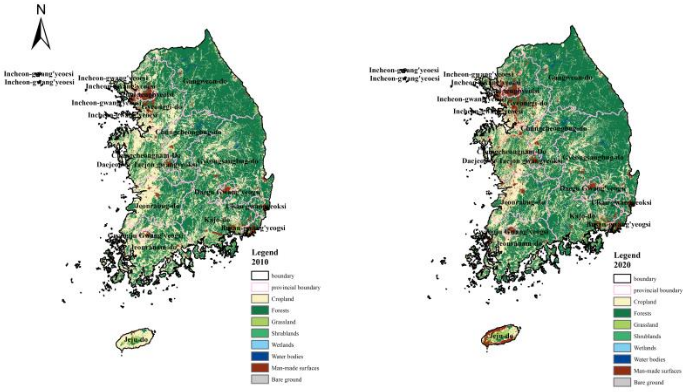

Figure 2: Spatial distribution map of surface cover in South Korea in 2010 and 2020

3.2 Distribution pattern of arable land in Korea

Under the dual influence of habitat and topographic factors, the distribution of arable land in Korea shows a specific pattern - most of the arable land is concentrated in the western part of the country where the elevation is relatively low and the slope is gentle. Combining the spatial distribution map of Korea's surface cover in 2010 and 2020 (Figure 2) with the analysis of Korea's topographic elevation data, the vast majority of cultivated land is distributed in areas with an elevation of less than 300m.

3.3 Spatial and temporal changes in cropland cover in Korea

3.3.1 Timing

As shown in Table 2, the overall decrease in the area of cropland in 2020 compared to 2010 land use data is the highest among the other land categories in a decreasing trend, and the rate of change is also more significant at -18.34%.

Table 2: Changes in Surface Cover Area in South Korea from 2010 to 2020

vintages	parameters	plow land	deforestation	grasslands	shrubland	wetlands	body of water	artificial surface	bare ground
2010-2020	Change/km^2	-6021.46	3446.07	-485.30	-11.14	-69.17	44.74	2945.60	137.79
	rate of change	-18.34%	6.18%	-10.70%	-21.69%	-30.74%	2.98%	82.96%	45429.08 %

The Markov surface cover type transformation matrix method [3-4] was applied to obtain the area transformation matrix between surface cover types in Korea for the period 2010-2020. Visualization was performed using OriginPro [5] to obtain Figure 3.

According to Figure 3, it can be seen more clearly that the main sources of the increase in the area of arable land are forests and grasslands, and the main destination of the decrease in the area of arable land is forests and man-made surfaces, by combining with the land-use transfer matrix (Figure 3), in which the increase in the area of arable land of 62.38% comes from forests, and 18.61% comes from grasslands.

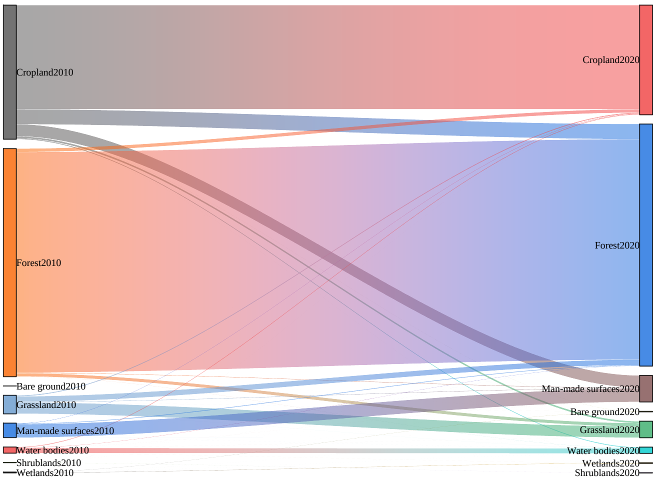

Figure 3: Sankey diagram Map of Land Use Transfer in South Korea from 2010 to 2020

3.3.2 Spatial variations

Using ArcGIS to map the changes in cultivated land (Fig. 4), the decrease in cultivated land is mainly concentrated in Gyeonggi Province in the northeast, the east side of Jeollanam-do in the south, the southwest side of Gyeongsangnam-do, the territory of Gwangju Metropolitan City, part of the central part of Gyeongsangbuk-do, and the coastal area of Jeju-do's roundabouts, with Jeju-do having the most pronounced decrease in the area of cultivated land; whereas, the increase in cultivated land is significantly weaker than the decrease in the area of cultivated land. On the other hand, the increasing trend of cultivated land area is weaker than the decreasing trend, and it is mainly concentrated in the northern part of Gyeongsangbuk-do, the coastal area of Gyeongsangnam-do, and the northern part of Gyeonggi-do and Gangwon-do, which are close to North Korea, in the form of dots or patches. It is not difficult to find that the cultivated land area shows a very significant spatial trend of decrease, with the overall rate of decrease being "larger in the west and smaller in the east".

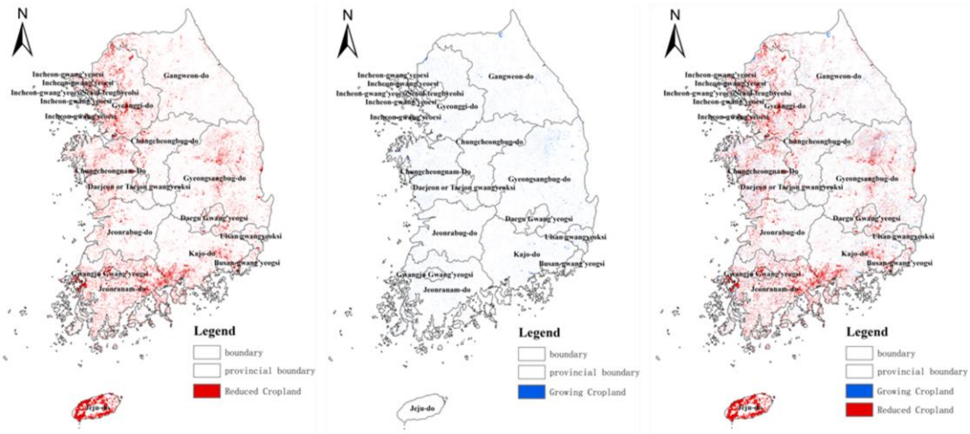

Figure 4: Changes in cultivated land from 2010 to 2020

4. Conclusion

(1) Some of the feature types have a more pronounced geospatial concentration in space. In particular, most of the cultivated land in Korea is concentrated in the western part of the country where the elevation is relatively low and the slope is gentle.

(2) In terms of temporal change, the amount of reduction in the area of cultivated land in Korea from 2010 to 2020 is the highest and significantly higher than that of other land categories. The rate of change is also more significant, at -18.34%, when compared with the land use data for 2010.

(3) In terms of spatial changes, the area of cultivated land in Korea has shown a very significant spatial trend of decrease, most notably in the coastal area of Jeju Province, and the decrease in the area as a whole is characterized by "more in the west and less in the east", which is closely related to human activities and topographical factors.

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