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RESEARCH ARTICLE

CULTIVATED LAND DYNAMICS IN THE BELT AND ROAD INITIATIVE (BRI) REGION: IMPLICATIONS FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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ABSTRACT

From 2010 to 2020, the Belt and Road Initiative (BRI) region experienced notable transformations in the dynamics of cultivated land. These changes were primarily influenced by factors including as urbanization, environmental legislation, and agricultural methods. The focal point of this transformation was the swift urban growth observed in China, which played a significant role in the notable decrease of arable land. Despite being partially mitigated by afforestation projects like the "Green for Grain Project," the decrease in land availability has raised apprehensions over the long-term viability of land utilization and the assurance of food security. Divergent patterns of cultivated land alterations were seen, as Southeast Asia exhibited a tendency towards the expansion of commercial agriculture, while countries such as Central and Eastern Europe faced the challenge of heightened fragmentation. Israel has emerged as a prominent example of sustainable agriculture, showcasing the potential of technological breakthroughs in improving land production. The synergistic benefits of reciprocal agricultural endeavours were emphasized through collaborative efforts, notably between China and nations participating in the Belt and Road Initiative (BRI) that possess significant agricultural resources. This study highlights the imperative requirement for ongoing surveillance and enduring administration of cultivated lands in the Belt and Road Initiative (BRI) region. In light of the increasing global difficulties, it is of utmost importance to adopt a proactive approach to managing these lands in order to guarantee sustainable food security, environmental well-being, and socio-economic resilience in the long run.

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INTRODUCTION

The Belt and Road Initiative (BRI), which was initiated by China in 2013, represents a significant undertaking with the objective of reconfiguring the global economic landscape. The Belt and Road Initiative (BRI) functions as a comprehensive network of infrastructure projects aimed at enhancing commerce, investment, and collaboration by establishing connections between Asia, Europe, Africa, and other regions. The Belt and Road Initiative (BRI) consists of two primary elements: the Silk Road Economic Belt, which encompasses land connections, and the 21st Century Maritime Silk Road, which emphasizes maritime routes. This initiative draws inspiration from historical corridors that historically facilitated significant cultural and commercial interactions(1). With a presence in more than 60 nations across three continents, the extensive scope of the Belt and Road Initiative (BRI) indicates its capacity to significantly influence land utilization, infrastructure development, and environmental conditions. Therefore, an investigation into the alterations in cultivated land inside the Belt and Road Initiative (BRI) region can provide valuable insights not only into agricultural transformations but also into the wider socio-economic and environmental consequences of this extensive undertaking (2,3). Cultivated land shifts in the Belt and Road Initiative (BRI) region are important not only as an agricultural study but also as a comprehensive analysis of the initiative's significant effects. BRI is an economic project to stimulate trade and investment. Thus, infrastructure investments and transportation route growth affect land use. Due to changes in cultivated land usage, agricultural regions may suffer economically (4). The BRI's broad expanse includes varied agroecological zones vital to global and regional food security. Changes in cultivated land usage or type might affect food supply and pricing (5). Environmental and ecological concerns are linked to cultivated land changes beyond food security. The infrastructure-driven BRI may harm soil health, biodiversity, and water resources by annexing or affecting their local environments (6). Land, especially cultivated land, is culturally and historically significant in many BRI nations. Thus, land use changes may affect agricultural practices, land ownership norms, and community identities (7). Finally, cultivated land modification research can greatly impact policy.

With ground-level data, policymakers may align BRI projects with sustainable, community-centric goals, aligning the initiative with local and regional needs (8). In conclusion, the BRI region's cultivated land dynamic is a complex web of economic, environmental, sociocultural, and policy narratives that requires careful study. The Belt and Road Initiative (BRI) regions have historically been important for agriculture. The fertile plains of China, the huge steppes of Central Asia, and the rich soils of Eastern Europe have been host to different agricultural practices, innovations, and revolutions for millennia. The rich Yellow and Yangtze river valleys in China are the birthplace of East Asian agriculture. One of the earliest organized agricultural practices in Asia was rice growing in the Yangtze River basin around 7000 BCE (9). The Yellow River Valley's wheat and millet cultivation traditions date back over 9000 years (10). However, the Kazakh Steppe and Turkmenistan-Uzbekistan grasslands and semi-arid regions dominate Central Asia. Domesticating horses and raising animals has been key to the regional economy in these pastoral nomad areas (11). However, oases like the Fergana Valley have been important agricultural hubs with fruit orchards and cotton fields (12). Moving west, Eastern Europe's grasslands, steppes, and river basins have contributed to Europe's grain output. The Black Earth region (Chernozem belt) from Ukraine to southern Russia and Kazakhstan is one of the world's most fertile agricultural zones, contributing to the agrarian economy of the countries (13).

Civilizations have relied on cultivated land for food and economic structure. Cultivated land is the foundation for agriculture, which contributes significantly to GDP, foreign exchange, and employment in many countries. Agriculture provides food and raw materials for textiles and pharmaceuticals (14). It greatly affects trade balances, national income, and macroeconomic stability. Cultivated land drives regional growth beyond economic benefits. Logistics, processing, and retail generally increase with agriculture, encouraging rural-urban links. Economic dynamics affect population distributions, infrastructure needs, and urbanization. The agricultural backbone of India and China has shaped migration patterns, urban labour supplies, and economic trajectories (15). Cultivated land affects socio-ecology. It affects biodiversity, soil health, and water cycles by shaping landscapes. Land-use changes in agricultural regions affect pollinator populations and carbon sequestration (16). Cultivated terrain is typically socioculturally significant. They preserve ancestral traditions, indigenous knowledge, and culture. Many communities' identities, history, and social systems are tied to these areas. The stories, rituals, and legacies they perpetuate are as valuable as their goods. Traditional farming practices frequently balance communal needs and ecological sustainability, making land care a generational obligation (17). Given the Belt and Road Initiative (BRI) region's wide geography and historical significance, many studies have examined cultivated land changes. This research examined spatial-temporal dynamics and socio-economic effects. Li*, et al.* (18) used satellite images and GIS to track China's cultivated land changes from the 1980s to the early 2000s. The research showed that urban expansion and industrial development reduced farmed areas near urban centres, especially in Beijing and Shanghai. In a Central Asian comparison, Petrick (19) found that cultivated land area changes. Kazakhstan's agricultural land declined post-Soviet due to socio-political upheavals and economic constraints, although it recovered in the next decade. Turkmenistan and Uzbekistan, however, increased planted acreage due to the official cotton planting policy. Ivanic and Martin (20) examined Ukrainian and Southern Russian agrarian trends. Their research showed that traditional crops are declining in favour of more commercially viable ones due to shifting global market dynamics and domestic laws. A more comprehensive study by Chen*, et al.* (21) examined the socio-economic effects of cultivated land modifications in multiple BRI nations. Their studies showed that cultivated land, rural employment, and migratory trends are interconnected. Farm-based employment declined in several places as infrastructure projects replaced agricultural land, driving rural-urban migration. Chen, Yu, Hu, Xiang, Zhou and Wu (21)concluded with a significant paper on the environmental impacts of cultivated land modifications. The study found that cultivated areas, especially in Western China, commonly replaced native grasslands and woodlands, causing ecological imbalances and jeopardizing local biodiversity. This study examines the Belt and Road Initiative (BRI)'s complex effects on cultivated land dynamics in its region. This study aims to quantify the quantity and spatial aspects of cultivated land changes since the BRI's establishment. The study also seeks to identify the economic, societal, and environmental factors driving these changes. It seeks to assess the socio-economic, environmental, and policy repercussions of these land changes. This research must also advocate sustainable land use and agricultural practices to ensure that the BRI's broader goals match the areas' agricultural and ecological well-being.

MATERIAL AND METHODS

Study Area: The Belt and Road Initiative (BRI) is a comprehensive and dynamic framework that encompasses a wide-ranging and heterogeneous geographical terrain. The scope of this analysis is carefully delineated to concentrate on a specific subset of the Belt and Road Initiative (BRI) region, encompassing 64 countries and spanning seven unique geographical zones. The countries mentioned above are geographically distributed throughout many regions, including East Asia, Central Asia, Southeast Asia, South Asia, Central and Eastern Europe, West Asia, and North Africa. The complex network among these nations offers a pathway that encompasses the dual nature of the Belt and Road Initiative (BRI). One of the key initiatives is the "Silk Road Economic Belt," which spans from China to Central and West Asia and culminates in Europe. On the other hand, the "21st Century Maritime Silk Road," delineates a maritime pathway that originates from China and concludes in Europe, with intermediate stops in Southeast Asia, South Asia, and North Africa (Fig. 1).

The rationale behind focusing on these 64 countries is multi-faceted. Primarily, this excerpt presents a comprehensive and diverse portrayal of the Belt and Road Initiative (BRI), encompassing its extensive scope and varied nature. The study incorporates a distinctive combination of socio-economic, cultural, and environmental factors, resulting in a comprehensive and broadly applicable set of conclusions. The alignment of this approach not only guarantees the application of rigorous academic standards but also provides a valuable opportunity to expand upon current knowledge, thus advancing the ongoing discussion on alterations in cultivated land. The socio-economic fabric of these countries holds great importance.

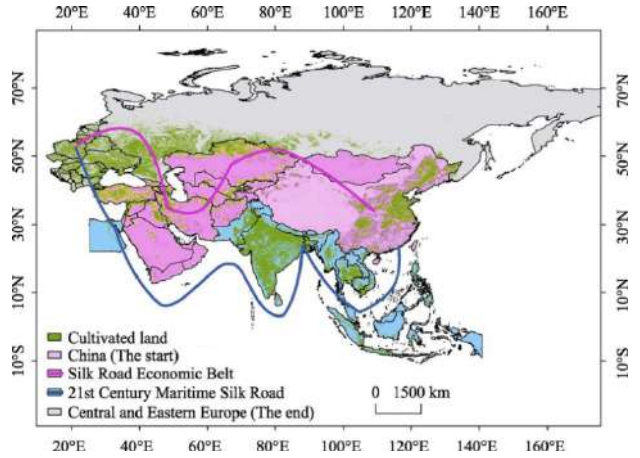


Figure 1. Visual representation of Belt and Road (BRI) initiative

A significant proportion of the Belt and Road Initiative (BRI) is comprised of developing countries. Within these particular contexts, agriculture assumes a role that extends beyond being a mere sector, as it frequently serves as the fundamental pillar supporting socio-economic advancement. According to data obtained from FAOSTAT, a considerable number of nations exhibit an agricultural sector that makes a more substantial contribution to their respective national economies compared to the world average. Therefore, comprehending alterations in cultivated land within this particular framework is not only intellectually captivating but also an examination of socioeconomic dynamics and their ramifications.

Data and Application: The fundamental basis of our satellite data is the GlobeLand30 dataset, which may be accessed from its official website (http://www.globeland30.com). GlobeLand30 is well recognized as a prominent worldwide land cover database, renowned for its remarkable spatial resolution of 30 meters. The sculpture is derived from a collection of remote-sensing photos with varying resolutions, primarily sourced from satellites such as Landsat TM/ETM+ and HJ-1 (22,23). The information provides us with two significant land cover maps for the years 2010 and 2020. The maps presented in this study cover a total of eleven separate land classifications, ranging from cultivated fields and forests to shrublands and marshes. The cultivated land maps are particularly important in our study, as they are crucial to our research. It is encouraging to observe that the maps in question exhibit a notable level of precision, ranging from 93.63% to 98.90% throughout the duration of our study, spanning from 2010 to 2020 (24). In addition to utilizing satellite imagery, we employ statistical data pertaining to harvested areas particular to each country. The information provided by FAOSTAT (http://www.fao.org/faostat/en/#home) allows a detailed analysis of the agricultural dynamics inside the Belt and Road Initiative (BRI) region. Our methodology also encompasses the utilization of three sets of indicators to extract the spatial and temporal changes in cultivated land within the Belt and Road Initiative (BRI) from 2010 to 2020. The metrics discussed in this context are mostly dependent on the datasets described, encompassing various factors such as shifts in the overall amount of cropland (ΔCA) and metrics related to land utilization, like the multi-cropping index (MCI).

Methodological Approach: This study utilizes Geographic Information Systems (GIS) analysis and sophisticated statistical tools to examine the complex dynamics of cropland changes in the BRI region.

Geographic Information Systems (GIS) Analysis: Geographic Information Systems (GIS) provide an exceptional geographical framework that facilitates the management of several layers of information and the synthesis of spatial data for the purposes of display and analysis. The extensive scope of BRI, which covers more than 64 nations across diverse geographical regions, necessitates the use of Geographic Information Systems (GIS) to analyze and interpret this intricate network of connections. The research prominently utilizes the GlobeLand30 dataset, which offers a high spatial resolution of 30 meters. Geographic Information System (GIS) technologies facilitate the extraction of relevant data from the dataset, with a primary emphasis on cultivated land patches throughout the years 2010 and 2020. The application of Geographic Information Systems (GIS) facilitates the creation of comprehensive land conversion matrices for individual countries. These matrices provide a thorough representation of the transitions occurring between cultivated areas and many other land cover classifications. The matrix plays a crucial role in comprehending the influx and efflux from cultivated lands during a span of ten years. Figure 1provides a full depiction of the Belt and Road Initiative (BRI), differentiating between the countries falling under the "Belt" and "Road" categories. The utilization of geographical visualization is crucial for understanding the spatial patterns of cultivated land changes within the expansive Belt and Road Initiative (BRI) region.

Statistical Tools: In addition to doing spatial analysis, this research extensively relies on statistical approaches to quantify and understand the alterations in cultivated land. This objective involves the consideration of three unique groups of indicators, the computation of which frequently entails the utilization of complex statistical equations. For example, the metrics of the rate of change in area (RCA) and the shifts in the overall amount of cropland (ΔCA) are calculated based on national-level data on cultivated land for the years 2010 and 2020. The calculations are described in equations (1) and (2).

$$\Delta CA = CA_{2020} - CA_{2010}$$

$$R_{CA} = \frac{\Delta CA}{CA_{2010}} \times 100\%$$

Where CA_{2020} represents the total land area under cultivation in the year 2020, whereas CA_{2010} denotes the overall cultivated land area in the year 2010. The research paper also presents measures such as the multi-cropping index (MCI) and fragmentation index (FI) as tools for assessing the level of land utilization. The indices utilized in this study are derived from a combination of the GlobeLand30 dataset and harvested area data sourced from FAOSTAT. Formulas (3) through (6) provide a detailed explanation of the mathematical calculations involved in determining these measurements. The validation and alignment of datasets is a crucial component of this scientific approach.

$$Share_{IN_m} = \frac{IN_m}{CA_{2020}} \times 100\%$$

IN_m represents the total area of cultivated land that has undergone conversion from land cover class m within a specific place over the time period between 2010 and 2020.

$$Share_{OUT_n} = \frac{OUT_n}{CA_{2010}} \times 100\%$$

OUT_n represents the total area of cultivated land that has been changes to other land type*n* within a certain geographic location over the time period between 2010 and 2020.

$$MC_{it} = \frac{HA_{it}}{CA_{it}}$$

The terms *HA* and *CA* refer to harvested area and agricultural land area, respectively. The variable *i* is used to denote a certain country, whereas the variable *t* is used to represent a particular time stage.

$$FI_{jt} = \frac{NP_{jt}}{CA_{jt}} \times 100\%$$

The term *NP* refers to the count of agricultural land patches, which is determined using the FRAGSTATS software at both the national and county levels. The variable *j* is used to denote a county. When calculating the country-level FI, the variable *i* will be utilised as a substitute for the variable *j*.

RESULTS

Shifts in Agricultural Land Area: The period spanning from 2010 to 2020 had notable changes in the cultivated land areas within the geographical scope of the Belt and Road Initiative (BRI). The cultivated land area significantly increased by roughly 3.73×10^4 km^2, equivalent to approximately 0.39% throughout the specified time period. The cultivation of land in East Asia was primarily concentrated in the eastern regions, extending across Southern, and northern parts of Central Asia and Westers Asia, and the southwestern area of CentralEurope and Eastern Europe (Fig. 2). Various locations, such as northeast India, south Kazakhstan, the Nile Delta of Egypt, and central Vietnam, exhibited notable expansions in cultivated lands. In stark contrast, there was a significant decline observed in the agricultural land in China. The observed disparity in modifications made to farmed land was also observed in specific regions of significance, namely southwest Iran and southwest Russia. The patterns that have been previously stated provide a more full comprehension of the modifications performed to cultivated land within a certain geographic area.

When examining the data based on geographical regions, it is observed that Central Europe and Eastern Europe exhibited the highest level of change in agricultural land areas, with a notable rise of approximately 2.76×10^4 km^2. In contrast, the region of East Asia observed a net decrease in land area, mostly ascribed to China, totalling around -1.88×10^4 square kilometres. Southeast Asia subsequently had a net increase of approximately 10,500 square kilometres. It is noteworthy that Central Asia exhibited the most minimal net change. Upon analyzing the growth rates, it is evident that North Africa had the most substantial growth, reaching around +8.65%. This was followed closely by Southeast Asia, which experienced a growth rate of +1.21%, and Central and Eastern Europe, which recorded a growth rate of +1.04%. In contrast to other regions, East Asia experienced a decline in cultivated land, specifically a decrease of approximately -0.93%. This trend can be mostly attributed to the fall in China's net cultivated land. Upon further examination of the trends particular to each country between 2010 and 2020, it was observed that among the nations encompassed by the Belt and Road Initiative (BRI), 38 countries experienced an increase in their agricultural land areas, while 25 countries observed a decrease. It is worth noting that Bhutan, Brunei, and Laos experienced significant growth rates of 20.15%, 15.73%, and 12.14%, respectively. In contrast, it can be observed that nations such as Israel, Jordan, and Lebanon underwent significant declines in their rates, specifically -18.82%, -11.08%, and -7.21%, respectively. It is imperative to emphasize that the countries mentioned above possess limited farmed regions, so even minor fluctuations in the area can lead to substantial percentage shifts.

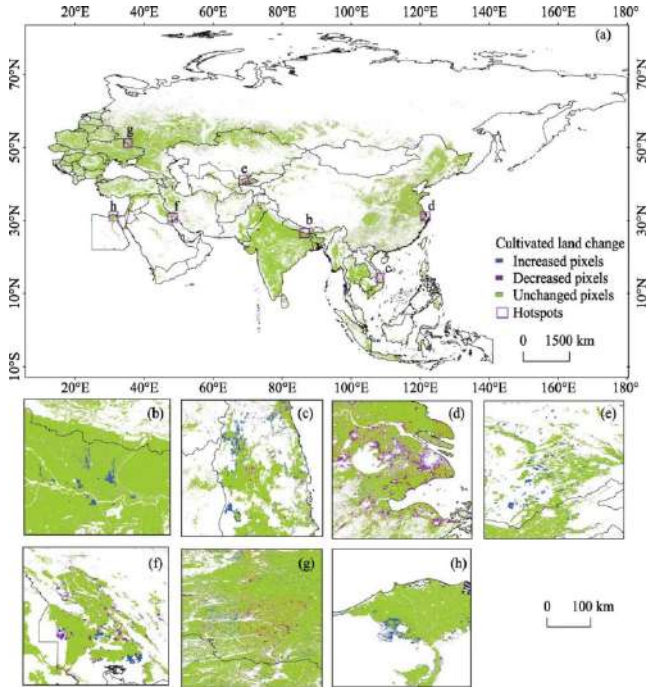


Figure 2. Encapsulates the changes within the BRI from2010 to 2020. It spotlights seven geographical hotspots that symbolize the broader cultivated land changes across various zones

Conversions in Land Types: Between the years 2010 and 2020, an overwhelming majority of the cultivated land inside the Belt and Road Initiative (BRI) region, specifically around 96.50% of it, maintained its original classification. Nevertheless, notable shifts were seen in the conversion of cultivated land to several land use classifications, including woods, grasslands, bare fields, and artificial surfaces, with discernible variations across different regions. In the context of the expansion of cultivated land, Southeast Asia experienced significant changes, wherein approximately 3.57% of its cultivated land resulted from the conversion of forested areas. The expansion of cultivated areas in West Asia and North Africa can be attributed to the conversion of previously uncultivated land. Specifically, the growth rate in cultivated areas in West Asia was 1.03%, while in North Africa it was 10.26%. The region of Central and Eastern Europe experienced a conversion of 1.76% of its newly cultivated land from grassland sources. In contrast, Central Asia and West Asia experienced reductions in cultivated areas, with corresponding transitions of 3.51% and 1.44% of their cultivated fields being converted into grasslands. Moreover, it should be noted that in the East Asia region, a total of 1.76% of the land that was formerly used for cultivation has been transformed into artificial surfaces. This information can be seen in Fig. 3 and Fig. 4.

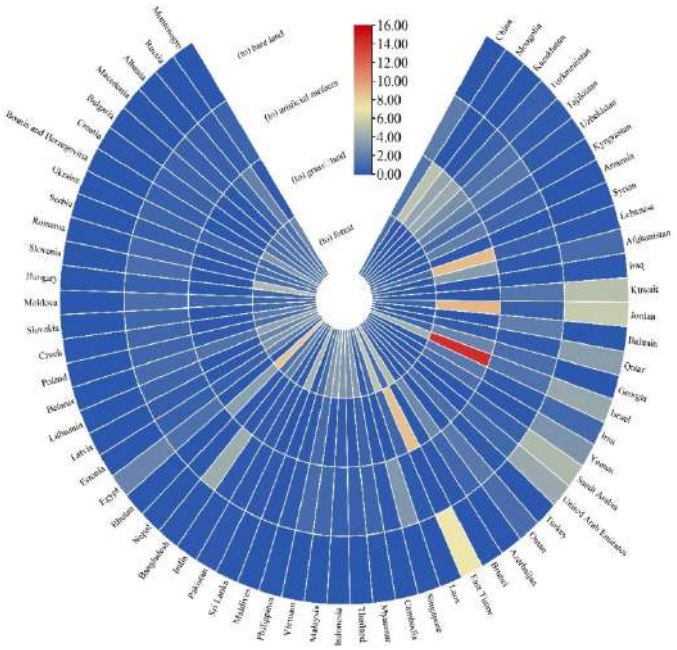


Figure 3. Percentage of agricultural land changed into other land cover types, and other land cover types changed into agricultural land in the BRI region between 2010 and 2020 (IN_m)

An in-depth analysis reveals that the emergence of new cultivated areas resulting from the conversion of grasslands and bare lands is mostly concentrated in the geographical regions commonly referred to as "the Belt," which encompasses Central Asia and West Asia. As an example, Armenia, Azerbaijan, and Kazakhstan saw grassland conversions resulting in 15.05%, 11.83%, and 3.85% of their cultivated areas, respectively. In the geographical regions encompassing the United Arab Emirates and Oman, the transformation of uncultivated lands into cultivated areas constituted around 10.11% and 9.59% of the total land area, respectively. On the other hand, there was a higher occurrence of transitions from forests to cultivated areas in nations featured in "the Road," with a particular emphasis on Southeast and South Asia. Bhutan and Laos serve as prime examples of this prevailing pattern, as 25.80% and 12.90% of their forested areas, respectively, are undergoing conversions into cultivated land.

These percentages notably surpass those of other land cover categories. When doing an assessment of land that has undergone a shift from cultivated classification to other categories, it becomes evident that the conversions to artificial surfaces have predominantly occurred in China and some nations with a significant focus on infrastructure development, such as Bangladesh and Singapore. Bangladesh, Singapore, and China have witnessed conversion rates of cultivated land to artificial surfaces at 4.13%, 3.14%, and 1.77%, respectively. In Central and Eastern European countries, as well as inside the territories known as "the Belt," there were more noticeable changes from cultivated lands to grasslands. Russia and Israel exhibit notable characteristics in this aspect, as they have observed conversion rates from cultivated land to grassland of 2.05% and 14.16%, respectively. These values significantly surpass the conversion rates observed in other land cover areas. Visually represented in Figure 3, the first segment (a) showcases the proportion of cultivated land that underwent conversion to diverse land cover categories within the BRI nations.

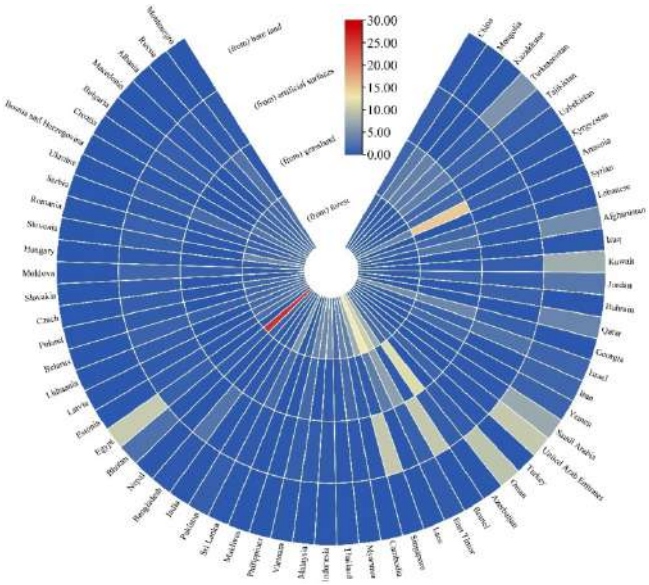


Figure 4. Percentage of agricultural land changedfrom other land cover types, and other land cover types changedfromagricultural land in the BRI region between 2010 and 2020 (OUT_n)

In parallel, the second segment (b) portrays the percentages of various land cover classes that transformed into cultivated lands within the BRI countries, all set within the decade of 2010 to 2020.

Gradual Changes in the Amount of Agricultural Land Use

Multi-cropping Index: Between the years 2010 and 2020, there was a significant rise in the Multi-cropping Index (MCI) within the BRI region. The MCI reached a value of 0.85 in 2020, indicating an increase of 0.03 or +3.64% compared to its value in 2010.

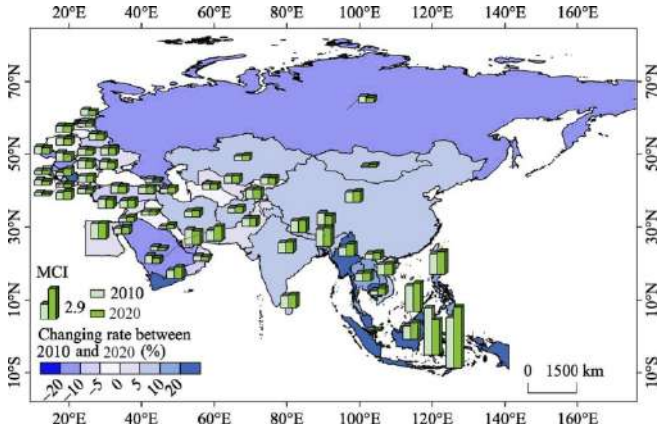


Figure 5. Gradual Changes in the Amount of Agricultural Land Use in the countries that are part of the Belt and Road Initiative (BRI)

The countries of Southeast Asia, specifically Malaysia, the Philippines, and Brunei, exhibited a notably high MCI value, exceeding 2.00. In the interim, a significant proportion of nations participating in the Belt and Road Initiative (BRI) were found to have a Multidimensional Poverty Index (MPI) ranging from 1.00 to 2.00. Nevertheless, the regions with the lowest MCI values, which were below 1.00. A noticeable trend emerged wherein the BRI regions located in the southeastern section demonstrated a higher rate of rise in MCI compared to their counterparts in the northwestern regions over the course of the decade.

Table 1. The countries involved in the "Belt and Road Initiative" (BRI)

BRI	China		The Belt		The Road			Central and Eastern Europe
Geographical zone	East Asia		Central Asia	West Asia	Southeast Asia	South Asia	North Africa	Central and Eastern Europe
Countries	China	Mongolia	Kazakhstan, Turkmenistan, Tajikistan, Uzbekistan, Kyrgyzstan, Armenia, Syrian, Lebanese, Afghanistan, Iraq, Kuwait, Jordan, Bahrain	Qatar, Georgia, Israel, Iran, Yemen, Saudi Arabia, United Arab Emirates, Turkey, Oman, Azerbaijan	Brunei, East Timor, Laos, Singapore, Cambodia, Myanmar, Thailand, Indonesia, Malaysia, Vietnam, Philippines	Maldives, Sri Lanka, Pakistan, India, Bangladesh, Nepal, Bhutan	Egypt	Estonia, Latvia, Lithuania, Belarus, Poland, Czech, Slovakia, Moldova, Hungary, Slovenia, Romania, Serbia, Ukraine, Bosnia and Herzegovina,Croatia, Bulgaria, Macedonia, Albania, Russia, Montenegro

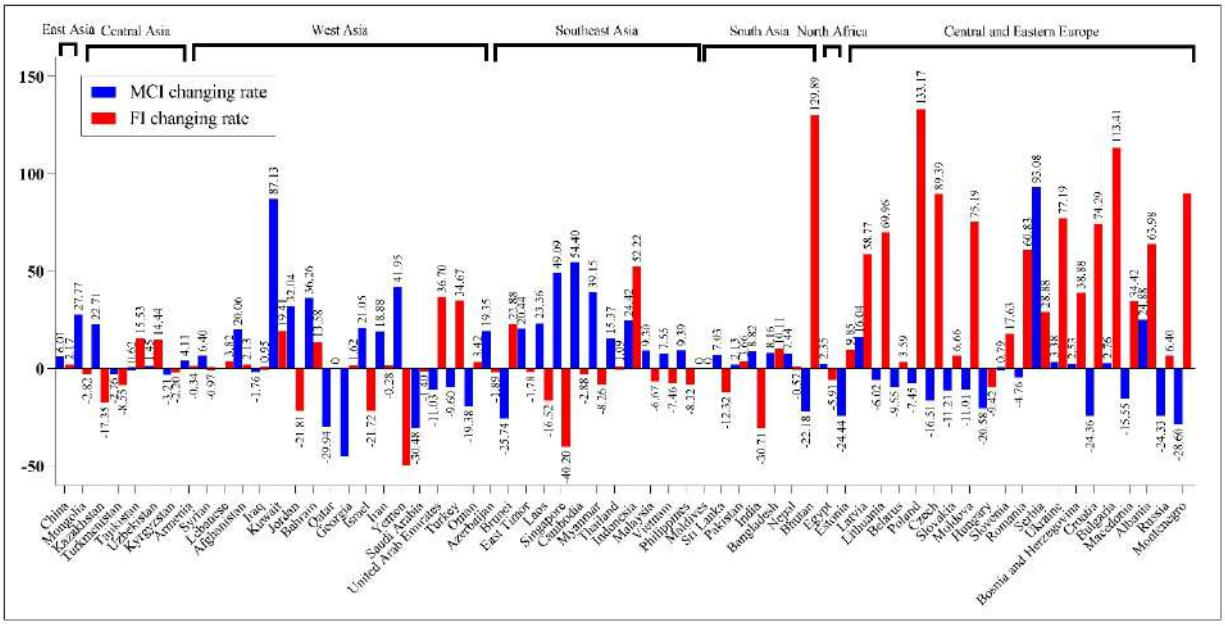
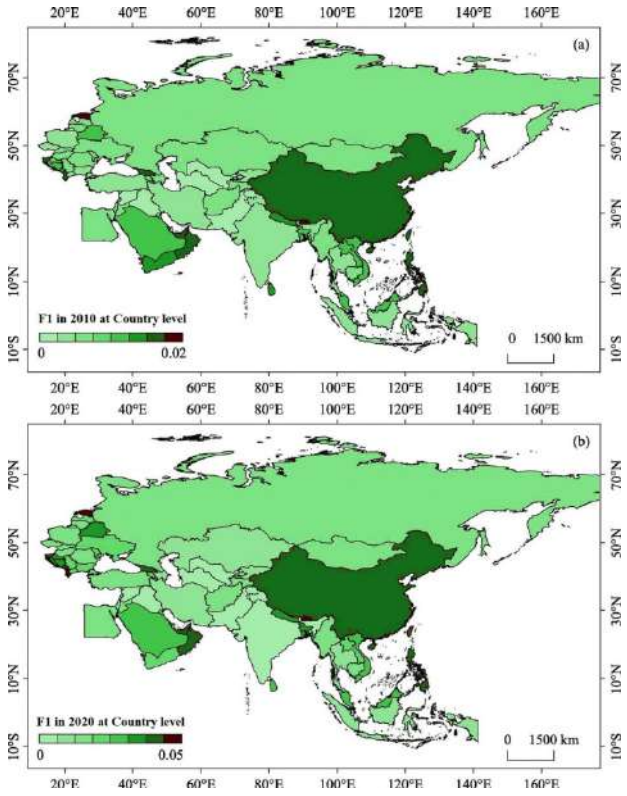
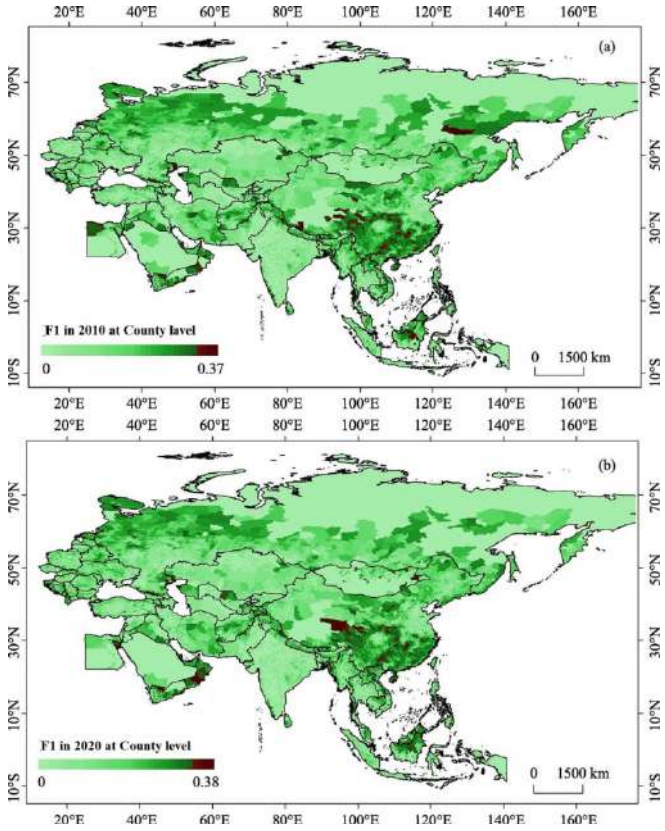


Figure 6. Variations in the multi-cropping index and fragmentation index across seven geographical zones and individual countries within the Belt and Road Initiative (BRI) region over the period from 2010 to 2020

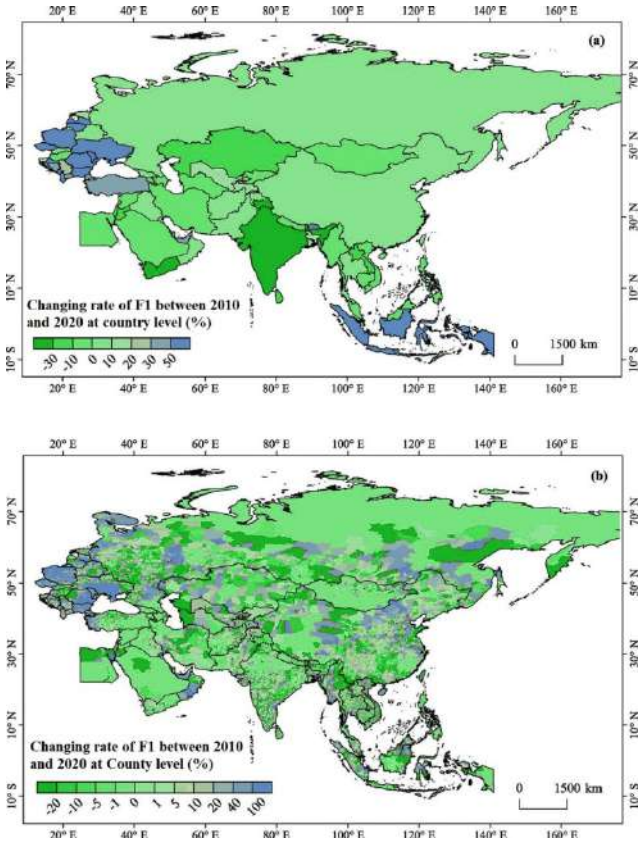
The growth rate of MCI in Southeast Asia experienced a significant increase, reaching 17.30%, which was notably higher than the growth rate of 1.98% observed in West Asia. The sole region seeing a downward trajectory in Central and Eastern Europe exhibited a decline of -11.76%. In the realm of transportation infrastructure, it was seen that nations such as Indonesia, Laos, and Thailand experienced significant increasesMCI. Specifically, Indonesia recorded a notable MCI increment of 21.40%, while Laos and Thailand observed increments of 20.68% and 13.45% respectively. In contrast, the "Belt" region exhibited a more varied scenario, with Israel and Kazakhstan witnessing significant increases in MCI rates at 18.97% and 20.33%, respectively. Conversely, Oman and Turkey observed declines in MCI rates at 17.42% and 8.57% respectively. The growth rate of China's MCI was recorded at 5.45%, positioning it as the 28th-ranked nation among the countries participating in the Belt and Road Initiative (BRI).



Fragmentation Index: Regions such as Easters Asia, southern parts of Westers Asia, and select states in CentralEurope and Eastern Europe, including China, Philippines, had elevated Fragmentation Index (FI) values. In marked contrast, nations situated in Southers, Central, and Westers parts of Asia demonstrated diminished FI values. Upon conducting a more in-depth analysis of fragmentation at the county level, notable spatial disparities were revealed, including the identification of a higher prevalence of fragmented farmed regions in the southern regions of China.



The composite Financial Index (FI) for nations participating in the Belt and Road Initiative (BRI) experienced a notable increase of 5.86% throughout the period spanning from 2010 to 2020.



The trend of a significant increase in Foreign Direct Investment (FDI) was primarily driven by countries in CentralEurope and Eastern Europe, which experienced a spectacular growth rate of +20.96%.

Nevertheless, it is worth noting that regions like Central and Southern parts of Asia demonstrated a downward trend in the FI trajectory, seeing significant declines of -12.78% and -15.14%, respectively. At the national level, a wide variety of tendencies were evident. Israel, Kazakhstan, and Saudi Arabia, which are part of "the Belt," experienced a decrease in cultivated land FIs of -19.82%, -15.61%, and -1.25%,respectively. The Road areas exhibited analogous trends, as evidenced by the decline in economic growth rates observed in nations such as the Philippines (-7.42%), Myanmar (-7.38%), and Vietnam (-6.68%). Nevertheless, countries located at the endpoints of "the Belt" and "the Road," experienced an increase in Foreign Direct Investments (FDIs). China's foreign investment (FI) experienced a notable increase of 1.94% during the course of the decade, resulting in its attainment of the 31st position among the nations participating in the Belt and Road Initiative (BRI). Intra-national disparities have also been apparent, as exemplified by the Yangtze River Delta and Beijing-Tianjin-Hebei Region in China experiencing heightened levels of fragmentation, whilst specific southern regions have experienced a greater concentration of farming activities.

DISCUSSION

The period spanning from 2010 to 2020 witnessed a significant decrease in cultivated land in East Asia, which emerged as a matter of worldwide apprehension, with China leading the way in this drop. The correlation between urban expansion and the decrease in cultivated areas has become more evident, indicating a noteworthy interaction among land use policies, economic progress, and environmental preservation. According to Yuan and Chen (25), China's urban expansion has reached a remarkable extent of 5.4×10^4 km^2 by the year 2020. The observed expansion, which serves as an indicator of a thriving economy and the progress of urbanization, also draws attention to a significant issue: the possible jeopardization of food security as a result of diminishing agricultural areas. The transformation of an estimated 5.1×10^4 square kilometres of arable land into urban areas aligns with similar patterns observed in other major cities worldwide. Urban areas across the globe experienced significant growth as a result of increasing population, the process of industrialisation, and a collective aspiration for improved quality of life(26). Nevertheless, China's level of conversion surpassed that of most nations, highlighting its unique path of development and the pressing want for inventive urban design and sustainable land use tactics.

The afforestation initiatives, including the "Green for Grain Project," emerged as a promising endeavour amidst these formidable circumstances. China's dedication to environmental restoration was exemplified by the conversion of 3.5×10^4 km^2 of cultivated land into woods, as documented by He*, et al.* (27). The praiseworthy nature of this dedication raises inquiries regarding the long-term viability of this trade-off. Furthermore, can the implementation of afforestation in isolation effectively mitigate the environmental consequences associated with the rapid process of urbanization? When examined from a global standpoint, the agricultural land challenges in China exhibit both divergences and parallels. The disparity in cultivated land dynamics between China and its neighbouring countries exhibited a significant contrast (28).

The aforementioned disparity serves to underscore the contextual intricacies that each country encounters, which are shaped by distinct socio-economic, political, and environmental circumstances. The complex relationship between the fragmentation of cultivated land and agricultural productivity was further elucidated. Despite presenting difficulties in implementing large-scale commercial agriculture, fragmentation has revitalized small-scale farming. The capacity to diversify crops in a cost-effective manner not only served to preserve local agricultural practices but also provided a means of safeguarding against potential crop failures. The story was further enhanced by notable agricultural transformations in the regions encompassed by the Belt and Road Initiative (BRI). Southeast Asia, characterized by its rich agricultural legacy, encountered a pivotal juncture. The proliferation of commercial agriculture and the increasing prevalence of large-scale land acquisitions have resulted in significant modifications within conventional farming landscapes. The evolution observed in regions such as Thailand and Indonesia can be seen as a manifestation of a broader global phenomenon characterized by the adoption of capital-intensive agricultural practices. This shift is affected by the dynamics of global markets and geopolitical considerations (29). In sharp contrast, many regions, including portions of China, Central and Eastern Europe, and West Asia, experienced a notable rise in fragmentation and the degradation of cultivated land. The factors contributing to this phenomenon were diverse, encompassing regulatory shifts such as the implementation of China's Household Responsibility System, as well as larger socio-economic and political changes (30).

The substantial repercussions of these transitions extend beyond land use to encompass socio-cultural landscapes and traditional livelihoods. China's engagements, particularly with nations involved in the Belt and Road Initiative (BRI), have revealed a positive aspect within the intricate dynamics of land use. The phenomenon of cultivated land abandonment in places such as Russia, Kazakhstan, and Ukraine has created opportunities for agricultural collaborations across these countries (31). These collaborations, utilizing China's significant financial capabilities and technological proficiencies alongside the abundant agricultural resources of the host country, serve as evidence of the possibility of international collaboration in tackling worldwide difficulties. Israel has made significant advancements in agricultural innovation, namely in the field of irrigation technology, which can serve as a model for other dry locations. The authors (32) argue that the recent technical developments serve as a reminder that its amount does not exclusively determine the productivity of land but also the quality of the land and the inventive approaches employed. Lessons of this nature hold significant value for nations such as China, which confront the dual predicament of diminishing arable land resources and a burgeoning population.

CONCLUSION

Over the course of the last decade, there have been notable developments in the dynamics of cultivated land in the region, including the Belt and Road Initiative (BRI). These changes have highlighted the complex relationship between urban expansion, environmental preservation, and the assurance of food security.

One of the most significant discoveries pertains to the remarkable expansion of urban areas in China. This expansion, while indicative of the nation's tremendous economic advancement, has led to a worrisome decline in cultivated land. Although partially mitigated by initiatives such as the "Green for Grain Project," the decrease in forest cover has prompted significant inquiries on the long-term viability of land utilization, agricultural efficiency, and ecological rehabilitation. Moreover, the Belt and Road Initiative (BRI) region exhibited divergent patterns in the dynamics of cultivated land. Southeast Asia observed a surge in commercial agriculture, but regions in Central and Eastern Europe, West Asia, and certain portions of China faced challenges related to heightened fragmentation and land degradation. The irrigation technology advancements made by Israel highlight the importance of both technological progress and sustainable practices in improving land productivity. The demonstration of possible mutual advantages and the significance of global partnerships in tackling land use concerns was exemplified by collaborative endeavours, including those between China and nations participating in the Belt and Road Initiative (BRI) that had extensive agricultural resources. Given the aforementioned discoveries, it becomes increasingly imperative to emphasize the significance of ongoing surveillance and control of alterations in cultivated land inside the Belt and Road Initiative (BRI) region. In light of the global challenges posed by climate change, population growth, and geopolitical shifts, the responsible management of cultivated lands in the Belt and Road Initiative (BRI) region and other areas will have a crucial impact on guaranteeing food security, maintaining environmental equilibrium, and fostering socio-economic stability for future generations.

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