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Editorial

Editorial for Special Issue "Land Use Change and Anthropogenic Disturbances: Relationships, Interactions, and Management"

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Land use has become a highly attractive research topic for understanding human–environment interactions in the Anthropocene [1]. Tremendous changes in population, resources, and the environment—most as a result of human civilization—have transformed our planet, and land use problems frequently draw the attention of scholars from many fields, from environmental science to geography, from remote sensing to regional economics, and from management to sociology, to name just a few. It is undeniable that land use change has resulted in many major advancements, but also pressing challenges, most of which can be described as the consequences of anthropogenic disturbances [2,3]. Increasing human activities and their impacts on resource consumption, pollution, and climate change bring multiple challenges to the investigation of land use change, especially when viewed from the perspective of addressing global challenges [4–6]. Thus, this presents new tasks for scholars, government officials, and policymakers, who should explore and understand how land use and anthropogenic disturbances interact in order to address these unsustainable relationships by using a range of management or policy tools.

Because land use is closely related to human livelihood and well-being [7], this Special Issue of *Land* aims to update the latest knowledge and progress in explaining the mechanism that links anthropogenic disturbances to land use change and to identify potential areas for future research. It is of practical significance to review the entire land use process and its changes over time by considering anthropogenic disturbances. Understanding these factors allows for sustainable responses to global changes and hazards, both in the short term and long term. In most cases, the challenges that await systematic solutions include understanding—through retrospectives, analyses, summaries, and predictions—how human activities contribute to or adapt to quantifiable land use change within complex societal, political, economic, and environmental contexts.

Land use interacts strongly with local conditions such as the built environment and natural resources, in addition to socio-demographic factors and, not least, the way land use management and policies are implemented, most of which can be attributed to anthropogenic factors [8,9]. The interactions are multidimensional and complex, leaving much that has not yet been explored. Because conceptual knowledge is required to better understand human activities and their consequences on local land use, earth observation technologies, statistical analyses, and prediction models should be improved to better assess the outcomes of anthropogenic disturbances, and corresponding tools and policies are urgently required to resolve specific land use problems [10,11]. Moreover, land use falls into the field of policymaking, regional governance, and demography, which must be involved in the efforts to strengthen environmental stewardship and sustainable development [12]. Accordingly, this Special Issue brings together a collection of papers that critically evaluate the links between land use and anthropogenic disturbance from multidisciplinary perspectives and using transdisciplinary approaches. This issue includes 15 peer-reviewed papers by scholars from developing countries that have faced, and continue to face, intensive human–land conflicts, clearly demonstrating that unbalanced interconnections between land use change and human activities are a global challenge. The papers fall into three categories. First, some empirical evidence [13–16] is reported on ways to address divisive debates on policy-driven land use issues and to highlight the conclusion that the effects of human activities (e.g., deforestation for urbanization) are magnified primarily by changes to natural systems such as land use. Second, several papers [17–22] discuss land use outcomes (e.g., land use structure, ecological services, carbon emission) regarding the performance of the environment, economy, and society with the considerations of anthropogenic process, and put forward countermeasures to achieve specific development goals. Third, some papers [23–27] analyze specific cases of land use or land management and the influencing factors behind those decisions, policies, and actions, with the goal to improve land use performance regionally. The spatial framework provides additional evidence about the way land in which is occupied and used geospatially [13,15,17,18,21].

The "human footprint" (HF) is a popular approach that captures the relations between humans and nature in a land use context. Tan et al. [13] explore human activities using the HF measure to assess the effectiveness of a protected area in China, the Sanjiangyuan Nature Reserve (SNR). They develop an HF dataset by localizing and optimizing the global HF model. The study concludes that the SNR is partially effective in mitigating human pressure. HF values decreased during the period 2005 through 2010 but increased over the following 5 years. The core areas of the reserve witnessed the lowest increase. A great challenge still remains for the government to balance conservation and development. The study's results are robust because of their consistency with other assessments using ecological indicators.

Land use in border areas has become a critical issue because disturbances can be produced within different economic, social, and cultural contexts. Cheng et al. [14] focus on China's border areas and present a human activity index (HAI) by involving land cover, population density, and nighttime light. The result reveals that the HAI on the Chinese side is generally higher than that on the neighboring side, and land use intensity increased greatly. Three types of HAI change—unilateral expansion, bilateral expansion, and cross-border fusion—were identified. The spatial evolution of border effects, isolation, and agglomeration point to the competition and cooperation between China and neighboring countries.

Another empirical study that investigates the humankind-driven land use change in border areas is from Rao and Zhang [15], who present their new findings about the context of rapid land conversion in southeast Asia, which is the result of the prosperity of the oil palm and rubber industries and consequent deforestation. They mapped land use volatility in the border and adjacent areas of five southeast and east Asian countries: Myanmar, Thailand, Laos, Vietnam, and China. The authors choose the normalized burning index (NBR) to better indicate land use change. Their results show that the agglomeration effect of human activities is dominant when comparing the size of the land use volatility area with NBR value change. Land use volatility gradually spreads on lands that have been artificially disturbed; stronger spillover effects and spatial characteristics are highlighted, along with the growth of intensity in human activity.

Land use history influences people's livelihood in both direct and indirect ways. Berget et al. [16] review land use history in two neighboring rural villages in southern Mexico. Qualitative ethnography, oral history research, and remote sensing techniques were utilized. Findings indicate that interacting historical social–ecological drivers, such as land conflicts with Indigenous peoples, land tenure, Guatemala's civil war, regional wildfires, and highway construction, determine each village's unique land use history and landscape composition. The history of each village influences farmers' preference to invest in and/or benefit from productive land use or off-farm activities, bringing implications for livelihood diversification. This diversification in turn relates to improvements in land use policies and forest conservation strategies in the tropical agroforest frontier.

General or specific land use change and its driving forces can be explicitly addressed using optional relational models [28]. Zhou and Zhou [17] present a case study of the Loess Plateau in northern Shaanxi in China that focuses on the spatiotemporal variations of land use change and influencing factors in the period 1980 through 2020. Employing the geographically and temporally weighted regression model, the researchers prove that national ecological restoration policies such as the Green for Grain Project and increased precipitation have accelerated the conversion from arable land to grassland and woodland. The growth of both the gross domestic product and the population has increased the expansion of construction land.

Cropland abandonment and the reasons behind it are often international hot issues. Li and Song [18] present research dealing with cropland abandonment in a mountainous county in Chongqing, China. They critically evaluate land use trajectories in the study period to overcome the lack of more refined and specialized remote sensing tools. Results show that, on average, more than 13% of cropland is abandoned. Hotspots and concentrated areas of abandoned cropland land exhibit obvious regional characteristics. Socioeconomic factors, including gross domestic product density, population density, and road density, have greater impacts than environmental factors on the spatial distribution of abandoned cropland. The research suggests that government should strive to reduce production expenses associated with sporadic patches, poor agricultural infrastructure, and high labor costs.

Land use has undoubtedly impacted the evolution of ecosystem conditions [29–31]. To help ensure regional biodiversity and ecological security in vulnerable areas, Tang et al. [19] investigate land use change in the Huaiyang section of the Grand Canal in China by decomposing the ecosystem services into water, soil, and biodiversity conservation, as well as carbon sequestration. They develop an analytic method that draws information about ecological sources and ecological corridors based on the importance of landscape patches. The ecological network, with key source patches, important source patches, terrestrial corridors, aquatic corridors, and ecological nodes, forms a foundation of ecological protection and territorial restoration. Land use change is found to significantly impact regional ecosystem services. Thus, territorial spatial planning that includes ecological red line delineation should be strictly followed to achieve both development and ecological goals.

There has been a contradiction between land exploitation and ecological conservation in lake basins. Li et al. [20] choose four functions—crop production, nitrogen export, carbon storage, and water yield—to evaluate ecosystem services (ES) that can best cater to the requirements of agricultural production and water protection in Sihu Lake Basin, an agricultural region in central China, and to measure the trade-offs and synergies of ES as well as their correlations at both the county and grid scales. Their results show that ES values vary spatially, synergy dominates ES relations at both scales, and correlations increase as the scale does. In regard to the impact of landscape patterns on ES, landscape metrics explain approximately 45% to 61% of ES variations, in which agricultural land change is the main contributor. The construction of rivers and channels positively correlates to crop production and nitrogen export, whereas forestland contributes more to carbon storage and water yield.

Concepts and methods associated with the environment, geography, remote sensing, and socio-ecological studies have frequently been merged with statistical and spatial analysis techniques to reveal land use changes and identify trade-offs between land use and carbon cycles [32,33]. Yin et al. [21] examine the evolution of space utilization efficiency and the resulting carbon emissions, from spatial and regional perspectives. They define the efficient use of territorial space by considering the efficiency of both construction and agricultural production. The gravity center of space use efficiency and carbon emissions show diametrically opposite migration directions. The coordination of space use efficiency and carbon emissions exhibits a downward trend. A win–win situation of high efficiency and low emissions can be found in high-quality agricultural space. Dynamic evolution, coordination, and sensitivity to the efficiency of territorial space utilization and carbon emissions help bring an understanding of the inconsistency of the development pace in urban agglomerations or even regions, which ultimately require more targeted policies for the optimization of space utilization and reduction of carbon emissions.

Forest land plays a key role in the global carbon cycle. Vijitharan et al. [22] use remote sensing technologies and enhanced vegetation index threshold values to track land cover change, especially of forest land in the Vavuniya District of Sri Lanka, and they assess the subnational forest reference emission level. A phenology-based threshold classification method was creatively utilized to identify land cover categories, which were further validated using reference data. Changes in forest cover, especially the dominant dry monsoon forest, resulted in a net increase in carbon emissions, deeply influencing the realization of national emission-reduction targets. Conservation and management strategies for forest resources and result-based payments from the REDD+ scheme of the UN Framework Convention on Climate Change can benefit to reduce the loss in carbon stock.

Sustainable concepts still pose considerable challenges to reliable and efficient land management. For example, an increase in farmland production capacity has helped feed the exploding population around the world. However, insufficiency and transition of farmland use have always plagued countries facing higher population pressure and threatened their food security [34]. Land available for cultivation is especially precious in the context of the pandemic and regional war in today's world [35]. Li et al. [23] pay much attention to ways to improve the quality of farmland. They present an empirical comparison between two scenarios—traditional and modern agricultural areas in northeastern China. Their results show that the quality of development projects, improved landscapes, and ecology is better in modern agricultural areas. However, the risk of poorer fertility in modern agriculture raises concerns about over-farming. The differences between comprehensive farmland quality in the two areas can be partially associated with different management modes and varying agrarian property systems.

Farmland production capacity is deeply impacted by the way in which farmers use and manage farmland. Sun et al. [24] assess the production capacity of farmland with respect to the improvement of the agro-ecological zone (AEZ) model. The constraints of farmers' management and input levels are considered and embedded to revise the AEZ model, aiming to reduce biased estimations of grain production. The empirical study in Yuanjiang County in central China, using an improved AEZ method, supports the conclusion that considerable potential to increase grain productivity exists, even under current limitations. The village-based survey data that record the behaviors of rural households is an ideal supplement for the traditional AEZ model that includes natural limitations only. The authors warn that "non-grain" use of farmland, like planting, breeding, tree planting, and farmland abandonment, can be the main culprit for the huge gap between expectations and the reality of regional total grain production. In any case, sound policies and financial means are important for the effective cultivation of grain.

Technology input is a great channel to artificially promote the effective use of farmland resources. Liu et al. [25] explore how policy tools impact farmer preferences in adopting conservation tillage technology in China, which can contribute to the sustainable utilization of farmland resources. They define a theoretical framework that involves the decision-making and dynamic influence mechanism when linking various policies to farmers' technology adoption choices. Combining the questionnaire survey with the Agent Belief–Desire–Intention model, the empirical results show that the effects of policy on farmers' adoption of conservation tillage technology vary in both intensity and time.

Agricultural services are a solution for effective farmland use in the post-labor-intensified agricultural era. Xu et al. [26] analyze the contributions of this modern service to sustainable agriculture by estimating its effects on the agricultural green total factor productivity (AGTFP) in 31 provincial administrative regions of China from 2011 through 2020. The authors calculate agricultural production carbon emission, which increases first and then decreases. Taking carbon emissions as an unexpected output for measurement, the AGTFP keeps increasing on the whole, with short-term fluctuations. Agricultural services exhibit heterogeneously positive impacts on AGTFP, contributing primarily to the improvement of green technology. The agricultural machinery service, as the main component of agricultural services, plays a dominant positive role in the growth of AGTFP in the eastern region of China, most of which is filled with flat land.

Planning transportation land in advance is conducive to strengthening economic and social ties between cities. Wang et al. [27] provide a decision-making resource for governments of Chinese cities to achieve sustainable transportation development via the adjustment of land supply. The authors propose a system that helps determine the priority of transportation land supply. The system is built based on an overall evaluation of a city's transportation condition from its dominance, dependence, coordination, accessibility, and land demand forecasting. The multidisciplinary concepts and methods used show that transportation land demand in cities shifts from east to west and central China. Land transportation, especially roads, now dominates most cities. Industrial development also has a significant impact on a city's choices of transportation modes and its level of dependence on those transportation modes.

In this Special Issue, *Land* continues its contribution to the fast-growing field of land science. We recognize the tremendous potential of multidisciplinary concepts, transdisciplinary knowledge, and interdisciplinary methodologies for the study of interactions between human and land as a reference point, or even a pathway, for solving predicted as well as unforeseen problems in future development. We believe that a synergetic effort within the areas of the environment, soil, economy, geography, remote sensing, politics, and sociology will be indispensable in this growing field of land science. We hope that the focused articles in this Special Issue are beneficial for promoting follow-up research in land-related solutions for the sustainable development of human society.

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