

Progress in the Study of the Drivers of the Transformation of Arable Land Use

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Abstract

The sustainable use of arable land is a necessity to ensure future global food security. Arable land provides most of the food and necessities of life for human beings, and is the key to achieving the "poverty-free" (Sustainable Development Goals 1, hereinafter referred to as SDG1), "zero hunger" (SDG2), "sustainable cities and communities" (hereinafter referred to as SDG2) and "sustainable cities and communities" (hereinafter referred to as SDG2) objectives of the United Nations Sustainable Development Programme. SDG1 (hereinafter referred to as "SDG1"), "Zero Hunger" (SDG2), "Sustainable Cities and Communities" (SDG11), and "Climate Action" (SDG13) of the United Nations Sustainable Development Programme (SDP), "terrestrial organisms" (SDG15), and other key resource-environmental elements of the Sustainable Development Goals (SDGs). Cropland expansion and cropland intensification have been important strategies for increasing food production, but with the global depletion of cropland reserves, increasing food production by expanding the area of cropland is no longer viable, and the pressure for food security has shifted to the existing cropland, which accounts for 38 per cent of the global terrestrial area. In the last 20 years, global food production has almost doubled, but the area of arable land has increased by only 9%. Demand for food is accelerating in tandem with rapid global economic and social development, population expansion and improved diets. The global demand for food is expected to increase by about 70 to 100 per cent by 2050, which not only puts enormous pressure on existing arable land but also poses a great challenge to the future food security of the world. The sustainable use of existing arable land is the only way to meet the growing demand for food and avoid a global food crisis.

Keywords

Arable Land; Driving Force; Sustainable Development.

1. Introduction

Research on the mechanism driving the transformation of arable land use has gradually shifted from qualitative to quantitative, and the methodology and content of research have become increasingly rich. In terms of research scope and scale, relevant studies have focused on densely

populated regions with rapid economic development and fragile ecological environment, and fewer studies have been conducted in economically underdeveloped regions with less prominent conflicts over arable land, and the research has started later. In terms of research objects, studies on the drivers of explicit transformation of arable land use have always been the focus of attention, while studies on the drivers of implicit transformation of arable land use are relatively few. In terms of driving factors, most studies classify driving factors into natural factors and socio-economic factors, with the former being regarded as a relatively stable driving factor that does not cause drastic fluctuations in arable land area, and the latter being generally regarded as the main causal factors affecting the changes in arable land in recent years in China, with the rapid development of the economy, the fast growth of the population, and the investment in fixed assets being the top three factors, and the policy factor being a factor that is a kind of policy, and the policy factor being a kind of policy that is a kind of policy.

2. Drivers of Cropland Transformation

Existing studies have shown that the driving factors for the transformation of arable land use have significant regional differences. In rapidly urbanising regions, due to the fast pace of economic development and high level of urbanisation, land encroachment for construction and restructuring of the agricultural industry are often regarded as the main driving factors, while population increase and agglomeration are the root causes of cultivated land encroachment, and factors such as expansion of construction and economic development are the direct factors for the loss of cultivated land. The main grain-producing areas, with good natural geographical conditions and abundant arable land resources, are under the double pressure of economic development and food security, and the transformation process of their arable land use is affected by both urbanisation and policy control, with areas close to the urban periphery being mainly affected by economic and social development, and areas far away from the cities and towns being more affected by the policies on arable land protection [1].

In ecologically fragile areas, due to sparse population, low level of economic development and poor ecological environment, the transformation of arable land utilisation is greatly affected by the return of farmland to forests and changes in the ecological environment, which is mainly manifested in the reduction of arable land area due to the continuous deterioration of the natural factors, and the reduction of arable land area due to the return of farmland to forests and the ecological restoration policy with the aim of improving the ecological environment, while the improvement of the agricultural technology due to the economic and social development increases the area of arable land. At the same time, the upgrading of agricultural technology due to economic and social development has increased the area of cultivated land [2].

3. Optimisation of Arable Land Use Simulation

Mitigating conflicts in land use through optimal regulation has always been the focus of land science research, and its core is the regulation of land use structure and spatial layout of land use. Cultivated land is an important part of land resources, and the optimisation and regulation of cultivated land will inevitably involve the adjustment of other land use, and more research has been carried out at home and abroad on the optimal allocation of land use. With regard to the optimisation of land use structure, its theoretical basis is the theory of comparative advantage, which refers to the allocation of land to sectors with more efficient and effective use under resource constraints, so as to improve the overall efficiency of land use, which is essentially a resource allocation problem in economics [3].

3.1. Arable Land Optimisation Targets

The determination of optimisation objectives is an important part of the optimisation of land use structure, and the initial decision-making often pursues single-objective optimisation, and then gradually shifts to multi-objective optimisation under the promotion of the concept of sustainable development and the game played by stakeholders [4]. As the support and an important content of economic and social development, the development and utilisation objectives of arable land are the objectives of economic and social development. Most of the current researches divide the objectives of land optimisation at the macro level into maximisation of economic, social and ecological benefits, while at the regional level they mainly focus on minimisation of a specific land use conflict, often equalising the roles or values of various types of land use, which is in conflict with the spatial heterogeneity of land resource allocation. In terms of optimization methods, with the needs of land use structure optimization and multi-objective decision-making, traditional mathematical optimization models such as linear models, grey prediction models, genetic algorithms (GA), ant colony algorithms (ACO) and other prediction methods can no longer satisfy the selection of land use objectives, and optimization models based on uncertainty have become an important approach to solving the problem of determining the optimization objectives under complex uncertainties, and have achieved good results. In land use structure prediction, Markov method can predict the land use structure according to the probability of land use conversion, and the prediction result is more scientific [5].

3.2. Optimisation of Land Use Layout

Optimisation of land use layout often refers to the spatial rearrangement of various types of land by planners to achieve land use objectives. The fundamental criterion of layout optimisation is the degree of spatial appropriateness, which is achieved by transferring land from an unsuitable location to a more suitable spatial unit, and can generally be divided into two aspects, namely land use zoning and micro-allocation optimisation. Zoning is the overall layout optimisation of land use, highlighting the main functions undertaken by different zones and determining the management strategies of different zones, with a view to obtaining better comprehensive land use benefits and spatial development objectives [6]. The functional zoning of land use in the land use master plan and the zoning of construction land control belong to the category of land use zoning, whose fundamental objective is also to improve the comprehensive benefits of land use [7].

3.3. Optimisation of the Spatial Distribution of Arable Land

Research on land use spatial layout at home and abroad mainly relies on the simulation and deduction of spatial and temporal dynamic changes of LUCC, which is roughly divided into three aspects: firstly, monitoring the dynamic change process of land use and cover through remote sensing and GIS technology; secondly, revealing the mechanism of land use and cover change through driving force analysis; and thirdly, simulating the possible changes and impacts of land use and cover change at different spatial and temporal scales by setting various parameters and rules and combining with the study of driving factors. Thirdly, by setting various parameters and rules and combining them with the study of driving factors, we can simulate the possible changes and impacts of land use and cover changes at different spatial and temporal scales. Overseas research on the optimisation of cropland layout mainly focuses on agricultural land, and the means of layout optimisation has been continuously expanded with the improvement of spatial analysis means. Domestic research on the optimisation of land use layout only appeared in the 20th century, and the initial research has been in the primary stage, mostly through empirical judgement, and then improved by adopting methods such as the geotechnical method, and then under the support of the "3S" technology, it has gradually analysed the

reasons for the conflicts between different land use types from the perspective of multi-level and multi-objective [8].

4. Conclusion

Domestic research on the spatial layout of arable land mainly focuses on the spatial pattern change and transfer of land use, mostly starting from the three aspects of spatial pattern change, driving mechanism and development trend, and then proposing the optimal layout plan, which is a relatively passive layout optimisation research idea. On the other hand, there are fewer studies on "active" layout optimisation based on spatial heterogeneity and taking into account differences in land suitability and constraints. Meanwhile, the depth of scenario analysis is not deep enough, and the research on layout optimisation combined with the scenario analysis of the new round of land spatial planning has not yet been theoretically studied [9]. The method of zoning arable land generally adopts the "evaluation score division method", i.e., by constructing an evaluation system based on the indicators of a particular function of arable land, the comprehensive score of the arable land is measured, and then the arable land is divided into zones. However, judging from the evaluation results of many regions, this zoning method has obvious spatial agglomeration, making it difficult to balance the problem of unbalanced agricultural development among regions, and it is also difficult to effectively connect with existing plans, making it difficult for the evaluation results to support actual management work [10].

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