Study on the influence of urban expansion on cultivated land utilization intensity in China

Panpan Zhang1,2,3,4,*, Min Chang1,2,3,4

1Shaanxi Provincial Land Engineering Construction Group Co., Ltd, Xi’an 710075, China
2Institute of Land Engineering & Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd, Xi’an 710075, China
3Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi’an 710075, China
4Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi’an 710075, China

*Corresponding author: 410207176@qq.com.

Abstract. Urbanization in China has led to significant changes in the utilization of cultivated land. This paper aims to further understand the relationship between urban expansion and agricultural land intensity based on predecessors. The results show that there is a negative correlation between urban expansion and cultivated land utilization intensity. Per capita cultivated land area, industrial development, per capita output input ratio of cultivated land utilization intensity have a certain impact. The relationship between urban expansion and arable land means that as cities continue to expand, arable land is likely to expand, and the pressure on China's natural land resources will remain great in the future.

1. Introduction
In recent years, Chinese cities have developed rapidly. The notable change is the continuous expansion of urban residents and urban areas. Statistics show that China’s urban area has increased by nearly 50% since the 1990s, and urban land coverage has even been faster than population growth. This has led to the encroachment of large areas of arable land, especially in the southeast coastal areas and central China. This phenomenon is more serious in the region, which has further led to the concentration of arable land in the northern and western border provinces of China [1]. Although the amount of lost arable land is unclear and controversial, it is recognized that the productivity of newly reclaimed arable land is lower than that after remediation. With the reduction of arable land, the input-output level, farming frequency, and arable land utilization intensity are of great significance to maintaining food production capacity [2]. However, urban expansion and economic development have provided more employment opportunities, leading to labor shortages in the agricultural sector. Records show that the intensity of arable land utilization in many areas has declined and abandoned farmland has increased, which makes food security and ecological environmental protection faced more Challenge [3].
The relationship and scale between urban expansion and the intensity of cultivated land use directly affect agricultural production and food supply, and further affect the country's agricultural land pattern. Understanding the relationship between urban expansion and the intensity of arable land use is crucial to formulating policies to balance urban growth with the use and protection of agricultural land. In addition, the reduction in the intensity of cultivated land use means that future expansion of farmland will be at the expense of other ecosystems [4]. Therefore, understanding the impact of urban land expansion on the intensity of cultivated land use is more conducive to understanding the impact of urban expansion on the environment and the sustainability of land resource use.

The expansion of urban land means the reduction of agricultural land and the improvement of urban development. It can be expected that the shortage of land will trigger the intensive use of agricultural land, and urban development will increase non-agricultural employment, which will undoubtedly increase the further intensive use of agricultural land. Many previous studies have analyzed the impact of urban expansion, and explored the impact of urban expansion on the intensity of cultivated land use [5], in addition, most of the research on cultivated land use intensity in our country is for a certain region, which is greatly affected by region and time, and there are also large differences in different regions and different periods. Moreover, most of these researches are general in nature, trying to analyze the social economy Changes in cultivated land use intensity caused by environmental changes [6].

This article attempts to further understand the relationship between urban expansion and cultivated land use intensity by analyzing the impact of urban expansion and socio-economic factors on cultivated land use intensity.

2. Cultivated land use intensity

Land intensification refers to a management method in which more production materials and labor are concentrated on a certain area of land, and advanced technology and management methods are used to obtain high income on a small area of land. The local demand for agricultural products is growing, and the land use is a one-way intensive process. The intensity of land use here is driven by population pressure and land scarcity for a long time, the intensive use of limited land, endogenous induction technology and institutional innovation to increase the agricultural output of a given land, this theory has received a lot of Confirmed [7].Under the pressure of population growth, the transformation of land use from extensive to relatively intensive is almost a common phenomenon in the world. This interpretation of changes in land use emphasizes the relationship between demand and land resources. Based on this, both the increase in demand caused by population growth and the scarcity of land caused by the reduction of agricultural land may lead to intensification of land use. Later scholars conducted detailed studies on this theory and believed that other demand factors, such as consumers' diet, may also affect the intensity of cultivated land use.

Market-based agricultural land intensification is different from the above-mentioned theories. It considers market demand and non-agricultural employment, and establishes a conceptual model of an open economic environment. In an open economic environment, farmers decide agriculture based on market demand and commodity prices regulated by the market. Produce. An open market environment will also bring more job opportunities, and better job opportunities will lead to a longer fallow period and less labor input [8]. It is unrealistic to ignore the demand factor when analyzing the intensity of agricultural land. In fact, the more open the economy, the lower the intensity of arable land utilization, but the more dependent on land. China's agricultural product market is controlled by the government, and demand for agricultural products and production factors determine the intensity of cultivated land utilization. In addition, the relevant policies introduced also have a certain degree of intervention. In recent years, China has paid more and more attention to agricultural development. In order to increase productivity and improve the living standards of farmers, it has continuously increased investment and subsidies in agriculture.
3. Multiple crop index analysis

Cultivated land use intensity is mainly measured by planting frequency per unit area and unit time and agricultural input and output as indicators. In this study, we use the Multiple Cropping Index (MCI) as an indicator to measure the ratio of the total sown area of crops on the arable land to the arable land area a during the year, that is, the average number of crops planted on the arable land area in the year.

Looking at a large amount of data, from 1998 to 2014, China's multiple cropping index basically showed a steady growth trend, from 120.17% in 1998 to 135.18% in 2014, an increase of 15.01% in 17 years, an average increase of 0.88% per year, and there were also several years in the period. For example, the multiple crop index in 2006 was 128.94%, but in 2007, it dropped to 126.00%, mainly because of the frequent occurrence of natural disasters in China in 2006, severe disasters in the southeast and central regions, and low enthusiasm for farming by farmers [9].

The multi-cropping index of China's arable land shows a high distribution in the central region (16.97%), followed by the east (147.44%), low in the west (108.97%), and lowest in the northeast (90.41%). Fertilizer, labor, scientific and technological level and other conditions, good heat conditions, long frost-free period, high total accumulated temperature, and sufficient water are the basis for improving the multiple crop index. Restricted by geographical factors, the central and eastern regions of China have good hydrothermal conditions, warm and humid climate, and high utilization rate of arable land. The multiple cropping index in most regions is above 200%, which means that two or even three crops a year; Western China includes Southwest and northwest, the southwest region has a warm climate and abundant rain, and the multiple cropping index varies between 120% and 140%, while the northwest region is a mountainous area with arid climate and less rain. The multiple cropping index varies between 75% and 95%. Comprehensively speaking, the multiple cropping index is not high in the southwest and northwest. Although the northeast region is an important food production base in northern China, the terrain and soil conditions are good, but due to the limitation of climate and heat conditions, the multiple cropping index is between 78% and 102%.

From 1998 to 2014, except for the decrease in the index of multiple cropping of cultivated land in eastern China, other regions showed an upward trend. The eastern region dropped from 152.28% in 1998 to 145.97% in 2014, and the central region rose from 151.88% in 1998 to 151.88%. In 2014, 168.54%, the western region rose from 98.05% in 1998 to 122.08% in 2014, and the northeastern region rose from 78.48% in 1998 to 102.50% in 2014. The decline in the index of multiple cropping in the eastern region is due to the fact that the eastern region is the coastal area of China, with a developed economy, many non-agricultural employment opportunities and high income. Although the state has introduced many favorable agricultural policies, the agricultural income is far lower than the non-agricultural income; in other areas, restricted by natural conditions and traditional concepts, policies have a certain stimulant to these areas, mobilizing farmers’ enthusiasm for production, and the multiple cropping index has been significantly improved.

4. Discussion on the relationship between urban expansion and cultivated land use intensity

Some scholars used the multiple cropping index as a dependent variable to establish a function of urban expansion, scarcity of arable land, income, other employment opportunities, and agricultural subsidies, using 1,670 counties nationwide (486 in the east, 544 in the middle, and 640 in the west) 16 A panel econometric model was established using empirical data to reveal the relationship between urban expansion and cultivated land use intensity. The results showed that in eastern, western, and central China, the area of cultivated land is negatively correlated with the multiple crop index, and the reduction in cultivated land Pressure leads to further intensification of land use [10] Urban expansion has significantly reduced the intensity of cultivated land use in the eastern and western regions; while in the central region, the intensity of cultivated land use is relatively stable and is less disturbed by urban expansion.

The expansion of urban land also means the development of the process of industrialization. The level of industrialization is also negatively correlated with the intensity of cultivated land use. The development of industrialization increases non-agricultural employment and income, absorbs more
agricultural labor, and reduces the intensity of cultivated land use. This is the economy Reasons for the lower utilization intensity of cultivated land in developed areas. In terms of farmers’ income, the higher the income of farmers in the central and western regions, the greater the intensity of arable land utilization, but this is not significant in the eastern region. For agricultural inputs, input contributes to the increase in arable land utilization intensity, but in the east and west, the central area is not significant.

The higher the level of urban development, the greater the opportunities for non-agricultural employment, which has further led to urban expansion. As cities continue to attract agricultural labor, fewer and fewer people are engaged in agricultural production. In view of the increasing scarcity of agricultural labor, increase agricultural profits by changing agricultural production methods. If profits are still lower than input or non-agricultural work, more farmland will be abandoned, which will lead to a decline in the intensity of farmland.

Agricultural production methods including increased productivity and changes in crop types will all lead to a decline in the intensity of cultivated land use. In the early 1980s, China introduced the household production contract responsibility system, and productivity has been significantly improved, mainly reflected in the substantial increase in agricultural output and the moderate decline in total sown area. Agricultural production technology innovation has also played a vital role in it. In the 1990s, China’s land leasing market developed extensively and the scale of farms increased day by day, which further promoted the development and implementation of mechanized production and new technologies. This phenomenon is particularly prominent in China’s developed provinces. Among these provinces, urbanization and non-agricultural economy the prosperity of China has gradually aggravated the tension of labor supply in the agricultural sector. For example, in Zhejiang Province on the east coast, about one-third of the cultivated land is leased.

In order to increase agricultural profits, farmers also have the motivation to transform the traditional agricultural system based on food crop production into a more diversified agricultural system. With the increase in market demand, more and more arable land is used to grow vegetables and other cash crops. In addition, the labor force is limited and the price of food crops is relatively low. This has led to the overall transition from double rice production to single rice production. A sharp drop in the frequency of food crop planting may eventually lead to a decline in planting intensity.

Relatively speaking, the eastern region has good water and heat conditions and a long frost-free period, which is conducive to increasing the multiple cropping index and increasing the intensity of arable land utilization. The newly-added arable land area increased rapidly from 1995 to 2005, but the urbanization and industrialization of this area are developing rapidly. The population is also large, arable land resources are gradually decreasing, and the development potential of arable land is not large, and the pressure on the existing arable land continues to increase; the climate conditions in the central region are good. In order to compensate for the loss of arable land and ensure food security, the development of arable land in the central region has increased significantly, and the potential consumption the western region is restricted by the natural environment. There are not many developments at present, and there is still great potential for development. In the future, the transfer of agricultural production and development to the western region is the general trend and requires further improvement and innovation in technology. Although the western region has great potential, the process of urbanization development is also very rapid. If we blindly pursue high-speed development without considering the reduction of cultivated land, it will inevitably lead to a decrease in the intensity of cultivated land utilization, and the prospects for land resources and food security are not optimistic.

This paper uses multiple cropping index as the standard to measure the intensity of cultivated land use. Increasing the multiple cropping index on the basis of limited arable land can stimulate land use potential, relieve land use pressure, and increase the intensity of arable land use.

5. Conclusion
In the above discussion, we can basically confirm that there is a negative correlation between urban expansion and cultivated land use intensity. The absorption of urban labor and the decline in the level of agricultural land use indicates that other production factors must compensate for the decline in
agricultural production capacity to meet the people's growing demand for food. Agricultural imports, agricultural land expansion, land consolidation and mechanization promotion may lead to further improvements in production efficiency. However, considering the huge amount of land required to grow various products and the government's strict control of strategic commodity self-sufficiency, agricultural land expansion is also inevitable.

In fact, land conversion is essential for urbanization and economic development. However, urban expansion will also lead to a decline in the intensity of agricultural land, which will put continuous pressure on agricultural land and natural land resources. Although China has remained largely self-sufficient for decades, this does not mean that China’s agricultural production and long-term use of land resources are sustainable. In order to achieve the dual goals of urban development and farmland protection, effective land use management and planning are essential. Integrating urban planning into farmland protection policy formulation integrated land use management can improve the inefficiency of land use and ease the tension between urban growth and farmland protection. In addition, investment in agricultural infrastructure and institutions (such as tenure security) can increase the economic returns of intensive agriculture.

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