Cultivated Land Expropriation in China —

The Roles of Agglomeration and Government Fiscal Deficits

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Abstract: Land occupation for construction has become the primary driving force behind the reduction of cultivated land in rural areas of China during the rapid industrialization and urbanization stage, leading to a decline in both the quantity and quality of the country's cultivated land. This study utilizes provincial data from the period 2006-2021 to investigate the impact of (industrial and population) agglomeration and local government fiscal deficits on cultivated land expropriation in China. The findings reveal that industrial agglomeration has a significant and positive impact on the expropriation of cultivated land. Although population agglomeration does not directly affect the rate of cultivated land expropriation, it significantly increases the ratio of cultivated land being converted into residential land. The local fiscal deficits (primarily at the provincial level) significantly increase the cultivated land expropriation rate.

Keywords: Industrial agglomeration; population agglomeration; fiscal deficits; cultivated land; China

1. Introduction

Urbanization is a common feature of economic development, which is experienced or will be experienced by most parts of the world (Deng et al., 2010). Almost by definition urbanization leads to an increase in urban land use. This increase is primarily driven by agglomeration economies, which are external economies of scale resulting from the clustering of firms and production factors. A study by Gao and O'Neill (2020) shows that in the 21st century urban land is expected to increase by a factor 1.8-5.9 worldwide. This generally implies that a large amount of agricultural land (i.e. crop, pasture and forest land) and land occupied by homesteads will be converted to urban land. Land conversion is not only the result of economic growth but also acts as one of its driving forces (Ding and Lichtenberg, 2011; He et al., 2014).

Cultivated land is a crucial production factor required for sustainable agricultural development and national food security (Chen et al., 2022). Many developed and developing countries, have therefore implemented policies to protect the quantity and quality of cultivated land. In China specifically, a number of regulations have significantly contributed to cultivated land protection (Liu et al., 2023; Tang et al., 2021). However, despite the "no reduction" rule for total cultivated land (Ho and Lin, 2003), there has been an overall decline in the amount of cultivated land by 8.47 million hectares from 1989 to 2021 (MLR, 2000-2018; MNR, 2019-2022; Qu et al., 2011). To mitigate this decline, policies were introduced to maintain a sustainable and stable level of cultivated land in the long run.

Apart from the threat to the quantity of cultivated land, there is the problem of diminished land quality that arises from land expropriation. For instance, land taken into cultivation in China to compensate for the loss cultivated land due to urban expansion is generally two to three grades out of 15 lower in quality than expropriated cultivated land, and is mostly located in areas with poor infrastructure and irrigation systems (Tang et al., 2020; Xiao and Ning, 2013). Acquiring cultivated land also diminishes farmers' incentives to invest in their remaining fields when they fear further expropriations, further jeopardizing overall land quality (Gyourko et al., 2022; Jacoby et al., 2002).

The conversion of cultivated land into urban land primarily occurs through the expropriation of cultivated land. When governments sell the converted cultivated land to urban users for residential, commercial, or industrial purposes, they generate revenue in the short run and in the long run. This revenue can be substantial and has become known as 'land finance' in China. When

faced with fiscal deficits, local governments need this revenue to fund various public projects and services such as infrastructure, education facilities, and health care (Shu et al., 2018; Wu and Heerink, 2016).

Previous studies have explored various perspectives regarding issues associated with cultivated land expropriation, such as conflicts and investment (Jacoby et al., 2002; Lin et al., 2018; Wu and Heerink, 2016), violence (Sargeson, 2013), livelihoods and welfare of displaced farmers and national food security (Chen et al., 2022; Liu et al., 2023; McCarthy et al., 2012; Qu et al., 2018; Tagliarino et al., 2018; Wang et al., 2020; Xie, 2019), and negative environmental impacts (Kusiluka et al., 2011). The causes of cultivated land expropriation, particularly agglomeration and fiscal incentives, have received less attention so far. Insights into these causes and the underlying mechanisms can provide useful inputs into central and local government policies aimed at promoting balanced economic development and securing national-level food security.

This paper therefore aims to investigate the impact of agglomeration and local government fiscal deficits on the expropriation of cultivated land in China. To reach this aim, an empirical analysis is conducted using a panel data set for 29 provinces covering the period 2006 to 2021. This study has two main contributions to the available literature. First, it examines the impact of agglomeration on cultivated land expropriation and thereby distinguishes between industrial and population agglomeration and between the expropriation of cultivated land for residential purposes. Second, it examines the mechanisms through which local government fiscal deficits affect land expropriation and further reveals the impact of government fiscal deficits at different times as well as the influence of provincial-level and prefecture-level city fiscal deficits on land expropriation.

The remainder of this paper is organized as follows. Section 2 provides background information on the pressure that cultivated land protection faces in China. Section 3 presents a theoretical framework for the analysis. Section 4 outlines the data set and variable definitions, while Section 5 describes the econometric models used for estimation of the relationships. The results of the analysis and discussion are presented in Section 6, and Section 7 presents the conclusion and general discussion.

2. Background

The Land Administration Law, initially enacted in 1986, is the primary legal instrument

governing land use in China. Through multiple revisions, this law has gradually enhanced its provisions addressing issues such as protecting cultivated land, regulating land expropriation, and monitoring illegal land use, to meet the demands of socio-economic development (Wu and Heerink, 2016). In addition, given the pivotal role of protecting cultivated land in ensuring national food security, the "Regulation on the Protection of Basic Cultivated Land", was enacted in 1998. This regulation emphasizes the preservation of both the quantity and quality of basic cultivated land and outlines the conditions under which conversions of such land are permissible (Ding, 2003; Liu et al., 2023).

Changes in cultivated land area, 1989-2021

When urban expansion takes up cultivated land, the occupied land must be compensated elsewhere within the same province (or other provinces) through reclamation and opening up of wasteland (Fischer et al., 2007), while ensuring the quality and quantity of cultivated land (Chen et al., 2022; Gao et al., 2014). This approach is known as the "balance between the occupation and compensation of cultivated land" (1997), which is aimed at achieving a sustainable and stable level of cultivated land over time. The ultimate goal of this policy is to ensure that China has enough cultivated land to meet the needs of its growing population and food demands, while also safeguarding the environment and promoting sustainable land use practices. Moreover, in 2006, China has set the "Red Line" of 120 million hectares of cultivated land as a fundamental national policy to further protect the quantity of cultivated land (Huang and Yang, 2017; Zhou et al., 2021). Despite this, China's cultivated land area is decreasing (see Table 1 for details). Moreover, as mentioned in the Introduction, the quality of the newly acquired land is in practice mostly lower than the land taken out of agricultural production.

China has conducted three national land surveys during the periods 1984-1997, 2007-2009, and 2017-2019. These surveys indicate that China's cultivated land area was 130.04 million hectares, 135.27 million hectares, and 127.44 million hectares in 1998, 2010, and 2020 respectively. Changes in measurement methods used for these surveys have caused unrealistically large changes in the total amount of cultivated land recorded in the years when the method changed, and make it problematic to compare their results (Qu et al., 2011). The most recent data from 2021 indicates that the total area of cultivated land is 127.52 million hectares.

Table 1 presents statistics compiled by the Ministry of Natural Resources of the People's Republic of China (MNR, 2019-2022) (Formerly Ministry of Land and Resources of China, herein and hereafter referred to as MLR) (2005–2018) on the four main factors contributing to the changes in cultivated land area in China between 1989 and 2021. On average, 0.68 million hectares of cultivated land were taken out of cultivation annually, while 0.41 million hectares were brought into cultivation, resulting in a net decline of 0.26 million hectares per year. Land expansion for construction was a significant and relatively stable factor throughout the entire period, accounting for an average of 0.22 million hectares of land taken out of cultivation per year. There was a notable acceleration in land taken out of cultivation from 2000 to 2008, reaching 1.27 million hectares per year. As noted by, for example, Tan et al. (2007) and Qu et al. (2011), the increase during this period was primarily driven by ecological restoration programs (0.72 million hectares per year) and agricultural structural adjustment (0.30 million hectares per year). From 2010 to 2017, the average annual rate of land taken out of cultivation declined to 0.37 million hectares annually. Land used for construction purposes was responsible for the largest share of this decline, i.e., 80%. During the same period, 0.30 million hectares of land was on average taken into cultivation each year, resulting in a net annual loss of 0.06 million hectares. From 2018 to 2021, the area of cultivated land occupied for construction purpose was 0.52 million hectares, and compensation was made through the "no reduction" policy. However, data on the reduction of cultivated land due to ecological restoration, destruction by natural disasters, and agricultural structural adjustment is missing. Therefore, the net decrease in cultivated land area for this period is reported as zero.

Table 1: Changes in cultivated land area, 1989-2021 (million hectares)

	1989-1999	2000-2008	2010-2017	2018-2021 [a]	Entire period
Land taken into cultivation	6.20	3.99	2.43	0.52	13.14
Land taken out of cultivation:	6.69	11.47	2.93	0.52	21.61
Construction	2.14	1.90	2.35	0.52	6.91
Ecological restoration	2.53	6.51	0.13	-	9.17
Destroyed by natural disasters	1.19	0.39	0.11	-	1.69
Agricultural structural adjustment	0.83	2.67	0.34	-	3.84
Net land taken out of cultivation	0.49	7.48	0.50	0.00	8.47

Source: Based on Qu et al. (2011) and MLR (2007-2018). For definitions of the type of land taken out of cultivation, see Table A1.

[a]: The data from 2018 to 2021 are sourced from the China Natural Resources Statistical Yearbook (MNR, 2019-2022). This yearbook exclusively accounts for the information on the occupation and compensation of cultivated

land for construction purposes, and does not include statistics on other forms of cultivated land occupation. Consequently, there is a lack of data pertaining to ecological restoration, destruction by natural disasters, and agricultural structural adjustment.

Cultivated land expropriation since 2004

The average annual land expropriation from 2004 to 2021 in China was 0.36 million hectares, with cultivated land accounting for 48.1% of the expropriated land, averaging around 0.17 million hectares per year (MLR, 2005-2018; MNR, 2019-2022). As indicated in Figure 2, the total expropriated area increased after 2004 and reached its peak in 2011 and 2012, with a total expropriated area of 0.56 and 0.50 million hectares respectively. This peak was likely driven by China's economic growth demands after the global financial crisis of 2007-2009, which was considered by leading economists as the most severe financial crisis since the Great Depression (Yuan et al., 2010). China was significantly affected by this crisis, prompting the government to implement an economic stimulus package called the "4-Trillion-Yuan Stimulus Plan". Its implementation greatly boosted urban economic development, leading to increased demand for urban housing, industry, infrastructure, and so on. After 2011-2012, the land expropriation area gradually decreased each year. By 2019, the newly acquired cultivated land area was about half of what it was in 2011. However, this trend rises slightly in 2020 and falls back in 2021. The trend in cultivated land expropriation during the period 2004-2021 mirrored that in the total expropriated area, as depicted in Figure 2. Its share fluctuated around 50% throughout the entire period.

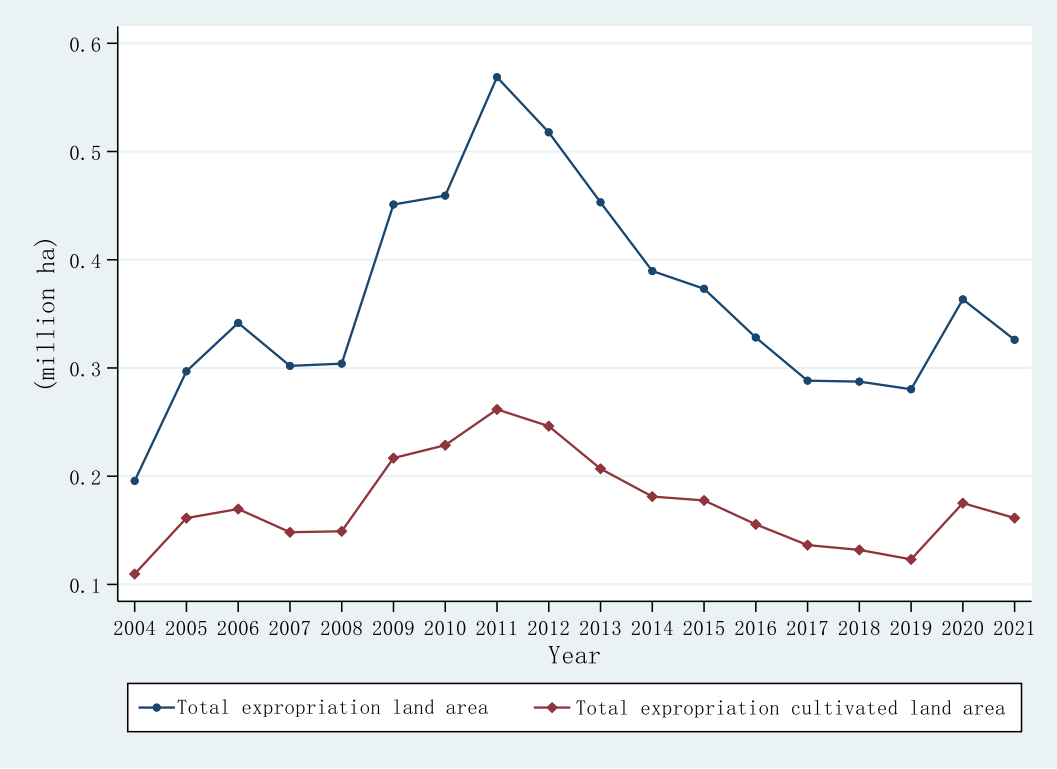

Figure 1 Expropriation of (cultivated) land, 2004-2021

Source: Calculated from MLR (2005-2018) and MNR (2019-2022)

3. Theory

Agglomeration implies lower production costs when firms cluster. There are three sources of agglomeration (McCann, 2013). First, knowledge spillover effects (e.g., Peng et al., 2022) emphasize that proximity maximizes the mutual accessibility of all individuals/firms within the cluster, thereby enhancing the availability of knowledge and information to all local participants. Second, presence of local non-traded inputs, such as specialized legal and software firms and banks whose role it is to provide specialist information or services, and local infrastructure, e.g., roads or a wide-band fibre-optic cable system. The more firms join the cluster the lower the costs of the non-traded local inputs. Third, presence of a local skilled labor pool (e.g., Carbonaro et al., 2018 and Tilley et al., 2023). If firms require specialist labor, the existence of a specialized local labor pool is advantageous because it reduces labor acquisition costs, leading to lower wages and training costs.

This study focuses on industrial agglomeration and population agglomeration. The relationships between both types of agglomeration and the demand for cultivated land are schematically illustrated in Figure 2. When industrial agglomeration occurs in a region, it tends to attract more population. Consequently, commercial activities flourish. Therefore, industrial

agglomeration not only increases the demand for new industrial land but also has spillover effects on the land demand for commercial and residential purposes. This motivates local governments to acquire cultivated land and transfer it to private and public enterprises for different construction purposes.

Besides firms, people also tend to cluster in cities. There are two possible explanations for this. First, the creative class hypothesis. Places that are tolerant of cultural diversity and cultural differences are environments which are ideally suited for fostering unconventional approaches to the development of novel ideas, systems, products or services. The influx of creative people reinforces this. This hypothesis has been criticized but the effect of highly educated and creative people on economic growth is not (Besley et al., 2011; Gyimah-Brempong et al., 2006). Second, the consumer city hypothesis. High-skilled and high-income people will increasingly migrate towards cities offering high-quality amenities, such as opera houses, museums, etc. (Florida et al., 2023). Besides these two explanations it is of course the employment opportunities and the availability of services (e.g., health services, shops, schools and universities) in cities that attract people.

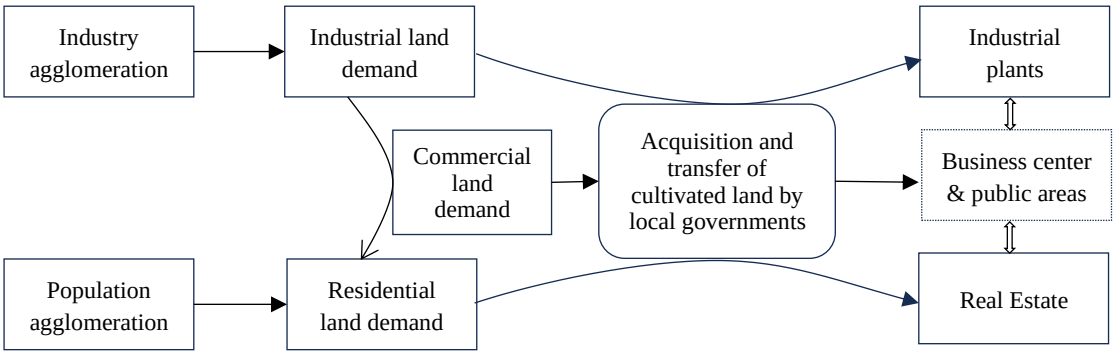

Figure 2 Relationship between agglomeration and demand for cultivated land

In China only the government can legally acquire cultivated land (*e.g.,* Tan et al., 2009). Local governments have two main motives for acquiring land. First, the previously mentioned agglomeration requires cultivated land for industry location, housing and the other services for the population (recreational, health, etc.). Second, the financial pressures faced by local governments while undertaking social responsibilities such as urban infrastructure construction and healthcare provision stimulates the use of 'land finance' as a complementary source of revenues (Cao et al., 2008; Tan et al., 2011). Local governments can alleviate the financial burden by selling expropriated

cultivated land in the urban residential land market at higher price, while selling it in the industrial land market at lower prices. Additionally, they can generate tax income from these enterprises at a later stage (*e.g.,* Wu and Heerink, 2016). Given their monopoly position, governments are able to acquire land at artificially low prices set by them (Liu et al., 2018; Tan et al., 2011). This way, land finance has become one of the most effective approaches to address local government fiscal deficits, as it constitutes the largest and most easily controllable portion of fiscal income (Shu et al., 2018). Other sources, such as central government contributions and land taxes, often experience delays (Fan et al., 2020).

4. Data set and variable definitions

4.1 Data set

The data on the expropriation of cultivated land for the 2006–2021 period was obtained from the China Land and Resources Statistical Yearbook (MLR, 2007-2018) and the China Natural Resources Statistical Yearbook (MNR, 2019-2022). The data for the total urban construction land area originates from the China Urban Construction Statistical Yearbook (MHURD, 2007-2022). Data were available for 29 provinces. Shanghai, Hong Kong, Macao and Tibet were excluded because of missing data. The data used for the core independent variables and control variables originate from the China Statistical Yearbooks (NBSa, 2007-2022), the Finance Yearbook of China (2007-2022), and other relevant yearbooks. The exact definitions and data sources of the variables are listed in Table 2. Descriptive statistics are provided in Table 3.

4.2 Variable definitions

Dependent variables

The core dependent variable in this study is the expropriation of cultivated land. To account for variations in urban land shares across provinces, we utilize two ratios as dependent variables: (1) the ratio of expropriated cultivated land to the total area of urban construction land; and (2) the ratio of expropriated cultivated land for residential purposes to the total area of urban construction land.

Core explanatory variables

Industrial value-added. We selected the industrial value-added as the indicator of industrial agglomeration given its availability on provincial level. A higher industrial value-added not only indicates a greater level of industrial activity but it also shows the potential for increased industrial concentration given that a high level of industrial activity attracts further industrial settlement. Hence, the demand for land is expected to be larger in regions with a high industrial value-added.

Urban population density is used as a measure of population agglomeration (McCann, 2013). Urban population density is defined as the ratio of the total urban population to the total urban construction land area, Population density is a widely used measure of agglomeration economies in the available literature due to its apt representation of the proximity among individuals in a city (Yan and Huang, 2022). Henderson et al. (2021) provides evidence that a straightforward measure of population density is just as effective as more intricate measures of population agglomeration

Fiscal deficit rate. We adopt the ratio of government fiscal deficits to the general public budget revenue as an indicator of local government fiscal pressure - referred to as the fiscal deficits rate hereafter. The general public budget revenue and general budget expenditure data used to calculate the fiscal deficit are the sum of the data for provincial governments and prefecture-level city governments.

Control variables

Four control variables are included in the regression analyses. Per capita GDP reflects the level of development of the market economy in a city or region (Tong et al., 2023; Wu and Heerink, 2016). A higher per capita GDP creates positive incentives for businesses and individuals to cluster around urban or regional centers, resulting in an increased demand for land. The GDP growth rate indicates the economic vitality of a city or region. This vitality may lead to an increased demand for land at given agglomeration levels. The GDP growth goal reflects the target of the local government to improve the level of economic activity of the city. To achieve this goal, the local government may acquire more cultivated land to attract more firms as a way to increase GDP. Land needed for green space puts an additional pressure on rural-urban land conversion independent of the land is required for industrial or residential purposes.

Table 2 Variable definitions and sources

Variables	Description	Source
Dependent variables		
Expropriated cultivated land ratio	Expropriated cultivated land area (hectares) / Total urban construction land area (hectares) [a] ×100%	CLRSY & CNRSY & CUCSY
Expropriated cultivated land for residential purpose ratio	Expropriated cultivated land area for residential purpose (hectares) / Total urban construction land area (hectares) ×100%	CLRSY & CUCSY
Core explanatory variables		
Industrial value added	Industrial value added (ten billion CNY [b]) (2006 CNY)	CSY
Location entropy	See details in section 6.2.	
Urban population density	Total urban population [c] / Total urban construction land area (persons/km^2)	CUCSY
Fiscal deficit rate	The sum of provincial and prefecture-level government fiscal deficits (100 million CNY) / The sum of provincial and prefecture-level government general public budget revenues [d] (100 million CNY) ×100%	FYC & CSY
Control variables		
GDP per capita	GDP per capita (ten thousand yuan, in 2006 prices)	CSY
GDP growth rate	Growth rate of the real gross domestic product (GDP)	CSY
GDP growth goal	GDP growth goal set by provincial governments at the beginning of the year (%)	PSYSB
Green space	Green coverage rate of built district (%)	CUCSY

Notes: **CUCSY** = China Urban Construction Statistical Yearbook (MHURD, 2007-2022); **CLRSY** = China Land and Resources Statistical Yearbook (MLR, 2007-2018); CNRSY = China Natural Resources Statistical Yearbook (MNR, 2019-2022); **CSY** = China Statistical Yearbook (NBSa, 2007-2022); **PSYSB** = Provincial Statistical Yearbooks and Statistical Bulletins (PBS, 2006-2022); **FYC** = Finance yearbook of China (MFC,2007-2022)

[a]: The total area of urban construction land refers to the total, i.e. existing and newly added, land area occupied by residential land, land for administration and public services, land for commercial and business facilities, land for industrial manufacturing, land for logistics and warehousing, land for roads, streets and transportation, land for municipal utilities, and land for green spaces and squares.

[b]: CNY stands for Chinese Yuan.

[c]: Total urban population includes the population with urban *hukou* and the urban temporary resident population. Urban *hukou*, also known as urban household registration, refers to a system in China that categorizes individuals based on their legal residency in urban areas.

[d]: The provincial government financial data here only shows the provincial level data, excluding the data of prefecture-level cities under provincial jurisdiction. The financial data of prefecture-level city governments are also limited to only the financial data of the prefecture-level cities themselves.

Table 3 Descriptive statistics

Variables	Mean	SD	Min	Max	N
Dependent variables					
Expropriated cultivated land ratio (%)	4.653	3.615	0.040	31.54	464
Expropriated cultivated land for residential purpose ratio (%)	1.662	1.159	0.000	5.928	348 [a]
Core explanatory variables					
Industrial value added	3472	3316	165.4	13245	464

Location entropy	0.954	0.263	0.372	1.834	464
Urban population density	2838	1216	598.0	6307	464
Fiscal deficit rate	146.9	91.69	12.22	544.0	464
Control variables					
GDP per capita	3.402	1.900	0.610	11.91	464
GDP growth rate	9.584	3.590	-5.000	19.20	464
GDP growth goal	9.071	2.095	4.500	15.00	464
Green space	38.05	4.647	22.99	49.29	464

Note: Data from 29 provinces for the years 2006-2021.

[a] : Data on cultivated land expropriation for residential purposes is only compiled within the MLR from 2007 to 2018.

5. Model specification and estimation

The empirical model specification is as follows:

$$LA_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + \delta_t + \mu_i + \varepsilon_{it} \quad (1)$$

Where LA_{it} denote the expropriated cultivated land ratios in province *i* in year *t*. C_{it} are the core explanatory variables for province i in year t. X_{it} are the control variables for province i in year t. β_0 is the constant term. β_1 are the coefficients of interest for the core explanatory variables. β_2 are the coefficients for the control variables. δ_t are the unknown coefficients representing time heterogeneity with individual province invariance. μ_i are the within-province error terms representing individual provincial heterogeneity, with time invariance; ε_{it} are the random disturbances, which vary across provinces and time; they are assumed to be independent, identically distributed, and uncorrelated with δ_t and μ_i.

The fixed effects estimator (using the *reghdfe* estimator in Stata) was used to estimate the model. The absorb option was used to control for δ_t and μ_i. To address the potential heteroscedasticity resulting from omitted factors or nonlinear relationships between the dependent and independent variables, we followed Benoit's (2011) approach by applying the natural logarithm transformation to industrial value-added, GDP per capita and urban population density (see also Henderson et al., 2021), Moreover, we employed robust standard errors to estimate the model.

Endogeneity is potentially a problem in our estimations. One possible source of endogeneity is omitted variables that exhibit systematic variation over time and may be correlated with the dependent variable, such as financial crises (Wu and Heerink, 2016). In addition to the province

fixed effects, we have included year fixed effects into the model which help control for any impact from such omitted time-dependent variables (Combes and Gobillon, 2015; Wu and Heerink, 2016). To deal with potential revers causality, we use lagged explanatory variables (Combes et al., 2008; Combes and Gobillon, 2015). The selected explanatory variables generally do not influence land expropriation within the same year, given that it takes time to realize the land expropriations. The actual time lags between land expropriation and the explanatory variables are unknown. We therefore include one-year and two-year lagged variables, respectively, and use the results to test the robustness of the main findings.

To tests the robustness of the main findings we use three alternative model specifications. First, we replaced the industrial value added as measure for industrial agglomeration by an alternative measure, the location entropy index. Second, instead of taking expropriated land as dependent variable we took expropriation of cultivated land for residential purposes. Third, we identified differences in cultivated land expropriation policies before and after 2013. We therefore estimated the empirical model before and after this year. Finally, we tested the impact of fiscal deficits at the provincial and prefecture-level city on the expropriation of cultivated land.

6. Estimation results

6.1 Baseline results

Table 4 reports the regression results for models (1). Results of the Hausman test and the F-test, shown at the bottom of the table, indicate that the two-way fixed effects model is appropriate. Estimation results for the one-year lag explanatory variables are presented in column (1), while the results for the two-year lagged explanatory variables are shown in column (2).

Industrial agglomeration, as measured by industrial value added, is found to have a statistically significant positive impact on the expropriated cultivated land area ratio. The estimated coefficients indicate that a 1% increase in industrial value added corresponds to a 0.068 percentage points increase in the expropriated cultivated land ratio. Urban population agglomeration, as measured by the urban population density, does not have a significant impact on the expropriated cultivated land ratio. Hence, population agglomeration does not contribute to cultivated land conversions when we control for industrial agglomeration. One possible explanation for this finding is that urban housing

in China is characterized by high-rise buildings, which need little land as compared to land used for industrial expansion. To investigate this further we will examine the impact of population agglomeration on cultivated land expropriation for residential purposes later.

The government's fiscal deficit does not affect the ratio of expropriated cultivated land. This finding contradicts the conclusions of previous research. For instance, Liu et al. (2018), using data from Chongqing for the period 2003-2015, suggest that in response to fiscal deficit pressures, local governments are more likely to engage in the expropriation of cultivated land to generate additional revenue from land conversion activities. Similarly, Bai et al. (2023), analyzing micro-plot transaction data from www.landchina.com for the period 2007–2015, arrived at the same conclusion. The discrepancies in research outcomes can be attributed to two main factors. First, our dataset is updated to include the most recent year available, encompassing data from the "post-land finance era." During this era, influenced by national land use policies, the government gradually reduced its reliance on land finance and instead aimed to achieve stable and sustainable tax revenue through industrial restructuring, among other strategies. We examine this issue later. Second, previous studies only considered the provincial level of fiscal deficit (e.g., Bai et al., 2023), whereas we aggregate fiscal deficits at both the provincial and prefecture-city levels by weighting and summing them, to account for the primary role that prefecture-city governments play in the expropriation of cultivated land. We will examine later.

The ratio of expropriated cultivated land is not significantly affected by the control variables, except for GDP per capita and GDP growth goal. It is interesting to note that GDP per capita has a negative and statistically significant impact on the expropriated cultivated land ratio at a significance level of 1%. Specially, the estimated coefficients reveal that a 1% increase in GDP per capita corresponds to a 0.062-0.074 percentage points decrease in the expropriated cultivated land ratio. This finding is inconsistent with previous studies conducted by Deng et al. (2010) and Shu et al. (2018), which suggest that economic development positively influences the expansion of urban construction land area through the conversion of rural lands, including cultivated land. One possible explanation for this inconsistency is that we use ratios instead of absolute amounts for measuring the dependent variables. This approach reduces differences between provinces in terms of scale, potentially affecting the observed relationship with GDP per capita. As regards the GDP growth

goal, we find that it has a positive and significant effect on the expropriated cultivated land ratio. For a one unit increase in the GDP growth goal, the ratio of expropriated cultivated land is estimated to increase by 0.27 percentage points.

Table 4 Regressions results, fixed effects model

	Panel A: one-year lag of explanatory variables	Panel B: two-year lag of explanatory variables
VARIABLES	(1)	(2)
ln (Industrial value added)	6.771**	6.030
	(2.749)	(3.698)
ln (Urban population density)	0.764	0.352
	(1.032)	(0.912)
Fiscal deficit rate	0.003	0.001
	(0.006)	(0.007)
ln (GDP per capita)	-6.210***	-7.444***
	(1.659)	(2.235)
GDP growth rate	0.062	-0.161
	(0.093)	(0.115)
GDP growth goal	0.154	0.269*
	(0.155)	(0.157)
Green space	-0.062	0.016
	(0.132)	(0.108)
Constant	10.144	29.979
	(24.505)	(26.767)
Year-fixed effects	Yes	Yes
Province-fixed effects	Yes	Yes
Observations	435	406
Adjusted R-squared	0.636	0.652
Within R-squared	0.055	0.072
Hausman test	12.97**	12.55*
F test	5.90***	6.39***

Note: Robust standard errors clustered at provincial level in brackets.

*, * *, *** denote significance levels of 10%, 5%, 1%, respectively.

The dependent variable is expropriated cultivated land ratio.

The F-test, based on the fixed effect model (using the *xtreg* estimator in Stata), controls for time fixed effects by including year dummy variables. This joint F-test assesses whether all years collectively have an effect equal to zero.

All explanatory variables were lagged by one or two years, except for the GDP growth goal which is set by the local government at the beginning of each year.

6.2 Robustness check: using new independent variable

Following the approach of Duranton and Puga (2004) and Liu et al. (2024), we used the location entropy as an alternative measure of industrial agglomeration to examine the robustness of the main findings. Location entropy includes the spatial distribution of value added and helps to mitigate the heterogeneity effect of urban size. Location entropy (LE) is defined as:

$$LE_{i,t} = (\frac{IG_{i,t}}{\sum_i IG_{i,t}})/(\frac{G_{i,t}}{\sum_i G_{it}}) \quad (3)$$

where $IG_{i,t}$ and $G_{i,t}$ represent the total industrial value-added and the total value-added of the secondary and tertiary industry in province *i* in year *t*, respectively. Given the concentration of industry mainly in urban areas, this study incorporates both the secondary and tertiary sectors within urban regions for the calculation of the industrial locational entropy.

The results for the robustness check are presented in Table 5. The results align with the findings of Table 4. Hence the main conclusions regarding the effect of industrial agglomeration on expropriated cultivated land remain valid.

Table 5 Robustness check: using new independent variable (fixed effect model)

	Panel A: one-year lag of explanatory variables	Panel B: two-year lag of explanatory variables
VARIABLES	(1)	(2)
Location entropy	6.200**	4.680*
	(2.312)	(2.523)
ln (Urban population density)	0.716	0.293
	(1.030)	(0.917)
Fiscal deficit rate	0.001	-0.000
	(0.005)	(0.005)
Control variables	Controlled	Controlled
Year-fixed effects	Yes	Yes
Province-fixed effects	Yes	Yes
Observations	435	406
Adjusted R-squared	0.641	0.653
Within R-squared	0.069	0.077
Hausman test	18.1***	14.37**
F test	7.15***	3.92***

Note: Robust standard errors clustered at provincial level in brackets.

*, * *, *** denote significance levels of 10%, 5%, 1%, respectively.

The dependent variable is the expropriated cultivated land ratio.

All explanatory variables were lagged by one or two years, except for the GDP growth goal which is set by the local government at the beginning of each year.

6.3 The effect of population agglomeration on cultivated land expropriated for residential purpose

Population agglomeration is also expected to be a major driving force for the expropriation of cultivated land. In China, when converting cultivated land to construction land, the purpose of the conversion is determined, although it can still be changed later. Therefore, we replaced the dependent variable by land expropriation for residential purpose, to further examine the impact of population agglomeration on cultivated land expropriation for residential purpose. The data for this

variable was sourced from the China Land and Resources Statistical Yearbook (2007-2018)[1]. Consistent with the previous analyses, this variable was calculated as a ratio to the total urban construction land area. Table 6 presents the estimation results for both the 1-year lagged and the 2-year lagged explanatory variables.

The findings in Table 6 demonstrate that population agglomeration has a positive and significant effect on the increase of land designated for residential purposes when we control for the fiscal deficit on provincial level. When a 2-year lag of explanatory variables is incorporated, population agglomeration significantly and positively affects cultivated land conversion for residential land purpose at the 1% significance level. Urban population density serves as a representation of population agglomeration in the preceding one or two years. This suggests that local governments invest in the development of additional residential infrastructure to meet the needs of residents. Industrial agglomeration leads to increased land conversions for residential land purpose. This reveals the role of industrial agglomeration and its facilitation of population mobility. Notably, the fiscal deficit has no effect on land conversion for residential purposes.

Table 6 Regression results for cultivated land conversion for residential purpose, fixed effects model

	Panel A: one-year lag of explanatory variables	Panel B: two-year lag of explanatory variables
VARIABLES	(1)	(2)
ln (Industrial value added)	6.147***	6.196***
	(1.799)	(1.414)
ln (Urban population density)	0.435*	0.986***
	(0.246)	(0.234)
Fiscal deficit rate	0.003	0.003
	(0.002)	(0.004)
Control variables	Controlled	Controlled
Year-fixed effects	Yes	Yes
Province-fixed effects	Yes	Yes
Observations	319 [a]	290
Adjusted R-squared	0.581	0.607
Within R-squared	0.157	0.170
Hausman test	37.96***	34.89***
F test	2.49**	3.48***

Note: Robust standard errors clustered at provincial level in brackets.

*, * *, *** denote significance levels of 10%, 5%, 1%, respectively.

The dependent variable is the ratio of expropriated cultivated land for residential purposes to the total area of urban construction land.

[1] No data regarding the expropriation of cultivated land for a specific purpose has been included in China's natural resources yearbooks. Therefore, the relevant data is restricted to the China Statistical Yearbook of Land and Resources 2007-2018.

All explanatory variables were lagged by one or two years, except for the GDP growth goal which is set by the local government at the beginning of each year.

[a]: Data on the expropriation of cultivated land for specific purposes is not included in China's natural resources yearbooks (2019-2022), but is available in the China Statistical Yearbook of Land and Resources 2007-2018.

6.4 Cultivated land conversion changes in different periods

Land finance has been a significant driver of China's economic growth, contributing to the country's widely acknowledged "economic miracle" in recent decades (Gyourko et al., 2022). This reliance on land finance has also alleviated fiscal pressures for local governments. Nevertheless, this growth strategy raises concerns regarding its sustainability due to the escalating economic and social costs and risks associated with local governments' strong reliance on land finance (Gyourko et al., 2022). It is worth noting that the Chinese government has recognized these issues. Since 2005, China has repeatedly proposed in national policy documents to narrow the scope of land expropriation. This paper uses the "Decision of the Central Committee of the Communist Party of China on Several Major Issues Concerning Comprehensively Deepening Reform" in 2013 (hereinafter referred to as the *Decision*) as important point in time. This is because prior to this point in time, the premise of narrowing the scope of land expropriation was to improve the property rights system and land expropriation system. The 2013 *Decision* then proposed to establish a unified urban-rural construction land market, aiming to allow rural collective construction land to enter the market, in order to effectively narrow the scope of cultivated land expropriation. Consequently, the year 2013 marks the point in time when local governments initiated the reduction of their reliance on land finance. In the subsequent analysis, we conducted regressions separately for samples from these two distinct phases, utilizing variables and model definitions consistent with those reported in Table 4.

The regression results presented in Table 7 show the impact of industrial and population agglomeration, as well as the fiscal deficit, on the ratio of expropriated land. The results reveal that industrial and population agglomeration consistently align with the findings reported in Table 4 for both periods. Notably, the fiscal deficit rate exhibits a positive and significant effect on the expropriated cultivated land ratio from 2006 to 2013, but this effect is not present in the subsequent period from 2014 to 2021. This finding is consistent with prior research predating 2018, which indicated that the fiscal deficit contributes to increased cultivated land expropriation (Liu et al., 2018;

Bai et al., 2023). This suggests that in the post land finance era, local governments have curbed their dependence on land expropriation.

Table 7 Regressions results for different time periods, fixed effects model

	Panel A: one-year lag of explanatory variables	
	(1)	(2)
	Expropriated cultivated land ratio	
VARIABLES	Period of 2006-2013	Period of 2014-2021
ln (Industrial value added)	11.911***	4.230*
	(4.232)	(2.463)
ln (Urban population density)	0.980	-1.136
	(0.848)	(1.041)
Fiscal deficit rate	0.044**	-0.003
	(0.017)	(0.003)
Control variables	Controlled	Controlled
Year-fixed effects	Yes	Yes
Province-fixed effects	Yes	Yes
Observations	203	232
Adjusted R-squared	0.657	0.615
Within R-squared	0.170	0.061
Hausman test	27.92***	7.55
F test	3.34***	3.28***

Note: Robust standard errors clustered at provincial level in brackets.

*, * *, *** denote significance levels of 10%, 5%, 1%, respectively.

All explanatory variables were lagged by one year, except for the GDP growth goal which is set by the local government at the beginning of each year.

6.5 Considering the effect of provincial fiscal deficits and prefecture level fiscal deficits separately

In the previous section, we combined the deficits at the provincial and prefecture-level city levels into a unified variable, which aimed to capture the local government fiscal deficits. However, this approach may have led to an underestimation of the influence of prefecture-level city governments, considering their central role in land expropriation. In China, a significant portion of the land transfer fees (70%), is directly channeled into the revenue of these local governments. Therefore, for a more comprehensive analysis, we employed the fiscal deficits of provincial and prefecture-level city governments as separate variables. The results are detailed in Table 8.

Table 8 reveals that the expropriated cultivated land ratio is significantly and positively influenced by the provincial fiscal deficit rate, with a one unit increase in the provincial fiscal deficits rate corresponding to a 0.013-0.017 percentage points increase in the expropriated cultivated land ratio. This finding is consistent with the research of Wu et al. (2015) and Liu et al. (2023), suggesting that local governments engage in cultivated land expropriation to generate revenue when

facing provincial fiscal deficits. However, unexpectedly, the prefecture level fiscal deficit rate does not affect the expropriated cultivated land ratio.

Table 8 Considering the effect of provincial fiscal deficits and prefecture level fiscal deficits separately, fixed effects model

	Panel A: one-year lag of explanatory variables		Panel B: two-year lag of explanatory variables	
VARIABLES	(1)	(2)	(3)	(4)
ln (Industrial value added)	7.947**	6.732**	7.698*	6.106*
	(2.918)	(2.653)	(4.009)	(3.510)
ln (Urban population density)	1.021	0.729	0.620	0.307
	(1.073)	(1.033)	(0.940)	(0.901)
Fiscal deficit rate, provincial level	0.013**		0.017*	
	(0.006)		(0.009)	
Fiscal deficit rate, prefecture level		-0.005		-0.008
		(0.005)		(0.005)
Control variables	Controlled	Controlled	Controlled	Controlled
Year-fixed effects	Yes	Yes	Yes	Yes
Province-fixed effects	Yes	Yes	Yes	Yes
Observations	435	435	406	406
Adjusted R-squared	0.647	0.638	0.668	0.657
Within R-squared	0.084	0.060	0.117	0.087
Hausman test	20.26***	11.35	22.50***	11.88*
F test	6.60***	5.82***	4.89***	6.96***

Note: Robust standard errors clustered at provincial level in brackets.

*, * *, *** denote significance levels of 10%, 5%, 1%, respectively.

The dependent variable is the expropriated cultivated land ratio.

All explanatory variables were lagged by one or two years, except for the GDP growth goal which is set by the local government at the beginning of each year.

6.6 Further discussion

Comparison with Existing Research Findings

First, the process of industrial agglomeration involves the concentration of industries in certain areas, leading to increased economic efficiency, innovation, and productivity due to reduced transportation costs, easier access to markets, and enhanced opportunities for knowledge sharing among firms (Fujita and Thisse, 2002). Our research findings confirm that industries require substantial amounts of land for factories, warehouses, and other facilities, leading to the appropriation of cultivated land for these purposes, at the expense of agricultural land, which potentially affect food production and ecology (Zhang et al., 2023). This highlights the need for balanced approaches that accommodate economic growth and industrial development while also preserving cultivated land ensuring food security.

Second, despite that our study does not find a direct link between population agglomeration

and cultivated land expropriation, we expect an indirect link via industrial agglomeration, aligning with Skog and Steinnes' research from 2016 (Skog and Steinnes, 2016). As urban populations swell, demand for housing escalates, necessitating the conversion of agricultural land to accommodate the growing population. In developed nations and regions, government intervention by means of planning regulates the pressures of industrial clustering and demographic expansion. White and Allmendinger (2003) note that despite differing approaches—the UK's "plan-led" versus the US's "market-led" systems—both countries' planning have led to similar outcomes: rising prices, reduced supply, increased housing density, certainty provision, and risk mitigation. Shen et al. (2009) contend that only through planning policies high-density cities like Hong Kong can achieve sustainable land use, balancing environmental, social, and economic demands.

Third, our research findings suggest that government fiscal deficits have a significant and positive impact on the rate of cultivated land expropriation from 2006 to 2013. However, this effect was not present from 2014 to 2021. This suggests that local governments' reliance on land finance has weakened. Moreover, our findings indicate that provincial fiscal deficits increase cultivated land conversion. This is consistent with previous studies (e.g., Wu et al. 2015 and Liu et al. 2023). However, we do not find that prefecture-level city fiscal deficits have a significant effect on the cultivated land conversion. This might be because prefecture-level city governments converting cultivated land into construction land are subject to controls by provincial or central governments (Gyourko et al., 2022; Han et al., 2020; Wu et al., 2015).

Challenges and recommendations for the future

In 2022, China's rural population reached 491.04 million, with an urbanization rate of 65.22%[2], which is still below the urbanization rate in western countries[3]. According to data from the Natural Resources Statistics Bulletin, in 2022, 0.46 million hectares of agricultural land were converted for construction purposes, with 0.16 million hectares being cultivated land[4]. These statistics indicate a continuing robust urbanization trend in China, presenting challenges to the protection of cultivated land. The effects of the post-pandemic crisis in China's real estate market have notably reduced revenue from land finance, emphasizing the need to decrease local governments' reliance on such

[2] https://www.ndrc.gov.cn/fgsj/tjsj/jjsjgl1/202301/t20230131_1348084.html

[3] https://hbs.unctad.org/total-and-urban-population/#:~:text=Over%20the%20last%20ten%20years,increase%20in%20the%20same%20period.

[4] https://www.mnr.gov.cn/sj/tjgb/202304/P020230412557301980490.pdf

funds. One approach to achieve less pressure on cultivated land is by improving land use efficiency and minimizing the expropriation of cultivated land. To address fiscal deficits and reduce local governments' dependence on generating revenue through land finance, it is vital to reform land expropriation, as suggested by Wu et al. (2015). Given that provincial fiscal deficits show a stronger dependence on 'land finance' than prefecture-level city governments it is important to reform the fiscal structure of provincial local governments Moreover, it is important to improve the efficiency and transparency of the use of public funds, and reduce unnecessary expenditure and waste. The same applies also to prefecture-level city governments but less.

Implications for other countries

In the context of rapid urbanization and economic development, the competition for land use becomes more pronounced. This is a challenge not unique to China. With industrialization and population concentration, the increasing demand for land may conflict with environmental protection and sustainable development needs. China's experience offers valuable insights and lessons.

7. Conclusion

Cultivated land is a critical factor for sustainable agricultural development and national food security. In the process of industrialization and urbanization the expropriation and illegal conversion of cultivated land pose serious threats to the quality and quantity of China's cultivated land, thereby endangering national food security. This study adds to the available literature on the declining availability of cultivated land in China by examining the impact of (industrial and population) agglomeration and local government fiscal deficits on cultivated land expropriation and illegal land conversion. Provincial data on cultivated land expropriation between 2006-2021 were used for the empirical analysis. It was found that industrial agglomeration has a significant and positive impact on the expropriation of cultivated land. Although population agglomeration does not directly affect the rate of cultivated land expropriation, it significantly increases the ratio of cultivated land being converted into residential land. The local fiscal deficits (primarily at the provincial level) significantly increased the cultivated land expropriation rate before 2014, but this effect is no longer significant thereafter. Further examination reveals that, within the study period, provincial-level fiscal deficits significantly elevated the land expropriation rate, whereas fiscal deficits at the

prefectural-city level had no impact on it.

However, our analysis, though based on the most recent data available, does not encompass recent events, such as the impact of China's recent real estate crisis on land expropriation. Therefore, future discussions should further explore the effects of similar crises on land acquisition in light of our findings.

References

Bai, X., Lu, J., Li, P., 2023. Fiscal Pressure, Inter-Industrial Allocation of Land and Agglomerations Effects. China Finance Econ. Rev. 12, 65–82. https://doi.org/10.1515/cfer-2023-0016

Benoit, K., 2011. Linear regression models with logarithmic transformations. Lond. Sch. Econ. Lond. 22, 23–36.

Besley, T., Montalvo, J.G., Reynal-Querol, M., 2011. Do Educated Leaders Matter? Econ. J. 121, F205-227. https://doi.org/10.1111/j.1468-0297.2011.02448.x

Cao, G., Feng, C., Tao, R., 2008. Local "Land Finance" in China's Urban Expansion: Challenges and Solutions. China World Econ. 16, 19–30. https://doi.org/10.1111/j.1749-124X.2008.00104.x

Carbonaro, G., Leanza, E., McCann, P., Medda, F., 2018. Demographic Decline, Population Aging, and Modern Financial Approaches to Urban Policy. Int. Reg. Sci. Rev. 41, 210–232. https://doi.org/10.1177/0160017616675916

Chen, X., Yu, L., Du, Z., Liu, Z., Qi, Y., Liu, T., Gong, P., 2022. Toward sustainable land use in China: A perspective on China's national land surveys. Land Use Policy 123, 106428. https://doi.org/10.1016/j.landusepol.2022.106428

Combes, P.-P., Duranton, G., Gobillon, L., 2008. Spatial wage disparities: Sorting matters! J. Urban Econ. 63, 723–742. https://doi.org/10.1016/j.jue.2007.04.004

Combes, P.-P., Gobillon, L., 2015. Chapter 5 - The Empirics of Agglomeration Economies, in: Duranton, G., Henderson, J.V., Strange, W.C. (Eds.), Handbook of Regional and Urban Economics, Handbook of Regional and Urban Economics. Elsevier, pp. 247–348. https://doi.org/10.1016/B978-0-444-59517-1.00005-2

Deng, X., Huang, J., Rozelle, S., Uchida, E., 2010. Economic Growth and the Expansion of Urban Land in China. Urban Stud. 47, 813–843. https://doi.org/10.1177/0042098009349770

Ding, C., 2003. Land policy reform in China: assessment and prospects. Land Use Policy 20, 109–120. https://doi.org/10.1016/S0264-8377(02)00073-X

Ding, C., Lichtenberg, E., 2011. Land and urban economic growth in China*. J. Reg. Sci. 51, 299–317. https://doi.org/10.1111/j.1467-9787.2010.00686.x

Duranton, G., Puga, D., 2004. Chapter 48 - Micro-Foundations of Urban Agglomeration Economies, in: Henderson, J.V., Thisse, J.-F. (Eds.), Handbook of Regional and Urban Economics, Cities and Geography. Elsevier, pp. 2063–2117.

Fan, X., Qiu, S., Sun, Y., 2020. Land finance dependence and urban land marketization in China: The perspective of strategic choice of local governments on land transfer. Land Use Policy 99, 105023. https://doi.org/10.1016/j.landusepol.2020.105023

Fischer, G., Huang, J., Keyzer, M., Qiu, H., Sun, L., van Veen, W., 2007. China's agricultural prospects and challenges: Report on scenario simulations until 2030 with the Chinagro welfare model covering national, regional and county level. http://eprints.soas.ac.uk/12657/1/CHINAGRO-prospects_challenges.pdf

Florida, R., Rodríguez-Pose, A., Storper, M., 2023. Critical Commentary: Cities in a post-COVID world. Urban Stud. 60, 1509–1531. https://doi.org/10.1177/00420980211018072

Fujita, M., Thisse, J.-F., 2002. Economics of Agglomeration: Cities, Industrial Location, and Regional Growth. Cambridge University Press, Cambridge.

Gao, J., O'Neill, B.C., 2020. Mapping global urban land for the 21st century with data-driven simulations and Shared Socioeconomic Pathways. Nat. Commun. 11, 2302.

https://doi.org/10.1038/s41467-020-15788-7
Gao, J., Wei, Y.D., Chen, W., Chen, J., 2014. Economic transition and urban land expansion in Provincial China. Habitat Int. 44, 461–473. https://doi.org/10.1016/j.habitatint.2014.09.002
Gyimah-Brempong, K., Paddison, O., Mitiku, W., 2006. Higher education and economic growth in Africa. J. Dev. Stud. 42, 509–529. https://doi.org/10.1080/00220380600576490
Gyourko, J., Shen, Y., Wu, J., Zhang, R., 2022. Land finance in China: Analysis and review. China Econ. Rev. 76, 101868. https://doi.org/10.1016/j.chieco.2022.101868
Han, W., Zhang, X., Zheng, X., 2020. Land use regulation and urban land value: Evidence from China. Land Use Policy 92, 104432. https://doi.org/10.1016/j.landusepol.2019.104432
He, C., Huang, Z., Wang, R., 2014. Land use change and economic growth in urban China: A structural equation analysis. Urban Stud. 51, 2880–2898. https://doi.org/10.1177/0042098013513649
Henderson, J.V., Nigmatulina, D., Kriticos, S., 2021. Measuring urban economic density. J. Urban Econ., Delineation of Urban Areas 125, 103188. https://doi.org/10.1016/j.jue.2019.103188
Ho, S.P.S., Lin, G.C.S., 2003. Emerging Land Markets in Rural and Urban China: Policies and Practices. China Q. 175, 681–707. https://doi.org/10.1017/S0305741003000407
Huang, J., Yang, G., 2017. Understanding recent challenges and new food policy in China. Glob. Food Secur. 12, 119–126. https://doi.org/10.1016/j.gfs.2016.10.002
Jacoby, H.G., Li, G., Rozelle, S., 2002. Hazards of Expropriation: Tenure Insecurity and Investment in Rural China. Am. Econ. Rev. 92, 1420–1447. https://doi.org/10.1257/000282802762024575
Kusiluka, M.M., Kongela, S., Kusiluka, M.A., Karimuribo, E.D., Kusiluka, L.J.M., 2011. The negative impact of land acquisition on indigenous communities' livelihood and environment in Tanzania. Habitat Int. 35, 66–73. https://doi.org/10.1016/j.habitatint.2010.03.001
Lin, Q., Tan, S., Zhang, L., Wang, S., Wei, C., Li, Y., 2018. Conflicts of land expropriation in China during 2006–2016: An overview and its spatio-temporal characteristics. Land Use Policy 76, 246–251. https://doi.org/10.1016/j.landusepol.2018.05.018
Liu, J., Fang, Y., Ma, Y., Chi, Y., 2024. Digital economy, industrial agglomeration, and green innovation efficiency: empirical analysis based on Chinese data. J. Appl. Econ. 27, 2289723. https://doi.org/10.1080/15140326.2023.2289723
Liu, Y., Fan, P., Yue, W., Song, Y., 2018. Impacts of land finance on urban sprawl in China: The case of Chongqing. Land Use Policy 72, 420–432. https://doi.org/10.1016/j.landusepol.2018.01.004
Liu, Z., Jiang, C., Huang, J., Zhang, W., Li, X., 2023. Fiscal incentive, political incentive, and strategic interaction of illegal land use by local governments. Land Use Policy 129, 106647. https://doi.org/10.1016/j.landusepol.2023.106647
McCann, P., 2013. Modern Urban and Regional Economics. Oxford University Press.
McCarthy, J.F., Vel, J.A.C., Afiff, S., 2012. Trajectories of land acquisition and enclosure: development schemes, virtual land grabs, and green acquisitions in Indonesia's Outer Islands. J. Peasant Stud. 39, 521–549. https://doi.org/10.1080/03066150.2012.671768
Ministry of Housing and Urban-Rural Development of China (MHURD) (2007-2022). China Urban Construction Statistical Yearbook (2007-2022). Beijing: China Statistics Press. (In Chinese)

Ministry of Land and Resources of China (MLR) (2007-2018). China Land and Resources Statistical Yearbook (2007-2018). Beijing: Geological Publishing House. (In Chinese)

Ministry of Natural Resources of the People's Republic of China (MNR) (2019-2022). China Natural Resources Statistical Yearbook (2019-2022). Beijing: Geological Publishing House. (In Chinese)

Ministry of Finance of the People's Republic of China (MFC) (2007-2022) Finance yearbook of China (2007-2022). Beijing: China State Finance Magazine. (In Chinese)

National Bureau of Statistics of China (NBSa) (2007-2022). China Statistical Yearbook (2007-2022). Beijing: China Statistics Press. (In Chinese)

Peng, D., Li, R., Shen, C., Wong, Z., 2022. Industrial agglomeration, urban characteristics, and economic growth quality: The case of knowledge-intensive business services. Int. Rev. Econ. Finance 81, 18–28. https://doi.org/10.1016/j.iref.2022.05.001

Provincial Bureau of Statistics for each province (PBS) (2006-2022). Provincial Statistical Yearbooks and Statistical Bulletins (2006-2022). (In Chinese)

Qu, F., Kuyvenhoven, A., Shi, X., Heerink, N., 2011. Sustainable natural resource use in rural China: Recent trends and policies. China Econ. Rev. 22, 444–460. https://doi.org/10.1016/j.chieco.2010.08.005

Qu, S., Heerink, N., Xia, Y., Guo, J., 2018. Farmers' satisfaction with compensations for farmland expropriation in China. China Agric. Econ. Rev. 10, 572–588. https://doi.org/10.1108/CAER-07-2016-0094

Sargeson, S., 2013. Violence as development: land expropriation and China's urbanization. J. Peasant Stud. 40, 1063–1085. https://doi.org/10.1080/03066150.2013.865603

Shen Q., Chen Q., Tang B., Yeung S., Hu Y., Cheung G., 2009. A system dynamics model for the sustainable land use planning and development. Habitat Int. 33, 15–25. https://doi.org/10.1016/j.habitatint.2008.02.004

Shu, C., Xie, H., Jiang, J., Chen, Q., 2018. Is Urban Land Development Driven by Economic Development or Fiscal Revenue Stimuli in China? Land Use Policy 77, 107–115. https://doi.org/10.1016/j.landusepol.2018.05.031

Skog K.L., Steinnes M., 2016. How do centrality, population growth and urban sprawl impact farmland conversion in Norway? Land Use Policy 59, 185–196. https://doi.org/10.1016/j.landusepol.2016.08.035

Tagliarino, N., Bununu, Y., Micheal, M., De Maria, M., Olusanmi, A., 2018. Compensation for Expropriated Community Farmland in Nigeria: An In-Depth Analysis of the Laws and Practices Related to Land Expropriation for the Lekki Free Trade Zone in Lagos. Land 7, 23. https://doi.org/10.3390/land7010023

Tan, R., Beckmann, V., van den Berg, L., Qu, F., 2009. Governing farmland conversion: Comparing China with the Netherlands and Germany. Land Use Policy 26, 961–974. https://doi.org/10.1016/j.landusepol.2008.11.009

Tan, R., Qu, F., Heerink, N., Mettepenningen, E., 2011. Rural to urban land conversion in China—How large is the over-conversion and what are its welfare implications? China Econ. Rev. 22, 474–484. https://doi.org/10.1016/j.chieco.2011.07.013

Tang, H., Sang, L., Yun, W., 2020. Challenges and Technological Innovation in Implementing China's Land Occupation-Compensation Balance Policy. Bull. Chin. Acad. Sci. 35, 637-644 (In Chinese).

Tang, P., Feng, Y., Li, M., Zhang, Y., 2021. Can the performance evaluation change from central government suppress illegal land use in local governments? A new interpretation of Chinese decentralisation. Land Use Policy 108, 105578. https://doi.org/10.1016/j.landusepol.2021.105578

Tilley, H., Newman, J., Connell, A., Hoole, C., Mukherjee, A., 2023. A place-based system? Regional policy levers and the UK's productivity challenge. Reg. Stud. 57, 2102–2114. https://doi.org/10.1080/00343404.2022.2152436

Tong, D., Chu, J., MacLachlan, I., Qiu, J., Shi, T., 2023. Modelling the Impacts of land finance on urban expansion: Evidence from Chinese cities. Appl. Geogr. 153, 102896. https://doi.org/10.1016/j.apgeog.2023.102896

Wang, Z., Zhang, Q., Zhou, L.-A., 2020. Career Incentives of City Leaders and Urban Spatial Expansion in China. Rev. Econ. Stat. 102, 897–911. https://doi.org/10.1162/rest_a_00862

White, M., Allmendinger, P., 2003. Land-use Planning and the Housing Market: A Comparative Review of the UK and the USA. Urban Stud. 40, 953–972. https://doi.org/10.1080/0042098032000074263

Wu, Q., Yongle, L., Yan, S., 2015. The incentives of China's urban land finance. Land Use Policy 42, 432–442. https://doi.org/10.1016/j.landusepol.2014.08.015

Wu, Y., Heerink, N., 2016. Foreign direct investment, fiscal decentralization and land conflicts in China. China Econ. Rev. 38, 92–107. https://doi.org/10.1016/j.chieco.2015.11.014

Xiao, B., Ning, X., 2013. Situation and countermeasures for protection of cultivated land and basic farmland in Guangdong province. Guangdong Agric. Sci. 40, 227-231+236 (In Chinese).

Xie, Y., 2019. Land expropriation, shock to employment, and employment differentiation: Findings from land-lost farmers in Nanjing, China. Land Use Policy 87, 104040. https://doi.org/10.1016/j.landusepol.2019.104040

Yan, Y., Huang, J., 2022. The role of population agglomeration played in China's carbon intensity: A city-level analysis. Energy Econ. 114, 106276. https://doi.org/10.1016/j.eneco.2022.106276

Yuan, C., Liu, S., Xie, N., 2010. The Impact on Chinese Economic Growth and Energy Consumption of the Global Financial Crisis: An Input–Output Analysis. Energy, Demand Response Resources: the US and International Experience 35, 1805–1812. https://doi.org/10.1016/j.energy.2009.12.035

Zhang, Z., Ghazali, S., Miceikienė, A., Zejak, D., Choobchian, S., Pietrzykowski, M., Azadi, H., 2023. Socio-economic impacts of agricultural land conversion: A meta-analysis. Land Use Policy 132, 106831. https://doi.org/10.1016/j.landusepol.2023.106831

Zhou, Y., Li, X., Liu, Y., 2021. Cultivated land protection and rational use in China. Land Use Policy 106, 105454. https://doi.org/10.1016/j.landusepol.2021.105454

Appendix

Table A1: Types of Cultivated Land Increase and Decrease

Increase in Area of Cultivated Land	Land renovation	Adjusting and transforming the land use status to improve the utilization and output of land, and to improve the production, living conditions, and ecological environment. It includes the consolidation of agricultural land and construction land. The main contents include adjusting land use structure, merging scattered land parcels, leveling land, comprehensive management of roads, channels, etc., and the concentration, relocation, and internal renovation of village and rural enterprise land.
	Linking the Increase and Decrease of Urban and Rural Construction Land (Balanced Occupation and Compensation of Cultivated Land)	
	Reclamation of industrial and mining wasteland	Rehabilitating damaged land caused by excavation, subsidence, or occupation during the process of production and construction, by taking measures to restore the land to a usable state.
	Agricultural restructuring	Area of land that has been converted from other agricultural uses to cultivated land as a result of agricultural structural adjustment. For instance, the adjustment of the percentages of lands used by crop growing, forestry, livestock farming, aquatic products farming, and side-line occupation in agricultural production during the reporting period to meet the requirements for the economic development and eco-environmental protection.
	Other activities	Other activities that could increase cultivated land area
Decrease in Area of Cultivated Land	Construction	Reduction in cultivated land area due to various types of construction occupation. Before cultivated land is converted into construction land, it is necessary to go through the cultivated land expropriation procedure for approval.
	Destroyed by natural disasters	Cultivated land that cannot be cultivated due to natural disasters such as water erosion, sand pressure, landslides, mudflows, gully erosion, earthquakes, and other natural disasters.
	Ecological restoration	Cultivated land that is returned to forests, pastures, or lakes according to planning, plans, and actual needs for ecological environmental construction.
	Agricultural structural adjustment	Area of cultivated land that has been converted to other agricultural uses as a result of the adjustment of agricultural structure. For instance, the adjustment of the percentages of lands used by crop growing, forestry, livestock farming, aquatic products farming, and side-line occupation in agricultural production during the reporting period to meet the requirements for the economic development and eco-environmental protection.

Source: MLR (2007-2018) and MNR (2019-2022)