

Original Paper

A Study on the Impact of Non-agricultural Use of Agricultural Land in Shandong Province on Economic Growth

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Abstract

China's farmland has been shifted to factories, roads, and housing faster than at any point in its history—and Shandong has been at the front of that wave. The conversion helped push the province's GDP up for years, but it has also eaten into grain acreage, strained the Yellow River basin's ecology, and left displaced rural households with few alternatives, costs that now gnaw at the very growth it fed. Given the needs of urbanization and industrialization, it is essential to effectively address the negative impacts of farmland non-agriculturalization while meeting the demand for expanded land use. To ensure that farmland non-agriculturalization promotes economic growth and urbanization in certain regions, it is crucial to clarify the relationship between the two and implement appropriate measures to manage related challenges. Taking Shandong Province as a case study, this paper investigates the relationship between farmland non-agriculturalization and economic growth. Using a combination of literature review and empirical research methods, we collected 20 years of data from Shandong and applied the C-D production function model to analyze the contribution of farmland non-agriculturalization to economic growth, concluding that it is a significant factor. The pace of farmland non-agriculturalization in Shandong has been rapid, with a substantial increase in the proportion of non-agricultural land use, making it a major engine of economic growth. This transformation has promoted industrialization and urbanization, stimulated investment and consumption, created employment opportunities, improved living standards, increased tax revenues, and driven optimization and upgrading of the industrial structure. By calculating the contribution rate of farmland non-agriculturalization to economic growth, we derive conclusions and propose recommendations for sustainable development based on local conditions. These suggestions aim to prevent minor problems from escalating and avoid over-reliance on farmland non-agriculturalization, which could lead to negative consequences such as reduced arable land, heightened food security risks, ecological damage, employment and social insurance challenges, and illegal non-agricultural land occupation in some areas.

Keywords

Non-agricultural use of farmland, Economic growth, Cobb-Douglas production function

1. Research Background

After 2000, as China's economy surged and its cities sprawled outward, the hunger for land began to swallow farmland at an accelerating rate. How to protect and utilize arable land effectively and achieve sustainable development in this transformation is a major strategic issue concerning national economic development, social stability, and national security. In Shandong Province, the pace of farmland non-agriculturalization has quickened, placing significant pressure on resource and environmental carrying capacity, making it a key constraint on socioeconomic development. Studying the non-agriculturalization of farmland in Shandong, analyzing its socioeconomic impacts, and proposing appropriate countermeasures are of great significance for the sustainable use of land resources and coordinated socioeconomic development.

In 2023, Shandong held meetings on land and agricultural management, new urbanization, and rural land transfers. Those sessions kept up the pressure on curbing farmland non-agriculturalization and laid out steps covering land governance, ecological restoration, agricultural and urban development, and land-system reform. The province strengthened its focus on intensive land utilization and resource conservation, controlled the expansion of various construction land uses, safeguarded national grain production bases, and prevented further damage to ecosystems. In the same year, Shandong released the "Implementation Opinions on Guiding the Orderly Circulation of Rural Land Management Rights and Promoting Moderately Scaled Agricultural Operations," which set goals of ensuring food security, enhancing agricultural efficiency, and increasing farmers' incomes. It upheld the principle of "three rights separation"—ownership, contracting rights, and management rights—of rural land, adhered to voluntary, compensated, and legal transfers with government support and market-driven resource allocation, encouraged land management rights to be transferred through seven types of mechanisms, fostered new types of agricultural operators, activated the land circulation market, revitalized idle land, prevented land fragmentation, and achieved optimal land resource allocation.

To make sense of Shandong's farmland non-agriculturalization, we have to set it inside the province's wider economic shift—industrial upgrading, cities still expanding, tighter ecological and food-security demands, and a land system mid-reform. Taken together, those are what decide whether farmland gets protected or spent. Only through coordinated progress in these areas can a positive feedback loop be established, enabling dynamic balance between development and environmental protection. Against this backdrop, this paper investigates the impact of farmland non-agriculturalization on economic growth in Shandong Province. Through empirical analysis, it examines whether the process of farmland conversion has been reasonable, proposes targeted policy recommendations, and advocates for appropriate criteria to align agricultural land use with economic, social, and ecological outcomes, thereby promoting sustainable socioeconomic development.

Agricultural land is the most fundamental and crucial resource for all production activities. The loss of farmland resources and changes in their utilization patterns inevitably exert profound impacts on economic growth. Studying the effects of non-agricultural conversion of farmland on economic development can enrich land resource management theories, promote theoretical advancement and innovation—such as in land resource management, regional development, ecological civilization, high-quality development, agricultural development, and policy evaluation—and help formulate scientific and rational strategies and models for land use. It broadens research perspectives, providing theoretical references and case support for decision-making and development in related fields, such as optimal allocation of land resources, industrial structure adjustment, ecological security maintenance, food production assurance, and policy evaluation. Furthermore, it drives innovation in policy evaluation theories and methods by applying rigorous research frameworks and assessment tools to evaluate policy implementation effectiveness, identify existing problems, and offer targeted recommendations. This study is grounded precisely in the theoretical significance of farmland non-agriculturalization. Moving forward, we will explore this theoretical dimension using sound research methodologies to advance and innovate relevant theories, thereby contributing theoretically and supporting policy decisions regarding farmland non-agriculturalization in Shandong Province.

In practice, the study gives Shandong's planners a sounder basis to decide—starting with how land is zoned and where industry sits. Get those right, and land goes where it pays off while industry moves up the value chain. Second, it supports urbanization and new-type urbanization development, promoting coordinated growth between urban and rural areas. Third, it informs economic growth targets and policy formulation, helping establish a sound development path. Fourth, it provides a theoretical basis for the transformation and upgrading of rural economies and the construction of new rural communities, advancing agricultural modernization and integrated urban-rural development. Fifth, it serves as a reference for policymakers in formulating plans related to land use, industrial development, and socioeconomic progress, playing a crucial role in supporting transformative development.

The research primarily employed a methodology combining theory with practical application, as well as qualitative and quantitative approaches. A C-D production function was established to conduct regression analysis on the data. The study mainly utilized economic research methods including statistical analysis, literature review, and regression analysis.

2. Literature Review and Definition of Related Concepts

2.1 Literature Review

As urbanization and the economy advanced, farmland slipped out of agriculture ever faster. The result—land growing scarce and the environment under mounting pressure—has pushed the issue to the foreground of research on land use and regional high-quality development. Numerous existing studies have systematically explored the characteristics, impacts, and optimization pathways of farmland non-agriculturalization in China from multiple dimensions—including institutional policies, ecological

environment, industrial development, land circulation, benefit distribution, and government governance—yielding rich research outcomes.

From the perspectives of policy systems and ecological compensation, existing research focuses on the current status and evolutionary trends of domestic ecological value compensation. It clearly identifies improving the ecological value compensation system, innovating diversified compensation mechanisms, and advancing related legislative efforts as key directions for optimizing the governance of agricultural land non-agriculturalization and resolving contradictions in ecological development at present. Studies from the ecological assessment dimension are grounded in regional ecosystem change characteristics, conducting empirical evaluations of the non-agriculturalization process of farmland in northwestern Sichuan to explore patterns and driving factors behind changes in regional ecosystem service values. Empirical results indicate that adjustments in the structure of agricultural land use are the core factor influencing fluctuations in ecosystem service values; expansion of forested areas significantly enhances these values, while reduction in grassland area leads to ecological value loss. In contrast, the negative impact of construction land expansion on regional ecosystem service values is relatively limited. These findings strongly confirm that ecological projects such as returning farmland to forests play a crucial role in stabilizing regional ecosystem services and offsetting ecological losses caused by agricultural land non-agriculturalization.

The non-agricultural transformation of farmland not only triggers ecological and environmental changes but also profoundly reshapes regional industrial structures and farmers' livelihood systems. As the scale of agricultural land continues to shrink, regional industrial structures undergo continuous iteration and optimization, with agriculture's share gradually declining while the shares of secondary and tertiary industries steadily rise. This drives a deep transformation in both regional industrial composition and urban-rural employment patterns, significantly affecting rural residents' employment methods, income sources, and livelihood development. Research on land circulation and urbanization further elucidates their intrinsic connections: rapid urbanization has continuously expanded the scale of rural collective construction land circulation and fostered diverse forms of land transfer. Existing studies classify rural land circulation into two main types—government-led and farmer-initiated. In light of small-town development practices, regional economic foundations and shifts in urban-rural lifestyles provide practical conditions for implementing government-led land circulation models. Governments can leverage land resource integration to promote optimization and upgrading of the regional tri-sectoral industrial structure, facilitate rural labor migration and employment, and strengthen social security systems to alleviate livelihood challenges arising from farmland non-agriculturalization. However, uncontrolled and overly rapid expansion of urban land use may lead to loss of control over urban construction land scale, triggering imbalances in urban spatial layout, environmental degradation, and a series of sustainability issues.

Studies using both qualitative and quantitative methods converge on the finding that farmland non-agriculturalization produces varied negative effects through identifiable driving mechanisms.

Urbanization that expands without checks turns farmland over to other uses at vast scale, leaving resource depletion and social costs in its wake. Empirical research from the perspective of urban-rural development disparities shows that widening gaps between urban and rural areas intensify illegal non-agricultural conversion of farmland; insufficient fiscal support for agriculture and growing income disparities between urban and rural regions further exacerbate this negative effect. In response, relevant studies suggest establishing a sustainable investment and financing mechanism for urbanization, standardizing models of land resource development and utilization, promoting orderly non-agricultural conversion of farmland, and shifting the focus of urbanization toward peri-urban areas. By redeveloping idle and underutilized urban and rural lands and revitalizing brownfields, it is possible to transform the traditional, extensive model of land expansion.

Land use falls under the government's control. The state regulates land transfers and reshapes how land is allocated. In short, it is the lead player in this field. However, current land circulation governance still faces numerous practical challenges, with prominent issues including difficulties in integrating land resources and an inadequate mechanism for expressing the interests of stakeholders involved in land circulation. Addressing these challenges requires continuous deepening of land system reforms, establishing systematic and standardized land governance mechanisms, and enhancing the scientific rigor of land resource utilization decisions as well as the effectiveness of full-process supervision. This not only reflects the advancement of modern governance capabilities but also serves as a core support for ensuring high-quality development of territorial space.

On farmland protection and governance, we face two priorities. We must hold the red line for farmland and curb its disorderly conversion. Both remain strategic requirements for territorial spatial governance in the new era. The urban-rural fringe areas are the primary zones where agricultural land undergoes non-agricultural transformation. While economic growth and accelerated urbanization drive socioeconomic development, they have also significantly intensified the process of non-agricultural conversion in these regions. Due to the high uncertainty involved in this transformation, traditional policy-making models struggle to adapt to complex governance scenarios. In contrast, a diversified policy-making paradigm based on knowledge graphs can effectively address governance uncertainties, encompassing six core modes: rational reasoning, utility reasoning, uncertainty reasoning, social reasoning, public choice game reasoning, and think tank participation. Under modern governance systems, think tank involvement in policy formulation has become an important trend in managing agricultural land non-agriculturalization. By formulating sound public policies, it is possible to precisely resolve governance challenges and continuously enhance government effectiveness in land management.

This paper identifies an uneven split of land-appreciation gains as a core problem in farmland conversion. When farmland becomes urban construction land, its value surges, yet stakeholders fail to divide the gains fairly. That undermines land circulation and urban-rural equity. To address this issue, existing research, grounded in classical theories of land rights and land rent, systematically analyzes the practical challenges in allocating land appreciation gains from agricultural land conversion in China. It proposes

optimizing the benefit-sharing structure and safeguarding farmers' legitimate land rights through three key dimensions: reforming the land expropriation system, improving the land value-added tax system, and establishing a land development rights transfer mechanism.

From a nationwide spatiotemporal empirical perspective, the distribution of land appreciation gains in China exhibits significant regional disparities. Across the country, the gap in land appreciation gain distribution among provincial capital cities has generally widened, with social welfare levels steadily improving. However, regional development differences remain pronounced: while the disparity in eastern regions has gradually narrowed, the gap in central and western regions continues to expand, with the western region showing the most evident polarization. Moreover, improvements in social welfare display a gradient pattern from high in the east to low in the west, with the greatest gains observed in the eastern region and the weakest in the western region. Based on these findings, studies commonly recommend further deepening reforms of the land expropriation system, coordinating regional land development patterns, balancing equity and efficiency in land use, and comprehensively enhancing the social welfare level of urban and rural land utilization.

Based on existing research findings, the acceleration of non-agricultural conversion of farmland has led to resource and environmental constraints, pressures for industrial restructuring, and imbalances in benefit distribution—key challenges in current land governance. At this stage, it is essential to strengthen government macro-control over the scale and pace of land use, deepen land system reforms to address difficulties in allocating value-added gains, ensure balanced rights and interests among all stakeholders, and continuously improve the policy environment and modernize government land governance capabilities. These measures will provide solid support for the coordinated advancement of farmland protection, ecological management, and high-quality urban-rural development.

We close by pulling three lines of work together: comparative study, empirical analysis, and the Shandong case. They let us show how farmland non-agriculturalization drives economic growth. We examine that link through resource constraints, shifts in industry, and urbanization. The non-agricultural conversion of farmland is a complex issue requiring systematic analysis and investigation from ecological, economic, and social dimensions. At the regional level, the impacts of such conversion on socioeconomic development vary significantly across provinces, necessitating more detailed regional studies. Shandong Province, as a major economic province and an important grain-producing base in China, possesses abundant farmland resources. However, in recent years it has faced intense challenges due to farmland conversion, particularly in the peri-urban areas with relatively developed economies, where substantial farmland loss has occurred—inevitably affecting economic growth. Specifically, the reduction of farmland weakens the supporting role of agriculture, but also increases construction land availability and accelerates urbanization, thereby promoting related industries and upgrading secondary and tertiary sectors. These factors interact in ways that may either stimulate or constrain economic growth, calling for dedicated research and quantitative validation.

2.2 Definition of Related Concepts

2.2.1 Non-agricultural Use of Farmland

We define non-agricultural conversion of farmland as farmland leaving agriculture. That is, fields are pulled out of farming and put to other uses. In plain terms, it means turning farmland into urban or industrial land. This is an inevitable social phenomenon arising from urbanization and industrial structure upgrading, encompassing multiple aspects such as industrial restructuring, population mobility, and changes in land use. The reduction in agricultural land area, with its conversion into urban construction and industrial land, signifies a shift in land use from agricultural production to non-agricultural activities. The declining share of primary and secondary industries and the rising proportion of the tertiary sector indicate a transformation in the economic structure from agriculture-dominated to service-oriented and high-tech industry-led. Meanwhile, the transition of agricultural populations into non-agricultural populations, and farmers becoming urban residents, marks a shift in population movement from rural areas to cities.

2.2.2 Economic Growth

We define economic growth as a country or region putting more production factors to work and using them better over time, so that total output keeps expanding. It is the main gauge of how developed and how dynamic that economy has become.

The concept carries four implications.

- (1) Capital, labor, and technology flow in as larger factor inputs, raising the economy's capacity to produce and pushing growth forward.
- (2) Technological innovation, institutional reform, and structural optimization make resource allocation more efficient, which lifts output and feeds growth.
- (3) With more inputs and higher efficiency, the total flow of goods and services expands, and both gross national product and its per-capita figure climb.
- (4) Growth then raises living standards and lowers poverty, marking progress on the economic and social fronts alike.

Taken together, economic growth remains the central gauge of an economy's level and vitality, spanning factor inputs, efficiency, output, and socioeconomic progress.

3. Analysis of the Non-agriculturalization Process of Agricultural Land in Shandong Province

3.1 Farmland Loss, Industrial Structure Upgrading, and Rapid Urbanization

In the first phase (2000–2004), farmland gave way rapidly as industry restructured and cities expanded. The industrial overhaul and the urban push that came with it proved the dominant forces. Shandong Province accelerated its economic structural upgrading, as large areas of farmland were converted for industrial and urban construction purposes. Over five years, farmland decreased by 22.21 million mu, averaging 4.442 million mu annually. The industrial structure continued to improve, with the tertiary sector's share of GDP increasing by 7 percentage points to reach 42%. Urbanization advanced rapidly, with the urbanization rate rising from 48.9% in 2000 to 53.5% in 2004. As shown in the figure below:

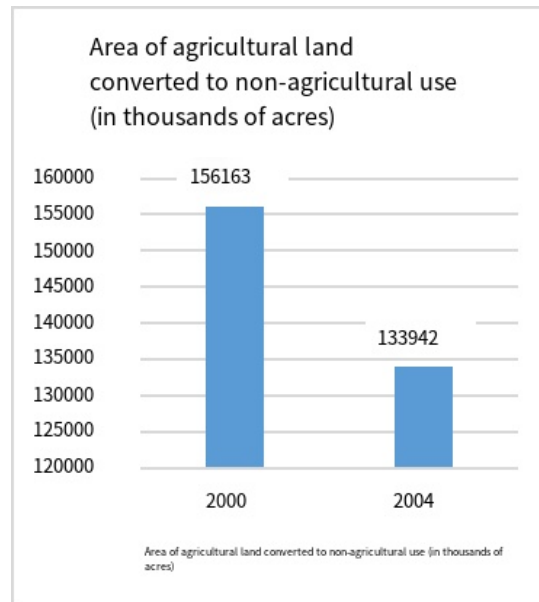


Figure 1. Non-agricultural Conversion Area of Farmland in the First Phase (ten thousand mu)

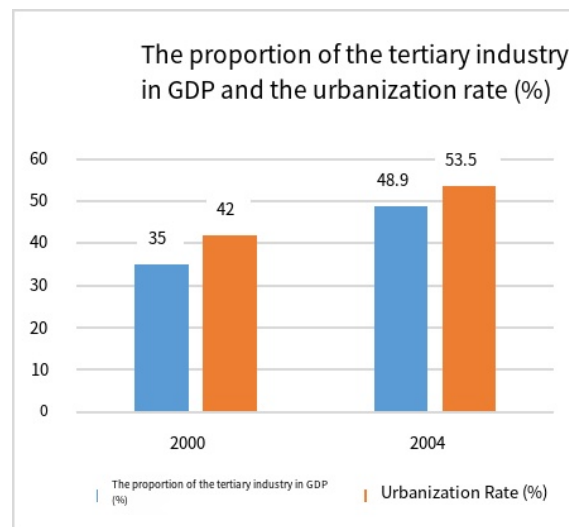


Figure 2. Proportion of Tertiary Industry to GDP and Urbanization Rate (%) in the First Phase

3.2 Farmland Loss is Expanding, Urbanization is Accelerating, and the Industrial Structure Continues to Optimize

Phase Two (2005–2009) ran much like the first, only faster. Farmland shrank as urbanization advanced rapidly and the industrial structure kept upgrading. Infrastructure development in Shandong Province accelerated, resulting in the occupation of large areas of high-quality farmland. Over five years, farmland declined by 26.51 million mu, averaging 5.302 million mu per year—a slower rate compared to the first phase. The industrial structure further optimized, with the tertiary sector increasing by 7 percentage points to reach 49%. Urbanization levels rose sharply, with the urbanization rate reaching 61.4%. As shown in the figure below:

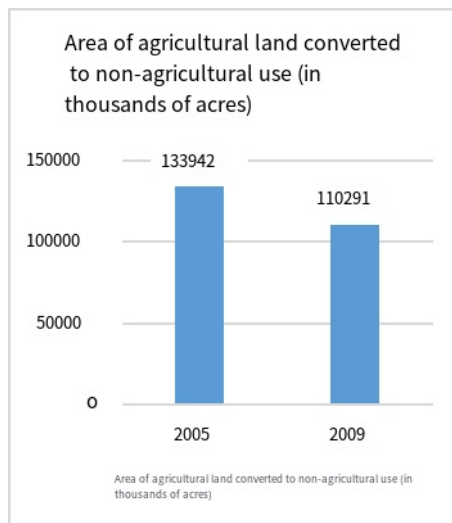


Figure 3. Non-agricultural Conversion Area of Farmland in the Second Phase (in ten thousand mu)

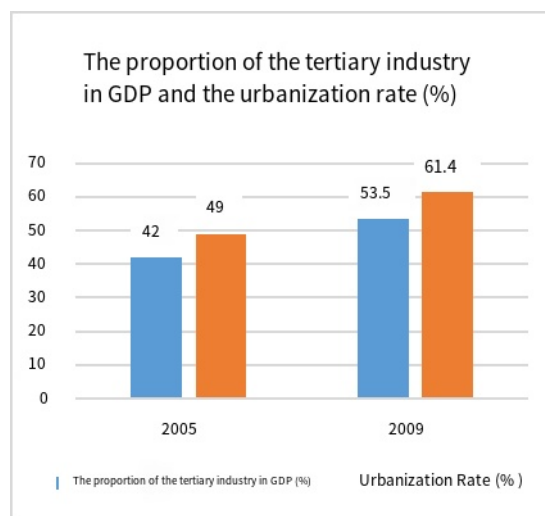


Figure 4. Proportion of Tertiary Industry to GDP and Urbanization Rate (%) in the Second Phase

3.3 The Scale of Farmland Loss is Expanding, Urbanization is Accelerating, and Industrial Structure Upgrading is Slowing Down

Phase Three (2010–2014) pushed the trend further, with a catch: farmland loss intensified and urbanization accelerated, while industrial upgrading began to slow. Shandong Province implemented its new urbanization strategy, accelerating the development of new urban areas. Over five years, farmland decreased by 32.23 million mu, averaging 6.446 million mu annually—an increase in reduction compared to Phase II. Industrial restructuring stabilized, with the tertiary sector rising by 5 percentage points to reach 54%. The urbanization rate reached 66.9%. As shown in the figure below:

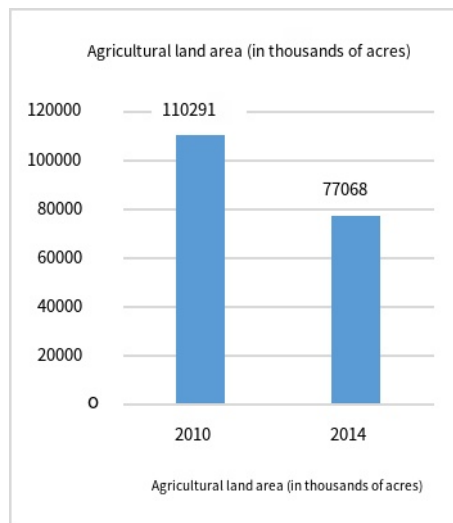


Figure 5. Non-agricultural Conversion Area of Farmland in the Third Phase (ten thousand mu)

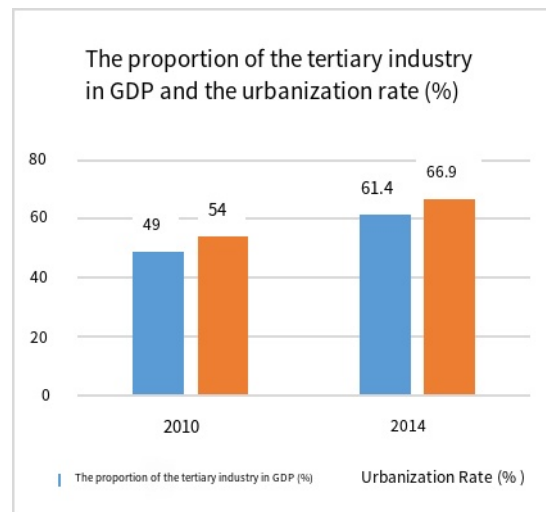


Figure 6. Proportion of Tertiary Industry to GDP and Urbanization Rate (%) in the Third Phase

3.4 Farmland Loss is Slowing Down, Industrial Structure Upgrading is Accelerating, and Urbanization Levels are Steadily Rising

Phase Four (2015–2019) broke the pattern on one front. Farmland loss finally slowed, even as industrial restructuring and urbanization kept accelerating. Shandong Province implemented its rural revitalization strategy, moderately controlled urban development, and slightly reduced the pace of farmland loss. Over five years, farmland decreased by 23.42 million mu, averaging 4.684 million mu annually. Industrial upgrading accelerated, with the tertiary sector increasing by 8 percentage points to reach 62%. The urbanization rate reached 72.4%. As shown in the figure below:

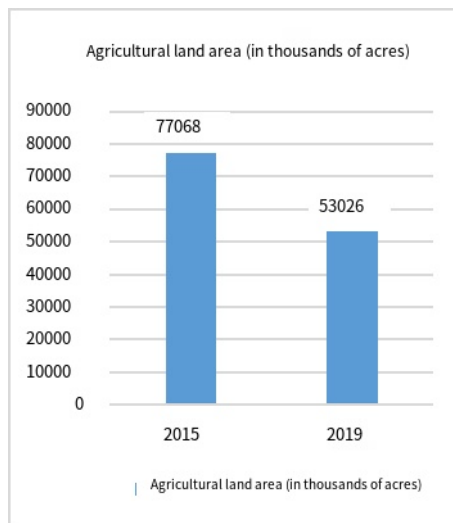


Figure 7. Non-agricultural Conversion Area of Farmland in the Fourth Stage (ten thousand mu)

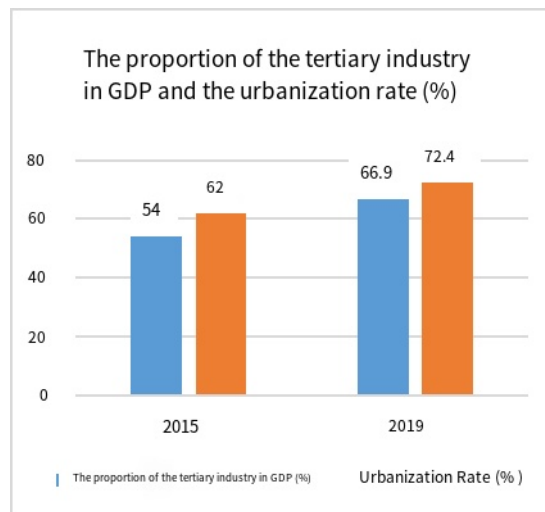


Figure 8. Proportion of Tertiary Industry to GDP and Urbanization Rate (%) in the Fourth Stage

3.5 Agricultural Land Use Efficiency has Improved, Industrial Structure has been Optimized, and Urbanization Levels have Continued to Rise

Phase Five (2020–2024): During this period, the rate of farmland loss is expected to continue slowing down, with ongoing optimization of industrial structure and further advancement in urbanization. Farmland utilization efficiency will improve, leading to a deceleration in land loss. Digital rural development and new-type urbanization in Shandong Province are projected to deepen, enhancing land use efficiency and potentially reducing the pace of farmland reduction even further. The industrial structure will continue upgrading, with improvements in the tertiary sector, and urbanization levels are expected to rise further.

We can sum up the five phases in three lines. Farmland loss slowed from rapid to gradual. Industrial upgrading quickened, then eased, then quickened once more. Urbanization kept climbing. This indicates

a complex interactive relationship among the non-agricultural conversion of farmland, industrial structure upgrading, and urbanization processes—each both promoting and constraining the others.

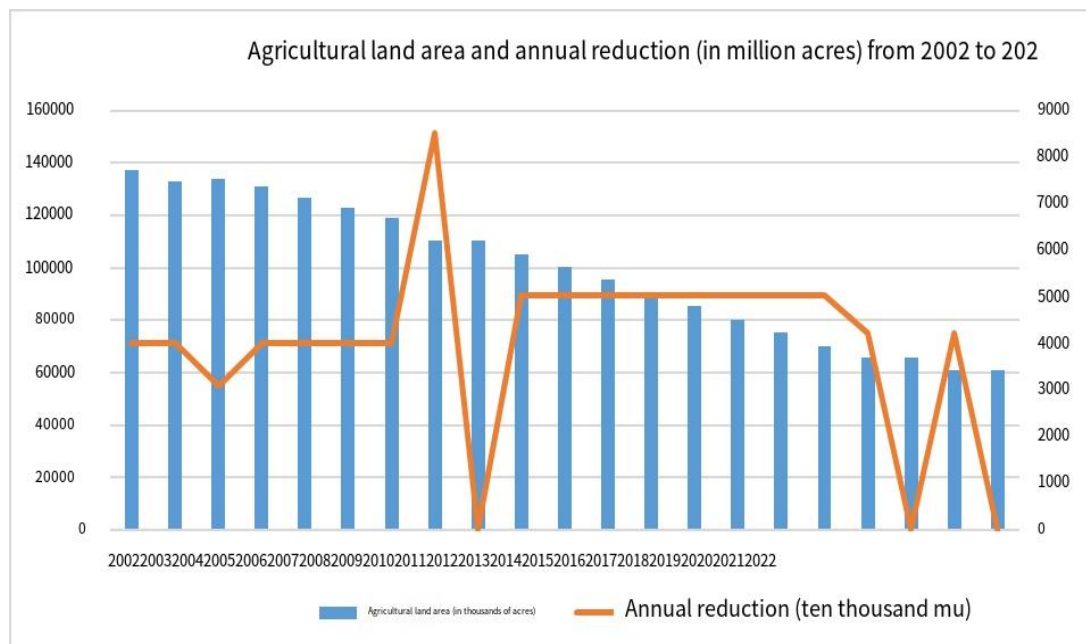


Figure 9. Agricultural Land Area and Annual Reduction (in ten thousand mu) from 2002 to 2022

4. Theoretical Analysis of the Mechanism by Which Non-Agricultural Use of Farmland Affects Economic Growth

4.1 Increasing National Wealth and Capital Formation

We argue that moving farmland into construction use lifts national wealth and capital formation. The resulting capital drives construction and infrastructure, and industrial-chain spillovers push growth beyond them. In 2019, capital formation contributed 44.5% to China's GDP growth. Capital formation includes wealth gains from rising real estate asset prices, which enhance household consumption capacity and expand domestic demand. The economic growth driven by increased capital formation also raises incomes and improves living standards, creating favorable conditions for greater factor input and innovative development. Enhanced capital formation lays a material foundation for socioeconomic development, boosts investment and consumption, promotes industrial upgrading, and elevates national living standards. The output and income growth resulting from increased capital formation further expands domestic demand and consumption, stimulates related industries, increases employment opportunities, and generates broad multiplier effects on the economy. Capital formation represents the material foundation and accumulation process of a nation's economic strength. Increasing capital formation and expanding the capital stock can boost output, generate wider income and consumption growth, and lay the groundwork for future innovation and industrial advancement. In 2019, China's total capital formation surpassed that of other major economies, with capital formation accounting for 44.5%

of GDP—providing strong momentum and significant potential for China’s economic development. According to growth theory, a country’s economic growth stems from increases in production factors, optimization and upgrading of industrial structures, and improvements in productivity. Increased capital formation constitutes an expansion of production factors, directly stimulating economic growth with long-lasting and profound effects. A 1% increase in capital formation leads to approximately a 0.4% rise in China’s GDP, indicating its exceptionally high contribution rate and substantial growth potential. In summary, agricultural land development enhances capital formation, exerting far-reaching impacts on socioeconomic development. It establishes a material foundation for progress, stimulates investment and consumption, drives industrial upgrading, promotes economic growth, and improves national living standards. China should increase investment and expand the scale of capital formation to fully leverage its supporting and leading role in economic development.

4.2 Expanding Urban Scale and Improving the Level of Urbanization

As cities expand and urbanize, consumption structures upgrade. At the same time, a fast-growing service sector keeps economic development moving. Urbanization fosters the agglomeration and development of modern services, accelerating industrial upgrading. It also promotes faster development in transportation, telecommunications, and modern logistics, improving resource allocation efficiency and productivity, thereby strongly stimulating industrial transformation and economic growth. Moreover, urbanization facilitates labor migration into the tertiary sector, increases employment opportunities, improves income distribution, and expands household consumption—all of which positively contribute to economic growth. The continuous expansion of cities and industrial upgrading create favorable conditions for innovation and modernization, enhancing the quality of economic development. The scale and agglomeration effects brought by urbanization promote integrated industrial development and technological progress, improving both economic quality and vitality. The higher the level of urbanization, the more pronounced the industrial agglomeration effect becomes, making it easier to achieve increasing returns to scale. High-level urbanization stimulates the development of transportation, communications, and logistics, strengthens interconnectivity within industrial chains, and creates network-scale effects. This accelerates structural adjustment and optimization of industries, driving greater technological advancement and innovation. Urbanization fuels rapid growth in the tertiary sector, spurs consumption upgrades, expands domestic demand, and provides enduring support for economic growth. Urban residents typically have more advanced consumption patterns and structures, helping to lead and drive overall societal consumption toward higher levels. High-level urbanization encourages the concentration and development of internet-based industries, next-generation information technology, and high-tech sectors, providing strong impetus for economic restructuring and transformation. In summary, the expansion of city size and the improvement of urbanization levels hold strategic significance for economic development and industrial upgrading. China should continue advancing new-type urbanization, leverage the scale effects of urban clusters, promote industrial integration and technological innovation, stimulate consumption upgrades, and achieve high-quality economic growth. Deepening

urbanization can unlock socioeconomic potential and play a pivotal role in supporting future industrial transformation, upgrading, and economic growth.

4.3 Optimizing Industrial Structure and Regional Layout

We note that secondary and tertiary industries call for denser land use. Turning farmland over to other purposes gives industry room to upgrade, which in turn optimizes the industrial structure and the regional distribution of plants. Optimizing the industrial structure can enhance total factor productivity and provide sustained momentum for economic growth. A well-planned regional industrial layout enables the full utilization of comparative advantages, reduces transaction costs, improves enterprise efficiency and regional integration, and fosters industrial clusters. This helps enterprises lower costs, strengthen competitiveness, and achieve increasing returns to scale. More optimized industrial structures and layouts allow regions to leverage their comparative advantages, improve productivity, and enhance the quality of economic operations. Optimizing industrial structure and spatial distribution increases resource allocation efficiency, strengthens regional competitiveness, and supports sustainable development. Structural optimization drives resources toward high-value-added industries, promotes industrial upgrading, and enhances output and efficiency. It also enables economies of scale, deepens industrial chain development, and stimulates integrated development and technological advancement across related sectors. Optimized regional industrial layouts help maximize local comparative advantages, increase industrial agglomeration and specialization, reduce transaction and transportation costs, improve enterprise efficiency and output, and foster cluster development. Such optimization further facilitates the formation of industrial chains, promotes deeper industrial integration, and creates greater economic value. An improved industrial layout contributes to regional integration and coordinated economic growth. Rational industrial structure and layout are key levers for achieving industrial upgrading, transforming development models, and enhancing competitiveness. China should accelerate industrial restructuring and upgrading, optimize regional industrial layouts, leverage comparative advantages, enhance industrial concentration and specialization, and promote industrial integration and innovation. These efforts are crucial for advancing high-quality economic development and strengthening regional competitiveness.

4.4 Increasing Fiscal Revenue and Expanding Employment

When farmland is opened for other uses, government revenue from land sales and taxes climbs. That revenue lets the state invest more in infrastructure and public services, improve the business environment, and lift market vitality. It also creates substantial employment opportunities, raises residents' incomes and consumption, and stimulates domestic demand and economic growth. The growing fiscal revenue strengthens the government's capacity to invest in infrastructure and public services, improving its ability to deliver public goods and services and creating favorable conditions for social development. Increased fiscal income from agricultural land development allows for expanded government spending on infrastructure and public services, which helps improve the quality of public services, enhances the business environment, and boosts governance effectiveness. Higher fiscal revenues also strengthen the government's capacity to respond to various risks and crises, increasing societal resilience and risk

resistance. The large number of jobs generated by agricultural land development promotes full employment, increases household incomes, expands consumption, and drives industrial development and economic growth. Full employment contributes to improved living standards, expands the middle class, alleviates social pressures, and fosters social equity and stability. The additional fiscal revenue and employment created through agricultural land development enhance the government's provision and investment in public services and infrastructure, supporting socioeconomic development and improving governance. Expanded consumption and domestic demand further stimulate industrial growth and economic expansion. In summary, increased fiscal revenue and employment opportunities from agricultural land development enhance the government's capacity to invest in public services and infrastructure, boost domestic demand and consumption, promote industrial development, and expand economic growth potential, while also improving governance efficiency and advancing social progress. China should deepen reforms further, broaden sources of fiscal revenue, increase the supply of public services, encourage job creation, and drive economic growth and social advancement.

4.5 Enhancing the Efficiency of Land Resource Allocation

Converting agricultural land into higher-yield and more profitable uses can significantly enhance land productivity and economic returns, achieving optimal resource allocation. Efficient and intensive land use reduces costs and enables increasing returns to scale, improving corporate efficiency and output. Rational utilization of land resources generates broad economic spillover effects and externalities, profoundly influencing economic growth. It directly increases land output and GDP, while boosting productivity and competitiveness, promoting industrial chain development and enhancing total factor productivity, thereby driving extensive economic growth. Transforming farmland into urban construction land allows for optimal land allocation, substantially improving land output and economic benefits. This increases the contribution of land resources to socioeconomic development and exerts a positive impact on economic growth. High-quality land development boosts government fiscal revenue, providing a material foundation for public service delivery. Efficient land use conserves resources, lowers development costs, and achieves economies of scale and increasing returns to scale. This enhances the efficiency and competitiveness of enterprises and industries, fostering technological progress and innovation. Intensive and efficient land use also avoids low-level repetitive construction, reduces resource waste, improves allocation efficiency, and supports sustainable development. Rational land development creates positive externalities, promotes industrial chain growth, drives related industry agglomeration, and fosters regional economic integration. This increases industrial value, forms network effects at scale, raises total factor productivity, and creates favorable conditions for socioeconomic advancement. In summary, agricultural land development improves land allocation efficiency, increases output and contribution, conserves land resources, reduces development costs, and enables increasing returns to scale. High-quality and efficient land use generates widespread economic spillovers, enhances productivity and competitiveness, stimulates industrial and regional development, and drives economic growth. China should adhere to the concept of sustainable development, accelerate agricultural land

development, achieve optimal land resource allocation, and promote economic growth and social progress.

5. Empirical Analysis of the Economic Effects of Non-Agricultural Use of Farmland

5.1 Model Construction

We use the Cobb-Douglas production function, the C-D model for short, to track how inputs shape output. It centers on capital and labor. It can also assess the contribution rates of technological progress, capital growth, and labor growth to output growth. The Cobb-Douglas production function was developed by American mathematician Charles W. Cobb and economist Paul H. Douglas through their joint research on the relationship between inputs and outputs.

5.2 Variable Selection

We draw on Shandong data from 2002 to 2021 to estimate the model's parameters and gauge how farmland non-agriculturalization affects the economy. The figures appear in the table below:

Table 1. Statistics on Factor Inputs and Outputs during the Non-Agriculturalization Process of Land from 2002 to 2021

Year	Gross Domestic Product of Secondary and Tertiary Industries (in billions of yuan)	Total fixed asset investment (in billions of yuan)	Number of employed persons in secondary and tertiary industries at year-end (in ten thousands)	Construction land area (square kilometers)
2002	8707.37	3509.29	2755.1	2281
2003	9446.25	5328.44	2853.6	2396
2004	11559.86	7629.04	2979.9	2436
2005	14019.34	10541.87	3106.3	2638
2006	16869.54	11136.06	3229.2	2848
2007	20267.05	12537.02	3342.9	3023
2008	24230.02	15435.93	3436.7	3192
2009	26464.61	19030.97	3541.9	3347
2010	30511.15	23276.69	3682.8	3471
2011	35296.38	26769.73	3750.1	3507
2012	38910.25	31255.96	3823.9	3526
2013	42890.22	36789.07	3866.1	3681
2014	46112.03	42495.55	3919.4	3854
2015	50385.97	48312.46	3977.6	3828
2016	53932.21	53322.49	4021	4279
2017	58179.39	55202.73	4070.5	4408

2018	61698.35	57465.23	4086.5	4540
2019	65423.49	58263.25	4115.1	4660
2020	67432.82	58712.65	4138	4885
2021	77066.87	59632.14	4159	4963

In the model we treat GDP as the output of the secondary and tertiary industries in the province. Fixed capital becomes total social fixed assets, labor the employees in those sectors, and farmland conversion the area of urban construction land. A new model needs to be established, using domestic gross output of the secondary and tertiary industries (GDP) as the dependent variable, total fixed capital investment of the entire society (fal) and the number of employees in the secondary and tertiary sectors (peoples) as control variables, and urban construction area (cfa), representing non-agricultural conversion of farmland, as the independent variable. Taking the natural logarithm of each variable, Model 5.1 is formulated:

$$\ln gdp_{it} = c_i + \alpha \ln fal_{it} + \beta \ln peoples_{it} + \lambda \ln cfa_{it} + \mu_{it} \quad (5.1)$$

Note: This article approximates the contribution rate of agricultural land conversion to economic growth by using the contribution rate of construction land to economic growth.

5.3 Unit Root Test

This paper first tests the panel data for stationarity to keep the results trustworthy and avoid spurious regression. We run a unit root test under three specifications in turn: with both intercept and trend, with intercept only, and with neither. Using Eviews 7.2 econometric software, we conduct the LLC statistic test for different variables. The null hypothesis of the LLC test is that each variable contains a unit root and thus is non-stationary. As shown in Table, at the 0.05 significance level, the p-values for all variables are less than 0.05, indicating that $\ln peoples$, $\ln gdp$, $\ln fa$, and $\ln cfa$ are all stationary series.

Table 2. Unit Root Test Results

	LLC		LLC
$\ln gdp$	-3.3617 (0.0290)	$\ln peoples$	-9.6475 (0.0000)
$\ln fal$	-2.0310 (0.0604)	$\ln cfa$	-1.3728 (0.0183)

5.4 Estimation Results and Analysis of Conclusions

At the 0.01 significance level, we reject the null hypothesis and establish a fixed-effects model, with the estimation results shown in the following table:

Table 3. Model Estimation Results

Variable	Estimated value	Standard error	t-value	p-value
c	-22.509	4.444	-5.065	0.000
Lnfal	0.066	0.100	0.664	0.516
Lnpeoples	2.902	0.694	4.183	0.001
Lncfa	1.031	0.178	5.787	0.000

Table 4. Model Summary

R^2	0.997	$\overline{R}^2$	0.996
F-statistic	1687.068	Prob(F-statistic)	0.000

The estimation results indicate that when the urban construction area increases by 1%, economic growth rises by 1.031%, with a p-value of 0.0000. Therefore, at the 0.01 significance level, the urban construction area—i.e., the non-agricultural conversion of farmland—has a significant positive effect on economic growth.

6. Policy Recommendations for Non-agricultural Use of Agricultural Land in Shandong Province

6.1 Enhance the Intensive Use of Urban Construction Land

As farmland shifts to other uses, we must keep growth sustainable and the industrial structure sound. That means using urban construction land more intensively. This means that in urban development, land resources must be used more efficiently to promote their rational allocation. Only in this way can sustainable economic growth be achieved while minimizing the conversion of agricultural land for non-agricultural purposes.

6.2 Establish and Improve Land Management Institutions and Systems

We should protect land resources by building institutions that fix clear duties. At the same time, the rural land management system needs reform to strengthen protection further. During land management, legal regulations of our country must be strictly followed to ensure lawful administration of land and prevent undesirable practices such as unauthorized cultivation and construction. Only in this way can land resources be effectively protected and sustainable development promoted.

6.3 Transforming the Pattern of Economic Growth and Achieving Coordinated Development

We must abandon the extensive growth model, the one marked by high investment, high consumption, high pollution, and low output, because it can wear down resources and the environment. Instead, we should focus on ecological conservation and recognize the importance of the principle that "lucid waters and lush mountains are invaluable assets." Under the premise of safeguarding the ecological environment and food security, agricultural land can be moderately converted into urban construction land to achieve

intensive economic growth and reduce excessive reliance on farmland. Only in this way can sustainable development be realized.

6.4 Enhancing Farmers' Awareness as Economic Market Participants

Farmers stand at the center of China's land reform, yet tradition and custom still shape how they see the land. That binds them to it more than they realize, and they seldom treat themselves as market players in land use. To ensure a healthier and more orderly development of "non-agriculturalization of farmland" in Shandong Province, it is essential to cultivate farmers' sense of agency and actively promote their participation through measures such as land circulation and the reform of the tripartite rights separation.

6.5 Enhancing the Market-Based Allocation of Non-Agricultural Use of Farmland

As land use turns more to the market, farmland's non-agricultural use adds more to growth. Shandong should therefore convert more farmland and open land transfer through bidding and auctions, lifting the marketization of land resources and feeding economic growth. At the same time, macro-level regulation of the land market is necessary, along with improvements in relevant laws and regulations, strengthened management of land transactions, and cracking down on illegal activities to ensure orderly operation of the land market. Only in this way can the transformation of farmland into non-agricultural uses be achieved, driving sustainable economic development.

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