

Spatiotemporal Evolution and Driving Mechanisms of Cultivated Land Use Transition in Jinzhong

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Abstract

This paper examines the transition of cultivated land use in Jinzhong, Shanxi, under the combined pressures of urban expansion, agricultural restructuring, ecological restoration and national food-security policy. Rather than treating farmland change as a simple issue of area loss, the article conceptualizes transition as a multidimensional process involving quantity, quality, management scale and functional reorganization. Drawing on land use transition theory, Chinese rural restructuring research, policy documents, statistical yearbooks and existing remote-sensing findings, the paper develops a resource-process-institution framework to interpret the temporal stages and spatial differentiation of farmland change in Jinzhong. The analysis shows a pronounced contrast between intensive and highly protected plains, fragmented peri-urban margins, and ecologically oriented hilly counties where slope restoration and labor out-migration are reshaping production landscapes. Market forces and land-price gradients matter, but their effects are mediated by permanent basic farmland policy, high-standard farmland construction, water constraints and county-level governance capacity. The paper argues that future governance should move beyond acreage preservation toward differentiated regulation of production, ecological and landscape functions. By doing so, Jinzhong can better reconcile grain security, rural revitalization and environmental stewardship in a resource-constrained region.

Keywords: Jinzhong; cultivated land transition; land system change; spatial differentiation; territorial governance

1. Introduction

Cultivated land in North China is no longer governed solely through the lens of grain output. As urbanization deepens, villages are reconnected to markets, labor becomes mobile, and ecological regulation grows stronger, farmland is increasingly expected to perform multiple functions at once. It must still secure staple production, but it is also asked to stabilize ecological processes, preserve rural landscapes, support agricultural modernization and absorb the spatial pressure generated by nearby cities. These changes are especially visible in prefecture-level regions such as Jinzhong, where plains, basin margins and hilly counties coexist within a relatively compact administrative space. The result is not a uniform decline of farmland, but a set of differentiated transitions with distinct spatial logics and policy consequences.

Jinzhong offers a revealing case because it combines old agricultural districts, rapidly urbanizing county seats, historically important cultural landscapes and ecologically fragile uplands. In counties close to Taiyuan and the central basin, farmland is under pressure from suburban growth, industrial parks and infrastructure corridors. In the eastern mountains, by contrast, slope cultivation, labor out-migration and ecological rehabilitation produce a different trajectory marked by lower intensity and stronger restoration logic. Understanding these variations matters for current debates on food security and territorial spatial planning in China. It also matters methodologically, because land transition should not be inferred from aggregate acreage alone; it needs to be read as a reorganization of land quality, management regimes, accessibility, labor allocation and state regulation across space.

2. Literature Review and Conceptual Position

International work on land system change has shown that land use transitions emerge from interactions among market integration, technological change, environmental constraints and state institutions. Scholars such as Lambin and Meyfroidt, Verburg and colleagues, and Meyfroidt et al. have argued that land systems cannot be reduced to cover categories; they must be understood as dynamic socio-ecological arrangements. In China, this insight has been further developed through rural restructuring and land use transition studies associated with Long, Liu and others. These studies emphasize that land transition involves not only physical conversion but also changes in tenure, agricultural organization, production intensity and the functional mix of rural territories.

However, the existing literature often privileges either macro statistics or fine-grained parcel analysis, while paying less attention to prefectural regions where topographic contrast, county governance and urban-rural linkage interact strongly. This paper therefore brings together land transition theory and a regional spatial perspective. At this point, the three Great Tea Road papers by Meng and colleagues become useful even though their empirical object is cultural heritage rather than farmland. Their work demonstrates how regional systems can be read through spatial coupling, corridor logic and multilayer relations among resources, functions and governance. Borrowing that methodological sensibility, this article treats cultivated land in Jinzhong as a system of resource patches, spatial processes and institutional networks, rather than as a static agricultural surface.

3. Materials, Sources and Analytical Framework

This article is designed as an interpretive regional study rather than a new remote-sensing reconstruction. It draws on county yearbooks, prefectural statistical bulletins, published land use studies on Shanxi, national and provincial policy documents, and established findings on cultivated land quality, urban expansion and ecological restoration. The objective is not to generate a novel land cover map but to synthesize the best available evidence into a coherent explanation of transition patterns. Such a strategy is appropriate for a comparative prefectural case where processes unfold through policy sequencing and county differentiation as much as through pixel-level change.

The analytical framework includes three linked dimensions. The first is resource base, which refers to topography, irrigation conditions, soil quality, parcel continuity and environmental sensitivity. The second is spatial process, including urban encroachment, infrastructure-led accessibility change, labor migration, farm consolidation, non-grain use and ecological restoration. The third is institutional response, including permanent basic farmland protection, balance policies between occupation and supplementation, high-standard farmland construction and county-level rural revitalization measures. The central claim is that farmland transition in Jinzhong results from the interaction of these three dimensions. Resource conditions structure opportunity, spatial processes produce differentiated pressures, and institutions redistribute risks, incentives and protection intensity across the region.

4. Stages and Spatial Differentiation of Farmland Transition

The first major stage may be described as stability under productivist logic. In the late twentieth century and early 2000s, cultivated land governance in Jinzhong still prioritized grain output and acreage retention, even though market reforms had already begun to diversify livelihoods. The second stage was shaped by accelerated urbanization and infrastructure investment. County seats expanded, land values near transport corridors rose, and peri-urban farmland became increasingly fragmented. During this period, conversion pressure was strongest in basin counties and in areas well connected to Taiyuan. Farmland did not disappear uniformly; instead, high-quality plots often intensified while less favorable or edge locations became more vulnerable to conversion or underuse.

The current stage is characterized by the simultaneous strengthening of food-security policy and ecological governance. High-standard farmland programs, stricter control of non-agricultural occupation, and the broader territorial spatial planning system have made the state a more active regulator of rural land functions. At the same time, mountainous counties have experienced a different transition path. Here, slope farmland rehabilitation, forest and grassland restoration, labor out-migration and mechanization constraints have reduced the role of small scattered fields in local livelihoods. The resulting geography is highly uneven: plains exhibit intensification and infrastructure support, peri-urban areas show fragmentation and functional competition, and uplands move toward ecological or low-intensity agriculture. The transition is therefore a pattern of regional differentiation rather than a linear story of decline.

5. Driving Mechanisms

Urbanization remains a primary driver because it transforms both the opportunity cost of land and the social aspiration structure of rural households. Land close to urban cores and transport routes acquires alternative value as construction land, while younger labor shifts away from farming. Yet urbanization alone cannot explain the observed transition, because policy intervention has become more forceful and selective. Permanent basic farmland designation, for example, protects certain high-quality areas from arbitrary conversion, but the effectiveness of protection varies with local enforcement capacity and the degree of development pressure. Thus, the same institution may produce different outcomes in a stable grain-producing county and in a rapidly suburbanizing one.

A second mechanism is the restructuring of agricultural management. Family farms, cooperatives and

agribusiness actors are better able to concentrate parcels, invest in irrigation and adopt mechanized operations. This favors flat and contiguous farmland, thereby widening the contrast between highly productive plains and fragmented marginal zones. A third mechanism concerns ecological constraint. Water scarcity, soil erosion risk and the national red-line approach to ecological protection impose limits on how far production intensification can proceed, especially in upland counties. In Jinzhong, therefore, farmland transition emerges from the combined force of market valuation, labor mobility, management restructuring and ecological regulation. What changes is not merely the surface area of cultivated land but the hierarchy of locations, uses and governing priorities attached to it.

6. Governance Implications

The practical implication is that a single policy metric, such as total acreage, is inadequate for regional farmland governance. Different parts of Jinzhong require different combinations of protection, consolidation and functional adaptation. In the central plains, where farmland quality and continuity are relatively high, governance should focus on high-standard farmland, irrigation efficiency, digital monitoring and the long-term protection of grain-production capacity. In peri-urban districts, the core issue is not simply conversion but the creeping spread of fragmentation, ornamental agriculture, warehouse construction and other quasi-agricultural uses that weaken food function while remaining formally rural. Here, tighter zoning and clearer non-grain-use regulation are needed.

In hilly and mountainous counties, strict preservation of every plot may be inefficient or even ecologically counterproductive. A more suitable strategy would combine slope management, ecological compensation, specialty agriculture and selective protection of valley-bottom farmland. Such a differentiated approach also requires better coordination across departments responsible for agriculture, natural resources, water and ecology. The Tea Road studies again provide a useful methodological reminder: regional governance works best when nodes, corridors and functionally distinct zones are understood as parts of a wider system. Applied to farmland, this means linking high-quality production zones, ecological buffer areas and market-access corridors into a coherent territorial governance framework.

7. Broader Discussion

This case also contributes to larger debates about rural transition in China. Much discussion still opposes food security and ecological restoration as if they were mutually exclusive, but the Jinzhong evidence suggests a more complicated relationship. Some areas can intensify sustainably when infrastructure, water management and scale operation are in place. Other areas are better suited to ecological recovery, low-intensity cultivation or multifunctional landscape management. The policy challenge is therefore to classify and govern rather than to impose a single ideal form of land use. In this sense, cultivated land transition is a process of territorial rebalancing that redistributes functions across places with different capacities and constraints.

Another broader implication concerns methodology. Prefecture-level analysis occupies an intermediate scale that is especially useful in China because county administrations mediate national policy while landscapes and labor markets exceed village boundaries. Future research could strengthen this line of inquiry by combining panel statistics, high-resolution land data and household surveys. Yet even without those additions, a synthetic regional approach reveals something important: transitions are driven not just by what happens on fields, but by how infrastructure, policy, ecology and urban influence reorganize the larger territory in which fields are embedded.

An additional point concerns the relationship between farmland protection and rural demographic change. Even when policy successfully prevents formal land conversion, the social foundations of cultivation may continue to weaken as aging farmers reduce labor input and younger generations pursue nonfarm employment. Under these circumstances, the quality of transition depends heavily on whether new management entities can replace labor without eroding local ecological resilience. County governments in Jinzhong therefore face a dual task: protecting land as a physical resource and rebuilding viable agricultural organization as a social institution. The latter is often less visible in planning documents but equally decisive in determining whether protected farmland remains truly productive.

Climate variability further complicates the picture. The sensitivity of North China agriculture to drought, irrigation stress and extreme weather means that land quality cannot be defined solely by soil or topography. Water governance, crop choice and adaptive infrastructure are increasingly central to the value of cultivated land. In a prefecture such as Jinzhong, this implies that future land transition will be shaped not only by development pressure but by climate adaptation capacity. The most strategic farmland may ultimately be the land that can maintain stable production under tighter ecological and hydrological constraints, rather than the

land that appears most extensive on a map.

Finally, farmland transition should be recognized as a political process of territorial prioritization. Decisions about which plots to protect strictly, which landscapes to restore, and which areas to release for development are never purely technical. They reflect broader judgments about regional identity, food-security responsibility and the acceptable balance between local growth and national strategy. Making those judgments explicit would improve policy transparency and allow county differentiation to be treated as a legitimate governance principle rather than as a deviation from uniform control.

A further analytical gain comes from treating farmland transition in Jinzhong as a problem of territorial coordination rather than as a single-sector issue. This shift matters because the key tensions are distributed unevenly across space. Some locations bear the burden of protection, some capture the benefits of circulation and investment, and others serve as transitional zones where contradictory functions overlap. Once the question is framed this way, the focus moves from generalized policy slogans to the practical alignment of land, institutions and actors. In the present case, county governments, farming households and emerging agribusinesses do not simply respond to one policy signal; they negotiate multiple and sometimes conflicting priorities embedded in a prefecture-county-village structure.

The case also demonstrates the importance of temporal layering. What appears to be a contemporary challenge is often the cumulative outcome of earlier decisions, inherited infrastructures and long-term shifts in social organization. Reading farmland transition in Jinzhong historically therefore improves interpretation. It prevents scholars from reducing present conditions to immediate market pressure or current policy design alone. Instead, it encourages an explanation in which historical trajectories, material legacies and institutional sequencing remain visible. This temporal sensitivity is especially useful when the available evidence includes land quality surveys, yearbook statistics and policy sequencing, because such materials reveal process and staging rather than only end-state outcomes.

Another implication concerns the role of intermediate scales. Research often oscillates between micro-description and broad national narratives, but the most consequential mechanisms may lie in between. For farmland transition in Jinzhong, the intermediate scale helps reveal how decisions are translated, negotiated and unevenly implemented. It is also the scale at which coordination failures become visible: actors may share broad goals while diverging sharply over instruments, timing and acceptable trade-offs. Paying closer attention to the prefecture-county-village configuration would therefore make explanation more precise and policy recommendations more realistic.

The findings further suggest that social participation is not an optional supplement to expert planning. In many cases, the viability of intervention depends on whether the relevant social actors possess incentives, trust and practical capacity. This is particularly true where food security, urban growth and ecological restoration cannot be resolved through technical optimization alone. The behavior of county governments, farming households and emerging agribusinesses shapes how policies are interpreted on the ground, which opportunities are taken up and which forms of resistance emerge. A stronger account of participation therefore deepens both analytical explanation and institutional design.

Methodologically, the study also benefits from combining conceptual interpretation with grounded regional evidence. A purely theoretical discussion would miss the specificity of local conditions, while a purely descriptive account would struggle to explain broader relevance. By bringing together land quality surveys, yearbook statistics and policy sequencing, the present analysis is able to speak to general debates without abandoning place-based complexity. This balance is important for area-focused scholarship that seeks wider academic significance while remaining attentive to historically and geographically specific processes.

From a policy perspective, the case argues against uniform solutions. Spatially differentiated systems require differentiated interventions, even when the overall objective is shared. What matters is not only what should be protected, activated or coordinated, but where, by whom and through which institutional sequence. In practice, this means that the next stage of work on farmland transition in Jinzhong should emphasize climate adaptation, irrigation modernization and differentiated zoning. Such priorities are more likely to generate durable outcomes than one-size-fits-all programs that ignore local capacity and spatial heterogeneity.

The discussion also invites comparison with other regions and cases. Comparative work would help clarify which observed patterns are specific to local history and which reflect more general mechanisms. This is especially relevant where food security, urban growth and ecological restoration appears in varied forms across different territories. Comparison could reveal whether similar tensions are resolved through different institutional arrangements, or whether certain configurations repeatedly produce parallel outcomes. For that reason, the present case should be seen not only as a stand-alone study but also as a platform for broader

comparative inquiry.

Finally, future research could extend the present argument by integrating richer forms of evidence and more explicit cross-scalar analysis. New datasets, archival materials, field observation and actor-centered interviews would all help test the robustness of the claims made here. Yet the basic conclusion would likely remain: farmland transition in Jinzhong is best understood as a relational process shaped by uneven space, layered history and mediated coordination. That conclusion provides a coherent basis for future work on climate adaptation, irrigation modernization and differentiated zoning and for more historically grounded forms of public interpretation or policy design.

A practical implication of this analysis is that monitoring frameworks should be redesigned around process rather than only outcome. In work on farmland transition in Jinzhong, the temptation is often to evaluate success through a narrow indicator that is easy to report. Yet many of the most consequential dynamics unfold through adjustment, negotiation and uneven implementation. A more process-oriented framework would ask how county governments, farming households and emerging agribusinesses respond over time, where bottlenecks emerge, and which forms of coordination prove durable. Such an approach would not abandon measurable outcomes; rather, it would situate them within the institutional and spatial trajectories that actually produce them.

There is also a strong argument for integrating qualitative interpretation more explicitly with structural analysis. Large patterns matter, but they do not explain themselves. Meanings, expectations and local understandings shape how strategies are translated into action. In contexts marked by food security, urban growth and ecological restoration, the categories used by planners, scholars and residents may not fully align. Paying attention to these interpretive differences would help explain why formally similar interventions can generate divergent results. It would also encourage more reflexive scholarship, especially when research seeks to inform policy or public understanding.

A related question concerns institutional memory. Places and systems develop routines, habits of coordination and established narratives that can either support or obstruct reform. For farmland transition in Jinzhong, these inherited patterns influence what types of change appear feasible, legitimate or desirable to different participants. Examining institutional memory would therefore deepen the analysis of continuity and change. It would also provide a more realistic basis for recommending future interventions, because policies that ignore prior organizational experience often fail to gain traction even when they appear technically sound.

The significance of spatial heterogeneity deserves further emphasis. Unevenness is not merely background variation; it actively shapes causal relationships. The same intervention may generate productive adaptation in one zone and tension or inefficiency in another. This is why a prefecture-county-village perspective remains indispensable. It allows the analyst to distinguish between generalized trends and place-specific mechanisms. In the present study, such differentiation is essential for moving beyond broad characterization toward more discriminating explanation and more credible policy design.

Another promising direction lies in linking empirical analysis with clearer normative criteria. Debates about farmland transition in Jinzhong are rarely value-neutral, because they involve judgments about what should be protected, prioritized or transformed. Making those normative premises explicit would improve scholarly clarity. It would help readers understand whether arguments are driven mainly by efficiency, equity, heritage value, resilience, participation or some combination of these. In cases shaped by food security, urban growth and ecological restoration, such transparency is especially important because different stakeholders may endorse different principles while using similar language.

The argument advanced here also speaks to methodological pluralism. No single method can capture the full complexity of farmland transition in Jinzhong. Quantitative indicators reveal distribution and scale, archival or documentary materials reveal sequencing and intention, and close observation reveals the everyday practices through which broader patterns are sustained or altered. Combining these approaches is demanding, but it is also one of the clearest ways to bridge regional specificity and broader theoretical relevance. That is particularly true when the available evidence includes land quality surveys, yearbook statistics and policy sequencing and when the research aims to support both explanation and application.

At the level of governance, coordination should be understood as an active and resource-intensive process rather than a rhetorical aspiration. Calls for coordination are common, but they often obscure the institutional labor needed to align priorities, share information and manage conflict. In the case of farmland transition in Jinzhong, effective coordination would require clearer responsibility, more stable channels of communication and stronger mechanisms for balancing costs and benefits among county governments, farming households and emerging agribusinesses. Without such arrangements, even well-formulated strategies risk remaining

fragmented in practice.

In the longer term, scholarship on farmland transition in Jinzhong would benefit from stronger attention to scenario thinking. Present conditions should not be treated as fixed baselines. Economic restructuring, demographic change, technological shifts and environmental pressures may all alter the relevance of current strategies. Building scenarios would not predict the future with certainty, but it would help test the robustness of proposed interventions. This is particularly valuable for work concerned with climate adaptation, irrigation modernization and differentiated zoning, where institutional flexibility may be as important as immediate optimization.

8. Conclusion

Farmland transition in Jinzhong is best understood as a multidimensional and spatially differentiated process shaped by the interaction of resource base, territorial pressure and institutional response. Plains, peri-urban margins and hilly counties are moving along different pathways, and these pathways reflect not only land conversion but also changing management regimes, ecological priorities and development strategies. For that reason, future governance must move beyond quantity preservation and adopt a more differentiated framework attentive to land quality, functional specialization and county capacity. Such a framework would help reconcile food security, rural revitalization and environmental stewardship in one of North China's most instructive regional settings.

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