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Urban-Rural Synergy Pathways: Exploring Human-Factor in Multifunctional Utilization of Urban Farmland Based on Rural Push-Pull Theory

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ABSTRACT

In the context of ecological civilization construction, advanced urbanization exacerbates conflicts between construction land expansion and farmland protection. Fragmented urban-farmland layouts and low production efficiency remain prevalent, alongside persistent issues of farmland non-agricultural conversion and non-grain conversion. This study, using Ningbo as a case, applies the rural push-pull theory to construct a reverse urbanization attraction model, analyzing how policy thrusts, management strategies, and development constraints influence urban farmland multifunctional utilization. Findings reveal that optimizing policy management, integrating urban-rural resources, and innovating business models can reconcile urban-rural development. Urban farmland, through its integrated value proposition, attracts urban populations, fostering resource flows and population redistribution.

Keywords: Urban farmland, Human-factor, Rural push-pull theory, Integrated value proposition

INTRODUCTION

As global urbanization accelerates, urban agriculture gains global academic and practical attention. Urban farmland, a critical component of urban agriculture, plays multifaceted roles in sustainable urban development. Multifunctional agriculture theory posits four core functions: production (Cardillo et al., 2023), ecology, landscape-culture, and economy (Zhong et al., 2017). Studies propose a "Composite Utilization Model" leveraging agricultural multifunctionality via technological innovation and policy frameworks (Li et al., 2012), forming a synergistic mechanism to address urban land constraints and support global city-building.

Global arable land faces dual pressures from urban expansion and agricultural transformation, exacerbating de-farming and de-fooding. Research indicates urbanization will permanently loss 3.3% of high-quality farmland globally (d'Amour et al., 2017), with Asian peri-urban areas losing 1.2–3.6% annually (Seto et al., 2012). Economic incentives for non-agricultural conversion accelerate global urban farmland shrinkage by 2.1% yearly (Thebo et al., 2014). Meanwhile, agricultural workforce aging and youth migration cause "human desertification," leaving 38% of peri-urban farms worldwide succession-deficient (Graeub et al., 2016). This dual crisis jeopardizes food supply resilience and severs urban-rural ecological/cultural ties.

Urban farmland research, drawing on multifunctional agriculture and urban green infrastructure theories, has advanced two key directions: integration of composite utilization patterns and urban-rural spatial integration. Existing studies have constructed a multifunctionality framework, analyzed spatial drivers of industrial integration, and developed evaluation systems. However, critical challenges remain: research gaps in urban built-up areas, limitations of urban-rural dichotomy thinking, and diminishing policy marginal benefits. Thus, there is an urgent need to transcend traditional perspectives, prioritize urban farmland research, and explore market-policy hybrid protection models.

In this context, this study develops an Urban Farmland Attractiveness Model integrating planned behavior theory and an innovative 'counter-urbanization' push-pull framework. By analyzing policy drivers, operational strategies, and development constraints, the model transcends the urban-rural binary divide. Using Ningbo as a case, it uncovers stakeholder interactions through qualitative interviews and consumer surveys, aiming to inform sustainable urban-rural integration.

LITERATURE REVIEW

Analysis of Related Concepts

The Concept of "Urban Farmland"

Farmland, or arable land, is defined as land suitable for crop cultivation. As the core carrier of urban agriculture, urban farmland is closely linked to urban systems and residents. This study defines urban farmland as agricultural land located within 10 km of urban built-up areas, integrating production, living, and ecological functions to serve urban needs through high-efficiency, multifunctional, and sustainable practices (Yang, 2022).

This paper synthesizes national and international research and defines urban farmland as farmland that is closely associated with urban space and residents, and is located within 10 kilometers of a built-up area and its periphery.

Concept of Composite Utilization of Agricultural Land

Compound utilization of farmland refers to the integration and optimization of the multiple functions of farmland in the development of urban agriculture, in order to improve the efficiency of land use and the comprehensive benefits of agriculture (Wu et al., 2023). In the context of urban farmland, it refers to the overlaying of composite functions such as agriculture, industry, culture, tourism and commerce on the basis of guaranteeing the food production function of farmland.

Literature Analysis

Urban farmland, as a key component of urban agriculture, lacks a fully mature theoretical system. However, building upon related urban agriculture research, the academic community has established two primary research directions: ①integrating production, ecological, landscape-cultural, and economic functions through technological innovation and policy support (Zhu, 2000); ②promoting urban-rural spatial harmony via urban planning integration (Zhong et al., 2017). While existing studies provide foundational insights for rural development, practical implementation strategies remain underdeveloped.

Existing studies span three dimensions: domain-level exploration emphasizes expanding farmland functions under urban-rural synergy, highlighting roles in food security, ecological buffering, cultural memory, and recreational space while fostering resilient urban-rural interfaces (Zhang et al., 2023); content-level analysis focuses on multifunctionality realization through spatial-location-driven industrial integration and proposes cultural-tourism strategies to activate leisure-education values (Yang and Liu, 2022; Wu et al., 2022); methodological innovation employs empirical quantification (e.g., AHP) to construct composite utilization evaluation systems, enabling functional value quantification and spatial visualization to address limitations of traditional qualitative research (Li et al., 2023).

While existing studies provide foundational insights into farmland composite utilization, gaps remain in three key areas:

1. Research scope: Domestic studies primarily focus on peri-urban farmland (Kong et al., 2024), leaving urban built-up area farmland under-explored.
2. Theoretical perspective: Farmland is often perceived as a rural domain, creating an urban-rural binary divide, with limited exploration of its role as a "third space" for reconciling urban-rural value conflicts.
3. Existing studies primarily focus on macro constraint mechanisms, forming a comprehensive policy framework (Lin et al., 2018). However, accelerating urbanization and market-driven siphoning of arable land have diminished the marginal effectiveness of protection policies (Lu, 2022), leaving challenges that cannot be resolved solely through macro interventions.

THEORETICAL FRAMEWORK

People-Centered Evaluation System

Farmland evaluation, critical for national security, remains an academic focus. To explore urban farmland's appeal to consumers/producers, this study employs a tourism psychology lens to analyze behavioral drivers. In response to diversified academic trends, developing a satisfaction evaluation system integrating consumer and producer perspectives addresses research gaps while offering practical and theoretical contributions.

Based on the results of previous research, this paper mainly refers to the theory of planned behavior and divides the evaluation system into two levels: "cognitive evaluation" and "behavioral drive".

Analysis of Factors Affecting the Attractiveness of Compounding Utilization

New Endogenous Development Theory

Criticizing the marginalization of the countryside as a result of neo-liberal globalization, it emphasizes that local development should be based on the synergy of "endogenous dynamics" (e.g., indigenous knowledge, social capital) and "external resources" (e.g., policy support, technology diffusion) (Ray, 1999). Combined with the results of previous theoretical research, this paper summarizes the new endogenous development theory into two major components: "endogenous drive" and "exogenous linkage".

Urban farmland compound utilization relies on endogenous drive and exogenous linkages for sustainable development. By embedding "local subjectivity" to activate rural resources and creativity while adopting "external linkage" strategies to align with urban demand and national market integration.

Rural Push and Pull Theory Concepts

The "rural push-pull theory," adapted from Lee's (1966) population migration framework, explains rural-urban labor flows through dynamic interactions of origin pushes, destination pulls, and intermediate barriers (Lee, 1966). This study transcends the traditional rural-urban binary by redefining push-pull dynamics within cities, positioning urban farmland as a counter-flow "third space." Innovatively combining new endogenous development theory, we construct a "Reverse Urbanization Push-Pull Model" that reinterprets pulls, resistances, and thrusts to reverse urban-rural resource flows.

The pull, resistance and thrust are interpreted as management measures, development constraints and control policies respectively, and the "Reverse Urbanization Rural Push-Pull Theory Model" is constructed as shown in Figure 1.

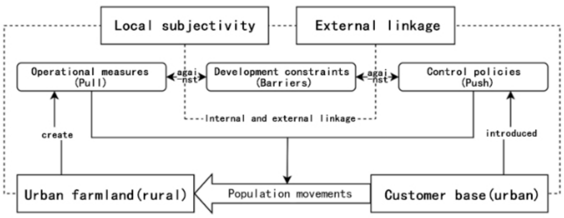

Figure 1: A theoretical model of the push-pull of the reverse urbanized countryside (author's own drawing).

Regulatory Policy Influences

Control policies in urban farmland research encompass planning, protection, utilization, and management. They exert a "catch-up effect" on multifunctional agriculture development, with precise location decisions and technology investment as critical determinants (Ren, 2023). This paper summarizes the influencing factors of urban farmland control policies into three items: policy system, control mechanism and planning implementation.

Factors Affecting Operational Measures

Farmland management relies on the value of compound utilization (Zhang et al., 2023; Xiong et al., 2021) (production, ecology, landscape and other functions), and based on the guarantee of production functions, the management measures are summarized into five factors: landscape enhancement, production increase, ecological protection, cultural implantation, and social communication, so as to promote sustainable and diversified utilization of arable land.

Development Constraints

Farmland development is not only constrained by internal resistance, but also faces multiple challenges from external resistance.

Internal resistance:Natural environment issues. These are mainly characterized by land resource degradation, water scarcity, climate change and loss of biodiversity (Lal, 2015).

External resistance:Agricultural multifunctionality is affected by multiple economic, social and environmental factors (Yan et al., 2024; Li et al., 2024; Qiao et al., 2024). Based on the existing research results, the two main factors can be summarized as administrative support and socio-economic factors.

Theoretical Modeling

This paper proposes a theoretical model as shown in Figure 2, based on the urban farmland composite use with cognitive evaluation and behavioral drive as criteria:

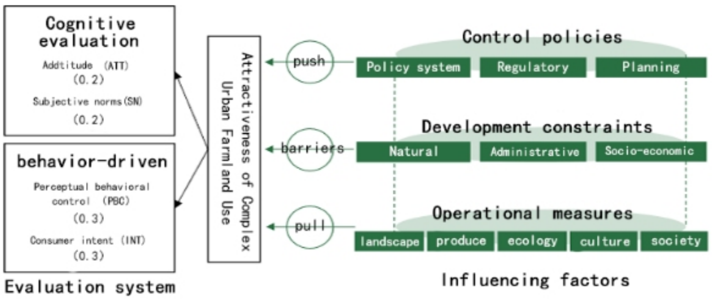

Figure 2: Modeling the attractiveness of complex urban farmland use (author's own drawing).

Scale Design

Following the preliminary survey, supplementary adjustments were made to the measurement questions, leading to the final questionnaire.The scales were presented on a 5-point Likert scale. In the survey design, the farmland attractiveness evaluation system focuses on two dimensions: cognitive evaluation and behavioral drive, as outlined in Table 1. The farmland attractiveness scale questionnaire incorporates three sub-dimensions and 11 survey items developed based on interview data, as detailed in Table 2.

Table 1: Farmland attractiveness evaluation system source: author's own production.

Dimension	Latent Variable	Source	Weight
Cognitive evaluation	Attitude (ATT)	Ajzen, I. (1991)	0.2
	Subjective norm(SN)		0.2
Behavior-driven	Perceptual-behavioral control (PBC)		0.3
	Consumer intent(INT)		0.3

Table 2: Farmland attraction scale design source: author's own.

Purpose of the Scale		Empirical Analysis of Factors Influencing the Value of Urban Farmland	
Level 1	**Level 2**	**Scale Items**	**Criteria**
Control policy	Policy regime	Evaluation through interviews	/
	Regulatory mechanism		
	Planning implement	Do you think the farmland is only performing a productive function?	Score on a scale of 1–5 from "very poor" to "very good"
		Would you like to participate in the investment of this farmland?	
Business measure	Landscape Enhancement	Does the farmland fit your aesthetic?	
	Increased production	The farmland uses certain measures to make the crops grow better, harvest more?	
	Ecological protection	The farmland uses certain measures to protect the ecosystem?	
	Cultural implantation	Can you feel the farming culture in this farmland?	
		Does this farmland do the integration of industry and research?	
	Social exchange	Is socializing appropriate on that farmland?	

Continued

Table 2: Continued

Purpose of the Scale		Empirical Analysis of Factors Influencing the Value of Urban Farmland	
Level 1	**Level 2**	**Scale Items**	**Criteria**
Development constraints	Socio-economic	Inadequate funding for this farmland	Ditto 1–5 scoring (negative)
		The farmland is little known	
	Natural environment	There is environmental pollution on this farmland	
	Administrative support	Evaluation through interviews	/

RESEARCH DATA ANALYSIS

This paper mainly adopts the quantitative research method to explore and analyze the attractiveness model of urban farmland composite utilization: taking 100 pieces of urban farmland in Ningbo City as the research object, through the questionnaire scale setup for the evaluation system related data statistics, combining each element of the countryside push-and-pull theory to determine the variables and setup the path relationship, so as to establish the structural equation model for the empirical test and analysis.

In this study, the multi-stage sampling method was used and the sample size was calculated according to the simple random sampling formula $n = \frac{(Z\frac{\alpha}{2})^2\pi(1-\pi)}{E^2}$, After setting the confidence level at 95% and the margin of error (E) at 3%, The sample size was calculated to be 1068 and expanded to 1100. Finally, 1082 valid questionnaires were returned, and the following data analysis is carried out on the 1082 data.

Reliability and Validity Tests

Firstly, the study was subjected to reliability and validity tests t and the results are tabulated as follows.

Table 3: Reliability and validity analysis table.

Variable	Cronbach Factor	KMO	Item Count
Control policy	0.887	0.876	3
Development constraints	0.836	0.859	3
Business measure	0.918	0.773	5
Totally	0.815	0.816	11

According to Tables 3, it can be concluded that the data from the questionnaire passed the reliability and validity tests and is suitable for validated factor analysis.

Setting Up Structural Equation Modeling

Structural equation modeling (SEM) requires normality assumptions, so this study tested skewness/kurtosis to assess data distribution. Based on established criteria (skewness <1, kurtosis <7), questionnaire data met normality requirements (skewness <1, kurtosis 0.2–1). Using Amos 29.0, confirmatory factor analysis (CFA) with a multifactor oblique model validated the hypothesized framework: CIN/DF = 3.819, RMSEA = 0.078, IFI = 0.879, TLI = 0.863, CFI = 0.821. Fit indices indicated acceptable model-data alignment, supporting the urban farmland composite value indicator system. Drawing on push-pull theory, the study hypothesizes pathways through which control policies, development constraints, and operational measures influence composite utilization value.

H1: Control policies have a positive effect on the value of composite utilization, i.e., a push effect.

H2: Development constraints have a negative impact on the value of composite utilization, i.e., resistance effect.

H3: Operating measures have a positive effect on the value of composite utilization, i.e., a pull effect.

Before analyzing the structural equation modeling, the model fitness test needs to be conducted, and this study mainly uses the chi-square degrees of freedom ratio, RMSEA, IFI, TLI, and CFI to conduct the test.

Table 4: Composite utilization value model fitness test.

Norm	Reference Standard	Actual Results
CIN/DF	1–3 is excellent, 3–5 is good	2.816
RMSEA	<0.05 is excellent, <0.08 is good	0.078
IFI	>0.9 is excellent, >0.8 is good	0.849
TLI	>0.9 is excellent, >0.8 is good	0.854
CFI	>0.9 is excellent, >0.8 is good	0.851

According to Table, it can be seen that all the fitting indices used in this study meet the requirements and reach the good standard. Therefore the results of this analysis can show that the composite utilization value model is fitted relatively well and has a good fit.

Results of the Study

After passing the fitness test, the structural equation model is plotted using Amos and the normalized model results are as follows.

Table 5: SEM path relationship test results.

Path Relationship			Estimate	S.E.	C.R.	P
Compound utilization value	<---	Control policy	0.218	7.462	1.749	*
Compound utilization value	<---	Development constraints	−0.142	8.865	−1.658	*
Compound utilization value	<---	Business measure	0.792	59.532	2.399	***

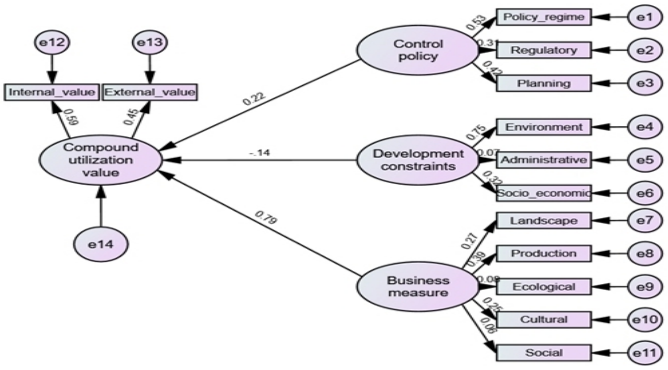

Figure 3: Composite utilization value model run results chart.

The path relationship hypothesis was tested based on the results of the model run. Comprehensive Table results, management measures exert a significant positive impact on composite utilization value (C.R. > 1.96, $p < 0.05$ at 95% confidence level), with the largest direct effect among tested factors. This underscores the critical role of proactive management strategies in enhancing urban farmland value through human intervention.

From the results of structural equation modeling, the hypotheses of the influence paths are valid, and the coefficients of each path are highly significant, indicating that the theoretical model can pass the empirical test in terms of control policies, development constraints, and operational measures, and therefore can be based on the theoretical model in the process of the composite use of urban farmland to make suggestions and recommendations.

CONCLUSION

A study of 100 urban farms in Ningbo found skewed distribution dominated by low-value farmland. Farmland value is significantly influenced by policy thrust and operational pulls, with operational-driven composite use having the greatest impact. The integration of agricultural production, science education, and leisure tourism emerges as a key future trend, highlighting the need to explore compatible development pathways to enhance multifunctional value.

Based on the new endogenous development theory and rural push-pull theoretical framework, this paper proposes a systematic enhancement path for the composite utilization of urban farmland, with the following specific conclusions.

1. Policy optimization: Reinforcing "thrust" driven mechanisms

   Cross-sectoral collaboration in special planning explores a "point land + permanent basic farmland" supply model to unlock industrial potential. Differentiated incentives (tax breaks, subsidies) and dynamic regulations facilitate land transfer toward refined management rights operations, activating market innovation and reducing policy dependency.

2. Value Enhancement: Building a "Three-Stage Value" Operation System
   From a marketing perspective, the "Integrated Value Proposition" of urban farmland can be operationalized through three dimensions: Functional Value: Relying on technological empowerment (IoT, blockchain traceability) and infrastructural innovation to optimize supply chain efficiency and guarantee production sustainability; Emotional value: Through the customization of crowd-level scenes (e.g. healing farming, parent-child education) and the design of immersive experiences (AR narratives, themed activities), the company has created a high-premium model of "rural life trafficking"; Brand value: linking geographical indication certification and city culture IP, building a layered brand matrix of "public - high-end - public welfare", and strengthening market penetration by combining cross-border co-branding and content co-creation.
3. Cracking the resistance: Multidimensional solutions to development constraints
   Funding mechanism: Innovative PPP models, financial products and blockchain traceability technology to attract social capital and reduce market risks; Public participation: Promote the formation of a multi-party sharing mechanism through publicity, education and community building; Planning and implementation: Optimizing spatial layout and ecological renovation to improve the suitability of farmland innate conditions.

This study transcends the urban-rural binary divide by redefining push-pull dynamics, positioning urban farmland as a "third space" to reconcile urban-rural value conflicts and offering a new paradigm for farmland protection and sustainable urbanization.

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