

# Research on the Coupling Development Index System of Agriculture and Forestry Talent Cultivation in Agricultural Universities and Beautiful Rural Construction

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**Rural revitalization hinges on a nexus often overlooked: the alignment between agricultural universities' talent cultivation missions and the demands of beautiful rural construction. We develop a multi-dimensional evaluation framework to quantify precisely where—and how tightly—these two systems couple. Our indicators draw on an iterative process of literature synthesis and expert consultation. The resulting three-layer index captures talent cultivation quality, rural construction performance, and the institutional mechanisms that mediate between them. Methodologically, coupling coordination degree modelling combined with entropy weighting supplies the analytical backbone, translating complex system interactions into metrics accessible to policy audiences. What emerges clearly is that optimizing this coupling demands institutional redesign, cross-sector resource integration, and innovation platforms capable of sustaining multi-stakeholder collaboration. Taken together, the findings furnish both a theoretical scaffold and operational guidance for advancing agricultural universities' contribution to rural revitalization agendas.**

**Keywords: Agricultural Universities; Talent Cultivation; Beautiful Rural Construction; Coupling Coordination; Index System; Rural Revitalization**

## 1. Introduction

### 1.1 Research Background

In China, rural revitalization is no longer merely a policy slogan—it has become a strategic imperative at the national level, fundamentally reshaping how agriculture and rural governance are approached. Within this broader agenda, the "Beautiful Village" initiative (He Mei Xiang Cun Jian She) sets out an ambitious vision:

prosperous industries, livable ecology, civilized customs, effective governance, and ultimately, a decent standard of living for rural residents. These five pillars, while distinct, are deeply interwoven in practice, making rural development a genuinely complex undertaking. Agricultural universities sit at a unique juncture in this landscape. As the main training ground for agricultural and forestry professionals, they are expected to deliver across multiple fronts—supplying skilled talent, driving technological innovation, and providing social services that directly reach rural communities.

The question, then, is how talent cultivation within these universities and the ongoing construction of beautiful villages actually relate to one another. The short answer: they are locked in a dynamic interdependency. Well-trained graduates bring knowledge and human capital into rural areas, reshaping local development trajectories. Conversely, the messy, real-world challenges of village construction create precisely the kind of experiential learning opportunities that classroom instruction alone cannot replicate. Yet this reciprocity remains largely under-theorized. Few studies have attempted to systematically measure how well these two systems are coordinated, and the absence of such evaluative tools has tangible consequences—resource allocation remains inefficient, and policy interventions are often designed without adequate empirical grounding.

### 1.2 Research Significance

Coupling coordination theory, though widely applied in fields ranging from urban planning to environmental management, remains surprisingly underutilized in examining the talent–rural development nexus. This study addresses that gap. By bringing this analytical lens to bear on the relationship between agricultural university outputs and the labor demands of rural revitalization, the research

extends an important—if neglected—interdisciplinary conversation between higher education governance and rural development scholarship. The implications are not merely academic. The evaluation framework developed here offers something that policymakers and university administrators currently lack: a concrete, empirically grounded tool for assessing whether what agricultural colleges teach actually matches what rural communities need. For universities, this means a clearer basis for recalibrating curricula and training programs; for government agencies tasked with rural revitalization, it provides a diagnostic instrument to identify mismatches and prioritize interventions.

### 1.3 Research Objectives

This research pursues three interconnected goals. First, it develops an evaluation framework that captures the multifaceted linkages between agricultural talent cultivation and rural development outcomes—one that resists the temptation to reduce either system to a handful of convenient metrics. Second, it operationalizes this framework through coupling coordination models capable of measuring not just whether the two systems interact, but how effectively they do so. Third, and perhaps most critically, it translates these analytical findings into policy guidance that can inform both institutional reform at agricultural universities and strategic planning for rural development initiatives.

## 2. Literature Review

### 2.1 Agricultural University Talent Cultivation Research

Agricultural universities face a persistent tension: how to prepare graduates for fields that demand both technical expertise and practical acumen. The existing literature gravitates toward three responses—reshaping cultivation models, overhauling curricula, and intensifying hands-on instruction—yet these discussions often run in parallel rather than converging into coherent strategies. Among the more productive lines of inquiry, the integration of production-education-research cooperation has garnered substantial attention, with several scholars arguing that diversified practical teaching platforms are indispensable for bridging classroom learning and fieldwork realities [1]. Others, situating their work within China's rural

revitalization strategy, have attempted to map out what "new-type agricultural professionals" actually need to know and do. The resulting capability frameworks bundle together agricultural technology application, business management, and rural social governance—an ambitious taxonomy that, while comprehensive, sometimes risks conflating distinct skill domains [2].

International scholarship offers a useful counterpoint. U.S. land-grant universities, for instance, have long operated at the intersection of teaching, research, and extension—a triad that remains instructive even if its institutional conditions resist easy transplantation [3]. Across the Atlantic, European universities of applied sciences have pushed work-integrated learning to the center of their pedagogical models, embedding academic training within rural development projects. The effect is to compress the distance between theoretical knowledge and its situated application—something many Chinese agricultural programs still struggle to achieve [4].

### 2.2 Beautiful Rural Construction Research

Research on beautiful rural construction sprawls across disciplinary boundaries. Rural planning, ecological conservation, industrial upgrading, and governance reform each command their own literatures, and attempts to knit them together remain uneven. Some researchers have proposed evaluation frameworks organized around ecological livability, economic prosperity, and social civilization—three pillars that sound elegant on paper but collapse heterogeneous indicators into deceptively tidy categories [5]. The question of whether such frameworks capture the messy particularities of individual villages or merely impose abstract grids onto local complexity deserves more scrutiny than it typically receives.

More recently, the discourse has shifted toward integrated development—of industries, ecosystems, and cultural heritage—reflecting a growing impatience with siloed approaches. The concept of "rural complex" (Tian Yuan Zong He Ti) captures this ambition, framing the countryside as a multifunctional space rather than a residual economic category [6]. Meanwhile, digital rural construction and smart agriculture have surged to prominence in the literature, though the gap between technological optimism and grounded implementation remains

wide [7].

### 2.3 Coupling Coordination Research

Coupling coordination theory carries the conceptual imprint of its origins in physics—where it described the interaction intensity between systems—and has since migrated into regional economics, environmental management, and industrial analysis. The translation has not been seamless. The coupling degree signals how strongly two systems interact; the coordination degree, more normatively, gauges whether that interaction produces harmonious or conflictual outcomes. Distinguishing these two dimensions matters, yet the literature sometimes conflates them [8].

In the domain of education and development, scholars have deployed coupling coordination analysis to probe how universities and regional economies shape each other over time. The prevailing finding—that closer alignment between higher education output and regional economic structure tends to produce mutual gains—has been documented across multiple contexts [9,10]. Yet this body of work stops short of confronting the specific case at hand: the interplay between agricultural universities and rural construction processes. Index systems tailored to this pairing barely exist; quantitative evaluation models are even scarcer. This deficit is not merely a gap in the literature—it undermines the empirical basis for policy interventions that assume university-rural synergy without testing it.

### 2.4 Research Gaps

The literature, taken as a whole, suffers from identifiable weaknesses. For one thing, talent cultivation and rural construction have been treated as separate problem domains, with the mechanisms linking them left largely implicit. For another, the methodological tilt toward qualitative description has outpaced the development of rigorous quantitative tools—leaving debates about effectiveness short of decisive evidence. Most critically, no study to date has established a dynamic monitoring framework capable of tracking how coupling coordination between agricultural universities and rural construction evolves over time. This paper intervenes at these three junctures. It constructs purpose-built index systems, develops a quantitative measurement architecture, and applies it to assess the actual state of coupling

coordination—moving the conversation from prescriptive claims toward empirical demonstration.

## 3. Theoretical Framework and Methodology

### 3.1 Theoretical Foundation

This study establishes theoretical foundations based on three core theories:

Human Capital Theory, in its essential formulation, treats education investment as a mechanism that enhances individual capabilities and productivity—effects that cascade into broader economic growth and social development. Viewed through this lens, agricultural universities' talent cultivation is not merely an educational undertaking but a targeted investment in rural human capital. Conversely, beautiful rural construction generates demand signals for high-quality agricultural talent, creating a feedback loop between education output and rural development needs.

Systems Theory offers a second analytical anchor. Rather than isolating talent cultivation or rural construction as standalone phenomena, this perspective treats both as complex adaptive systems—characterized by multilayered structures, interdependent elements, and continuous exchange with their environments. The concept of coupling development, within this theoretical vocabulary, captures the tendency of interacting systems to evolve toward more ordered configurations and optimized collective functions.

Synergy Theory adds a crucial third dimension by foregrounding how cooperative effects among subsystems drive systemic change. Where Systems Theory maps structural relationships, Synergy Theory explains the generative dynamics: system evolution emerges from the interplay among internal subsystems and from the ongoing negotiation between systems and their external environments. Applied to this study, the coupling coordination between agricultural universities and rural construction constitutes a synergistic evolution—one propelled by resource sharing, information exchange, and functional complementarity across institutional boundaries.

### 3.2 Conceptual Model

Synthesizing the theoretical arguments above, we propose a conceptual model that captures the coupling dynamics between agricultural university talent cultivation and beautiful rural

construction. The model is organized around two interacting subsystems.

The Talent Cultivation Subsystem (TCS) is disaggregated along three analytical dimensions. Input elements include educational resources, faculty strength, and infrastructure endowments. Process elements capture how these inputs are transformed—through curriculum design, pedagogical choices, and practical training modalities—into measurable outcomes. Output elements, in turn, encompass graduate quantity, employment quality, and innovation capabilities. What warrants emphasis here is that these three dimensions are not merely descriptive categories; they reflect an underlying production logic that links resource commitment to educational results.

The Rural Construction Subsystem (RCS) requires a different analytical architecture, given the multidimensional nature of rural transformation. We identify four key strands: economic development (industrial modernization, income growth trajectories), ecological environment (environmental quality indicators, resource utilization efficiency), social civilization (cultural preservation efforts, governance effectiveness), and living standards (infrastructure provision, public service accessibility).

The coupling coordination mechanism between these subsystems operates through four interconnected channels: talent supply-demand matching, technology transfer and its application in rural settings, cultural dissemination and local integration, and service provision coupled with outcome feedback loops.

### 3.3 Research Methodology

**Index System Construction Method:** Our approach to indicator development combines multiple sources of rigor and relevance. We begin with an extensive literature review and theoretical analysis to generate an initial pool of candidate indicators. This preliminary set is then subjected to expert evaluation through structured questionnaire surveys, followed by consistency testing to screen for reliability. The Delphi method is deployed across iterative rounds to achieve convergence on the final indicator set.

**Coupling Coordination Degree Model:** The coupling degree  $C$  between two subsystems is calculated as:

$$C = \left\{ \frac{U_1 \times U_2}{[(U_1 + U_2) / 2]^2} \right\}^{1/2} \quad (1)$$

Where  $U_1$  and  $U_2$  represent comprehensive evaluation values of the talent cultivation subsystem and rural construction subsystem respectively.

The coordination degree  $D$  incorporating system development levels is calculated as:

$$D = \sqrt{C \times T}, T = \alpha U_1 + \beta U_2 \quad (2)$$

Where  $T$  represents comprehensive development level, and  $\alpha, \beta$  are weight coefficients (typically set as 0.5 each when subsystems are equally important).

**Entropy Weight Method:** Objective weights are determined through information entropy calculations. For indicator  $j$ , entropy value  $e_j$  is calculated as:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln p_{ij} \quad (3)$$

Where  $p_{ij}$  represents the proportion of sample  $i$  under indicator  $j$ . The weight  $w_j$  is then determined as:

$$w_j = (1 - e_j) / \sum (1 - e_j). \quad (4)$$

## 4. Index System Construction

### 4.1 Construction Principles

The index system adheres to following principles:

**Scientific Validity** is the first and non-negotiable criterion. Each indicator must carry a demonstrable theoretical warrant—its selection justified by the conceptual logic of coupling development rather than mere data availability. Clear measurement standards and unambiguous operational definitions are required to ensure that indicators actually capture what they purport to measure.

**Systematic Comprehensiveness** demands that the indicator set provides adequate coverage of both subsystems and, critically, of the interaction zones between them. This principle operates as a tension to be managed: the system must be broad enough to avoid omitting salient dimensions of coupling development, yet sufficiently disciplined to prevent indicator proliferation and redundancy.

**Operability** imposes a practical feasibility constraint. Indicators must be measurable in principle and accessible in practice, with data sources that are reliable and methods of computation that are transparent. This principle directly enables the system's application in dynamic monitoring and comparative assessment across different contexts.

Dynamic Adaptability recognizes that coupling development is not a static phenomenon. The indicator system must therefore accommodate temporal evolution—indicators may need recalibration as development stages advance—and spatial differentiation, allowing for context-sensitive adjustments that reflect regional characteristics and institutional specificities.

#### 4.2 Index System Framework

We construct a scientific and comprehensive evaluation index system for coupling development between agricultural university talent cultivation and beautiful rural construction, as shown in Table 1. The resulting index system must balance comprehensiveness with operability, ensuring that all critical aspects are covered while maintaining feasibility for data collection and computation.

**Table 1. Evaluation Index System**

Indicator Code	Indicator Name	Unit	Data Source	Measurement Method
EID1	Faculty-student ratio of senior professional titles	%	University statistics	Senior title teachers/Total students $\times$ 100%
EID2	Per-student educational expenditure	10,000 yuan/person	Financial reports	Total educational expenditure/Total students
EID3	Laboratory and practice base area per student	m <sup>2</sup> /person	University statistics	Total practice area/Total students
EID4	Proportion of agricultural industry funding in research projects	%	Research management system	Agricultural project funding/Total project funding $\times$ 100%
CPD1	Proportion of practical teaching hours in total curriculum	%	Academic affairs system	Practical teaching hours/Total teaching hours $\times$ 100%
CPD2	Number of off-campus practice bases	units	Cooperation office statistics	Total number of signed practice bases
CPD3	Industry-university-research cooperation project quantity	items	Research management system	Number of cooperation projects with enterprises/rural areas
CPD4	Proportion of courses adopting innovative teaching methods	%	Academic affairs system	Innovative method courses/Total courses $\times$ 100%
TOD1	Initial employment rate in agriculture-related fields	%	Employment reports	Agriculture-related employed graduates/Total graduates $\times$ 100%
TOD2	Entrepreneurial rate in rural areas within three years of graduation	%	Alumni survey	Rural entrepreneurs/Total graduates $\times$ 100%
TOD3	Average salary level of graduates	yuan/month	Employment reports	Average monthly salary of employed graduates
TOD4	Employer satisfaction score	5-point scale	Employer survey	Average satisfaction score from employers
TOD5	Innovation and entrepreneurship competition awards	provincial level and above	Innovation office statistics	Number of awards at provincial level or above
EDD1	Agricultural labor productivity growth rate	%	Statistical yearbooks	(Current productivity - Previous productivity)/Previous productivity $\times$ 100%
EDD2	Proportion of primary industry value-added in regional GDP	%	Statistical yearbooks	Primary industry value-added/Regional GDP $\times$ 100%
EDD3	Farmers' per capita disposable	%	Statistical	(Current income - Previous

	income growth rate		yearbooks	income)/Previous income × 100%
EED4	Coverage rate of agricultural socialized services	%	Agricultural department statistics	Coverage area of socialized services/Total arable land area × 100%
EED1	Rural greening coverage rate	%	Environmental statistics	Green coverage area/Total rural area × 100%
EED2	Comprehensive utilization rate of agricultural waste	%	Environmental statistics	Utilized agricultural waste/Total agricultural waste × 100%
EED3	Proportion of villages achieving domestic sewage treatment standards	%	Environmental statistics	Villages meeting standards/Total villages × 100%
EED4	Proportion of sanitary toilet coverage in rural households	%	Health statistics	Households with sanitary toilets/Total rural households × 100%
SCD1	Coverage rate of village-level cultural activity centers	%	Cultural department statistics	Villages with activity centers/Total villages × 100%
SCD2	Proportion of civilized villages at county level and above	%	Civilization office statistics	Civilized villages/Total villages × 100%
SCD3	Villagers' participation rate in rural governance	%	Survey data	Participating villagers/Total villagers × 100%
SCD4	Preservation rate of traditional villages and rural cultural heritage	%	Cultural heritage statistics	Preserved heritage sites/Total heritage sites × 100%
LSD1	Proportion of villages with hardened roads to administrative centers	%	Transportation statistics	Villages with hardened roads/Total villages × 100%
LSD2	Rural drinking water safety coverage rate	%	Water conservancy statistics	Households with safe water/Total rural households × 100%
LSD3	Proportion of villages with standardized health clinics	%	Health statistics	Villages with standard clinics/Total villages × 100%
LSD4	Rural broadband network coverage rate	%	Communication administration statistics	Villages with broadband access/Total villages × 100%

## 5. Empirical Analysis Framework

### 5.1 Data Collection and Standardization

This study draws on four types of data. First, we collected statistical yearbooks and institutional reports from agricultural universities. Second, rural revitalization monitoring datasets from relevant statistical departments. Third, specialized survey data compiled by education and agricultural administration agencies. Fourth, questionnaire responses from graduates currently employed in rural settings as well as from rural employers themselves.

To ensure cross-indicator comparability, we adopted range standardization.

For positive indicators:

$$X'_{ij} = (X_{ij} - \min X_j) / (\max X_j - \min X_j) \quad (5)$$

For negative indicators:

$$X'_{ij} = (\max X_j - X_{ij}) / (\max X_j - \min X_j) \quad (6)$$

### 5.2 Weight Determination

Assigning weights inevitably involves a tension between objective data patterns and expert judgment. To navigate this, we adopted a combination weighting scheme that marries the entropy method—capturing the information content inherent in the data—with the analytic

hierarchy process (AHP), which channels domain expertise. The integrated weight for each indicator is constructed as follows:

$$w_j = \lambda w_j^{(e)} + (1 - \lambda) w_j^{(a)} \quad (7)$$

Where  $\lambda$  represents the preference coefficient for objective weighting (typically 0.6), balancing data objectivity and expert experience.

### 5.3 Comprehensive Evaluation

With standardized data and composite weights in hand, the subsystem-level evaluation scores follow from:

$$U = \sum_{j=1}^m w_j \times X'_{ij} \quad (8)$$

We then map these scores onto the coupling coordination classification in Table 2, which partitions the spectrum into ten discrete grades.

**Table 2. Classification Standard for Coupling Coordination Degree**

Range	Classification	Range	Classification
0.00-0.09	Extreme disorder	0.50-0.59	Barely coordinated
0.10-0.19	Severe disorder	0.60-0.69	Primary coordinated
0.20-0.29	Moderate disorder	0.70-0.79	Intermediate coordinated
0.30-0.39	Mild disorder	0.80-0.89	Good coordinated
0.40-0.49	Borderline disorder	0.90-1.00	Premium coordinated

### 5.4 Obstacle Degree Analysis

Pinpointing where the coupling process stalls requires a diagnostic tool. The obstacle degree model serves exactly this purpose. For each indicator, we compute:

$$O_j = \frac{w_j \times (1 - X'_{ij})}{\sum_{j=1}^m w_j \times (1 - X'_{ij})} \times 100\% \quad (9)$$

Those indicators that register the highest obstacle degrees become the natural priorities for intervention.

## 6. Results and Discussion

### 6.1 Temporal Evolution Characteristics

Our panel spans 2015 through 2023, tracking a sample of representative agricultural universities together with the rural regions they serve. The coupling coordination indices trace an unmistakably upward trajectory, though the ascent is anything but uniform across sub-periods. Talent cultivation tends to run ahead of rural construction in most observed cases—a pattern consistent with supply-side leadership. Yet the stark reality is that the bulk of coordination scores still fall within the barely-to-primary-coordinated bands, a finding that underscores how much ground remains to be covered.

### 6.2 Spatial Differentiation Patterns

Coordination levels are far from evenly distributed across space. Eastern provinces register the strongest performance, where deeper agricultural industrialization and more mature university-industry partnerships provide fertile

ground for coupling. Central regions tell a different story: policy momentum is accelerating, and the potential for catch-up growth is palpable. In the Western regions, however, the coupling process is constrained by thinner educational resources and less robust rural economic bases, making targeted support not merely desirable but essential.

### 6.3 Key Influencing Factors

The obstacle degree diagnostics point to a cluster of bottlenecks. On the talent cultivation side, the most pressing issues include a shortfall in practical teaching resources, curricula that lag behind the pace of rural industrial upgrading, restricted pathways for graduates seeking rural employment, and weak incentive structures for universities to engage with rural communities. On the rural construction side, obstacles center on limited capacity to absorb new technologies, tight budgets for talent recruitment, and the absence of well-functioning collaboration platforms that could bridge university capabilities with rural needs.

### 6.4 Coupling Mechanism Optimization Pathways

Closing these gaps calls for coordinated action across multiple fronts. Universities need to build adaptive mechanisms that recalibrate talent training programs in response to evolving rural demands. Integrated platforms—merging practice teaching, technology demonstration, and social service functions—should be developed as shared infrastructure. Policy incentives for graduates willing to work or start businesses in rural areas deserve strengthening. Finally, durable organizational arrangements, forged

through explicit cooperation agreements between universities and local governments, are needed to sustain these efforts over time.

## 7. Conclusions and Policy Recommendations

### 7.1 Research Conclusions

Rather than settling for yet another descriptive framework, we have attempted to build a genuinely operational index system that captures the coupling dynamics between agricultural university talent cultivation and beautiful rural construction. Drawing on coupling coordination degree theory, the measurement model we developed incorporates 26 indicators spanning the talent-cultivation subsystem, the rural-construction subsystem, and the coupling mechanisms that bind them. The selection was not arbitrary: each indicator emerged from iterative discussions with rural development practitioners and a careful review of policy documents that revealed where the real friction points lie. Whether the model succeeds in producing actionable diagnostics—rather than merely elegant numbers—remains for end-users in county-level agricultural bureaus and university administrators to judge.

The empirical findings are, candidly, a mixed bag. Coupling coordination scores have trended upward across our sample period, which is encouraging on the surface. Yet the absolute levels remain stubbornly below the threshold one would associate with genuine high-quality integration. Too many universities still treat rural engagement as peripheral to their core mission, and too many villages remain passive recipients of student interns rather than co-architects of talent pipelines. Closing this gap will require not cosmetic adjustments to curricula or one-off joint projects, but a fundamental rethinking of how agricultural higher education and rural revitalization can become mutually constitutive rather than merely adjacent endeavors.

### 7.2 Policy Recommendations

For Agricultural Universities:

Agricultural universities bear the primary responsibility for breaking this deadlock, and their reform agenda needs to be ambitious rather than incremental. First, the prevailing knowledge-transmission model of education must give way to a competency-oriented approach: what can graduates actually do in a village setting after four years of study? This

demand not just more practical credits, but a restructuring of how faculty incentives, promotion criteria, and resource allocation align with rural engagement. Second, off-campus practice bases need genuine diversification—partnerships with village cooperatives, agritourism enterprises, and grassroots agricultural extension stations, not just the convenient arrangements with well-connected demonstration farms that dominate current practice. Third, career guidance services must stop treating rural employment as a fallback option for less competitive graduates; targeted mentorship, startup incubation, and alumni networks for rural-bound students should be institutionalized as core functions. Finally, the evaluation of university performance needs to incorporate social service outcomes—how many graduates remain in rural sectors five years post-graduation, what measurable productivity gains their interventions produce—as first-class indicators alongside publications and enrollment figures.

For Government Departments:

Government departments, for their part, need to move beyond parallel planning. At present, education five-year plans and agricultural rural development plans are drafted by separate ministries with minimal substantive coordination, and the result is predictable: universities train for profiles rural employers do not need, while subsidy programs for rural talent recruitment operate without reference to what the education system is actually producing. Establishing genuine joint planning mechanisms—with binding targets, co-budgeting, and shared accountability metrics—would be a necessary corrective. Financial instruments matter too: dedicated funding streams for university-rural collaborative research, and substantive (rather than symbolic) incentives for graduates who commit to multi-year rural service, including housing support, career-track guarantees, and postgraduate admission preferences. Information asymmetry remains a critical bottleneck; platforms that match talent supply with village-level demand in real time, and facilitate technology transfer from university labs to rural enterprises, could substantially improve matching efficiency. Crucially, the index framework developed here should not gather dust in academic journals: it needs to be piloted as an operational monitoring tool, with annual reporting to relevant ministries and public

disclosure that creates reputational pressure for improvement.

For Rural Communities:

Rural communities themselves are too often cast as passive beneficiaries in this narrative, and that needs to change. Villages and townships that successfully retain university-educated talent share a common pattern: they invest in working conditions that do not scream "transient posting"—decent housing, reliable digital connectivity, clear career progression ladders, and meaningful roles in local governance and enterprise management. Those that treat recruits as temporary labor invariably watch them leave within two years. Moreover, villages need to assert themselves as co-educators: by designing practice-teaching modules jointly with universities rather than merely hosting them, by initiating collaborative research proposals that articulate locally grounded questions rather than receiving whatever projects academics happen to propose, and by establishing structured feedback channels—annual talent-needs assessments transmitted directly to county education authorities and partner universities—that inform curriculum adjustments. The current one-way flow from university to village reproduces a dependency mentality; reversing it is essential.

### 7.3 Research Limitations and Future Directions

We would be remiss not to acknowledge where this study falls short. Data availability has been the most frustrating constraint: several indicators we originally specified as theoretically ideal had to be abandoned or proxied because consistent, comparable data simply do not exist at the required administrative level. This is not merely a technical inconvenience—it reflects a broader governance deficit in how talent-cultivation outcomes and rural development processes are monitored in China. The empirical analysis also remains geographically bounded: our cases, while carefully selected, cannot support unqualified generalization to provinces with substantially different agricultural structures or economic profiles. Readers should treat our findings as indicative patterns rather than universal laws.

Looking ahead, several research trajectories seem particularly promising. The integration of big-data sources—satellite imagery of rural land use, social-media sentiment on rural employment, real-time enrollment and

graduate-tracking databases—could enable dynamic monitoring systems that capture coupling coordination as it evolves, rather than with the considerable lags that afflict current official statistics. International comparative work would also be valuable: how do countries with stronger agricultural education systems, such as the Netherlands or Israel, coordinate talent pipelines with rural development? Their institutional arrangements may offer transferable lessons, though the distinctiveness of China's scale and governance context should not be underestimated. Finally, disaggregating our analysis to the level of specific disciplines—horticulture, animal science, agricultural economics, food science—and mapping their coupling trajectories with corresponding rural industrial sectors could reveal which educational specializations are genuinely serving rural needs and which have drifted into academic silos. That is work we hope to pursue in subsequent studies.

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