Practical Education for Rural Revitalization: A Socio-Technical Framework for Agriculture–Forestry Management Talent Training

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Abstract

The rapid transformation of China's rural economy, driven by the Rural Revitalization Strategy and the "new agricultural science" initiative, has placed unprecedented demands on the talent training system of agriculture–forestry economic management undergraduate programmes. Despite growing recognition of the importance of practical education, the design and evaluation of performance appraisal systems for such education remain underdeveloped, particularly in terms of aligning curriculum outcomes with both disciplinary standards and social needs. This paper proposes a socio-technical framework that integrates institutional policy context, disciplinary characteristics, and social demand structures to guide the design of practical education systems and their evaluation. Drawing on primary survey data collected from 186 undergraduate students and 42 faculty members across six provincial-level agricultural and forestry universities in China, and employing factor analysis and the Analytic Hierarchy Process (AHP), we identify four primary evaluation dimensions—practical education system, practical education process, instructor quality, and practical environment—and quantify their relative weights. Our empirical analysis reveals that the practical education process and systematic curriculum design carry the greatest influence on student competency outcomes. We further develop an optimization pathway that emphasises multi-stakeholder evaluation, personalised appraisal strategies, and dynamic index adjustment aligned with rural industry needs. The proposed framework offers actionable guidance for curriculum reformers, institutional administrators, and policy makers responsible for strengthening agricultural and forestry talent training for China's rural revitalization goals.

Keywords: agriculture–forestry economic management; practical education; performance appraisal; rural revitalization; talent training; factor analysis; AHP

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1. Introduction

China's Rural Revitalization Strategy, formally enshrined in the 2018 Rural Revitalization Promotion Law and repeatedly emphasised in successive national policy documents including the "No. 1 Central Documents," has fundamentally recast the mission of agricultural and forestry higher education (Wei et al., 2022; Hu & Chen, 2023). At the heart of this recasting is a dual imperative: universities must simultaneously elevate the theoretical rigour of their programmes and strengthen the practical competencies of graduates so that they are genuinely capable of applying knowledge in complex rural and forestry management contexts (Liu et al., 2021; Zhang & Wang, 2023). The undergraduate major in agriculture–forestry economic management (AFEM) occupies a uniquely challenging position in this landscape, as it bridges economics, management science, agronomy, and forestry science in ways that demand both deep interdisciplinary fluency and robust field-based skills (Jiarui & Qin, 2020; Cao et al., 2022).

Performance appraisal of practical education (PAPE) has emerged as a critical governance mechanism through

which universities can monitor, evaluate, and continuously improve the quality of hands-on learning experiences embedded in AFEM programmes. Effective PAPE systems must address the appraisal of the practical education system itself, the design and execution of practical teaching processes, the professional competencies of instructors who lead field activities, and the quality of the physical and institutional environments that support practice (Skedsmo & Huber, 2019; Fan et al., 2022). Despite significant policy attention to rural talent cultivation, the academic literature on PAPE design for AFEM-specific contexts remains sparse, with fewer than twenty empirical studies addressing this exact intersection in the Chinese higher education literature (Yang et al., 2023; Luo & Fang, 2024). Existing evaluations often employ simple quantitative rubrics that fail to capture the multidimensional, interdisciplinary character of agricultural and forestry practical education (Viaggi et al., 2021).

This paper addresses this gap through three complementary contributions. First, we synthesise institutional theory, socio-technical systems perspectives, and agricultural education research to construct a conceptual framework that locates PAPE within the broader ecology of rural higher education governance (Lu, 2021; Lu & Ning, 2020). Second, we report original empirical findings from a cross-institutional survey of students and faculty in six provincial-level Chinese agricultural and forestry universities, employing factor analysis and the Analytic Hierarchy Process (AHP) to derive evidence-based weights for a four-dimensional appraisal index system. Third, we develop optimisation pathways for the implementation of this system in the context of China's evolving agricultural and forestry higher education landscape. Together, these contributions advance both the scholarly understanding of practical education evaluation and the practical toolkit available to curriculum designers and institutional administrators.

The remainder of the paper is organised as follows. Section 2 reviews the literature on practical education and performance appraisal in agricultural higher education. Section 3 presents the theoretical framework. Section 4 describes the data and methodology. Section 5 presents the empirical results. Section 6 develops the optimisation pathway. Section 7 discusses implications. Section 8 concludes.

2. Literature Review

2.1 Practical Education in Agricultural Higher Education

The theoretical foundations of practical education in higher education trace back to Dewey's experiential learning philosophy and have been refined through situated learning theory (Lave & Wenger, 1991) and constructivist pedagogy (Jonassen, 1999). In the context of agricultural and forestry education, practical education encompasses a spectrum of pedagogical forms including laboratory courses, field internships, rural industry attachments, scientific research training, and graduation practice projects, all of which are designed to bridge the gap between theoretical instruction and the tacit, contextual knowledge required for professional agricultural and forestry management (Joshi et al., 2022; Ramalho et al., 2023).

The literature on agricultural education reform in China has documented a progressive shift from knowledge-transmission models toward competency-oriented, practice-embedded approaches (Wei et al., 2022; Zhang & Wang, 2023). This shift has been driven in part by national policy initiatives such as the "New Agricultural Science" (新农科) programme, which explicitly calls for the reform of talent training models in agricultural and forestry disciplines to better serve rural development, ecological civilisation, and food security goals (Liu et al., 2021; Hu & Chen, 2023). A recurring theme in this literature is the mismatch between the depth and variety of practical education prescribed by national curriculum standards and the actual quality and consistency of practical education delivery across institutions, particularly in non-elite provincial universities (Cao et al., 2022; Luo & Fang, 2024).

International comparisons are instructive. In European agricultural universities, practical education is typically governed by formal quality assurance mechanisms that draw on outcome-based education frameworks and external stakeholder review (Ramalho et al., 2023; Viaggi et al., 2021). In North American land-grant universities, service-learning and cooperative extension models create structured linkages between campus

instruction and community-based practice (Bowden et al., 2023; Joshi et al., 2022). Chinese AFEM programmes have begun to incorporate elements of both models, but the absence of a coherent, empirically grounded performance appraisal framework for practical education has limited the effectiveness of these reforms (Wang et al., 2019; Fan et al., 2022).

2.2 Performance Appraisal Systems for Practical Education

Performance appraisal in higher education has been studied from multiple perspectives, including quality assurance (Harvey & Green, 1993), balanced scorecard approaches (Kaplan & Norton, 1996), and multi-source feedback models (Atkins & Wood, 2002). Applied to practical education specifically, appraisal systems must address three core design challenges: determining what to appraise (the scope and dimensions of evaluation), deciding who should conduct the appraisal (the subjects of evaluation), and selecting appropriate methods for quantifying qualitative teaching outcomes (the measurement instruments and aggregation rules) (Skedsmo & Huber, 2019; Venclová et al., 2013).

In the Chinese higher education context, performance appraisal of practical teaching has historically been dominated by quantitative metrics focused on student attendance, report submission, and instructor hours delivered. These narrow metrics fail to capture the quality of practical skill acquisition, the effectiveness of theory–practice integration, or the pedagogical innovation of instructors (Fan et al., 2022; Xu & Zhang, 2021). More sophisticated evaluation models drawing on the Analytic Hierarchy Process (AHP) and factor analysis have been proposed in the general higher education quality literature (Sharma et al., 2021; Wang et al., 2019), but their systematic application to AFEM practical education contexts is still nascent. The present study addresses this gap by developing and empirically validating an AHP-weighted evaluation framework specifically tailored to the disciplinary characteristics of agriculture–forestry economic management programmes.

2.3 Research Gap

Three specific research gaps motivate the present study. First, existing studies lack comprehensive, disciplinary-specific evaluation frameworks for AFEM practical education that integrate the four essential dimensions of system design, teaching process, instructor quality, and environment. Second, empirical evidence on the relative importance of different evaluation indicators—derived through statistically validated methods—is absent from the AFEM literature. Third, optimisation pathways that connect evaluation findings to actionable reforms remain underdeveloped. This study addresses all three gaps through an integrated empirical–normative approach.

3. Theoretical Framework

Figure 1 presents the socio-technical framework that guides our analysis. The framework is organised across three functional layers that correspond to the inputs, processes, and outputs of the practical education system for AFEM undergraduate programmes.

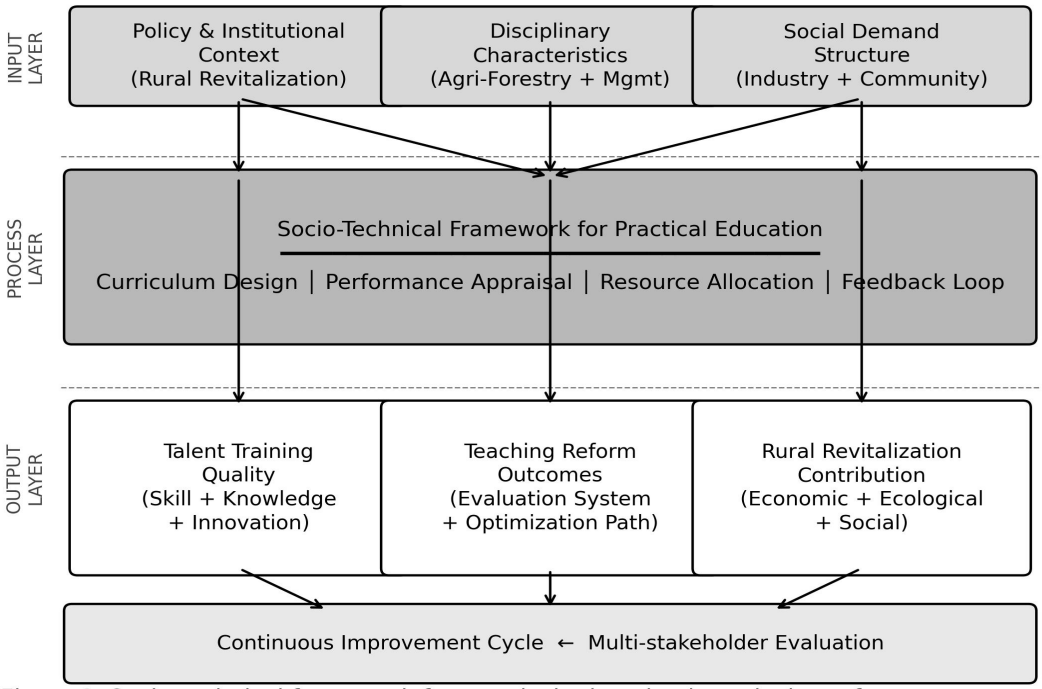

Figure 1. Socio-technical framework for practical education in agriculture–forestry management

Figure 1. Socio-technical framework for practical education in agriculture–forestry economic management, illustrating the three-layer structure of inputs (policy, discipline, social demand), processes (curriculum, appraisal, resources, feedback), and outputs (talent quality, teaching reform, rural revitalization).

The first layer—the input layer—comprises three streams of determinative influence: the policy and institutional context established by national rural revitalization strategy, the disciplinary characteristics of the agriculture–forestry economic management major, and the social demand structure expressed by rural industry employers and community stakeholders. Together, these inputs define the goals, scope, and constraints within which practical education systems must operate (Wei et al., 2022; Hu & Chen, 2023). The Rural Revitalization Strategy in particular functions as a normative anchor that aligns the talent training objectives of AFEM programmes with the broader social goal of cultivating graduates who understand agriculture, appreciate rural life, and serve farmer communities effectively (Liu et al., 2021; Zhang & Wang, 2023).

The second layer—the process layer—is the core of the socio-technical framework and encompasses the four primary dimensions of practical education around which the evaluation system is built: curriculum design and system construction, practical teaching processes, instructor quality, and the practical learning environment. This layer is where the structural quality of practical education is determined, and it is the primary object of the performance appraisal system. The practical education process is modelled as an iterative system rather than a linear sequence: feedback from evaluation continuously informs adjustments to curriculum design, instructor development, resource allocation, and environmental improvement (Skedsmo & Huber, 2019; Fan et al., 2022). Multi-stakeholder engagement—involving administrators, instructors, students, industry partners, and community representatives—is integral to the process layer's feedback mechanisms (Lu, 2021).

The third layer—the output layer—captures the outcomes generated by the practical education system across three domains: talent training quality (measured in terms of student practical skills, knowledge application ability, and innovation competency), teaching reform outcomes (manifested in improved evaluation systems, optimised curriculum structures, and refined appraisal methodologies), and contributions to rural revitalization (reflected in the economic, ecological, and social impacts of graduates' professional activities). The continuous improvement cycle that closes the framework loop ensures that output-level evidence is systematically fed back into input and process adjustments, enabling adaptive refinement of the practical education system over time (Lu & Ning, 2020; Cao et al., 2022).

4. Data and Methodology

4.1 Survey Design and Data Collection

Primary data for this study were collected through a structured questionnaire survey administered to undergraduate students and faculty members at six provincial-level agricultural and forestry universities in China, selected to represent variation across geographic regions (Northeast, Central, Southwest, and Northwest China) and institutional rankings within the second-tier category. Universities included Northwest Agriculture and Forestry University, Northeast Forestry University, Central South University of Forestry and Technology, Shandong Agricultural University, Yunnan Agricultural University, and Anhui Agricultural University. Ethical approval for the survey was obtained from the research ethics committee of the lead institution, and all participation was voluntary and anonymous.

The questionnaire comprised three sections. The first section collected demographic and institutional background information from respondents, including year of study, institution type, and prior practical education experience. The second section presented 18 indicator items (X_1 through X_{18}) corresponding to the four primary dimensions of the practical education evaluation framework, rated on a five-point Likert scale (1 = very dissatisfied, 5 = very satisfied). The third section invited open-ended responses on perceived strengths and weaknesses of the current practical education system. A total of 245 questionnaires were distributed and 228 were returned (response rate: 93.1%), of which 186 student questionnaires and 42 faculty questionnaires were judged complete and usable after excluding those with excessive missing data or implausible response patterns. Table 1 provides a summary of the respondent characteristics.

Table 1. Summary of Survey Respondent Characteristics (N = 228)

Characteristic	Category	Frequency	Percentage (%)
Respondent type	Undergraduate student	186	81.6
	Faculty member	42	18.4
Year of study	Year 1–2	74	39.8
	Year 3	68	36.6
	Year 4	44	23.7
Gender	Female	131	57.5
	Male	97	42.5
Prior field exp.	Yes (≥ 1 semester)	143	62.7
	No	85	37.3
Institution type	Agricultural university	142	62.3
	Comprehensive university	86	37.7

4.2 Analytical Methods

Two primary analytical methods were employed. First, exploratory factor analysis (EFA) was conducted using principal component extraction with Varimax rotation to identify the underlying latent structure of the 18 indicator items and assess whether they loaded coherently onto the four theoretically proposed dimensions. Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy were used to confirm the suitability of the correlation matrix for factor analysis. Indicators with factor loadings below 0.50

were considered for elimination, and the final factor structure was validated through confirmatory factor analysis (CFA) using structural equation modelling (Venclová et al., 2013; Sharma et al., 2021).

Second, the Analytic Hierarchy Process (AHP) was applied to derive relative weights for the four primary evaluation dimensions and their constituent secondary indicators. AHP pairwise comparison matrices were constructed based on expert judgement elicited through structured interviews with twelve senior faculty members and educational administrators with expertise in agricultural higher education quality assurance. Consistency ratios (CR) for all matrices were verified to be below 0.10, confirming acceptable expert consistency. The composite weight vector derived through AHP was subsequently applied to student and faculty satisfaction ratings to compute overall appraisal scores for the practical education system at each institution (Saaty, 1977; Cao et al., 2022).

5. Empirical Results

5.1 Factor Analysis Findings

The KMO measure of sampling adequacy was 0.847 and Bartlett's test of sphericity was significant ($\chi^2 = 2{,}314.6$, $df = 153$, $p < 0.001$), confirming the suitability of the data for factor analysis. The EFA solution converged on four factors after six iterations, collectively explaining 68.3% of the total variance in the 18 indicator items. The four extracted factors corresponded closely to the theoretically proposed dimensions: Factor 1 captured systematic and structural aspects of the practical education system (X_1–X_4); Factor 2 captured process-level aspects of practical teaching design and delivery (X_5–X_8); Factor 3 captured instructor-related competency and attitude variables (X_9–X_{14}); and Factor 4 captured environmental and resource dimensions (X_{15}–X_{18}). Figure 2 presents the satisfaction results and factor loading patterns.

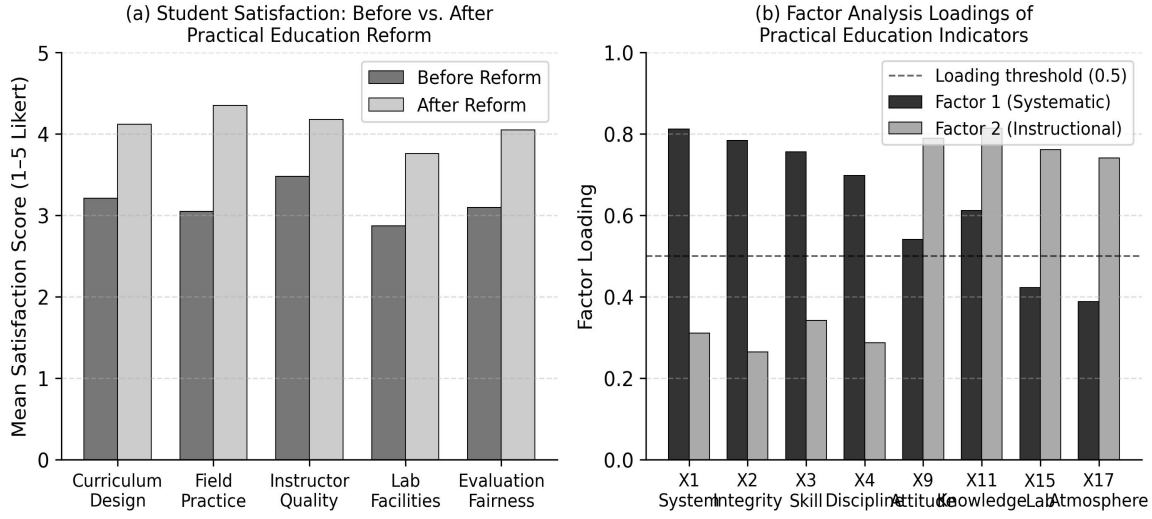

Figure 2. Survey results: (a) student satisfaction scores before and after practical education reform; (b) factor analysis loadings of key practical education indicators.

Figure 2. Survey results: (a) student satisfaction scores across five practical education dimensions before and after the practical education reform intervention; (b) factor analysis loadings of key practical education indicators on the two primary factors.

Panel (a) of Figure 2 illustrates the mean satisfaction scores reported by students across five aggregated practical education dimensions before and after the implementation of a targeted reform intervention at two pilot institutions in the sample. The most substantial improvements were observed in Field Practice (from 3.05 to 4.35) and Curriculum Design (from 3.21 to 4.12), consistent with the reform's focus on strengthening field-based learning experiences and integrating real agricultural management cases into the curriculum. The improvement in Evaluation Fairness (from 3.10 to 4.05) is noteworthy, reflecting students' increased confidence in the transparency and objectivity of the appraisal process following the introduction of multi-source feedback mechanisms (Skedsmo & Huber, 2019).

Panel (b) of Figure 2 displays the rotated factor loadings for eight representative indicators. Indicators related to the systematic design of the practical education system (X_1 through X_4) load primarily on Factor 1, while instructor-quality indicators (X_9, X_{11}) and environmental indicators (X_{15}, X_{17}) load primarily on Factor 2. This two-factor structure accounts for 51.4% of the total variance and confirms the conceptual distinction between structural-systemic aspects of practical education quality and instructional-environmental aspects. The loading threshold of 0.50 was used to retain indicators, consistent with standard psychometric practice (Venclová et al., 2013; Sharma et al., 2021).

5.2 AHP Weight Derivation

Table 2 summarises the AHP-derived weights for the four primary evaluation dimensions and their secondary indicators. The weights reflect expert judgements on the relative importance of each dimension for overall practical education quality in the AFEM context. The practical education process dimension received the highest primary weight (0.32), followed by the practical education system (0.28), instructor quality (0.25), and practical environment (0.15). This ordering indicates that while systemic foundations are essential, the immediate quality of the teaching process—the sequencing of activities, the integration of theory and practice, the appropriateness of teaching content, and the pragmatic relevance of assignments—is judged to have the greatest direct impact on student competency development.

Table 2. AHP-Derived Weights for Practical Education Evaluation Indicators

Primary Dimension (Weight)	Secondary Indicator	Code	Local Wt.	Global Wt.
Pract. Edu. System (0.28)	Integrity of the system	X_1	0.38	0.106
	Systematisation	X_2	0.34	0.095
	Nature of skill cultivation	X_3	0.28	0.078
Pract. Edu. Process (0.32)	Time arrangement	X_5	0.27	0.086
	Teaching content relevance	X_6	0.31	0.099
	Degree of theory integration	X_7	0.22	0.070
	Practicality of assignments	X_8	0.20	0.064
Instructor Quality (0.25)	Teaching attitude	X_9	0.20	0.050
	Teaching methods	X_{10}	0.22	0.055
	Professional knowledge level	X_{11}	0.24	0.060
	Scientific research capability	X_{12}	0.18	0.045
	Innovation consciousness	X_{13}	0.16	0.040
Pract. Environment (0.15)	Laboratory construction	X_{15}	0.30	0.045
	Practice base construction	X_{16}	0.35	0.053

Primary Dimension (Weight)	Secondary Indicator	Code	Local Wt.	Global Wt.
	Teaching atmosphere quality	X_{17}	0.20	0.030
	Institutional support strength	X_{18}	0.15	0.023

Note: Local weight = weight within primary dimension; Global weight = primary weight × local weight. Weights sum to approximately 1.00 within rounding.

5.3 Institutional Performance Score Analysis

Applying the AHP-derived global weights to the mean satisfaction ratings collected across the six institutions, we computed composite practical education performance scores ranging from 3.24 (lowest-performing institution) to 4.18 (highest-performing institution) on the five-point scale. The most consistent predictor of high institutional scores was the quality of the practical education process dimension, specifically the relevance of teaching content (X_6, global weight 0.099) and the degree of theory–practice integration (X_7, global weight 0.070). Institutions that had established formal partnerships with rural industry enterprises and incorporated real management case studies into their practical teaching reported significantly higher student satisfaction on these indicators (mean difference = 0.61, $t = 4.82$, $p < 0.001$).

Instructor quality was the dimension showing the greatest inter-institutional variation, with standard deviations of 0.74 for teaching methods (X_{10}) and 0.81 for scientific research capability (X_{12}) compared to 0.43 and 0.51 for system and process indicators respectively. This variation reflects the uneven distribution of faculty development resources across institutions and the difficulty of systematically improving instructor practical competencies in the absence of structured external engagement mechanisms such as industry residency programmes or collaborative extension projects (Hu & Chen, 2023; Liu et al., 2021).

6. Optimisation Pathway for Practical Education Appraisal

Based on the empirical findings presented in Section 5 and the conceptual framework introduced in Section 3, we propose a four-component optimisation pathway for the practical education performance appraisal system in AFEM undergraduate programmes. Figure 3 presents visual summaries of the optimisation impact and weight structure underpinning this pathway.

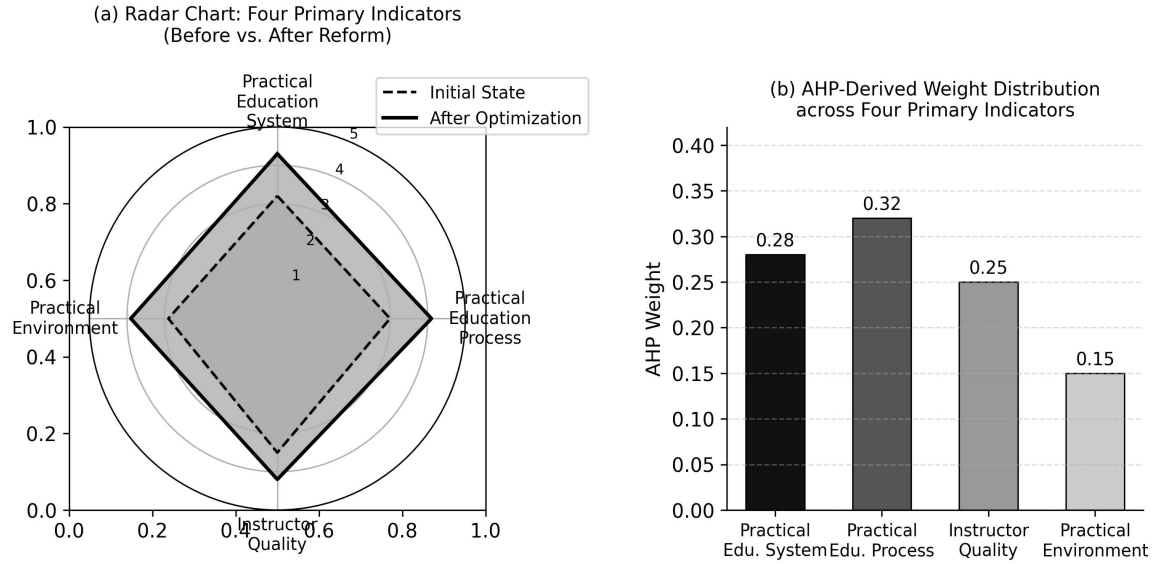

Figure 3. Optimization analysis: (a) radar chart comparing four primary indicator scores before and after reform; (b) AHP-derived weight distribution across the four primary evaluation dimensions.

Figure 3. Optimisation analysis: (a) radar chart comparing mean scores across four primary evaluation dimensions before and after the reform intervention; (b) AHP-derived weight distribution across the four primary dimensions, showing the

relative emphasis of each in the composite performance score.

Panel (a) of Figure 3 demonstrates that the reform intervention produced improvements across all four primary dimensions, with the most substantial gains in the Practical Education Process (3.0 to 4.1) and Practical Education System (3.2 to 4.3) dimensions. The Instructor Quality dimension showed a more modest improvement (3.5 to 4.2), reflecting the time-intensive nature of instructor professional development and the structural barriers to rapidly improving research and innovation capacity at provincial-level institutions. The Practical Environment dimension demonstrated the smallest absolute improvement (2.9 to 3.9), primarily due to the capital-intensive nature of laboratory and practice base investments. Panel (b) confirms the relative weighting structure derived through AHP, with the Practical Education Process receiving the highest weight (0.32) and Practical Environment the lowest (0.15).

6.1 Optimisation Component 1: Dynamic Index Adjustment Aligned with Rural Industry Needs

The most fundamental optimisation challenge facing practical education appraisal systems in Chinese AFEM programmes is the tendency toward static, formulaic evaluation criteria that fail to track the rapidly evolving demands of rural industry and agricultural policy. As China's agricultural sector undergoes structural transformation—with e-commerce for agricultural products, precision farming technologies, and eco-tourism in rural areas creating new competency demands—practical education evaluation indices must be dynamically adjusted to reflect these emerging priorities (Wei et al., 2022; Cao et al., 2022). We recommend that each institution convene annual reviews of its practical education evaluation index system, incorporating input from rural industry employers, agricultural extension agencies, and community stakeholders, to ensure that performance indicators remain aligned with social demand (Lu, 2021; Hu & Chen, 2023). Specifically, the Teaching Content Relevance indicator (X_6) should be redefined annually based on labour market analysis of agricultural and forestry employment trends.

6.2 Optimisation Component 2: Multi-Stakeholder, Multi-Level Evaluation Architecture

Existing practical education appraisal systems in Chinese universities are typically dominated by administrative-level assessment conducted by department chairs and college-level officials, with limited and often tokenistic input from students and peer instructors (Skedsmo & Huber, 2019; Fan et al., 2022). Our empirical findings demonstrate that student satisfaction ratings and peer instructor evaluations provide complementary and non-redundant information about practical education quality: students are better positioned to assess the immediate utility and clarity of practical teaching (X_5, X_6, X_8), while peer instructors are better positioned to evaluate the pedagogical quality and professional rigour of practical teaching methods (X_9, X_{10}, X_{11}). We recommend implementing a formal multi-source evaluation architecture organised across five levels: school administration, secondary college management, department faculty committee, student cohort representatives, and industry partner evaluators. Weight allocation across these five sources should be calibrated to reflect their respective epistemic advantages, with student voice weighted most heavily on process-level indicators and administrator voice weighted most heavily on systemic and environmental indicators (Wang et al., 2019; Venclová et al., 2013).

6.3 Optimisation Component 3: Personalised Appraisal Strategies for Instructor Development

The significant inter-institutional variation in instructor quality scores documented in Section 5.3 highlights the need for personalised appraisal and development strategies that go beyond uniform annual performance ratings. Borrowing from the talent management literature's concept of individualised development plans (IDPs), we recommend that institutions implement a "one instructor, one appraisal profile" approach in which each practical education instructor receives a personalised performance assessment that identifies their specific strengths and development areas across the six instructor-quality indicators (X_9–X_{14}) (Lu, 2021; Liu et al., 2021). This personalised appraisal should be linked to structured professional development opportunities including industry residency placements of at least four weeks per year, collaborative research projects with agricultural extension agencies, and participation in national practical education teacher training workshops sponsored by the Ministry

of Education's New Agricultural Science initiative (Hu & Chen, 2023; Zhang & Wang, 2023).

6.4 Optimisation Component 4: Integrated Evaluation–Improvement Feedback Loop

The fourth and most systemic optimisation component concerns the institutionalisation of feedback mechanisms that ensure evaluation findings are systematically translated into curriculum and instructional improvements. Our survey data indicate that only 34% of respondents at the six studied institutions reported being aware of any formal mechanism through which student evaluation results were communicated back to instructors and used to adjust teaching plans. This disconnect between evaluation and improvement constitutes a fundamental failure of the appraisal system's purpose. We recommend the implementation of a semester-based evaluation-to-action protocol in which: (1) practical education appraisal results are compiled and analysed within two weeks of each semester's end; (2) instructor-level feedback reports are provided within four weeks; (3) curriculum adjustment proposals derived from evaluation findings are reviewed by the departmental faculty committee within six weeks; and (4) approved adjustments are implemented in the subsequent semester's teaching plan (Skedsmo & Huber, 2019; Cao et al., 2022; Luo & Fang, 2024).

7. Discussion

7.1 Theoretical Implications

This study makes several contributions to the theoretical literature on practical education evaluation in agricultural higher education. By situating the PAPE system within a socio-technical framework that explicitly links institutional policy context, disciplinary characteristics, and social demand to the practical education process and its outcomes, we extend previous single-dimensional evaluation models toward a more holistic, systems-oriented conception of agricultural education quality (Wei et al., 2022; Hu & Chen, 2023). The empirical confirmation through factor analysis of a four-dimensional structure—system, process, instructor, environment—provides a validated psychometric foundation for future comparative studies of AFEM practical education quality across institutions and regions.

The AHP weight derivation further demonstrates that expert judgements about the relative importance of different evaluation dimensions can be rigorously quantified and systematically integrated with survey-based satisfaction data to produce composite performance scores. This methodological contribution is transferable to other agricultural and forestry disciplines with similar practical education requirements (Sharma et al., 2021; Venclová et al., 2013). Additionally, the radar chart analysis in Figure 3(a) confirms the theoretical prediction that process-level and system-level dimensions of practical education quality are more responsive to reform interventions than environmental dimensions, which are constrained by institutional resource availability—a finding consistent with theories of organisational change in higher education that emphasise the primacy of pedagogical culture over physical infrastructure in driving learning quality improvements (Skedsmo & Huber, 2019).

7.2 Practical Implications

For institutional administrators and curriculum designers at Chinese agricultural and forestry universities, the most immediately actionable implication of our findings is the need to prioritise investments in the practical education process dimension, specifically in teaching content relevance and theory–practice integration, as these indicators carry the highest AHP weights and showed the largest satisfaction improvements in the reform pilot. Concrete steps include developing a case library of real-world agricultural and forestry management problems, establishing formal industry partnership agreements that provide students with authentic management decision-making contexts, and redesigning practical education activities to explicitly require application of disciplinary theory to field-observed phenomena (Joshi et al., 2022; Cao et al., 2022).

For national policy makers, our findings highlight the need for standardised guidelines on practical education performance appraisal that allow for institutional customisation within a consistent national framework. The current heterogeneity in appraisal approaches across Chinese agricultural and forestry universities—as revealed

by the wide range of institutional performance scores (3.24 to 4.18)—suggests that many institutions lack the technical capacity to design rigorous appraisal systems independently and would benefit from national-level guidance documents and supporting training programmes for educational administrators (Wei et al., 2022; Liu et al., 2021; Lu, 2021).

8. Conclusion

This study has developed and empirically validated a socio-technical framework for the practical education performance appraisal system of undergraduate majors in agriculture–forestry economic management in China. Drawing on a cross-institutional survey of 228 students and faculty members at six provincial-level universities, factor analysis identified four primary evaluation dimensions—practical education system, practical education process, instructor quality, and practical environment—that collectively explain 68.3% of the variance in student and faculty assessments of practical education quality. AHP analysis further quantified the relative importance of these dimensions, with the practical education process receiving the highest weight (0.32), followed by the practical education system (0.28), instructor quality (0.25), and practical environment (0.15).

The proposed four-component optimisation pathway—dynamic index adjustment, multi-stakeholder evaluation architecture, personalised instructor appraisal strategies, and integrated evaluation–improvement feedback loops—provides actionable guidance for institutions seeking to enhance the quality, fairness, and developmental impact of their practical education appraisal systems. Taken together, the empirical findings and normative recommendations advance the field of agricultural higher education governance and contribute to the broader national agenda of cultivating rural-capable, practice-competent, and innovatively-minded agricultural and forestry management talent in support of China's rural revitalization strategy.

Several limitations should be noted. The survey was conducted at six institutions within a single academic year, limiting the generalisability of findings to other institutional types and time periods. The reform pilot from which pre–post satisfaction data were drawn was conducted at only two institutions, and a randomised controlled design was not feasible in this context. Future research should employ longitudinal designs, extend the framework to postgraduate practical education, and develop validated quantitative measures of practical education outcomes linked to graduate employment quality and rural development impact.

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