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How has the College of Agriculture and Natural Resources of Iran contributed to agricultural development over time?

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Abstract

The Third Mission has gained more attention worldwide in higher education but developing world universities face multiple entrenched barriers that prevent them from engaging with their communities. In Iran agricultural faculties still wrestle with building lasting partnerships with farming communities and the industrial sector. The aim of this research is to pinpoint, confirm and assess the elements of the Third Mission while also probing the long-standing gap that separates the Faculty of Agriculture and Natural Resources at the University of Tehran from the broader agricultural community using a longitudinal analysis that spans from 1992 to 2022. This study adopted a sequential exploratory mixed-methods approach. TM indicators were first identified via a three-round Delphi process involving 16 experts from academia, research, industry, and agriculture. In the second phase, six dimensions were validated through a 20-item questionnaire completed by 160 randomly selected faculty members (from a population of 232), with data analyzed using SmartPLS 3. Finally, a panel of 30 senior faculty members assessed TM performance over time using a 0–10 rating scale. Findings showed that during the second decade the overall Third Mission index rose by roughly 18 % only to ease back by about 2 % in the third decade. By contrast commercialization and entrepreneurial pursuits leapt by 63 % from the first to the third decade. That swing appears to signal a loosening of ties with the farming community even as market-oriented and entrepreneurial initiatives gain momentum. The validated model provides an empirical foundation for reshaping incentive structures and steering university policy toward sustainable agriculture and rural development.

Keywords: Delphi method, Knowledge transfer, Social impact, Third Mission, University–community engagement.

Introduction

Universities are more often called upon to pair their traditional roles of teaching and research with a steady quantifiable contribution to society—a duty that has been bundled under the banner of the Third Mission (TM) (Mancini et al., 2022). The Third Mission stresses that

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higher-education institutions should reach out to communities, industry partners and policy-makers turning scholarly insight into tangible social, environmental and economic benefits. Within this paradigm agricultural faculties claim a pivotal niche straddling the line between cutting-edge science and the gritty everyday of food networks, resource care and rural livelihoods (Atchoarena & Holmes 2005). Still across developing contexts—including Iran—the trajectory of agricultural higher education has long been haunted by a stubborn split, between scholarly production and what society calls for. While research output has risen the structures that channel findings into farming practice and rural development remain fragmented and poorly institutionalized (Izadi et al., 2022). Grasping the causes of this divide and charting ways to close it are essential, for repositioning Iran's universities as genuine engines of sustainable rural transformation (Shahsavari & Alamolhoda 2025). Historically Iran's agricultural education has been caught in a persistent tug-of-war between textbook theory and real-world farming needs. The Mozaffari School of Agriculture inaugurated in 1900 never succeeded in marrying its syllabus to the day-to-day challenges of cultivation as a result its alumni found themselves ill-equipped to translate classroom learning into field practice. After two graduating cohorts the school was compelled to shut its doors (Malek Mohammadi, 1983). Barzegaran Elementary School, established in 1917 also suffered from an absence of autonomy and a misalignment with the nation's agricultural agenda, which left many graduates unemployed and constrained sectoral growth; its thin focus on innovation and modern production methods only amplified these problems. The Karaj School of Agriculture that followed while conceived as a revenue-generating venture maintained minimal contact, with farming communities a shortfall rooted in curricular–competence inconsistencies (Iravani, 1992). When it was reshaped into the Higher School of Agriculture and Rural Industries in 1923 the institution took a decisive step toward genuine collaboration, launching exhibitions, extension programs and joint infrastructure projects that linked scholars, farmers and industry alike (Hosseini, 1991). The line of development reached its apex in 1940 with the founding of the Faculty of Agriculture and Natural Resources at the University of Tehran (FANRUT), which swiftly became the hub of agricultural higher education, in Iran.

Historically, the trajectory of agricultural education in Iran reveals the longstanding tension between academic knowledge and practical applicability. The Mozaffari School of Agriculture, founded in 1900, failed to link its curriculum to the realities of farming, leaving graduates unable to apply their knowledge in practice; after only two graduating classes, the

school was forced to close (Malek Mohammadi, 1983). The subsequent Barzegaran Elementary School (1917) likewise lacked scientific independence and coherence with national agricultural policy, resulting in graduate unemployment and limited sectoral growth; inadequate attention to innovation and modern production techniques exacerbated these limitations.The Karaj School of Agriculture that followed, though intended to generate revenue, maintained minimal interaction with farming communities due to curricular–competence inconsistencies (Iravani, 1992). Its 1923 rebirth as the Higher School of Agriculture and Rural Industries can be seen as a stride, toward substantive engagement; the institute promptly began staging exhibitions rolling out extension activities and co-authoring infrastructure undertakings that intertwined the worlds of academia, the farming community and commercial interests (Hosseini, 1991). The line of progression culminated in 1940, when FANRUT emerged, instantly positioning itself as the keystone of Iran's higher education landscape.

The way these institutions have evolved throws a spotlight on a dual-layered puzzle—both national and theoretical: how can agricultural faculties live up to their social mission when the prevailing incentives value academic metrics far more than community impact? Across the globe TM literature spins a tapestry of interpretations (from knowledge transfer and entrepreneurship to social responsibility and regional development) yet these frameworks differ markedly in scope and depth often zeroing in on the economic side of engagement while letting the civic and rural angles slip by. Generic TM models thus remain insufficiently attuned to the multifaceted relationships that agricultural faculties must maintain with farmers, cooperatives, primary schools, and small rural enterprises. In Iran, this conceptual and practical gap has been reinforced by decades of emphasis on quantitative expansion rather than qualitative responsiveness, a trajectory that has undermined the alignment between higher education outputs and rural needs (Tohidiyan Far & Rezaei-Moghaddam, 2024). Achieving genuine TM integration consequently demands not only structural reform but also a transformation in academic mindsets concerning what constitutes meaningful impact (Compagnucci & Spigarelli, 2020).

A string of crises—from mounting decline to tightening economic constraints—has deepened the pressure, on Iran's rural communities boosting expectations that agricultural faculties should adopt a more proactive development-focused role. Yet beyond a handful of isolated individual efforts organized and coordinated institutional responses have remained scarce (Izadi et al., 2022). Despite the normative importance of TM in higher education policy, no

systematic evaluation of FANRUT's third-mission performance over the past three decades has yet been undertaken. This absence of longitudinal assessment constitutes a significant knowledge gap, constraining both institutional learning and evidence-based policymaking. Accordingly, the present research asks: to what extent have the scientific outputs and engagement activities of FANRUT translated into measurable contributions to agricultural development and rural well-being in Iran?

FANRUT, as the country's oldest agricultural faculty, has historically served as a national benchmark for curriculum and research innovation. Yet activities related to its TM remain a secondary priority (Izadi, 2023). By quantifying indicators of university–community engagement and analyzing their trajectory across three successive ten-year intervals (1992–2022), this study constructs an empirical foundation for assessing institutional performance and identifying strategic levers to enhance the faculty's developmental role.

Conceptually, the article advances understanding by demonstrating why universal TM definitions (though valuable) do not adequately capture the realities of agricultural faculties embedded within heterogeneous rural systems. Empirically, it provides the first longitudinal, indicator-based assessment of TM implementation at FANRUT, directly addressing the gap identified by prior studies .Practically, it contributes to policy and institutional design by aligning TM principles with Iran's agricultural and rural development needs, emphasizing that qualitative alignment and mindset transformation are indispensable complements to structural reform.

The University's Third Mission (TM): Definitions, Historical Evolution, and Theoretical Context

Recent scholarship on education is increasingly viewing universities as having progressed through a succession of paradigms that reshape both their purpose and their practice. The earliest first-generation colleges were largely devoted to the transmission of the canonical body of knowledge whereas second-generation universities broadened their remit embracing systematic research and the drive, toward scientific advancement. The emergence of third-generation universities introduced a qualitatively new emphasis: the university's social mission, expressed through its ability to interact constructively with external stakeholders and generate tangible public value (Schneijderberg et al., 2021). This outward-facing orientation crystallized conceptually in Boyer's (1996) formulation of the Scholarship of Engagement, which defined knowledge not merely as an object of discovery but as a social instrument for

solving real-world problems. Later studies elaborated this vision, interpreting the TM as a form of practice-oriented innovation that transcends disciplinary silos and redefines academic excellence in terms of relevance and utility (Maximova et al., 2016; Tohidyan Far & Rezaei-Moghaddam, 2024).

Viewed analytically TM unfurls along two dimensions. The economic angle casts universities as drivers of competitiveness workforce development and knowledge commercialization (Pinheiro et al., 2017; Trencher et al., 2014). The social angle by contrast foregrounds their role, in community development, empowerment and civic participation (Mdleleni, 2022). Scholars refer to these backward and forward linkages reflecting how universities both respond to and shape societal needs. Together, they form the dual architecture through which engagement activities are conceptualized. Yet the balance between these linkages remains contested, particularly in disciplines where social and environmental externalities, rather than market exchange, define impact.

The agricultural sciences give a historically rich illustration of that duality. Tracing back the TM finds its beginnings in the Morrill Act of 1862 which created land-grant colleges across the United States to serve the nation's industrial needs (Mills & Cook 2023). The later Hatch and Smith-Lever Acts cemented cooperative-extension programs directly linking university research, with farmers and rural communities and in doing turned the ideal of the university as a civic partner into everyday practice. The record makes clear that agricultural education has, for ages functioned as a hub, for social involvement—turning research into real-world practice seeding local innovation systems and weaving universities tightly into regional economies. Boyer's (1997) reaffirmation of engagement as a core academic mission and later analyses of anchor institutions further positioned agricultural faculties as prototypes of universities that integrate teaching, research, and outreach in the pursuit of sustainable development (Gholamrezaei et al., 2010).

Analytical Developments in TM Frameworks

Subsequent scholarship has sought to codify TM through measurable indicators and conceptual models. Scoponi et al. (2016) proposed a tripartite framework encompassing knowledge sharing, physical infrastructure, and scholarly outputs to assess university economy linkages in Latin America's agricultural sector. Stretching the boundaries of that discussion Compagnucci and Spigarelli (2020) highlighted knowledge transfer, entrepreneurship, lifelong learning and social engagement, as interwoven pillars of a truly

comprehensive TM. Riding that wave Stolze and Sailer (2022) turned the spotlight on capability and leadership alignment sorting TM indicators into six overlapping domains that blend regional development, technological innovation and the cultivation of human capital. Recently Spanu et al. The 2024 study introduced an all-encompassing model that stitches together commitment, investment, education, stakeholder coordination and impact assessment. In contrast Dassoler et al. (2023) And Frondizi et al. (2019) Argued for embedding the Sustainable Development Goals, fostering collaboration and exerting greater policy influence. Rusciano (2024) highlighted initiatives, research income streams and civic-mission support, as strategic dimensions that should be woven into the institutional fabric.

Taken together, these studies reveal the diversification of TM measurement but also its fragmentation. The widespread use of indicators has not led to the development of a single taxonomy which unites economic and social measurement approaches. The majority of existing frameworks were created for industrial and technological environments which focus on commercialization and innovation metrics instead of community-based or rural development results. Despite the proliferation of indicators, there is no universally accepted taxonomy that reconciles economic and social orientations. Most frameworks have been designed for technologically intensive or industrial contexts and thus privilege commercialization and innovation-based metrics over community-driven or rural outcomes. For agriculture-focused institutions (where success often depends on tacit knowledge exchange, participatory learning, and environmental stewardship) such models capture only a fraction of engagement activity. Consequently, their direct transposition to settings like Iran risks both conceptual reductionism and empirical misfit.

Contextualization and Need for a Tailored Approach

In research scholars have long noted that the success of TM implementation hinges, on each country's institutional legacy and its broader socio-economic conditions (Izadi et al. 2025). Indicators that perform well in advanced innovation systems may lack validity in environments where universities are simultaneously expected to provide extension services, entrepreneurship training, and community education. As Göransson et al. (2009) and Molas-Gallart et al. (2002) argue, effective evaluation requires indicators that are simple, measurable, and reliable, yet adaptable to local governance structures. The Iranian case illustrates precisely this challenge: agricultural faculties operate within a policy environment

that has prioritized quantitative expansion of higher education over qualitative engagement with rural development needs. While TM frameworks exist globally, they rarely account for such institutional asymmetries or for the hybrid nature of faculties like FANRUT, which combine scientific research, professional training, and public extension.

Accordingly, a new study of FANRUT is warranted for three reasons. First, despite a century of agricultural higher education in Iran, no systematic attempt has been made to map how TM principles have evolved within this leading institution or to quantify their trajectory. Second, existing international indicators, though conceptually rich, do not adequately reflect the cultural, economic, and ecological specificities of Iran's agricultural sector. Third, empirical evidence from FANRUT can inform broader debates on how universities in developing contexts balance commercialization with social accountability. By situating the Iranian experience within global theoretical frameworks while recognizing its unique historical conditions, the present study contributes both to the refinement of TM theory and to the design of context-sensitive metrics for evaluating university–community engagement.

Research Methodology

This study employed a sequential exploratory mixed-method design consisting of three interlinked phases. The rationale for this design was to first identify and contextualize the core dimensions of the university's Third Mission (TM) through qualitative exploration, then validate these constructs quantitatively, and finally, assess their evolution over time within the Faculty of Agriculture and Natural Resources, University of Tehran (FANRUT). Each phase built directly upon the results of the previous stage to ensure methodological coherence and theoretical continuity.

Phase 1: Identification of Third Mission Indicators (Delphi Method)

The first phase aimed to extract and refine the conceptual and operational indicators of the TM within agricultural higher education in Iran. The Delphi method was chosen for its capacity to achieve consensus among experts with diverse yet complementary perspectives on university–community engagement.

A design and analysis panel composed of four senior academics from the Department of Agricultural Extension and Education and the Department of Agricultural Management and Development developed the Delphi protocol and supervised all analytical stages. The Delphi expert panel included sixteen individuals representing key stakeholder groups: nine faculty members from FANRUT, two researchers from the Agricultural Research and Education

Organization, two agricultural industry proprietors, and two progressive farmers. In this study, participants were selected based on criteria such as academic expertise, practical experience, sustained engagement with the university, and active involvement in outreach and development initiatives. This selection aimed to incorporate perspectives that reflect both theoretical and applied dimensions of university–community interaction, thereby enabling a more precise evaluation of Third Mission indicators.

Data were collected through semi-structured Delphi questionnaires conducted in iterative rounds. The first round comprised three open-ended questions exploring (1) expectations from university–community interactions, (2) indicators for evaluating TM performance, and (3) methods for assessing those indicators. Responses were thematically analyzed and categorized into provisional domains. During the ensuing cycles the categories were handed back to the participants, for confirmation and fine-tuning and this loop continued until the group reached a consensus. By weaving a literature review with stakeholder validation having two coders work independently and looping findings back to participants for feedback methodological rigor was kept on solid footing. This blend of approaches surfaced six TM dimensions, which then served as the conceptual scaffolding, for the quantitative phase.

Phase 2: Validation of Third Mission Constructs (Confirmatory Factor Analysis)

The second phase quantitatively validated the six TM dimensions identified in Phase 1. The statistical population comprised 232 faculty members across the Faculties of Agriculture and Natural Resources of the University of Tehran. After feeding the parameters into Cochran's formula, a floor of 145 participants emerged as the minimum. In practice we settled on 160 individuals, drawn by random sampling, from the university's official faculty registry thereby securing a broadly representative cohort.

The sample profile mirrored the demographics of the population: 41.6 % professors, 35.4 % associate professors and 22.4 % assistant professors; 96.9 % male and 2.5 % female with an average age of 53 years. This structure closely mirrored the composition of FANRUT's faculty body and thus strengthened the generalizability of the findings.

The research instrument was a 20-item questionnaire derived directly from the Delphi phase. Each TM indicator was translated into a set of measurable statements using participants' own phrasing and representative quotations. The instrument was reviewed by the Delphi panel to ensure content validity, and a pilot pretest with ten faculty members confirmed face clarity and reliability. Each item was measured on a five-point Likert scale ranging from very little

(1) to very much (5). The final questionnaire thus retained complete traceability to the qualitative findings of Phase 1.

The data were processed with SmartPLS v3. As Table 2 illustrates, the confirmatory factor analysis (CFA) substantiates both the reliability and the validity of the measurement model. Internal consistency was examined via Cronbach's alpha ($\alpha > 0.7$) and composite reliability ($CR > 0.7$) while an average variance extracted ($AVE > 0.5$) confirmed validity. We first secured validity with both the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio and the bootstrapped confidence intervals showed every HTMT value stayed beneath the 0.90 cutoff. The SRMR dropped below the 0.08 threshold signalling a fit while the R^2 and Q^2 statistics both pointed to strong predictive relevance, for the latent constructs. Every factor loading pushed past 0.7 attesting to the reliability of the indicators.

Phase 3: Longitudinal Evaluation of FANRUT's Third Mission Performance

The third phase examined how FANRUT's TM activities evolved over three decades (1991–2021). In contrast to Phase 2's breadth-oriented survey, this stage prioritized depth, experience, and temporal coverage. Thus, a purposive expert panel of 30 senior faculty members was formed, representing individuals who had personally participated in TM-related initiatives since the university's formative years. Participants were born between 1940 and 1958, and entered academic service between 1972 and 1988 spanning both the pre- and post-revolutionary decades. Their continuous professional involvement in teaching, research, and extension programs positioned them as institutional memory-holders, capable of providing historically grounded assessments of FANRUT's engagement with its surrounding communities. The purpose of this phase was therefore interpretive rather than inferential: to analyze the lived experience of internal actors and identify structural enablers and barriers to TM realization over time.

Each participant assessed FANRUT's performance on the six validated TM indicators for three distinct ten-year periods (1991–2001, 2001–2011, and 2012–2021) using a 0–10 rating scale. To enhance objectivity, individual evaluations were complemented by group discussions that allowed clarification and cross-validation of responses. Kendall's coefficient of concordance (W) was computed to verify inter-rater agreement, which indicated high internal consistency among expert judgments. Subsequently the Friedman test—a technique appropriate, for repeated ordinal data—was employed to uncover any statistically significant changes over time. While the sample size was modest the criterion-based selection ensured

that the seasoned informants were included, making it possible to conduct a thorough and credible longitudinal analysis of institutional transformation. This phase thus complemented the broader quantitative findings with historically rich insights into the evolution of FANRUT's TM performance.

The three phases of the research were designed to be methodologically interdependent. The Delphi method (Phase 1) identified context-specific TM indicators; these were operationalized into measurable constructs in the CFA (Phase 2) and subsequently evaluated longitudinally in Phase 3. Each phase validated and deepened the previous one—ensuring both construct validity and temporal interpretive depth. This integrative design not only triangulated data sources (experts, faculty, and historical actors) but also provided a coherent empirical foundation for understanding how the TM of FANRUT has developed, stabilized, and, in certain aspects, regressed over time.

Results and discussion

Table 1 summarizes six dimensions that operationalize the Third Mission (TM) at the Faculty of Agriculture and Natural Resources, University of Tehran (FANRUT): (1) collaborative research and consulting, (2) commercialization of facilities and entrepreneurial activities, (3) meeting graduates' educational needs and career guidance, (4) working in primary schools and training future farmers, (5) networking and public communication with tacit knowledge exchange and non-academic publications, and (6) facilitating and extension of micro and small agricultural and rural businesses. These indicators translate the broad theoretical framework of TM into practice-specific categories suited to Iran's agricultural higher education. They correspond to the dual structure discussed in the literature economic-backward linkages that promote competitiveness and knowledge transfer (Pinheiro et al., 2017; Trencher et al., 2014) and social-forward linkages that enhance civic participation and community empowerment (Mdleleni, 2022).

The first, second, and sixth dimensions in Table 1 embody the economic orientation of TM. "Collaborative research and consulting" aligns with the Land-Grant Colleges ethos, where knowledge production is directed toward practical problem-solving through partnerships with executive agencies and industries (Mills & Cook, 2023). This dimension captures Boyer's (1996) notion of the *scholarship of engagement*, positioning research as an instrument for societal development rather than as an isolated academic pursuit. "Commercialization and entrepreneurial activities" reflect the trend noted by Compagnucci and Spigarelli (2020),

where economic imperatives increasingly dominate university missions. Yet, in the Iranian context, commercialization through services such as soil laboratories and spin-off companies also compensates for public funding shortages, showing how local conditions reshape global TM patterns. The sixth dimension (facilitating micro and small rural businesses) illustrates hybrid engagement, combining economic and social purposes through informal training and support for community-based enterprises, consistent with Izadi et al. (2025).

The third, fourth, and fifth dimensions express TM's social orientation. "Graduate education and career guidance" respond to Tohidiyan Far and Rezaei-Moghaddam's (2024) critique that Iranian higher education emphasizes quantitative expansion over qualitative responsiveness. "Primary school and training," echoing Atchoarena and Holmes (2005), introduces agricultural literacy at early educational stages, echoing the cooperative extension legacy of U.S. land-grant Colleges (Morrill and Smith-Lever Acts). "Networking and public communication," as emphasized by Dubb and Howard (2012), reinforces two-way knowledge exchange through community media and non-academic outputs, bridging the gap between formal research and local practice. Together, the six TM dimensions in Table 1 demonstrate how FANRUT's engagement framework both parallels and diverges from international experiences. While economic linkages reflect global patterns of market-oriented universities, the social dimensions highlight efforts to localize TM by embedding it within Iran's rural development context. This alignment between theory and context provides the analytical foundation for interpreting FANRUT's longitudinal TM performance in subsequent results.

Table1. Indicators of the TM in the FANRUT.

Core coding	Primary Coding
Collaborative research and consulting	- Research as the most effective tool for engaging with society. - Providing innovative solutions to the problems of various organizations - Establishing joint think tanks with various organizations. - Conducting research with executive organizations in the country.
Commercialization of facilities and entrepreneurial activities	- Generating revenue from university facilities, such as the faculty's soil laboratory. - Creating spin-off companies within the educational group as a performance metric. - Positioning the faculty within the agricultural entrepreneurship ecosystem.
Meeting the educational needs of graduates and career guidance	- The existence of educational programs for faculty graduates. - Maintaining connections with graduates and providing career. - Networking with alumni and offering career counseling. - Fostering entrepreneurial activities after students' graduate.
Working in primary schools and training future farmers	- Collaboration between faculty and elementary schools in agricultural outreach. - Attracting talented students to the field of agriculture and encouraging their involvement with the faculty. - Teaching agriculture to elementary school students
Networking and public communication with tacit knowledge exchange and non-academic publications	- Outreach to the community by faculty members using community media. - Acquainting the agricultural community with the faculty's research activities through an up-to-date database. - Introducing faculty members and students to the agricultural community, highlighting their expertise
Facilitating and extension of micro and small agricultural and rural businesses	- Providing informal training to farmers and agricultural enthusiasts by the faculty - Accompanying farmers and villagers in establishing agricultural businesses - Developing and promoting agricultural tourism on campus and in rural areas

Assessing the measurement model using Confirmatory Factor Analysis

Table 2 presents the reliability and validity statistics for the six constructs constituting the Third Mission (TM) framework at the Faculty of Agriculture and Natural Resources, University of Tehran (FANRUT). The extracted average variance (AVE), composite reliability (CR), factor loading ranges, and Cronbach's alpha values confirm strong internal consistency and convergent validity across all constructs. AVE values exceed the 0.5 threshold, and CR coefficients surpass 0.8 for all dimensions, establishing that the measurement instrument accurately captures the underlying engagement constructs. These results substantiate that the six dimensions (outlined earlier in Table 1)represent empirically distinct yet theoretically interrelated components of the TM.

The high reliability values for "Collaborative research and consulting" (AVE = 0.760, CR = 0.913, α = 0.839) confirm the coherence of this construct in measuring research-based engagement. The strong factor loadings (0.713–0.881) indicate that the items (such as joint projects and think tanks with executive organizations) are consistent expressions of boundary-spanning collaboration.

The construct "Commercialization of facilities and entrepreneurial activities" records the highest reliability (AVE = 0.938, CR = 0.973, α = 0.967), reflecting the robustness of this

dimension. Such exceptional consistency suggests that, within FANRUT, income-generating uses of facilities and entrepreneurial spin-offs are well-understood and practiced indicators of institutional engagement. The social engagement constructs show sufficient validity in their measurement. Higher education institutions must address the needs of their graduates through effective career guidance as shown by the AVE of 0.690 and CR of 0.904.

"Working in primary schools and training future farmers" (AVE = 0.616, CR = 0.777) shows the lowest but still acceptable reliability, likely reflecting the marginal institutionalization of school outreach within Iranian faculties. The strong performance of "Networking and public communication" (AVE = 0.715, CR = 0.867) affirms the emergence of non-academic dissemination as a credible TM channel.

Finally, "Facilitating micro and small rural businesses" exhibits robust reliability (AVE = 0.789, CR = 0.863, α = 0.859), underscoring the faculty's role in rural enterprise support.

Table 2. Reliability and validity of research instrument questions.

Construct	The number of questions	Cronbach's alpha	Factor load range	Composite reliability (CR)	Extracted average variance (AVE)
Indicators constitute the TM of the FANRUT					
Collaborative research and consulting	4	0.839	0.713-0.881	0.913	**0.760**
Commercialization of facilities and entrepreneurial activities	3	0.967	0.760-0.825	0.973	**0.938**
Meeting the educational needs of graduates and career guidance	4	0.860	0.761-0.952	0.904	**0.690**
Working in primary schools and training future farmers	3	0. 719	0.899-0.932	0.777	**0.616**
Networking and public communication with tacit knowledge exchange and non-academic publications	3	0.803	0.748-0.909	0.867	**0.715**
Facilitating and extension of micro and small agricultural and rural businesses	3	0.859	0.857-0.907	0.863	**0.789**

The diagonal values (√AVE) amount to 0.872 for Collaborative research and 0.969 for Commercialization and 0.888 for Facilitating/extension and 0.845 for Networking-public communication and 0.785 for Primary-school future farmers and 0.831 for Graduates/career. By construction, each diagonal should exceed the corresponding off-diagonal correlations; This criterion is met uniformly throughout the matrix. Substantively, this means each Third Mission (TM) construct in Table 1 captures something specific that is not better explained by another dimension.

The HTMT side (left block) demonstrates which constructs have the most similar practical applications. The largest ratio appears between Commercialization and Facilitating/extension (0.460). This makes sense conceptually: using laboratories and services to generate revenue, and accompanying micro/small rural businesses, are contiguous economic engagement modes. The smallest ratios exist between Collaborative research vs Graduates/career (0.112) and Networking/public communication vs Facilitating-extension. The faculty demonstrates low values because it generates boundary-spanning knowledge for outside stakeholders while developing human capital for alumni and conducts distinct activities for civic communication-tacit exchange and enterprise accompaniment.

Table 3. Results of Diagnostic Validity with Fornell and Larcker Criteria and Heterotrait-Monotrait Ratio (HTMT).

	Heterotrait-Monotrait Ratio						Fornell and Larcker					
Indicators	Collaborative research	Commercialization of facilities	Facilitating and extension	Networking and public communication	Working in primary schools	educational needs of graduates	Collaborative research	Commercialization of facilities	Facilitating and extension	Networking and public communication	Working in primary schools	educational needs of graduates
Collaborative research							**0.872**					
Commercialization of facilities	0.322						0.308	**0.969**				
Facilitating and extension	0.282	0.460					0.254	0.424	**0.888**			
Networking and public communication	0.369	0.418	0125				0.336	0.386	0.280	**0.845**		
Working in primary schools	0.292	0.432	0.346	0.272			0.226	0.287	0.289	0.232	**0.785**	
educational needs of graduates	0.112	0150	0.125	0.148	0.169		0.032	0.386	0.099	0.392	0.144	**0.831**

Examining the status of the TM in the FANRUT over time

Table 4 sketches a juxtaposition of FANRUT's Third Mission (TM) indicators, over three contiguous decades—1992–2002, 2003–2012 and 2013–2022—subjected to scrutiny via Friedman's test. The analysis uncovers significant temporal shifts, in four of the six TM dimensions—collaborative research and consulting ($\chi^2 = 3.98$; $p = 0.04$) commercialization of facilities and entrepreneurial activities ($\chi^2 = 6.92$; $p = 0.03$) networking and public communication ($\chi^2 = 10.56$; $p = 0.005$) and graduate education and career guidance ($\chi^2 = 8.13$; $p = 0.01$)—and the composite TM index itself also registers a significant change ($\chi^2 = 8.53$; $p = 0.01$). Although facilitating micro and small rural businesses and primary-

school outreach did not show statistically significant differences, their mean ranks increased slightly, suggesting incremental but inconsistent engagement. During the first ten years of the second decade universities established official partnerships with industry through which they pursued global mission-driven research initiatives and collaborative research and consulting activities expanded (Boyer, 1996; Compagnucci & Spigarelli, 2020). The third decade shows a minimal decrease in mean scores at 14.70 which suggests that these positive results did not persist because of nationwide research funding problems and academic reward systems that lost their connection to practical applications according to Tohidiyan Far and Rezaei-Moghaddam (2024).

The most pronounced improvement occurs in commercialization of facilities and entrepreneurial activities (mean rising from 4.43 to 7.23). This pattern reflects the international tendency identified by Mancini et al. (2022) toward economic valorization of university assets. Yet, consistent with the literature's critique of over-commercialization, this growth seems to have occurred without a proportional enhancement of civic or rural impact indicating what Campanacci and Spiragli (2020) call a structural imbalance between economic and social missions.

The statistically significant fluctuation in networking and public communication underscores changing levels of institutional openness. Its peak in the third decade (average rank = 2.34) likely results from digital expansion and informal outreach initiatives, resonating with Dubb and Howard's (2012) assertion that non-academic communication platforms are central to university–community interaction. Similarly, the improvement in graduate guidance confirms progress in the human-capital dimension of TM, aligning with the call for qualitative responsiveness in Iranian higher education (Tohidiyan Far & Rezaei-Moghaddam, 2024).

Conversely, primary-school outreach and support for rural microenterprises remain statistically static, reflecting the enduring weakness of forward-linkage engagement noted by Atchoarena and Holmes (2005). Together, these findings depict a TM profile biased toward economic indicators (consistent with global patterns) but still underdeveloped in socially embedded, grassroots engagement. The significant improvement of the composite TM index ($p = 0.01$) confirms overall progress, but the uneven distribution across dimensions highlights the need for institutional strategies that reconcile commercialization success with the broader social mission envisioned in the original TM framework.

458 **Table 4.** The results of examining differences in indicators of TM in the three courses using
459 Friedman's test.

Indicators	Triple courses	Mean	Average rank	Degrees of freedom	Chi-square	Significance level
Collaborative research and consulting	The first ten-year period	13.33	1.73	2	3.98	0.04*
	The second ten-year period	15.83	2.22			
	The third ten-year period	14.70	2.05			
Commercialization of facilities and entrepreneurial activities	The first ten-year period	4.43	1.73	2	6.92	0.03*
	The second ten-year period	5.33	2.0			
	The third ten-year period	7.23	2.25			
Facilitating and extension of micro and small agricultural and rural businesses	The first ten-year period	6.73	1.28	2	3.80	0.15
	The second ten-year period	7.73	2.20			
	The third ten-year period	7.56	1.98			
Networking and public communication with tacit knowledge exchange and non-academic publications	The first ten-year period	5.63	1.73	2	10.56	0.005**
	The second ten-year period	6.56	1.93			
	The third ten-year period	6.13	2.34			
Education of future farmers and activity in primary schools in three courses	The first ten-year period	4.63	1.84	2	1.41	0.49
	The second ten-year period	5.13	2.07			
	The third ten-year period	5.16	2.09			
Meeting the educational needs of graduates and guiding them in their careers	The first ten-year period	5.07	1.64	2	8.13	0.01*
	The second ten-year period	6.39	2.13			
	The third ten-year period	6.70	2.23			
The TM of the FANRUT in general	The first ten-year period	43.50	1.58	2	8.53	0.01*
	The second ten-year period	51.40	2.30			
	The third ten-year period	50.33	2.12			

460 $p<0.05$ * $p\leq0.01$**

461

462 ## Conclusions

463 The research draws attention to an imbalance that separates the economic and social strands
464 of the TM at the Faculty of Agriculture and Natural Resources, University of Tehran
465 (FANRUT). Over the span of three decades the modest inroads made in commercialising
466 research and in building ventures have not been paralleled by comparable strides in
467 community-oriented developmental activities. Such a lopsided trajectory resists attribution, to
468 institutional inertia; it is rooted in deeper structural, cultural and policy-level dynamics
469 embedded within Iran's higher-education framework. At the level the incentive structure stays
470 stubbornly narrow. Promotion guidelines keep rewarding publication counts and grant dollars
471 leaving almost no space to acknowledge outreach, participatory research or
472 community-driven innovation. That bias nudges scholars toward a sort of individualism,
473 where engagement projects surface sporadically and often feel disconnected from the
474 institution's larger aims. On a systemic scale the highly centralized governance of higher

education reins in faculties' latitude to shape their activities, around regional and local priorities. National policy, still largely fixated on quantitative expansion has not devoted adequate resources to the qualitative mechanisms that could tether universities to the rhythms of rural development the fabric of farmer networks or the spark of local entrepreneurship. The combined effect of these oversights has entrenched a kind of isolation, where scientific breakthroughs coexist with a surprisingly faint echo, in society.

In comparative perspective, FANRUT's experience reflects an international trend described in the TM literature: the growing weight of economic linkages (consultancy, commercialization, and technology transfer) relative to the social and civic functions of universities (Pinheiro et al., 2017; Compagnucci & Spigarelli, 2020). Agricultural faculties, however, are distinct in their potential to mediate both sides of this equation. The worth of these initiatives depends on their success to create marketable knowledge and develop human and social capital which enables rural economic sustainability. The research shows that internal incentive systems require modification, and institutions need expanded freedom to fulfill their dual responsibility completely.

A more coherent approach is therefore required. Policy reform should begin by embedding TM performance indicators within national evaluation and funding frameworks. The university requires an intermediate governance unit to oversee TM initiatives while it connects faculty engagement targets to their work responsibilities and builds enduring relationships with outside organizations. The operational level achieves its goals through practical programs which establish rural entrepreneurship networks run by alumni and formal partnerships between the university and primary schools to provide tangible community benefits. The organization can achieve rural transformation through these strategic yet limited measures which establish a permanent system of change. In essence, the evolution of TM at FANRUT demonstrates that the university's societal role cannot depend on goodwill alone. It requires an enabling policy framework, supportive institutional culture, and deliberate integration of teaching, research, and outreach. Strengthening these foundations would not only revitalize FANRUT's historical mission but also provide a model for agricultural faculties across developing contexts seeking to link scientific knowledge with equitable and sustainable rural development.

For Future Studies

For Future Studies Future studies need to determine which factors result in TM activity success or failure while developing methods to assess TM indicators through qualitative evaluation. The initiative will serve as a vital tool to boost faculty social engagement while solving problems that affect agricultural stakeholders and their partners.

References

1. Atchoarena, D., & Holmes, K. (2005). The role of agricultural colleges and universities in rural development and lifelong learning in Asia. A*sian Journal of Agriculture and Development*, 2(1), 17–32. https://ageconsearch.umn.edu/record/165777.
2. Boyer, E. L. (1996). The scholarship of engagement. Bulletin of the American Academy of Arts and Sciences, 49(7), 18-33.
3. Compagnucci, L., & Spigarelli, F. (2020). The third mission of the university: A systematic literature review on potentials and constraints. *Technological Forecasting and Social Change*, *161*, 120284. DOI:10.1016/j.techfore.2020.120284.
4. Dassoler, F. E., Trierweiller, A. C., Ferenhof, H. A., Konrath, A. C., & Vincenzi, S. L. (2023). Indicators of the third university mission: Perspectives to measure universities contributions to society. *Educação em Revista*, *39*, e36619. DOI:10.1590/0102-469836619t.
5. Dubb, S., & Howard, T. (2012). Leveraging anchor institutions for local job creation and wealth building. *Big Ideas for Job Creation*, 04-12. Chicago, IL: ProGov21.
6. Fornell, C., & Larcker. D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50. http://doi.org/10.12691/jbms-9-4-2
7. Frondizi, R., Fantauzzi, C., Colasanti, N., & Fiorani, G. (2019). The evaluation of universities' third mission and intellectual capital: Theoretical analysis and application to Italy. *Sustainability*, *11*(12), 3455. DOI:10.3390/su11123455.
8. Gholamrezaei, S., Movahed Mohammadi, H., Asadi, A., & Hosseini, M. (2010). Strengthening mechanisms of university outreach function in Iran's agricultural extension system. *Iranian Agricultural Extension and Education Journal*, 5(2), 45-56. https://sid.ir/paper/109299/en.

9. Göransson, B., Maharajh, R., & Schmoch, U. (2009). New activities of universities in transfer and extension: Multiple requirements and manifold solutions. *Science and public policy*, 36(2), 157-164. http://dx.doi.org/030234209/10.3152X406863.
10. Hosseini, S. M. (1991). Faculty development needs and preferred developmental strategies as perceived by faculty members of Iranian agricultural colleges. Cornell University.
11. Iravani, H. (1992). *The History of Agricultural Education and Extension in Iran*. Mashhad Publishing. First Edition.
12. Izadi, H. (2023). Explaining Strategies and Mechanisms of Engagement in College of Agriculture and Natural Resources of Tehran University with the Community in Transition towards Third Generation University (Unpublished Master's thesis). College of Agriculture and Natural Resources, University of Tehran, Department of Agricultural Extension and Education.
13. Izadi, H., Hoseini, M., Asadi, A and Alambeigi, A. (2022). Development of indicators and criteria for measuring the Third Mission of the University in the fields of agriculture and natural resources. *Iranian Journal of Agricultural Education and Extension,* 18(3), 45–60. https://itvhe.areeo.ac.ir/article_127040_en.html.
14. Izadi, H., Hoseini, M., & Rezaei Moghaddam, K. (2025). Exploration of the conceptualization of the third mission of agricultural colleges: A qualitative meta-synthesis study. *Journal of Higher Education Outreach and Engagement*, *In press*.
15. Malek Mohammadi, A. (2007). *Agricultural and Natural Resources Extension and Education, Volume 1: Evolutionary Trend*. University Publication Center. Third Edition.
16. Mancini, M. C., Arfini, F., & Guareschi, M. (2022). When higher education meets sustainable development of rural areas: Lessons learned from a community–university partnership. *Social Sciences,* 11(8), 338. https://www.mdpi.com/2076-0760/11/8/338
17. Maximova, O., Belyaev, V., Laukart-Gorbacheva, O., Nagmatullina, L., & Hamzina, G. (2016). Russian education in the context of the third-generation universities' discourse: Employers' evaluation. *International Journal of Environmental and Science Education*, 11(16), 9101-9112.
18. Mdleleni, L. (2022). University as a vehicle to achieve social innovation and development: Repositioning the role of the university in society. *Social Enterprise Journal*, 18(1), 121-139. http://dx.doi.org/10.1108/SEJ-10-2020-0093.

19. Mills, D. B., & Cook, K. S. (2023). History and Purpose of Higher Education. *Educational Principles and Practice in Veterinary Medicine*, 471-478.
20. Molas-Gallart, J., Salter, A., Patel, P., Scott, A., & Duran, X. (2002). Measuring third stream activities. Final report to the Russell Group of Universities. Science and Technology Policy Research (SPRU), University of Sussex. Brighton (UK).
21. Pinheiro, R., Karlsen, J., Kohoutek, J., & Young, M. (2017). University's third mission: Global discourses and national imperatives. *Higher Education Policy*, 30(3), 367-385. http://dx.doi.org/10.1057/s41307-017-0057-5.
22. Rusciano, R. (2024). The strategic role of the third mission in universities: A concrete case study. *ESI Preprints*, *20*(16), 1-1. DOI:10.19044/esj. 2024.v20n16p1.
23. Schneijderberg, C., Broström, A., Cavalho, T., Geschwind, L., Marquina, M., Müller, L., & Reznik, N. (2021). Academics' societal engagement in the humanities and social sciences: A generational perspective from Argentina, Germany, Portugal, and Sweden. *Higher Education Policy*, 34(1), 42-65. http://dx.doi.org/10.1057/s41307-020-00218-6.
24. Scoponi, L., Fernandes Pacheco Dias, M., Pesce, G., Schmidt, M. A., & Gzain, M. (2016). Cooperación Académica en Latinoamérica para la Innovación en los Agronegocios. *Journal of technology management & innovation*, *11*(2), 111-120.
25. Shahsavari, A., & Alamolhoda, J. (2025). When the university desires, but society refuses: A case study of universities' missions in the context of contribution to development. *Studies in Higher Education*. https://www.tandfonline.com/doi/abs/10.1080/03075079.2025.2461270
26. Spanu, P., Ulmeanu, M. E., & Doicin, C. V. (2024). Academic third mission through community engagement: An empirical study in European Universities. *Education Sciences*, *14*(2), 141. DOI:10.3390/educsci14020141.
27. Stolze, A., & Sailer, K. (2022). Advancing HEIs' third mission through dynamic capabilities: The role of leadership and agreement on vision and goals. *The Journal of Technology Transfer*, *47*(2), 580-604. DOI: 10.1007/s10961-021-09850-9.
28. Tohidiyan Far, S., & Rezaei-Moghaddam, K. (2024). SWOT analysis of agricultural colleges for entrepreneurship: Delphi-fuzzy and fuzzy hierarchical application. *Education + Training*. http://doi.org/10.1108/ET-09-2023-0397.
29. Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N., & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation

for sustainability. *Science and Public Policy*, 41(2), 151-179. DOI:10.1093/SCIPOL/SCT044.

دانشکده کشاورزی و منابع طبیعی ایران در طول زمان چگونه به توسعه کشاورزی کمک کرده است؟

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چکیده

ماموریت سوم دانشگاه یا تعامل بین دانشکده کشاورزی و منابع طبیعی دانشگاه تهران با جامعه کشاورزی ضعیف است. این نگرانی وجود دارد که نقش افرینی محدود این دانشکده در دنیای واقعی کشاورزی پایان این دانشکده را رقم بزند. فقدان تعریفی روشن و معیارهای دقیق برای ارزیابی آن، توسعه این ماموریت را دشوار می‌سازد. این پژوهش، با بهره‌گیری از استراتژی اکتشافی متوالی، به بررسی تحولات ماموریت سوم در دانشکده طی سه دهه اخیر (1371-1401) می‌پردازد. در این پژوهش های از روش کیفی و کمی شامل تکنیک دلفی، تحلیل عاملی تاییدی و ازمون فریدمن بهره گرفته شده است. هدف این تحقیق شناسایی، تأیید و ارزیابی این ماموریت در این دانشکده است. یافته‌ها، شش حوزه اصلی ماموریت سوم را آشکار می‌سازند: پژوهش‌های مشارکتی و مشاوره؛ تجاری‌سازی امکانات و فعالیت‌های کارآفرینی؛ پاسخگویی به نیازهای آموزشی دانش‌آموختگان و هدایت شغلی؛ همکاری با مدارس ابتدایی و تربیت کشاورزان آینده؛ شبکه‌سازی و ارتباطات عمومی با تبادل دانش ضمنی و انتشارات غیرآکادمیک؛ تسهیل و توسعه کسب‌وکارهای خرد و کوچک کشاورزی و روستایی. تحلیل‌ها نشان می‌دهند که این دانشکده تا حدودی منزوی بوده و همکاری محدودی با جوامع کشاورزی و روستایی دارد. به طور کلی شاخص های ماموریت سوم، طی سه دهه گذشته کاهش یافته‌اند. با این حال، مشارکت دانشکده در انجام پژوهش با صنعت و گسترش شرکت‌های دانش‌بنیان مرتبط با کشاورزی بهبود داشته است. این پژوهش می‌تواند به ارزیابی ماموریت سوم در دانشکده‌های کشاورزی و بهبود سیاست‌های آموزش عالی کمک کند و منجر به ایفای نقش پررنگ‌تر دانشکده های کشاورزی در توسعه پایدار کشاورزی شود.