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Is agricultural education industry ready? Review of skill set interface and curriculum strategies

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Abstract

This study reviewed the reorientation of the agricultural education curriculum to address the evolving demands of the modern agricultural industry to ensure workforce readiness. The paper highlighted a mismatch between current agricultural curricula and industry requirements, emphasizing the personal and technical skills. This review was conducted on three key aspects including skill matching, curriculum strategies, and case studies related to agricultural education reform. It emphasized the growing importance of personal skills including soft skills, entrepreneurship skills, communication and interpersonal skills, while technical skills encompass proficiency in precision agriculture, data analysis and IOT and climate smart agricultural skills. This study highlighted that curriculum reform must focus on competency and outcome-based educational approaches to equip practical and industrial relevant skills. The study examined policy orientation and curriculum strategies, including case studies from India, to provide evidence-based recommendations for aligning agricultural education with industry readiness and addressing the significant skill gap facing agricultural graduates. Together, these aspects provide a comprehensive understanding of agricultural education systematically reoriented to develop industry ready graduates equipped with relevant skills required for evolving agricultural sector.

Keywords: Mapping, skillsets, agricultural graduates, curriculum, Agri – Industries

Introduction

The world population is expected to grow by two billion people by 2050, bringing the total to 9.7 billion. This implies that the world will require more food ^[32]. This rapid population explosion drives the creation and adoption of new technology, holds enormous job opportunities, and intensifying demand for skilled agricultural professionals across the various agricultural sectors ^[9,16,22]. The employers look forward to some set of skills from agricultural graduates in alignment with the various sub-sectors within agriculture. Agricultural graduates require cognitive skills for better decision making, technical skills for handling various implements and interpersonal skills for the exchange of farm related information ^[6].

In the contemporary job market, there is a need to strengthen the agricultural curriculum to enhance the human resources in agricultural sector through two educational approaches viz., Competency Based Education and Outcome – Based Education. This integration enables students to develop higher-order skills and refine their competencies throughout the academic journey ^[26].

According to the World Economic Forum's *Future of Job Report 2025* ^[33], it is predicted that by 2030, 39 percent of today's skills will be outdated, 40 percent of skills will be new or evolving, and 59 percent of workers will need

training to stay relevant to the sector. This underscores the growing needs for technical and human-centric skills in the future workforce. But the common challenge faced by graduates is securing the right job in their domain area. This situation is primarily due to students being forced to learn, and they are not focused on practical oriented skills during their academic period which leads to a mismatch between industry requirements and students acquired skills through agricultural curriculum. In the meantime, skill mapping and matching is the most significant problem for policy makers, academicians and graduates.

To align this gap, the New Education Policy (NEP) 2020 focused on aligning the skills towards the industrial requirement in the agricultural curriculum. This study aimed to review skillset requirements, curriculum strategies, and policy orientation for reorienting agricultural education towards industry readiness.

Methodology

This paper was based on a review of peer-reviewed research articles, policy documents, institutional reports, and international publications. The studies were published between 2010 and 2025 and addressed skill requirements, and skill improvement strategies in the agricultural education curriculum included in this review. The literature

was sourced from academic databases such as Google Scholar, Scopus, Web of Science, and ResearchGate. It is based on secondary data from various documentary evidence presented in a structured and thematic manner, supported by tables and comparative frameworks, to highlight the gaps and best practices in curriculum reorientation.

Skillset mapping in agricultural education

Skillset mapping is defined as the systematic identification, categorization, and assessment of competencies required for effective job performance in contemporary agriculture. This comprehensive literature review examines the current state of skills required for agricultural graduates by synthesizing evidence from competency frameworks. Diverse skills have been classified by various researchers.

1. Personal skillsets:

Personal skills encompass a range of skills that enable individuals to navigate personal and social interactions and to function effectively in the workplace. These skills beyond technical skills, help graduates work well with others, adapt to change, and manage their responsibilities. Agricultural graduates are expected to possess personal skills that enhance their employability. Some research has shown significant emphasis on personal skills when hiring to effectively interact, communicate, and collaborate with others in the workplace. For agricultural graduates to possess the personal skills that increasingly involve collaboration and enhance their technical skills, they should be enabled to be involved in and solve real-world problems, which improves their technical knowledge. Shivamurthy *et al.* (2023)^[28] revealed that 12 broad areas of skills and competencies are essential for agricultural extension professionals, with soft skills ranked first, followed by entrepreneurship development and communication skills. Team building skills, communication skills and interpersonal competencies enable extension workers to facilitate multi-stakeholder processes effectively^[8]. The ability to engage diverse stakeholders, build relationships of trust, and influence farmer clients represents essential skills needed for modern extension advisory roles^[14]. Entrepreneurial development skills encompass multiple dimensions, including business planning, financial management, market access and innovation implementation^[28]. Surono (2025)^[30] stated that agricultural extension curricula must integrate entrepreneurial education to prepare graduates for self-employment opportunities and business development in agricultural sector. Financial literacy and resource management capabilities are critical components of business competence. Extension professionals must guide

farmers in accessing credits, managing agricultural finances, and being proficient in subject matter concepts related to agricultural economics to strengthen the capacity of extension workers to support farmers livelihoods^[28]. Integration of these skills through curriculum will ensure graduates can effectively perform agricultural extension services in the modern extension world.

2. Technical Skills

Technical skills refer to the specific knowledge and ability required to perform the particular task effectively, especially involving handling tools, techniques, and applying scientific procedures in the field. Technical skills are necessary to meet the demands of modern agricultural systems, including precision agriculture, data analytics, and IOT technologies, to ensure that graduates are well prepared for modern agribusiness challenges^[19]. Current curricula fail to integrate advanced technologies and practical skills training needed in modern agricultural contexts^[30]. The integration of Industry 4.0 competencies, including artificial intelligence and digital platforms has become essential for agricultural graduates to remain relevant in technology-driven agricultural systems. Climate-smart agricultural skill has emerged a critical requirement for agricultural graduates, and they must develop expertise in climate smart agricultural technologies, conservative agriculture and integrated soil fertility management to meet the demands from farmers. The curriculum must include this skill by incorporating training in weather variability, agronomic decisions, disease and pest management, and adaptation strategies^[11]. Researchers have emphasised that agricultural industries are looking for technical skills from entry-level agricultural graduates, such as pest management, understanding plant nutrition, soil conservation, crop production, market forecasting, financial planning, pest and disease identification skill, weed management skill and value addition skill^[24,25]. Ramsey and Edwards (2011)^[23] identified 60 technical skills needed for agricultural graduates which were believed by agricultural industries to be conducted through a Delphi technique. However, in the agricultural curriculum in India, there are some notable technical skills gaps that affect the preparedness of graduates. These gaps include data management techniques, exposure to modern digital tools relevant to agriculture and the lack of an interdisciplinary approach to combine technical knowledge with personal skills needed by agricultural industries. Based on an extensive review of literature and policy documents, key skills were synthesized and presented in Table 1 through comprehensive competency frameworks across multiple core areas.

Table 1: Competency framework of key skill domains needed for agricultural extension professionals

Skill Domain	Skill set	Supported Studies
Technical skill	Crop production, Livestock management, pest control, knowledge on agribusiness management, market oriented agricultural extension education, linkages with cooperative societies, crop production, demonstrate soil conservation skill	Aregaw <i>et al.</i> (2023) ^[4] , Ghimire & Suvedi (2017) ^[13] , Shivamurthy <i>et al.</i> (2023) ^[28] , Suvedi & Sasidhar (2024) ^[31]
Soft skills	Communication skill, writing skill, participatory approaches in extension, conducting group session and problem solving, adult education skills, apprenticeships skills, diffusion of innovation skill, decision making, time management, and stress management	Aregaw <i>et al.</i> (2023) ^[4] , Easterly III <i>et al.</i> (2017) ^[12] , Ghimire & Suvedi (2017) ^[13] , Lopokoiyit <i>et al.</i> (2013) ^[20] , Movahedi & Nagel (2012) ^[21] ,

		Suvedi & Sasidhar (2024) ^[31] .
ICT skills	Writing media design and production, Audio visual design and use	Aregaw <i>et al.</i> (2023) ^[4] , Movahedi & Nagel (2012) ^[21] , Suvedi and Sasidhar (2024) ^[31] .
Research & Analytical skills	Data processing and analyzing, conducting research studies, data collection	Movahedi & Nagel (2012) ^[21]
Extension planning skill	Conduct monitoring and evaluation skill, prepare workable plan, ability to use need assessment tools, strategic planning, program planning,	Aregaw <i>et al.</i> (2023) ^[4] , Ghimire & Suvedi (2017) ^[13] , Lopokoiyit <i>et al.</i> (2013) ^[20]
Extension management skill	Team work, conflict management, leadership, motivation, change management, innovation management	Lopokoiyit <i>et al.</i> (2013) ^[20]
Communication skill	Listening skills, speaking skill, written communication	Blom and Saeki (2011) ^[7]
Entrepreneurial skill	Decision making skill, risk taking, creativity, networking, time management, leadership, critical thinking, ability to prepare business plan, and negotiation skill	Calvin (2024) ^[10]

Curriculum Strategies for Enhancing Industry Readiness

To enhance the industry readiness of agricultural graduates, curriculum strategies must focus on aligning educational outcomes with industry demands. This involves a comprehensive approach that includes competency-based training, a flexible course structure, and the incorporation of soft skills and technical skills. According to Ajao *et al.* (2022) ^[2], the curriculum should be reviewed regularly every 2-5 years to reflect current industry needs and technological changes. Implementing practical learning strategies includes hands-on experience through internships, farm practice, and industry attachment ^[2,15,27]. Enhancing the curriculum with learning activities related to technical skills in agriculture is essential and includes incorporating precision agriculture, sustainability practices, data analytics and IoT technologies into coursework ^[15,19]. To operationalize these

enhancements, educational institutions are increasingly adopting structured interventions such as competency-based education, outcome-oriented education, work integrated learning frameworks, and industrial collaborations.

Additionally, to incorporate practical skills through internships, immersion trips, group work, classroom presentations, integrating the research projects, encouraging the organization of young farmer clubs and junior farmer field schools, conducting workshops, encouraging UG and PG graduates to attend conferences and seminars, community-based project learning, and organizing summer training courses for students ^[18,1,5,29] ensuring that graduates not only acquire the skills but also practice them in consistently in their workplace. Figure 1 illustrate the curriculum strategies to enhance the industry readiness of agricultural graduates.

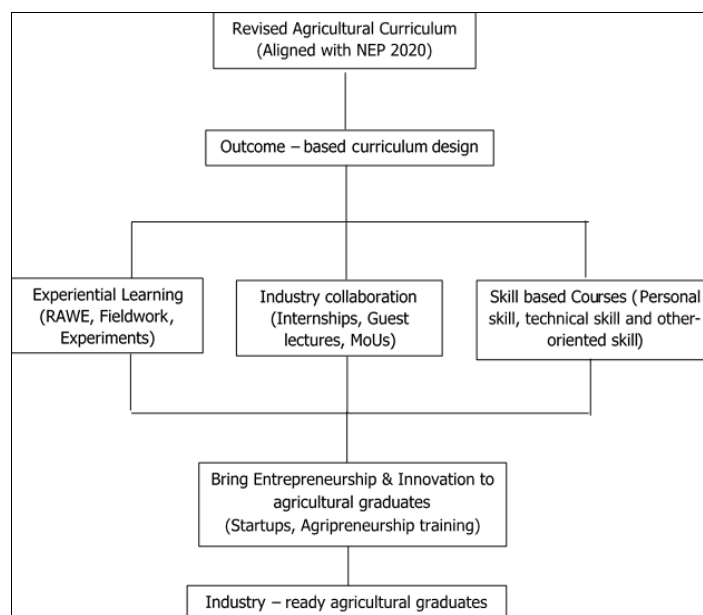


Fig 1: Curriculum strategies to enhance industry readiness for agricultural graduates

Case Studies on Agricultural Curriculum Reorientation in India:

The landscape of agricultural education has undergone a paradigm shift, focusing on food production in market and production-led intensive ecosystems. Due to this evolution, periodic reorientation of undergraduate agricultural curriculum is needed which is done by the Indian Council of Agricultural Research Dean's Committee. While the 5th Dean Committee laid the foundation for professionalizing

the degree through the Student READY program, the recent 6th Dean Committee aligned the agricultural curriculum with the National Education Policy 2020. This case study examines how agricultural curriculum reforms bridge the gap between academic theory and industry readiness by embedding digital skills, entrepreneurship, and flexible learning pathways in the transition from the 5th to the 6th Dean Committee recommendations.

Table 3: provides a comprehensive mapping of the change, identifying new inclusion courses and the specific skill gaps addressed.

Feature	5 th Dean Committee (2017) Focus	6 th Dean Committee (2024) Focus	Core skills emphasized	Skill Gap Addressed
Academic Structure	Four years professional degree (No exit options)	Flexible multiple entry/ exit (Certificate/ Diploma/ Degree) at years 1,2 and 4	Specialized technical skills at mid-level	Lack of middle level skilled professionals and high dropout rates without certification
Digital Technology	Basic Agri-Informatics course	Advanced Digital Agriculture & AI such as agricultural informatics and geoinformatics	Data analytic skills and crop diagnostic skills	Inability of graduates to work with Agri-tech startups or AI diagnostics
Sustainability	Climate change as a sub-topic in Agronomy	Climate Resilient agriculture is a core subject	Resource management skill, Climate-smart agricultural skills	Lack of experts in climate-risk assessment and precision weather based advisory
Foundation Learning	General orientation by individual colleges	Deeksharambh: 2-week mandatory foundation program	Ethical skills, and team building skills.	Poor soft skills and lack of ethical awareness among graduates
Industry Training	Student READY (20 weeks) in the final year only	Compulsory Internships (10 Weeks) at the end of each year/ exit	Problem solving skill, communication skill, flexibility skill and adaptability skill	Fresh graduates lack work experience,
Skill Courses	Standard practical's attached to theory courses	Skill Enhancement Courses (SEC) and choice-based modules from year one	Hands on vocational skills like micro-propagation skill, food safety skill, food processing skills etc.,	Mismatch between skill acquired and skills required by industry
Interdisciplinary course	Highly focused on Agricultural sciences	Focused multi-disciplinary courses such as include the credits for Arts, Humanities and Data Science	Critical thinking skill, creativity skill and problem-solving skills etc.,	Agricultural graduates will often struggle to adapt the organization environment
Evaluation System	Heavy external examination and traditional evaluation	Progressive assessment and Academic Bank of Credits (ABC), that allows student to store, transfer and redeem academic credits earned from Higher Education Institutes (HEIs)	Continuous learning skill and self-evaluation skills	Rote learning culture, inability to apply knowledge in dynamic field situations.

Source: Anuradha,2024 and ICAR, 2017 [3, 17]

Conclusion and Recommendations in Future Directions

In this article, we discussed challenges faced by agricultural graduates, mapped the skills needed for agricultural graduates, and outlined strategies to improve the skills through the curriculum. When we look at the future, agricultural industrial evolution needs more preparedness for agricultural graduates. Course curriculum developed based on the analysis of gaps through the stakeholder engagement. Graduate employability is influenced by economic growth. Recent policy also emphasized the integration of employability and innovation among the students through the curriculum. With the recent reforms in agricultural education policy being implemented through the revised agricultural curriculum, the reforms are in the early stage of implementation; therefore the outcome in terms of skills acquired by agricultural graduates can be assessed in the future. This total restructuring of the curriculum output should be matching with the industrial needs. Apart from the mapping, researchers failed to match the skills towards the agri-industrial needs. There are several statistical methodologies that should be a framework for matching the skillsets in terms of vertical and horizontal matching. Providing the continuous capacity development program for faculty members will help to understand the outcome-based curriculum, and industry -oriented teaching at UG and PG level. Similarly, foster the partnership between educational institutes and agricultural industries sectors to facilitate learning modules. Also continuously assessed the industrial

needs to produce graduates who are not only technically sound but also responsive to the future challenges and innovation within the agricultural industries. In the future the level of skills needed for agricultural graduates will be studied across all agri-industrial sectors to enter the workforce. It is important to note that to understand the expectation and skills of the agricultural graduates with the agricultural curriculum.

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