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Investigating Researchers' Skills and Competency Gaps of Agriculture Student: A Needs Assessment Approach

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HIGHLIGHTS

- The study found that technical skills, fund generation and research management were the most significant competency gaps among student researchers.
- Study highlighted software usage, research funding and planning research activities as the top priority areas needing improvement.
- Workshops, mentorship programs, and interdisciplinary collaborations were identified as the best approaches to enhance research skills and bridge competency gaps.
- Improved skills can increase quality publications, conference participation and problem oriented research topic selection among student researchers.

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ABSTRACT

The study was conducted to understand the important skills and competency gaps of student agriculture researchers for enhancing their research quality. Borich's need assessment model was used, highlighting the needs by studying the difference between relative importance of a research skill and extent of competence. A thorough review of the literature along with experts' advice was conducted, to collect skills needed for agriculture research, reliability was tested (Cronbach's alpha score-0.84) and questionnaire was prepared. The obtained Mean Weighted Discrepancy Scores (MWDS) conveyed that the top three needs of student agriculture researchers were technical excellence (3.19), fund generation (2.98) and management of research activities (2.48). By attaining these skills, respondents perceive fulfilling opportunities such as publishing articles in high-rated journals (82.93%), enhancing the quality of research (78.05%) and attending national and international conferences (72.36%). Based on these results, it could be suggested that agriculture universities organize hands-on experience workshops and training sessions and encourage cross-institutional and cross-border collaborations to help improve agriculture student research activities.

INTRODUCTION

A shift from agriculture to rural development was suggested by Maguire (2000). For this transition to occur, agricultural institutions–actively involved in research, extension, and education–play a crucial role in engaging multiple stakeholders. Agricultural education should focus on individuals' current and future needs rather than the past. With the changing world, these institutions, founded in line with the land-grant institutions of the USA and once operating with stability, now need to be in constant flux as rural development extends beyond technology development. It emphasizes natural resource conservation and requires economic and holistic solutions. Gazi et al., (2009) highlighted the misalignment of agricultural education with the realities of rural life and the

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ultramodern commercial sector. However, the modernization of agriculture shouldn't be confined to the physical and social infrastructure but should also focus on developing agricultural education that will produces trained and skilled graduates (Chaudhary & Pasa, 2015).

The master's and doctoral degrees in agricultural institutions help students find their research identity, a unique self-concept for researchers that may include research self-efficacy and interest. Its key components include confidence, faculty support, researchers' voices, and opportunities (Lamar & Helm, 2017). Furthermore, it is essential to integrate specific skills, abilities, and identities into the curriculum and training during the degree program (Jorgensen & Duncan, 2015). A qualitative analysis by Odena & Burgess (2015) on doctoral students' thesis writing experiences identified out three major themes: customized feedback from the guide/supervisor, personal resilience, and learning strategies. Their study further concluded that while expertise in academic writing is often assumed to be developed independently, the transition across subjects necessitates academic support to meet scholarly expectations.

The number of agriculture postgraduates passing out increases every year and shows a rising trend in India (Agricultural Education, 2016). Agriculture faculty play a crucial role in guiding student researchers toward meaningful studies, prioritizing quality over quantity. They stress the importance of multidisciplinary research, integrating internships and student exchange programs as essential elements (Lynam et al., 2016; Ochs et al., 2017). The goal of agricultural education should be to develop problem-solvers, not just subject matter experts.

When such is the case, the postgraduate education attained must meet the occupational demand to help the student assimilate the knowledge transferred and use it for commercial ends (absorptive capacity) (Rao et al., 1997). Students often view research as merely a degree requirement rather than an opportunity to build expertise. Their focus remains on literature reviews, with minimal emphasis on practical problem-solving or interdisciplinary approaches. Many researchers feel their work lacks impact and express disinterest in research activities (Majidi et al., 2018). There was no exclusive study carried out to analyze the competencies attained by student agriculture researchers.

Understanding the relative importance and competencies of student researchers research skills is vital for universities and policymakers to address gaps and foster quality outcomes that help in shaping educational policies and research frameworks that nurture innovation and engagement.

METHODOLOGY

An exlpratory design was followed to understand the needs of student agriculture researchers, encompassing respondents from all agriculture universities across India. A list of 18 skills which are needed for an agriculture researcher was compiled based on the researchers' experience, literature review, expert discussions, and input from student researchers. The Cronbach's alpha test, performed in MS Excel to measure internal consistency or inter-item homogeneity, yielded a result of 0.84, indicating good reliability (Glen, 2021).

The first set of respondents was contacted through Google Forms based on researcher's familiarity. Later, the form was circulated in relevant WhatsApp groups, and a total of 127 responses were received. After eliminating responses that failed to prove their credibility or showed response errors, 123 responses were retained. Focus group discussion were held to rationalize the obtained responses.

The Borich Needs Assessment model was used in this study to weigh and rank data collected from respondents, addressing limitations of previous studies in evaluating training program success. Unlike tools such as self-reporting (Patil et al., 2024), attitude scales, Q-sort, and Delphi techniques, which are one-dimensional, Borich's model considers both the importance of skills and individuals' competence levels, improving the validity of needs assessment for homogeneous groups (Waters & Haskell, 1989; Elhamoly et al., 2014).

Respondents were asked to rate the importance of agricultural research skills on a five-point scale, from "Very important" to "Not at all important," and their proficiency in these skills, from "Very much proficient" to "Not at all proficient." They also indicated opportunities they believed could arise if these skills were developed. The Mean Weighted Discrepancy Scores (MWDS) were calculated using the following formula:

MWDS = [Σ (Respondents Score for Importance - Respondents Score for Competence) × Importance Mean Score] / Number of Respondents.

Ranks were assigned to individual skills/needs based on the obtained scores, with higher scores indicating greater needs. Factor analysis was performed to group the skills/needs rated as important by the respondents where the suitability of the data was confirmed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. The Bartlett's test of Sphericity was used to test the hypothesis of a correlation between the variables (researcher's skills).

RESULTS

The need assessment among students in research and academic settings is crucial for identifying key areas for improvement and designing appropriate training programs. Understanding skill prioritization and competency levels provides insight into how individuals perceive the importance and proficiency of various research-related competencies and the mean weight discrepancy score obtained and ranked depicts the need (Table 1).

The mean scores indicate the relative importance given by respondents to specific skills. Higher mean scores reflect a higher perceived value for the respective skills, whereas lower scores suggest that respondents did not consider those skills as essential. Top three skills identified as most important by the present study were research management (4.73), commitment (4.73), and writing skills (4.65). These scores highlight that the respondents value the ability to effectively manage research activities, maintain dedication to research tasks, and produce well-structured written outputs.

On the other hand, the least prioritized skills were interdisciplinary collaboration (4.26), fund creation (4.30), and social responsibility (4.40). The relatively lower scores for

Table 1. Needs of student agriculture researchers depicted by Mean Weight Discrepancy Scores (MWDS)

S.No.	Needs of agriculture researcher	Importance Mean Score Value	Competency Mean Score Value	ΣWDS#	MWDS*	Rank
1	Communication skills (Ability to explain your research work)	4.64	4.34	171.75	1.40	13
2	Interdisciplinary collaboration (acting as a team player)	4.26	3.89	195.96	1.59	11
3	Writing skills (able to write articles and reports)	4.65	4.25	227.85	1.85	5
4	Perusing the literature (able to collect extensive content, read and make definitive interpretations)	4.39	4.24	83.41	0.68	18
5	Current affairs (know the latest advancement in your respective fields)	4.45	4.07	209.01	1.70	9
6	Knowledge of different journals and websites	4.46	4.07	218.69	1.78	7
7	Technical excellence (ability to access different software for analysis SPSS, AMOS, MATLAB, R software, etc)	4.57	3.87	392.93	3.19	1
8	Fund creation (avail scholarships and projects)	4.32	3.63	366.95	2.98	2
9	Commitment (dedication towards research activity)	4.73	4.35	222.40	1.81	6
10	Management (planning of research activities)	4.73	4.21	302.85	2.46	3
11	Discipline (able to manage professional and personal lives)	4.50	4.11	215.81	1.75	8
12	Economic research (research topic with practical utility)	4.43	4.05	208.26	1.69	10
13	Resource use efficiency (able to utilize the available infrastructure)	4.53	4.27	144.90	1.18	16
14	Ethical research (Prompt data collection, full disclosure of results)	4.41	4.14	145.43	1.18	15
15	Guidance (Involvement of chairperson in students research activities)	4.58	4.10	270.04	2.19	4
16	Researchers' Integrity (interpretation without data manipulations)	4.42	4.20	123.84	1.01	17
17	Motivation (urge to do better and develop skills for personal betterment)	4.59	4.30	160.48	1.30	14
18	Social responsibility	4.40	4.04	193.51	1.57	12

ΣWDS = [Σ(Respondents score for Importance - Respondents score for competence) × Importance Mean Score], * MWDS= ΣWDS / n

interdisciplinary collaboration suggest that focusing research work within specific departmental areas may hinder broader collaborative thinking. Additionally, readily available infrastructure and research topics lacking practical applicability might be factors contributing to the lower prioritization of fund generation and social responsibility.

The study also examined respondents' proficiency in executing research-related skills. The mean competency scores for certain skills were notably lower, with fund generation (3.63), technical skills (3.87), and interdisciplinary collaboration (3.89) being the weakest areas. For example, the lower competency score in fund generation implies that respondents struggle to secure research grants, possibly due to insufficient training in proposal writing or lack of awareness about funding opportunities.

The discrepancy between the importance of a skill and the ability to perform it highlights gaps in training thereby considered as needs of student agricultural researcher. For instance, while technical skills are considered crucial for research success, the lower competency score indicates a need for more hands-on training and workshops to enhance technical proficiency. According to Borich (1980), insufficient training is indicated when a skill is highly valued but poorly performed. The MWDS reveals these critical gaps, providing valuable insights for program planners to develop targeted training activities. For example, if software proficiency is a key area with a high MWDS, then organizing workshops on data analysis tools such as SPSS, R, or GIS software would be a priority.

The MWDS pinpoints the skills that respondents lack by calculating the difference between perceived importance and actual competency. The top three needs identified through MWDS were the ability to use different software (3.19), availing scholarships and projects (2.98), and planning research activities (2.46).

A study by Ochs et al., (2017) also emphasized the growing importance of software literacy for research, particularly in data analysis and project management. Similarly, He et al., (2019) highlighted the need for training in availing scholarships and securing research projects as critical for academic success. These findings underscore the necessity for targeted training programs to address these gaps.

Previous research by Ramesh et al., (2019) suggested that post-graduate and Ph.D. guidance is the least prioritized training needed for faculty in agricultural universities. However, the present study contradicts this finding. It aligns with research by Odena & Burgess (2015) and Hill & Conceição (2019), which emphasized the importance of guidance from the chairperson in academic research. This finding highlights the need for structured mentorship and support for post-graduate and Ph.D. students.

To further analyze and group the variables (skills) based on their inter-correlations, PCA was employed. PCA helps reduce data dimensionality and identifies underlying patterns among variables. Before conducting factor analysis, preliminary tests were performed to ensure data suitability. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy yielded a commendable value of 0.836, indicating that the sample size and data were suitable for factor analysis. Additionally, Bartlett's test of sphericity confirmed the presence of correlations among variables, signifying the appropriateness of factor analysis (Table 2).

The insights from skill prioritization, competency analysis, and MWDS, combined with PCA, provide a comprehensive understanding of the research skill gaps among respondents. This information is invaluable for developing targeted training programs to enhance research competencies and address existing gaps, thereby fostering a more proficient and collaborative research environment.

Table 2. Preliminary Tests for Factor Analysis - Important skills for agriculture researcher

S.No.	Preliminary Tests for factor analysis	Importance
1	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.836
2	Bartlett's Test of Sphericity (Approx. Chi-Square)	867.57* (degrees of freedom - 153)

*Significant (p<0.001)

The analysis of agricultural researchers' skills, as depicted in Table 3, highlights the results from a Principal Component Analysis (PCA) (Das et al., 2024) with Direct-Oblimin Rotation (as the component correlation matrix had at least one value greater than 0.32, indicating a significant contribution of variance by factors (greater than 10%), revealing four significant components that account for 57.438% of the variance in skills deemed important by the respondents. The first component, labeled externally aided skills, contributes the highest variance (36.457%) and encompasses fundamental skills necessary for effective research. These include social responsibility (h^2 = 0.812), writing skills (h^2 = 0.702), technical excellence (h^2 = 0.682), and guidance (h^2 = 0.604). Social responsibility, which reflects the researcher's commitment to addressing societal issues, emerged as the most important skill. For instance, an agricultural researcher engaged in developing sustainable farming techniques that also benefit local communities demonstrates social responsibility. Writing skills (h^2 = 0.638) are critical for researchers to effectively communicate their findings to a broader audience, and technical excellence (h^2 = 0.590) is essential for using modern software tools like SPSS or MATLAB for analysis.

The second component, Value-Addition Skills, explains 8.239% of the variance and includes economic research (h^2 = 0.815), ethical research (h^2 = 0.814), interdisciplinary collaboration (h^2 = 0.664), and literature review (h^2 = 0.632). These skills help enhance the quality and applicability of research. Economic research (h^2 = 0.657) is crucial because it bridges the gap between theoretical knowledge and practical application, such as conducting cost-benefit analyses to assess the feasibility of new agricultural technologies. Ethical research (h^2 = 0.682) ensures that data collection is conducted transparently, without manipulation, promoting trustworthiness in the findings. Interdisciplinary collaboration (h^2 = 0.602) fosters cross-disciplinary approaches, such as collaboration between economists, agronomists, and environmental scientists to develop sustainable agricultural practices.

Research Advancement Skills, the third component, explains 6.968% of the variance and consists of knowledge of current affairs (h^2 = 0.778), discipline (h^2 = 0.636), and fund creation (h^2 = 0.542). These skills help researchers stay relevant in their fields and secure the necessary resources for their work. Staying updated on current affairs (h^2 = 0.693) allows researchers to incorporate the latest advancements in their areas of study, such as integrating climate change adaptation strategies into farming practices. Discipline (h^2 = 0.636) ensures that researchers maintain a rigorous approach to both their professional and personal lives, a key factor in sustaining long-term research productivity. Fund creation (h^2 = 0.535) is a

Table 3. Factor Loadings from Principal Component Analysis with Direct Oblimin Rotation for Research skills Importance by the respondents

S. No.	Skills required for agriculture researcher	Components				Commu-nality (h2)
		Factor 1 Externally Aided Skills	Factor 2 Value-Addition Skills	Factor 3 Research Advancement Skills	Factor 4 Management Skills	
1	Management (planning of research activities)				.832	.662
2	Commitment (dedication towards research activity)					.395
3	Interdisciplinary collaboration (acting as a team player)		.664			.602
4	Economic research (research topic with practical utility)		.815			.657
5	Ethical research (Prompt data collection, full disclosure of results)		.814			.682
6	Perusing the literature (able to collect extensive content, read and make definitive interpretations)		.632			.594
7	Current affairs (know the latest advancement in your respective fields)			.778		.693
8	Knowledge of different journals and websites					.538
9	Fund creation (avail scholarships and projects)			.542		.535
10	Guidance (Involvement of chairperson in students research activities)	.604				.489
11	Discipline (able to manage professional and personal lives)			.628		.636
12	Communication skills (Ability to explain your research work)					.425
13	Technical excellence (ability to access different software for analysis SPSS, AMOS, MATLAB, R software, etc)	.682				.590
14	Writing skills (able to write articles and reports)	.702				.638
15	Resource use efficiency (able to utilize the available infrastructure)					.487
16	Researchers' Integrity (interpretation without data manipulations)					.575
17	Motivation (urge to do better and develop skills for personal betterment)					.492
18	Social responsibility	.812				.649
	Eigen Value	6.562	1.483	1.254	1.039	
	% of Variance	36.457	8.239	6.968	5.774	
	Cumulative %	36.457	44.696	51.664	57.438	

critical skill for agricultural researchers, enabling them to secure scholarships and grants for their projects, ensuring continuous research progress.

The Management Skills component, explaining 5.774% of the variance, includes management of research activities ($h^2 = 0.832$), and planning ($h^2 = 0.662$), which are necessary for effective project execution. Management skills help researchers effectively organize their research activities, allocate resources, and coordinate teams, ensuring that research is completed on time and within budget. Given that these skills are highly interrelated, training programs should focus on their complementarity. For example, a training session on research advancement could simultaneously cover current affairs, fund generation, and ethical considerations, all of which are essential for maintaining the relevance and integrity of the research.

In Table 4, respondents were asked about the opportunities they perceive would arise from acquiring these skills. The top three opportunities included publishing articles in high-rated journals (82.93%), enhancing the quality of research (78.05%), and attending national and international conferences (72.36%). Publishing in prestigious journals is often seen as a key indicator of a researcher's success, and acquiring these skills enables researchers to present their work at a global level. Enhancing the quality of research (78.05%) is another major benefit, as it directly impacts the credibility and impact of the research in the academic and professional communities. Finally, attending national and international conferences (72.36%) provides a platform for networking, learning from peers, and sharing research findings, which can further propel a researcher's career and foster new collaborations.

Table 4. Opportunities perceived to be attained by respondents when skills are improved (n=123)

S.No.	Opportunities	Percentage
1	Attend several national and international conferences	72.36
2	Pursue multi-disciplinary research	66.67
3	Attain scholarships and stipends	67.48
4	Publish articles in high-rated journals	82.93
5	Betterment in research area selection	64.23
6	Increased research motivation	57.72
7	Overall personality development	67.48
8	Enhancement of quality of research	78.05
9	Better interpretation of data	63.41
10	Involvement in student exchange programs	51.22

Other opportunities include pursuing multi-disciplinary research (66.67%), attaining scholarships and stipends (67.48%), and betterment in research area selection (64.23%). These opportunities underscore the broader career and personal development benefits (Sikdar and Prakash, 2025) that come with mastering these skills, contributing to a researcher's growth and recognition in the agricultural field.

DISCUSSION

Focus group discussions with student agriculture researchers reveal important insights into the factors influencing the self-reliance and professional development. Higher self-reliance among the respondents can be attributed to the fact that individuals with higher levels of education, particularly in agricultural sciences, tend to have increased confidence in their abilities. These individuals are not only aware of external factors beyond their control, but they also rely on their personal efforts and capabilities to achieve their goals.

Internships play a crucial role in bridging the gap between theoretical knowledge and practical application, offering students valuable opportunities to engage in real-world problem-solving. By immersing themselves in agricultural scenarios, students gain firsthand experience in field research, interact with professionals, and develop essential skills for addressing complex challenges. For instance, internships with NABARD have provided students with insights into agricultural finance, rural development, and farmers' socio-economic conditions. These experiences not only enhanced their understanding of real-world agricultural issues but also guided them in selecting more focused and impactful research topics for their academic work.

Interestingly, no student researchers reported disinterest in internships or workshops, highlighting a strong enthusiasm for experiential learning. This aligns with the observation by Rao et al., (1997) that integrating practical exposure into agricultural education can help shift away from traditional state-controlled models by fostering collaboration with the private sector and research organizations. Such partnerships create a mutually beneficial environment, where students gain problem-solving skills, and industries benefit from their fresh insights (Aba et al., 2015). Emphasizing internships and workshops within the curriculum can therefore enhance student engagement in research-related activities, promoting a more inquiry-driven mindset and preparing future professionals to address agricultural challenges effectively. In addition to internships, the study also emphasizes the importance of excelling in research activities within defined time frames. Student researchers are expected to produce high-quality, plagiarism-free synopses and theses while also contributing to academic knowledge through publishing articles. This requirement highlights the critical role of writing skills, which ranked highly among the respondents. The ability to write effectively is essential for translating complex research into clear and compelling academic papers, which can be shared with a wider scientific community. Writing skills are fundamental to disseminating research findings, and as such, they are considered indispensable for student researchers aiming to succeed in academia (Yadav & Mehta, 2020).

While data availability is a starting point for research, the way data is processed and analyzed significantly influences the quality of the final research output. The respondents ranked software skills highly, underscoring the importance of being proficient with advanced analytical tools (Gouseti, 2017) and software, such as SPSS, MATLAB, and R. These tools enable researchers to analyze data more efficiently and derive insights that are not only valuable but also contribute to the originality and rigor of the research. For instance, advanced statistical software allows researchers to handle large datasets, perform complex analyses, and generate findings that may not be immediately apparent through traditional methods. Alongside technical skills, fund-generation skills were identified as

another critical area of need. Fund generation ranked second on the list, emphasizing its importance in supporting long-term research endeavors. Funding is essential for sustaining research activities, acquiring necessary resources, and facilitating the execution of comprehensive projects. A well-funded research program enables students to pursue ambitious research ideas, acquire advanced tools and equipment, and participate in relevant conferences and workshops that further their academic and professional development.

The significance of fund generation is supported by the findings of Ochs et al., (2017), who highlighted the importance of publishing in high-impact journals as a primary research outcome for faculty engaged in agricultural research. This urge to publish in prestigious journals extends to student researchers as well, who recognize the importance of disseminating their findings in top-tier publications to enhance their academic standing. The results from Table 4 align with this perspective, as publishing articles in high-rated journals (82.93%) was the most sought-after outcome (Horta & Li, 2022), followed by enhancing the quality of research (78.05%) and attending national and international conferences (72.36%). Publishing in high-impact journals requires not only high-quality research but also the ability to analyze data effectively and present it in a clear and compelling manner. By attending conferences, student researchers can gain exposure to cutting-edge research, share their findings with experts in the field, and build their professional networks. However, the costs associated with attending such events and publishing in high-quality journals often require external funding, further emphasizing the need for fund-generation skills. Enhancing the skills of agricultural student researchers through internships, workshops, and training programs is essential for fostering a research-oriented mindset and improving the quality of research outputs. By addressing the identified skill gaps, particularly in technical proficiency, fund generation, and research management, institutions can better prepare students for successful careers in agricultural research and contribute to solving pressing agricultural challenges.

CONCLUSION

Understanding and addressing the needs of student agriculture researchers, agricultural institutions can contribute to the development of feasible and applicable technology and policy interventions. This, in turn, leads to the improvement of the entire research ecosystem. It recommends conducting similar assessments among faculties of state agriculture universities or other research organizations to gain a comprehensive understanding of the needs and enhance the overall quality of research in the agricultural sciences.

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