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Disconnect between Academic Research and Farmer Needs in Indian Agricultural Systems: A Comparative Study

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HIGHLIGHTS

- There is a gap between agricultural research and farmer's needs showing inequality.
- Extension exposure and awareness of research are the most important factors for adoption.
- Agricultural research needs to be more participatory and farmer-centric.

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ABSTRACT

The study was conducted in 2024-25 to assess the gap between agricultural research and farmers' needs and to compare the factors influencing technology adoption in Punjab and Uttar Pradesh. A convergent parallel mixed-methods design was adopted, and 384 farmers were selected from Ludhiana and Bathinda in Punjab and Varanasi and Azamgarh in Uttar Pradesh using multistage stratified random sampling. Primary data were collected through structured interviews, focus group discussions, and personal interviews and were analyzed using descriptive statistics, t-test, chi-square, correlation, and regression analysis. The study found that the farmers in Punjab showed higher awareness of recent agricultural research, greater extension contact, and higher adoption of improved technologies than farmers in eastern Uttar Pradesh. Regression analysis indicated that research awareness, extension contacts, irrigation access, farm size, and education significantly influenced technology adoption, with research awareness showing the strongest effect. The findings indicated that the research–farmer gap was associated with unequal access to knowledge, extension services, infrastructure, and resources. The study highlighted the need for participatory, region-specific, and farmer-centric agricultural research and stronger extension linkages.

INTRODUCTION

Agricultural development has been a major pillar of the overall development of the country. In terms of agricultural development, the pace of development of the individual farmer producer in the country has not yet kept pace with it (Lowder et al., 2025). Agricultural research promotes production, rural development and thus sustainable development by providing knowledge, methodology and technology. However, even where there is diversity in the types of agriculture, inequality persists (Khan et al., 2025). Developed areas and farmers have abundant resources such as irrigation, markets and educational opportunities. All these challenges are extremely difficult for underdeveloped farmers (Vyas et al., 2025). They have smaller farms, less access to farmer advisory services, more vulnerable to markets (Singh et al., 2024) and climate change. In this context, inequality is also found in the benefits of agricultural research. This means that only a few groups are benefiting from the same technological progress resulting from research (Shitaye et al., 2025).

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Farmers in India face many challenges, such as land fragmentation, climate risks, income instability and lack of institutional support (Mishra et al., 2024; Kademani et al., 2026). Due to these constraints, the relationship between research institutions and farmers is weak. Therefore, it is extremely important to establish harmony between research and the needs of farmers, so that it can be effective and helpful in solving the problems of farmers at every level (Singh et al., 2014; Kademani et al., 2020). This includes identifying the problems of the farmers, experiencing the field conditions and testing the technology, getting evaluation and feedback from the farmers and finding solutions to their problems (Nain et al., 2012; Srivastava et al., 2025). Although this research is scientifically advanced, it still has some limitations, such as the distance from land to laboratory and from laboratory to land, studies and technologies are often confined to laboratories and journals, and farmers may have difficulty implementing these studies in their daily lives, causing innovations and studies to remain on paper and not reach farmers (Karunathilake et al., 2023). Farmers are interested in adopting new technologies, they hesitate due to lack of knowledge and assurance, resulting in slow transfer from the laboratory to the field. Therefore, it is very important to make it practical, low-cost and risk-free which suits the local climatic conditions, soil conditions and market demand (Pochtrager et al., 2026).

In comparative study between Punjab and Uttar Pradesh, nature of agriculture and agri-parameter differs; Punjab usually practices commercialized, intensive and market-oriented practices (Vatta, 2014) whereas Uttar Pradesh practices are different, such as subsistence, based low input survival oriented. This is because Punjab has greater research integration such as strong research extension and farmers linkage whereas Uttar Pradesh lacks and has weak linkage to research exposure, so to enhance condition in Uttar Pradesh it is important to improve farmer awareness, campaigns and trainings or introducing more farmers fairs or to improve better coordination between scientists, extension workers and farmers (Yadav et al., 2026). For this study, two states with different scenarios in each parameter required for agricultural development.

METHODOLOGY

A convergent parallel mixed methods design was adopted to assess the gap between agricultural research and farmers needs in Punjab and Uttar Pradesh. Progressive and marginalized small farmers were selected from Ludhiana and Bathinda in Punjab and Varanasi and Azamgarh in Uttar Pradesh respectively, using multi stage stratified random sampling method. The basis of area selection was 95 percent irrigated land and land holding of more than 5 hectares in Punjab and rain-fed, flood affected areas and land holding of less than 2 hectares in Uttar Pradesh.

Adoption rates among the respondents were measured as differences using quantitative surveys. Production disparities were clarified through qualitative interviews conducted with farmers. Validity of the study was ensured by integration through joint demonstrations among farmers. The sample size was 384, equally divided in both state, using Yamane's formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where, n is the sample size, N is the total population, and e is the acceptable sampling error.

Primary data were collected through a structured interview schedule. In addition, focus group discussions and personal interviews were used to gather deeper views from farmers, extension officers, and researchers. Secondary data were collected from reports, published papers, census documents, and institutional records to support the analysis. The data were analyzed using a range of statistical tools. Descriptive statistics was used to describe the socio-economic profile of respondents and summarize the basic characteristics of the sample. t-test was used for continuous variables such as awareness scores, extension visits, and income for comparison between the two regions and determine the significance. Chi-square test was used for categorical variables such as adoption of a technology or participation in training. Correlation analysis was used for relationships among important selected variables. Regression analysis was used to identify the factors affecting adoption among the farmers. The statistical tools Cronbach alpha, Bartlett test and KMO measure were incorporated for testing the reliability of the variables and suitability of the data towards multivariate analysis. Therefore, the study used descriptive, inferential, and qualitative combination tools to produce a complete overview of the research-farmer disconnect.

RESULTS

The farmers connected with current developments in the agricultural practices and resources are thought to be in better profile. In the same path, the results showed that the socio-economic profile shows a clear structural difference between the two regions studied. A farmer with education, more land and higher income is more likely to experiment with new technologies, while a farmer with less land and less education tends to be risk averse. Thus, it is confirmed that both study areas are not only socially different, but also differ in their ability to adopt innovations.

The awareness index in Punjab is 0.78, while in Uttar Pradesh it is 0.42. This shows that research messages are reaching the farmers of Punjab more effectively. This large gap in awareness of improved varieties and climate-friendly agricultural practices indicates that farmers in Punjab receive formal agricultural information more frequently. Access to research publications is low in both regions, but the difference is clearly visible, reflecting unequal access to sources of knowledge. The average information score also reflects a more widespread dissemination of information in Punjab. These findings show that the issue is not just the production of research, but also its dissemination and accessibility. If farmers are not aware of the existence of a technology, they cannot adopt it, no matter how scientifically useful it is. The lack of awareness in Uttar Pradesh shows that academic research is far from the real-life conditions of farmers. The better awareness in Punjab is probably due to stronger extension networks, demonstrations and better institutional connectivity.

Agricultural extension linkages are much stronger in Punjab than in Uttar Pradesh, reflecting significant institutional differences between the two regions. Farmers in Punjab receive more than three times as many agricultural extensions visits annually, and their

Table 1. Disparity in awareness of Punjab and Uttar Pradesh farmers

Categories	Variables	Punjab	Uttar Pradesh
Awareness towards latest research in Agriculture	Awareness index	0.78	0.42
	Improved varieties knowledge (%)	88.0	54.0
	Climate-smart practices (%)	71.5	33.2
	Accessed research publications (%)	43.8	12.6
	Mean information score	4.1	2.6
Contacts with the extension personnels	Extension visits per year	6.4	2.1
	Training participation (%)	68.0	29.5
	Contact with KVK (%)	57.2	18.4
	Contact with Agri-input dealers (%)	74.5	61.3
	Advisory satisfaction score (out of 5)	3.9	2.3
Adoption of the latest technological advancements	Improved seed varieties	82.6	49.8
	Balanced fertilization	76.3	41.5
	Water-saving irrigation	69.4	24.7
	Mechanization practices	84.1	35.6
	Crop protection recommendations	73.8	38.9

participation in training programs is more than twice that of farmers in Uttar Pradesh. Contact with agricultural centers (KVKs) is also more common in Punjab, indicating that farmers in the developed region are better connected to formal advisory systems. Although agricultural input dealers remain an important source of advice in both sectors, the quality and reliability of such guidance may vary. Advice satisfaction scores are quite low in Uttar Pradesh, meaning that even when advice is available, it may not be timely, useful or relevant. This table is important because extension is the medium for putting research into practice at the agricultural level. Where research is not carried out in depth, the research remains abstract and is not properly converted into practical suggestions. The findings therefore suggest that the gap between research and practice is partly due to widespread access. This emphasizes the need for a more decentralized, participatory and locally sensitive extension system in less developed areas.

Inter-regional variations are clearly visible in the adoption of improved seed varieties, balanced fertilizer use, irrigation-saving practices, mechanization and crop protection recommendations. This pattern shows that farmers in Punjab are not only more aware of innovations but also more capable of implementing them due to better capital availability, irrigation infrastructure and institutional support. Low adoption rates in Uttar Pradesh probably reflect a combination of lack of resources, small farms, greater uncertainty, and weak counseling systems. This Table 1 is important because it shows the final practical outcome of the research-practice series. Research has value only when it leads to useful change at the farm level, and these figures show that the process of converting knowledge into practice is much stronger in Punjab. Low adoption in Uttar Pradesh should not be attributed to resistance alone; This may be a result of lack of coordination between technology and local constraints. Therefore, the table 1 reinforces the argument that innovation should be context-specific. Applying the same approach to all is unlikely to solve the problem of low adoption in backward agricultural systems.

The results of regression analysis confirm that factors such as extension connectivity, availability of irrigation, education, farm size and research awareness significantly influence the technology adoption process. Of these, the coefficient of research awareness is the strongest. This means that having access to information is a big reason why people adopt new technologies. Extension connectivity and the availability of irrigation also have positive effects. This shows that adopting new technology depends not only on determination but also on having access to support and useful resources. The size of a farm is important because it shows that bigger farms can be more flexible and less risky when trying out new things. Education also helps with this by making it easier to understand technical information and making better decisions. This Table 2 is important for analysis because it shows why Punjab does better than Uttar Pradesh when it comes to adopting new technologies. Farmers from Punjab are likely to do better on all the important factors, while farmers from Uttar Pradesh are behind. Farmers from Punjab are likely to do better on all the important factors, while farmers from Uttar Pradesh are behind on almost all of them.

Table 2. Significance level of the factors responsible for adoption among the respondents

Variable	Coefficient	Std. Error	z value
Education	0.182**	0.061	2.98
Farm size	0.241**	0.074	3.26
Extension contacts	0.317*	0.089	3.56
Irrigation access	0.286*	0.083	3.45
Research awareness	0.354*	0.091	3.89

(* = $P \leq 0.05$, significant; ** = $P \leq 0.01$, highly significant)

Therefore, regression analysis provides econometric support for the descriptive results. This shows that the gap between research and practice is not accidental; It arises systematically due to unequal access to knowledge, services and resources. The model also indicates that adoption requires more than distribution of technologies.

Both regions were found having disparities in constraints. Punjab was found with unstable prices and markets, which was due to the commercial expansion in the area. Rest all the constraints

with the structural issues were found with the farmers in the Uttar Pradesh. Major issues highlighted were vulnerability to climate, small holdings and poor extension services. Limited services of extension prove that they are insufficient in Uttar Pradesh. The improved methods are difficult to be adopted with such small holding. Climatic vulnerabilities such as droughts and floods guarantee uncertainty and therefore frightens the farmers from making investments. The results in the Table 3 supports that the same study differed in the two locations. Farm efficiency and profit is priority of the Punjab farmers with research results whereas institutional access and fundamental support for flexibility is desired by Uttar Pradesh farmers. It displays and reveals that research institutes should not make similar recommendations. Rather, they should experiment with interventions based on regional limitations. So, farm research is meaningful only to the extent that it meets farmers' needs, regional specificity and resource constraints.

Table 3. Comparation of constraints associated with Punjab and Uttar Pradesh farmers

Constraint	Punjab (%)	Uttar Pradesh (%)
High input cost	62.4	54.1
Poor extension access	28.7	79.5
Market instability	51.9	48.6
Small landholding	19.3	83.2
Flood/drought risk	24.6	71.8

Correlation values indicate whether awareness, extension contacts, adoption, income and irrigation move in the same direction, and this is very important in the study of research-behavior gap. The positive correlation between awareness and extension contact shows that farmers who have more frequent contact with advisory systems are also more likely to learn about improved technologies. The highest relationship is between exposure to extension services and usage, implying that not only is information transmitted to farmers through extension services, but they also actively suggest agricultural practice. This key result confirms the claim that research does not result in a change in agricultural practices without the delivery of the research through effective extension services. This is also true of the relationship between irrigation and use, suggesting that it is easier to use the technology in areas with better infrastructure. So, even if a farmer knows about a technology, farmer more likely to use it, if has access to water and the environment is suitable for growing crops. The income-usage relationship makes sense, too, because as income rises, the farmer is less likely to experience a financial loss from using the technology.

Diagnostic values add to the scientific rigor of the analysis. The value of Cronbach's alpha (0.84) shows that the items used to measure the variables are reliable. The KMO value of 0.71 suggests that the data are suitable for multivariate analysis while the significance of Bartlett's test suggests that there is enough correlation between the variables for this type of analysis. The variance inflation factor (VIF) values are low (1.22-2.84), which indicates that there is no multicollinearity. This is great news as the regression coefficients can be interpreted in an unbiased way. Lastly, the pseudo-R^2 value of 0.41 shows that the model explains a fairly good part of the adoption process, which is very good for agricultural studies.

DISCUSSION

The research indicates that the gap between the academic agricultural research and farmers demand is not only a communication problem, but it is a structural and institutional problem. In contrast to Punjab, the small structure of agriculture in Uttar Pradesh limits farmers ability to adopt innovations, even if these innovations are scientifically sound (Rajeev et al., 2025). This confirms that the process of research adoption is equally influenced by both the agricultural environment and the quality of the research.

There is a discrepancy found between the study and practice. Protection methods are becoming more and more advanced in Punjab. A high innovative environment is stimulated to above all with the help of technological advancements, advisory services, and financing facilities. In contrast all the above advancement are found at low adoption among the farmers. This was due to lack in the institutional support, innovations etc. with the farmers in Uttar Pradesh (Yadav et al., 2025). The adoption is not just a behavioral choice but the result of structural readiness. This is an important point because many agricultural research systems hold the misconception that farmers will adopt technologies only if recommended.

Table 4. Correlation matrix and diagnostic profile of the variables

Variables	Awareness	Extension contacts	Adoption	Income	Irrigation
Awareness	1.00	0.62***	0.58***	0.41**	0.49**
Extension contacts	0.62***	1.00	0.67***	0.46**	0.44**
Adoption	0.58***	0.67***	1.00	0.53***	0.59***
Income	0.41**	0.46**	0.53***	1.00	0.39**
Irrigation	0.49**	0.44**	0.59***	0.39**	1.00

Diagnostic measure	Value
Cronbach's alpha	0.84
KMO measure	0.71
Bartlett's test	Significant, $p < 0.001$
Variance Inflation Factor (VIF) range	1.22 to 2.84
Pseudo-R^2	0.41

(** & *** = P ≤ 0.01 & P ≤ 0.001, highly significant)

The information on the determinants of adoption, provides econometric support confirms that farmers who are better informed, better equipped and who frequently receive advisory support are more likely to implement the recommendations (Goodluck et al., 2024). The importance of extension contact also reinforces the argument that information distribution cannot be left to publications alone. The model therefore shows that the adoption process is influenced by both human capital and institutional linkages. In practice, this means that simply releasing technologies is not enough to improve adoption. For this, it is necessary to create such social and infrastructural conditions that will enable farmers to use them. The regression results thus validate the central argument that the research-practice gap is not random but systematic.

The constraints and priorities revealed that there are different types of agricultural stress in Punjab and Uttar Pradesh. Farmers in Punjab were more concerned about input costs, market instability and pressures of commercialization, while farmers in Uttar Pradesh were more affected by inadequate access to agricultural extension services, small landholdings and risk of flood or drought (Gireesh et al., 2019; Yadav et al., 2025). Hence, this section argues that research must be managed to suit demands of farming. The approach adopted in Punjab may not be adopted in Uttar Pradesh unless it has adaptation to the local needs and priorities.

The correlations and clinical profiles show that, adding a more statistical dimension to the study. Positive correlations between awareness, extension contacts, adoption, income and irrigation suggest that these variables complement each other. Similar findings were observed by Kumar et al. (2023) in case of ZBNF. It can be concluded that farmers do not always benefit from agricultural research. This disparity is mainly due to differences in socio-economic conditions, such as lack of knowledge and experience (Begho et al., 2022). Developed farmers in Punjab are found to be progressive thinking and endowed with innovative facilities. Farmers have access to good markets, infrastructure and extension services. At the same time, it is very difficult for the farmers of Uttar Pradesh to get these facilities. This makes farmers more vulnerable to risks and vulnerabilities. Therefore, it can be concluded that research should always be at the grassroots level, based on solid foundation, accessible to all and tailored to the needs of the farmers. During policy formulation, extension and educational institutions should be directly linked to the farmers (Kumar et al., 2026).

CONCLUSION

The study shows that the gap between agricultural research and farmer's needs is weak due to extension linkages, structural inequality, and unequal access to resources. The success of agricultural research depends not only on its scientific quality but also on the suitability of the technology to the farmer's adoption and conditions. Correlation and regression patterns show that income and irrigation promote adoption, while low access to extension services and small land holdings reduce it. Therefore, the gap between research and practice is not accidental. This arises due to unequal institutional and economic conditions. The policy implication is that agricultural research needs to be made more participatory, local and farmer-centric. Researchers should involve farmers right from the planning stage, especially in underdeveloped areas like Uttar Pradesh, so that technologies reflect real ground challenges. Extension systems should also be strengthened to provide timely, simple and local specific suggestions.

DECLARATIONS

Ethical considerations and consent to participate: The study was conducted in accordance with the principles laid out in the Declaration of Helsinki, 1964, and its modifications. The study was approved by the Departmental Review Board of the Department of Agricultural Economics and Extension, Lovely Professional University, Phagwara-144411 (Punjab), and ethical approval was waived off. Also, the Participation of respondents were voluntary, and informed verbal consent was obtained from all respondents. The confidentiality and anonymity of participants were strictly maintained throughout the research process.

Conflict of interest: The authors declare that the research possesses NIL conflict of interest in any manner whether financial or non-financial. The preparation of the article is thoroughly reviewed and revised as needed. The authors take full responsibility for the content of this manuscript.

Data availability statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. The data are not publicly available because they contain information that could compromise participant confidentiality.

Authors' contribution: ASM and BY designed the study, developed the research design, carried out the fieldwork, data analysis, and drafted the first report. AK, RKK and KKS monitored the formulation of the study plan, and critically analyzed the work for intellectual content and finally contributed towards the finalization and proof reading of the article.

Declaration of using AI tool: The authors have used Grammarly, as an AI tool for improving the text of grammar.

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