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Toward a standardised measure of farmers' research orientation: scale development and validation

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Abstract

Modern agriculture requires farmers not merely to adopt new technologies but also to actively engage in experimentation, knowledge generation, and informed decision-making. In this context, the scientific mindset and research orientation of farmers are of critical importance. Recognising the need to systematically assess this attribute, the present study aimed to develop and standardise a scale to gauge farmers' research orientation. In this study, research orientation is operationally defined as the extent to which an individual is inclined towards discovering new knowledge, critically evaluating existing knowledge and practices, and synthesising information through scientific inquiry or critical investigation. The scale was developed following established psychometric procedures, including item generation, expert validation, pretesting, and reliability assessment using Likert's method of summated rating. Item analysis, reliability testing, and validity assessment were conducted to ensure the robustness of the instrument. The findings revealed that the developed scale possesses high reliability and validity. The final scale consists of thirteen items. The scale can be effectively used by researchers, extension personnel, and policymakers to assess the research orientation of farmers, thereby facilitating the design of targeted interventions aimed at promoting grassroots innovations, co-learning and participatory research in agriculture.

Keywords: Research orientation, Likert method of summated rating, reliability, validity

Introduction

Farmers have always lived in changing environments with uncertainty and disturbances (Kummer *et al.*, 2017) ^[12]. The farming sector is always undergoing a rapid transformation due to changes in climate parameters, marketing systems, and technological advancements. To meet these challenges, continuous research and development on innovative solutions is important. The successful generation of agricultural innovations depends not only on scientific research institutions but also on farmers' orientation towards research, experimentation and innovation. Farmers can learn through experimentation, which is a crucial tactic for responding to change and enhancing adaptive farm management. By conducting and monitoring experiments, farmers can develop a deeper understanding of system dynamics, increase the number of options available in the event of a change, and improve their management practices based on the knowledge acquired (Darnhofer *et al.*, 2010) ^[4].

The ability of farmers to search and engage with scientific knowledge, experiment with new ways to solve field-level problems, participate in on-farm research trials, and collaborate with agricultural research institutions plays a pivotal role in enhancing their capacity to invent and innovate. This can be called as the research orientation of farmers. It refers to the extent to which a farmer is oriented towards the endeavour of discovering new knowledge or collating existing facts through scientific study or systematic

critical investigation (Devarakonda, 2015) ^[5]. But, according to Waters-Bayer *et al.* (2015) ^[23], 'farmer-led research' is a process in which farmers, together with other support agents, for example, formal researchers, extensionists, investigate possible ways to improve the livelihoods of local people in the realm of agriculture and natural resource management. Among farmers, a strong orientation towards research indicates a favourable attitude towards experimentation, critical thinking in problem solving, and evidence-based decision making in farming.

The historical development of locally adapted farming systems worldwide has been the result of continuous autonomous experimentation by farmers (Hoffmann *et al.*, 2007) ^[7]. According to Kummer *et al.* (2017) ^[12], farmers' experiments can be characterised as independent actions of farmers to attempt or implement something new at the farm, including assessing the success or failure of their own practices.

Experiments have produced several agricultural breakthroughs, allowed farmers to adjust their farms to changing conditions, and increased local knowledge. These experiments are influenced by various intervening factors such as environmental, social and personal conditions (Leitgeb *et al.*, 2014) ^[13], and the personal motives can be intrinsic, like interest or curiosity, and extrinsic, like confronting challenges and problem solving (Kummer *et al.*, 2017) ^[12].

According to Waters-Bayer *et al.* (2015) ^[23], farmer-led research has led to greater food and nutrition security through higher and more dependable yields, higher household incomes, bringing more benefits to medium farmers, leading to increased crop diversity. Moreover, this farmer-led research has many such profound, self-reinforcing and long-lasting impacts.

In this backdrop, measuring farmers' research orientation gains importance to understand their inventive capacity, innovativeness and participation in the agricultural knowledge development process. Recognizing the importance of this trait, the present study aimed to develop a scale to measure farmers' research orientation in a systematic and reliable manner.

By measuring farmer's research orientation, stakeholders in agricultural research, extension, education and policy can better understand the farmer's readiness for critical problem-solving, engagement in knowledge generation processes, participation in research activities, and scientific temper. This understanding can, in turn, help them tailor targeted strategies to nurture farmer-led research and innovation.

Methodology

In this study, research orientation is operationally defined as the extent to which an individual is inclined towards discovering new knowledge, critically evaluating existing knowledge and practices, and synthesising information through scientific inquiry or critical investigation. Likert's summated rating method (Likert, 1932) ^[14], which has been widely used in agricultural extension research (Husain, 2007; Vivek and Bonny, 2023; Matla *et al.*, 2025) ^[8, 22, 15], was used to develop the scale. The method consists of a series of steps, including statement collection, relevancy testing, item analysis, and standardisation of the scale.

Identifying and collecting statements or items related to research orientation is the first stage in a scale development process. Fifty-five statements, both positive and negative, regarding farmers' research orientation were generated based on literature review and discussions with subject-matter experts. Subsequently, the selected statements were revised in accordance with Edwards' (1957) ^[6] criteria for statement construction. Statements that were factual, contained double negatives, were irrelevant, or did not conform to Edwards' criteria were eliminated. Ultimately, 49 statements were retained for further analysis in the development of the research orientation scale for farmers.

To assess the relevance of the statements, a Strongly Disagree with scores from 5 to 1, respectively; scoring was reversed for negative statements. Respondents were then arranged in descending order based on their total scores, and the high-scoring and low-scoring groups were identified, each comprising 25 percent of the sample. These two groups served as criterion groups for evaluating the individual statements. Statements with higher *t*-values were selected for inclusion in the final scale.

To standardise the scale, its validity and reliability were examined.

A scale is considered reliable if it consistently yields the same results when applied repeatedly to the same sample.

Here, Cronbach's alpha suggested by ^[3] panel of agricultural extension judges Cronbach (1951), and followed by many comprising experts from ICAR institutes and State

Agricultural Universities (SAUs) researchers like Poornima and Husain, 2021; Vivek and Bonny, 2023; Boora *et al.*, ^[19, 22, 2] was constituted. The 49 statements were 2024, and the split-half method were sent to the judges by mail and, where possible, delivered in person. Judges were asked to rate each statement on a five-point scale ranging from "most relevant" to "irrelevant," assigning scores of 5, 4, 3, 2, and 1, respectively. Statements with a relevance score above 80 percent of the threshold value (Preethi *et al.*, 2014; Meethal and Thomas, 2024; Matla *et al.*, 2025) ^[18, 16, 15] were retained, resulting in a final set of 30 statements.

These statements underwent a comprehensive item analysis using the *t*-ratio approach suggested by Edwards (1957) ^[6] and subsequently followed by Ramakrishnan *et al.*, 2020; Raj and Thomas, 2022; Meethal and Thomas, 2024 ^[21, 20, 16]. For this purpose, the statements selected after the judges' relevancy rating were administered to a total of 40 farmers. Responses were collected on a five-point scale - Strongly Agree, Agree, Undecided, Disagree, employed to measure the internal consistency of the scale.

In the case of the split-half method of reliability checking, the final statements were divided into two halves by the odd-even method. The total score for each half was calculated separately. Then the split-half test reliability coefficient was calculated by the Pearson product-moment method, and the reliability coefficient of the whole test was estimated using the Spearman-brown prophecy formula (Kaplan and Saccuzzo, 2001) ^[11].

Validity refers to the extent to which an instrument accurately measures the construct it is intended to measure. A panel of experts considering the relevance of individual items within an instrument can be adopted as one of the approaches to examine content validity (Almanasreh *et al.*, 2019) ^[1]. The content validity of statements was assessed by subject experts' opinions through a relevancy test (Husain and Sundaramari, 2009; Pandey *et al.*, 2020; Boora *et al.*, 2024) ^[9, 17, 2].

Results and Discussion

A pool of 55 statements on the topic under study was initially edited and screened using the criteria enunciated by Edwards (1957) ^[6], which reduced the number to 49 statements. These statements were then subjected to a relevancy test. Statements with a relevancy percentage above 80 percent were retained, yielding a final set of 30 statements.

Item analysis was subsequently done using the *t*-ratio method suggested by Edwards (1957) ^[6] to identify the statements capable of discriminating between respondents with high and low research orientation. Thus, out of 40 respondents to whom the statements were administered for the item analysis, 10 respondents with the highest and 10 respondents with the lowest scores were selected to form the criterion groups. These two groups were then used to evaluate the discriminatory power of each statement.

Items with a *t*-value greater than 2.87 at one percent level of significance were selected as final statements. Nineteen statements met this criterion. However, to further enhance the robustness of the scale, only those items with comparatively higher *t*-values ($t > 4.5$) were retained in the final scale.

The 30 statements used for item analysis, along with their corresponding *t*-values and the items selected for inclusion in the final established through the content validity method, based on expert judgement.

Reliability

Cronbach's alpha is computed by comparing the variances for all individual item scores with the variance of the total score (Kaewkungwal, 2023) ^[10].

The formula is

$\alpha = (k/(k-1))(1 - \sum \sigma_{yi}^2 / \sigma_x^2)$ k = the number of items

σ_{yi}^2 = the variance of item i,

σ_x^2 = the variance of the observed total scores

Here, in this study,

k = the number of items = 13

σ_{yi}^2 = the variance of item i = 18.52

σ_x^2 = the variance of the observed total scores = 251.84

Hence $\alpha = 0.97$

The Cronbach's alpha value obtained was 0.97, which is close to 1, indicating that the scale is highly reliable and acceptable.

In the split-half method, the total score for each half of the scale was calculated separately. The correlation between the two halves was then computed using the Pearson product-moment method, and the reliability coefficient of the whole test was estimated using the Spearman-brown prophecy formula:

$$\text{Reliability coefficient (rSB)} = \frac{2 * r_{hh}}{1 + r_{hh}}$$

Scale, are presented in Table 1. The final Scale consists of 13 items.

Standardisation of the scale

The reliability of the scale was examined using the split-half method and Cronbach's alpha method, while its validity was Where, r_{hh} = Reliability coefficient of the half scale = 0.97 Reliability Coefficient (r_{SB}) = 0.98, which is close to 1, indicating high reliability of the scale.

Table 1: The statements with their t-value and p-value

Sl. No.	Statements	t-value	p- value
1.	I am interested in systematically investigating agricultural information to establish facts and reach new conclusions.	6.04	<0.001
2.	Has an endeavour to discover new facts (or) collate old facts by scientific study or process of critical investigation.	5.72	<0.001
3.	I enjoy conducting small experiments on the farm.	6.02	<0.001
4.	I am aware of ongoing agricultural research programmes that can benefit farming.	7.54	<0.001
5.	I enjoy trying out new farm techniques on a small scale to validate them.	6.39	<0.001
6.	I am willing to participate in on-farm trials and experiments led by researchers.	4.8	<0.001
7.	I enjoy scientifically analysing and investigating agricultural problems.	4.49	<0.001
8.	I am curious about discovering new techniques in agriculture through experimentation.	5.4	<0.001
9.	I am open to collaborating with researchers to improve my farming methods.	4.56	<0.001
10.	Research-based practices lead to long-term benefits in farming.	2.09	0.050
11.	I keep records of my farming trials and experiments for future reference.	4.70	<0.001
12.	Research is essential for finding sustainable solutions to agricultural problems.	3.57	0.002
13.	I read agricultural research articles, bulletins, and extension publications.	3.46	0.002
14.	I keep track of new research developments in agriculture.	5.78	<0.001
15.	I trust research-based recommendations over traditional farming methods.	5.51	<0.001
16.	The role of research in evaluating and testing the feasibility of new technology on the farmer's fields, along with extensionists, is not a must.	0.39	0.697
17.	I find it difficult to integrate scientific research into my farming practices.	0.36	0.719
18.	I attend research demonstrations and field trials organised by agricultural institutions.	6.62	<0.001
19.	I trust the research findings shared by agricultural universities and extension agencies.	4.43	<0.001
20.	I visit agriculture-related institutions to gain technical knowledge regarding farming.	2.68	0.015
21.	I use trial-and-error methods to develop better farming strategies.	4.05	<0.001
22.	Research recommendations are not practical for small-scale farmers.	0.771	0.450
23.	I enjoy testing new varieties and practices in farming on my farm to compare their performance.	5.77	<0.001
24.	I adapt the research findings to suit the specific needs of my farm.	4.33	<0.001
25.	I stick to evidence rather than intuition in farming-related decision- making.	3.5	0.002
26.	I am interested in identifying the factors that influence the success of a farming practice.	0.870	0.395
27.	I am open to learning about the latest scientific breakthroughs in farming.	3.19	<0.001
28.	I systematically test and document results when adopting new farming techniques.	6.04	<0.001
29.	I critically assess the credibility of new agricultural information before implementation.	2.86	0.010
30.	I collect and analyse data to track improvements in my farming practices.	2.55	0.019

*Items retained in the final scale

Validity

The scale's validity was established through expert content validation by agricultural extension specialists. It was considered valid as it adequately represented the construct, supported by literature review and expert judgment. Additionally, the computation of t-values ensured the statements' high discriminating power. Therefore, the scale was accepted as a valid instrument for measuring the research orientation of farmers.

Conclusion

The present study successfully developed and standardised a scale to measure farmers' research orientation using the Likert method of summated rating. The final scale comprised 13 items that demonstrated strong content validity as established through expert evaluation, indicating that the construct was adequately represented. The reliability of the scale was confirmed through high internal consistency, as evidenced by Cronbach's alpha and split-half reliability coefficients. Furthermore, the significant t-values obtained during item analysis ensured the strong discriminating power of the statements. Taken together, these findings indicate that the developed 13-item scale is psychometrically sound and can be reliably used as a valid instrument for assessing the research orientation of farmers.

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