AATCC Review

03 December 2024: Received
16 February 2025: Revised
09 March 2025: Accepted
13 March 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

Development and Validation of a Scale to Measure Farmers' Perceptions of Agricultural Sustainability Using the COARSE Method

Anuhya Pola[1*], Venkatesan P[2], Lakshmi T[3], Mukunda Rao B[4], Lavanya Kumari P[5] and Krishna Reddy G[6]

[1]*Department of Agricultural Extension Education, S.V. Agricultural College, Tirupati-517502*
[2]*Extension Systems Management, ICAR-National Academy for Agricultural Research Management, Rajendranagar, Hyderabad, Telangana*
[3]*Department of Agricultural Extension Education, S.V. Agricultural College, Tirupati, ANGRAU, Andhra Pradesh*
[4]*Directorate of Extension, Acharya N G Ranga Agricultural University, Lam, Guntur, Andhra Pradesh*
[5]*Department of Statistics and Computer Applications, Agricultural College, Bapatla, Acharya N G Ranga Agricultural University, Lam, Guntur, Andhra Pradesh*
[6]*Dean, SMGR College of Agriculture, Udayagiri, Acharya N G Ranga Agricultural University, Lam, Guntur, Andhra Pradesh*

ABSTRACT

Sustainability in Agriculture is an essential pursuit in this rapidly expanding tech-driven world. The Farmer FIRST Programme is a flagship initiative of ICAR, aiming to prioritize farmers by integrating indigenous technologies with newly developed ones. This approach seeks to preserve sustainable and environmentally friendly technologies. The present study was conducted during 2024-25 in ATARI Zone-X, where two adopted and two non-adopted villages were selected from each of the five Institutes. From the adopted villages, 30 beneficiary farmers were randomly selected, and from the non-adopted villages, 10 non-beneficiary farmers were randomly selected, making a total sample size of 400. Through a thorough literature search and a preliminary survey among farmers, statements measuring farmers' perceptions of sustainability were gathered which were then on consultation with experts were checked and filtered. Using these statements a likert type of scale was developed using COARSE method which was then used to collect final data the responses from which were subjected to confirmatory factor analysis to validate the scale. The responses were collected to assess the perception of farmers regarding sustainability in agriculture. The majority of beneficiary farmers had a good (48.00%) perception, followed by fair (37.00%) and poor (15.00%) perceptions. In contrast, most of the non-beneficiary farmers had a fair (46.00%) perception, followed by poor (29.00%) and good (25.00%) perceptions. By implementing strategies like public awareness campaigns, peer learning, regular farmer-scientist interactions and by extension of farmer FIRST programme to non-adopted villages farmers can be educated about sustainability in agriculture.

Keywords: *Sustainability, Farmer FIRST, Beneficiary, Non-beneficiary, Perception, Agriculture*

Introduction

Sustainability is the new lifestyle for some of the nature loving Indian citizens. 42.30 per cent of the Indian population is directly or indirectly depending on the agriculture for its livelihood and agriculture contributes to 18.20 percent of country's Gross Domestic Product (PIB, 2024). Economic survey during 2023-24 estimated that for every rupee invested in agricultural research (including education), there is a payoff of ₹13.85. It also emphasizes the importance of the PM Programme for Restoration, Awareness Generation, Nourishment, and Amelioration of Mother Earth (PM-PRANAM) initiative, which incentivizes states to reduce the use of chemical fertilizers. This initiative promotes sustainable agriculture by encouraging the adoption of alternative fertilizers such as Nano Urea, Nano DAP, and organic fertilizers. Sustainable agriculture is essential for environmental conservation, economic stability, social and cultural benefits, food security, and climate change mitigation (PIB, 2024). Sustainable practices help protect soil health by reducing erosion and maintaining nutrient levels through crop rotation, cover cropping, and reduced tillage (Kodaparthy *et al*., 2024). These practices also preserve water with efficient irrigation systems and water-saving techniques. Additionally, sustainable agriculture enhances ecosystem services by supporting biodiversity, pollinators, and wildlife through habitat preservation and organic farming (Gupta *et al*., 2021).

Farmer FIRST (Farm, Innovation, Resources, Science and Technology) Programme is one such initiative launched during 2015 by Indian Council of Agricultural Research for promoting sustainable agriculture by encouraging farmers to integrate indigenous technologies with new technologies (Ashok *et al*., 2021). It was implemented on a pilot basis through 51 institutes all over India. Through this programme they aimed to promote farmer-scientist interaction for the development of agricultural technologies which are location-specific, demand-driven, and farmer-friendly technological solutions that are crucial for sustainable agricultural progress (Manjeet et al., 2019 & Venkatesan *et al*., 2023). Each institute has undertaken some of the location specific and sustainable interventions in their respective adopted villages over the time of seven years. In the current study an attempt has been done to study the perception

Corresponding Author: **Anuhya Pola*

DOI: https://doi.org/10.21276/AATCCReview.2025.13.02.37

of beneficiary and non-beneficiary farmers on sustainability in agriculture in ATARI Zone-X. This helps to enable the development of specific strategies tailored to the unique needs and conditions of different farming communities, ensuring more effective and practical solutions for achieving sustainability in agriculture.

Letter	Component	What It Means
C	Construct Definition	Clearly defining the concept or idea being measured
O	Object Classification	Identifying what or who the construct is being applied to
A	Attribute Classification	Listing the features or dimensions that make up the construct
R	Rater Identification	Deciding who will be rating or responding to the scale
S	Scale Formation	Creating and refining the items to represent the construct
E	Enumeration	Organizing the final list of items and preparing for data collection

Material and Methods

The present study was carried out in ATARI Zone-X during 2024-25 in Tiruvallur district of Tamil Nadu, Eluru district of Andhra Pradesh and Rangareddy, Sangareddy and Vikarabad districts of Telangana as the student belonged to Andhra Pradesh state. A multi-stage random sampling method was followed for this study. Firstly, all the five Institutes in ATARI Zone-X where Farmer FIRST Programme was being carried out were selected. Secondly, under each institute two adopted villages and two non-adopted villages were selected randomly making a total of 10 adopted villages and 10 non-adopted villages. Finally, from each adopted village 30 farmers and from non-adopted village 10 farmers were selected randomly making a sample size of 300 beneficiary and 100 non-beneficiary farmers which rounds up to 400. First a thorough literature search was done and then preliminary survey was done among the villages to collect relevant statements measuring the perception of farmers of sustainable practices in agriculture. These statements were reviewed by experts from various State Agricultural Universities, ICAR institute and experts linked to Farmer FIRST Programme. Using these statements a likert type of scale was developed using COARSE method which was then used to collect final data the responses from which were subjected to confirmatory factor analysis to validate the scale.

Results and Discussion

During 2022 a thorough literature search was done and a preliminary survey was conducted among beneficiary and non-beneficiary farmers to collect statements measuring the perception of farmers regarding sustainability in agriculture. Based on suggestions of experts from various State Agricultural Universities and ICAR Institutes and experts related to farmer FIRST programme a psychometric scale was developed through COARSE method developed by John Rossiter (2002) as this method relies heavily on statistical methods to validate content validity which he believes that as the most crucial form of validity to measure the subjective constructs like attitudes, perceptions or beliefs. COARSE stands for

COARSE method ensures strong content validity, conceptually driven, encourages logical item development and rigorous expert review because of which this is the most suitable approach for development of scale to measure perception of sustainability in agriculture among the beneficiary and non-beneficiary farmers of farmer FIRST Programme.

Step-1: Construct Definition

The construct under investigation here is "Perception of farmers about sustainability in agriculture". It was defined as the extent to which the beneficiary and non-beneficiary farmers of farmer FIRST programme perceive sustainable agricultural practices that are environment friendly, economical and socially responsible.

The definition was tailor made by consulting the experts who are related to farmer FIRST programme and by referring to the sustainable agriculture literature along with consulting other stakeholders i.e., farmers.

The construct is defined as "the perception of sustainability in agriculture can be operationally defined as farmers' or stakeholders' beliefs, attitudes, and understanding regarding the following dimensions: soil and crop management practices, focusing on their awareness and evaluation of methods like crop rotation, conservation tillage, and organic amendments to ensure soil health and sustainable productivity; pest and disease management practices, capturing their perceptions of integrated pest management (IPM), reliance on biological controls, and reduced chemical usage to minimize risks while maintaining ecological balance; environmental protection and resource consumption, reflecting their views on resource conservation, efficient usage of soil, water, and biodiversity, and mitigating climate change impacts through responsible farming practices; and socio-economic factors, highlighting their opinions on equitable access to benefits, enhanced profitability, contributions to community welfare, and reduction of social and economic vulnerabilities".

Step-2: Object classification

The focus was on how the farmer personally evaluates and interprets various sustainable practices on their farm, based on their experiences, awareness, and involvement with or without the Farmer FIRST Programme. The unit of observation was thus the individual farmer, not a group, community, or physical farm performance indicator. So, the object of measurement here was individual farmer's perception of the sustainable practices in agriculture.

Step-3: Attribute classification

Based on the definition of sustainability and literature review, the construct was broken down into four major attributes or dimensions.

1. Soil and Crop Management Practices: Includes practices such as crop rotation, cover cropping, organic input use, proper soil preparation, and avoidance of burning residues.

2. Pest and Disease Management Practices: Encompasses biological control methods, diversification, and sustainable strategies for reducing chemical dependency and enhancing crop resilience.

3. Environmental Protection and Resource Conservation: Involves conservation of water, biodiversity, reduction of agrochemical use, and protection of natural resources for future generations.

4. Socio-Economic Factors: Captures the farmer's perception of long-term benefits, cost-effectiveness, knowledge complexity, and impact of sustainable practices on livelihood and farm productivity.

Each attribute was represented by multiple items to ensure comprehensive coverage of the construct.

Step-4: Rater identification

The raters in this study were defined as the final respondents who would respond to the scale items. They included beneficiary and non-beneficiary farmers of the Farmer FIRST Programme, selected from the adopted and non-adopted villages respectively. Beneficiary farmers had received interventions or support through the programme, while non-beneficiaries had not. This classification allowed for comparative analysis of perceived sustainability. Special care was taken to ensure that the language used in the items was simple, culturally appropriate, and understandable to both groups of farmers.

Step-5: Scale formation

At first 35 statements were collected to measure the perception of sustainability in agriculture from review of literature, analysis of farmer FIRST literature and expert consultation. They were filtered out by considering the ambiguity and other factors leaving out 27 statements which were sent to 65 judges through e-mail, WhatsApp and through personal contact who were experts of various disciplines and across the nation and especially to the people who had expertise in farmer FIRST programme of whom 42 judges responded which was enough sample to assess relevance and validity. The relevancy was measured on a three-point continuum with most relevant, not sure and irrelevant responses with 1, 0, -1 scores respectively.

Validity assessment: Validity was assessed through Lawshe's content validity ratio. Items with acceptable LCV Ratio were retained and revised for further clarity. Through this process 15 final statements were selected which was pre-tested.

LCV Ratio is useful in retention and rejection of individual items (Pan and Schumsy, 2012) while LCV Index is the mean of all LCV Ratios showing the overall validity of the measuring instrument (De Von *et al*., 2007).

$$CVR = \frac{n - N/2}{N/2}$$

Where, n = no of panelists rating the item as useful

N = Total no of experts

LCV Ratio ranges from -1 to +1, with higher values indicating greater agreement among experts about the item's essentiality.

Table 3.3 Selection of indicators based on relevancy test

S. No.	Indicators	LCVR
1.	Cover crop cultivation improves soil fertility and reduces erosion	0.809
2.	Sustainable farming practices lead to higher crop yields in the long run	0.714
3.	Use of organic fertilizers and mulches increases soil fertility and conserves soil moisture	0.857
4.	Plant residues should not be burned after harvest	0.904
5.	Good soil preparation and sowing limits weeds and gets high yields	0.761
6.	Sustainable farming techniques can increase the resilience of crops to pests and diseases	0.666
7.	Biological control is the best way to control and reduce damage of pests and weeds	0.714
8.	Crop rotation and diversification reduce pests and diseases	0.952
9.	Natural resources must be protected for future generations	0.809
10.	The indiscriminate uses of agrochemicals are harmful for human health and environment	0.762
11.	Sustainable farming practices enhance the overall health of my farm ecosystem	0.761
12.	Sustainable agriculture reduce the impact of climate change and prevents the polluting and destroying of natural resources	1
13.	The diversity of living things is essential for sustainability	1
14.	Additional costs associated with sustainable practices outweigh the potential benefits (-)	0.809
15.	Sustainable practices are too complicated and time consuming to implement on my farm (-)	0.857
16.	Relying solely on chemical pesticides leads to long-term pest resistance.	0.571
17.	Using compost or farmyard manure is more sustainable than synthetic fertilizers.	0.190
18.	Regular field monitoring helps in early detection and eco-friendly pest control.	0.238
19.	Government incentives encourage me to adopt sustainable practices.	0.047
20.	I would adopt sustainable practices even without subsidies if they improve my livelihood.	0.000
21.	I actively avoid over-extraction of groundwater.	0.000
22.	Indigenous technical knowledge is valuable for pest and disease management.	-0.047
23.	Incorporating legumes in cropping systems improves soil fertility.	-0.095
24.	Sustainable farming is only suitable for rich farmers.	0.333
25.	Sustainable practices are only needed in organic farming, not conventional farming.	0.476
26.	The goal of sustainable farming is to completely avoid modern science.	-0.143
27.	Sustainable practices are only important for export crops, not for local consumption.	-0.333

By using LCV Ratios closer to 1 are selected were considered for inclusion in the scale. Based on this criterion, 15 statements were selected for the final procedure. Through this process, the final indicators for the scale were selected, modified, and revised based on judges' comments. A total of 15 statements were chosen to be included in the scale.

Step-6: Enumeration
After content validation, the finalized items were arranged logically within their respective attributes and the final scale had four attributes of which Soil and Crop Management Practices had five statements while Pest and disease management practices had three statements, Environmental protection and resource conservation had four statements and Socio-economic factors had three statements.

Pre-testing: The finalized scale was pre-tested in one of the adopted villages of CRIDA i.e., Pudugurty village of Vikarabad district, Telangana where survey was done among 60 beneficiary farmers. Data were collected using a five-point Likert scale with response options as Strongly Agree (5), Agree (4), Not Sure (3), Disagree (2), and Strongly Disagree (1).

Reliability: The reliability of the measuring instrument, which consisted of 15 statements, was assessed using Cronbach's alpha. This statistical measure evaluates the internal consistency of the scale, indicating how well the items within the scale measure the same construct. The calculated Cronbach's alpha coefficient, using SPSS, was 0.712 which indicated that it was good.

Data Collection
The scale was administered to 300 beneficiary and 100 non-beneficiary farmers with identical backgrounds and the responses were collected on a five-point continuum with response options as Strongly Agree (5), Agree (4), Not Sure (3), Disagree (2), and Strongly Disagree (1).

Testing the validity of the scale
The validity of the scale was established to ensure that it accurately measures what it intends to measure. Content validity was used to assess the representativeness and adequacy of the scale's content. The content was thoroughly reviewed through literature and expert opinions. The content validity is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. Scale's convergent validity was measured using Confirmatory Factor Analysis. Convergent validity measures how well multiple items or indicators that are designed to measure the same construct correlate with each other. Convergent validity was estimated in three steps. They are

1. Factor loadings: Statements with standardized factor loadings ≥ 0.5 were considered as it indicates good convergence. For this scale all the standardized factor loadings were ≥ 0.5, the items of a scale had good convergence.

2. Model Fit Indices: These indicate whether the overall model (including constructs and relationships) fits the data well, which is critical for validating the entire framework of the scale. Good fit indices (e.g., CFI ≥ 0.9, RMSEA ≤ 0.08) ensure that the constructs, including convergent validity, are part of a coherent and valid structure.
In this case CFI is 0.907 and RMSEA is 0.057 which were appropriate and hence the scale had convergent validity.

3. Average Variance Extracted (AVE): It measures the internal consistency of the items within a construct.

$$\text{AVE} = \frac{\Sigma(\textit{Standardized Factor Loadings})^2}{\textit{Number of items}}$$

An AVE value ≥ 0.5 suggest good convergent validity. In this case AVE was 0.525 which was ≥ 0.5 which indicated a good convergent validity of the scale.

Measurement of perception of sustainability in agriculture:
The responses were recorded on five-point continuum viz., viz., strongly agree (SA), agree (A), undecided (UD), disagree (DA) and strongly disagree (SDA) with scores '5', '4', '3', '2', '1' respectively for positive statements and '1', '2', '3', '4', '5' respectively for negative statements. The scores obtained for each item were summed up to get final farming commitment score for the individual. The respondents were classified in to low, medium and high categories by k-mean cluster values.

Table 2: Distribution of the respondents based on the level of perception

Perception	Beneficiary farmers		Non-beneficiary farmers	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Poor	45	15.00	29	29.00
Fair	111	37.00	46	46.00
Good	144	48.00	25	25.00
Total	300	100.00	100	100.00

48.00 per cent of the beneficiary farmers had good perception of sustainability followed by fair (37.00%) perception and only 15.00 per cent of the beneficiaries had poor perception of sustainability. In contrast, major portion (46.00%) of non-beneficiary farmers had medium perception of sustainability followed by poor perception (29.00%) and good perception (25.00%) of sustainability. The results were in conformity with the findings of Gopika and Lalitha (2018).
The difference in perceptions between beneficiary and non-beneficiary farmers likely due to the support and resources provided to the beneficiaries. Beneficiary farmers often receive training, financial incentives, and access to sustainable farming technologies, which can enhance their understanding and appreciation of sustainable practices. This support helps them see the benefits of sustainability, leading to a higher percentage of fair and good perceptions. On the other hand, non-beneficiary farmers may lack access to these resources, making it harder for them to adopt and appreciate sustainable practices. This could result in a higher percentage of poor and medium perceptions among non-beneficiary farmers.

Conclusion and policy implications:
The present study was conducted in ATARI Zone-X where survey was conducted and data was collected from 300 beneficiary farmers and 100 non-beneficiary farmers of Farmer FIRST Programme. A scale was developed and was pre-tested. The study focussed on exploring the different perceptions of beneficiary and non-beneficiary farmers perception on sustainability in agriculture which revealed that major portion of beneficiaries had good perception of sustainability followed by fair and poor perceptions while non-beneficiaries had fair perception followed by poor and good perceptions. The probable reason for this variation might be the influence of regular trainings, meetings conducted under FFP which spread

awareness about sustainability along with their planned activities which mainly focussed on sustainable technologies. The findings from this study have several policy implications: enhanced training programs, targeted support for non-beneficiaries, incentive structures, community-based approaches, monitoring and evaluation, and integration of local knowledge. By addressing these areas, policymakers can create a more supportive environment for sustainable agriculture, ensuring that both beneficiary and non-beneficiary farmers are equipped to adopt and benefit from sustainable practices.

References

1. Ashwitha, K., Reddy, K. V., Laraib, K., Madhuri, V. B., Hritabrat, N. C., Akila, A., Shweta, R., Sai, J. V and Kalyani, C. 2024. Environmental Conservation for Sustainable Agriculture. *Springer*. 15-45 https://doi.org/10.1007/978-3-031-53270-2_2

2. Bird, C. 1940. Social psychology. Appleton-Century.

3. Edwards, A. L and Kilpatrick, F. P. 1948. A technique for the construction of attitude scales. *Journal of Applied Psychology*. 32(4):374–384. https://doi.org/10.1037/h0057313

4. Gopika, M. H and Lalitha, K. C. 2018. Perception of Beneficiary and Non-Beneficiary Farmers towards Integrated Farming System Demonstration. *Mysore Journal of Agricultural Sciences*. 52(2):227-233.

5. Gupta, N., Shanal, P., Abhishek, J and Nayha, P. 2021. Sustainable Agriculture in India 2021 – What we know and how to scale up. *New Delhi: Council on Energy, Environment and Water.*

6. Likert, R. 1932. A technique for the measurement of attitudes. *Archives of Psychology*. 55:22-140.

7. Press Information Bureau, 2024. https://pib.gov.in/Pressreleaseshare.aspx?PRID=2034943

8. Rossiter, J. R. 2002. The C-OAR-SE procedure for scale development in marketing. *International journal of research in marketing*. 19(4):305-335.

9. Singh, A. K., Venkatesan, P., Sivaramane, N., Sontakki, B. S., Chahal, V.P and Rao, Ch. S. 2021. Key Outcome of Farmer FIRST Programme 2016-2020 - Transforming the Lives and Livelihood of Indian Farmers. *Indian Council of Agricultural Research (ICAR), New Delhi, India*. 136.

10. Thurstone, L. L and Chave, E. J. 1929. The measurement of attitude. Univ. of Chicago Press.

11. Venkatesan, P., Sivaramane, N., Sontakki, B.S., Rao, S., Chahal, V.P., Singh, A.K., Sivakumar, P.S., Seetharaman, P and Kalyani, B. 2023. Aligning Agricultural Research and Extension for Sustainable Development Goals in India: A Case of Farmer FIRST Programme. *Sustainability*. 15(3):2463.

12. Wang, C. K. A. 1932. Suggested criteria for writing attitude statements. *The Journal of Social Psychology.* 3:367–373. https://doi.org/10.1080/00224545.1932.9919161