P-ISSN 2322 - 0678 & E-ISSN 3048 - 9946
https://doi.org/10.56572/gjoee.2026.41.1.0033 Gujarat Journal of Extension Education Vol. 41 : Issue 1 : June - 2026

A SCALE TO MEASSURE ATTITUDE OF FARMERS TOWARDS CARBON FARMING

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ABSTRACT

Farmers' attitude plays a crucial role in the adoption of sustainable agricultural practices, a scientifically standardized scale is essential to measure their attitude towards carbon farming. Therefore, the present study was undertaken to develop and standardize a scale to measure the attitude of farmers towards carbon farming. The Scale Product Method, combining Thurstone's equal-appearing interval technique and Likert's summated rating method, was used for the construction of the scale. Initially, 50 statements were collected through literature review, expert consultation and discussion with extension personnel. After careful editing based on the criteria suggested by Edwards (1957), 31 non-ambiguous statements were retained and administered to 50 judges for rating on a five-point continuum ranging from strongly relevant to strongly not relevant. Based on the median (S value) and interquartile range (Q value), 12 statements comprising 9 positive and 3 negative statements were finally selected for inclusion in the scale. The reliability of the scale was tested using the split-half method and Rulon's formula, which yielded a reliability coefficient of 0.999, indicating high reliability and consistency of the scale. The developed scale was also found to possess satisfactory content validity and can be effectively used for measuring farmers' attitude towards carbon farming.

***Keywords**: Carbon farming, carbon sequestration, scale product method, reliability, validity*

INTRODUCTION

Climate change has emerged as one of the most serious global challenges affecting agriculture, natural resources and environmental sustainability. Rising temperatures, irregular rainfall, droughts and floods are negatively influencing agricultural productivity and ecosystem stability. According to the Copernicus Climate Change Service and National Oceanic and Atmospheric Administration (NOAA), January 2025 was recorded as the warmest January globally, with temperatures 1.75°C above pre-industrial levels. Agriculture is both affected by and contributes to climate change through greenhouse gas emissions such as methane, nitrous oxide and carbon dioxide. In India, agriculture contributes about 13.72 per cent of the total greenhouse gas emissions (Chachei, 2024).

Carbon farming has emerged as an important strategy for climate change mitigation and sustainable agriculture. It includes practices such as conservation tillage, agroforestry, cover cropping and improved nutrient management, which help in reducing greenhouse gas emissions and increasing soil carbon sequestration (Paul *et al*., 2023; Yadav *et al.*, 2025). India has significant potential for carbon sequestration through improved soil and crop management practices (Dhyani *et al*., 2020). Despite policy initiatives and growing carbon market opportunities, adoption of carbon farming practices among farmers remains limited due to economic uncertainty, lack of technical knowledge and perceived risks.

The adoption of sustainable agricultural practices is influenced not only by economic and technical factors but also by farmers' attitudes and perceptions. There is a "high intention-low behaviour" gap in the adoption of low-carbon technologies, (Jiang *et al*., 2022) emphasizing the importance of psychological factors in behavioural change. However, there is limited availability of standardized tools to measure farmers' attitudes towards carbon farming. Therefore, the present study was undertaken to develop and standardize a reliable scale to measure the attitude of farmers towards carbon farming.

OBJECTIVE

To develop a scale to measure the attitude of farmers towards carbon farming

METHODOLOGY

Attitude is conceptualized as the positive or negative feelings of farmers towards carbon farming independently. Among the techniques available, 'Scale product method' which combines the Thurstone's technique (1928) of equal

appearing interval scale for selection of items and Likert's technique (1932) of summated rating for ascertaining the response on the scale as proposed by Eysenck and Crown (1949) was used. To ensure the validity and reliability of the instrument, a well-defined scale development procedure was adopted with reference to methodologies employed in previous studies (Patel *et al*., 2023; Chaudhary & Patel, 2023; Radadiya *et al*., 2025). The steps followed to develop the scale are item selection, evaluation by judges, calculation of scale and quartile values, testing for reliability and validity and final categorization, respectively.

RESULT AND DISCUSSION

Item selection

The items making up an attitude scale are known as statements. The 50 statements were collected from the relevant literature, experts, major guide and extension personnel and selected statements were edited on the basis of the criteria laid down by Edward (1957) and finally, 31 statements were selected as they were found to be non-ambiguous.

Judges rating of attitude statements

Fifty copies of the attitude statements were sent to 50 experts working in the field of agricultural extension, across State Agricultural Universities and related institutions through direct contact and mail, in order to judge the relevancy and not relevancy of each statement for its inclusion in the final scale. The experts were requested to indicate their responses on a five-point equal appearing interval continuum of agreement, *viz.*, strongly relevant, relevant, neutral, not relevant and strongly not relevant, with scores of 5, 4, 3, 2 and 1, respectively, for positive statements and the reverse scoring pattern for negative statements. Out of the 50 experts contacted, all the experts returned the statements after duly recording their judgments and their responses were considered for further analysis.

Calculation of scale and quartile Value

The five points of the rating scale was assigned, score ranks from 1 for most unfavourable and 5 for most favourable. Based on judgment, the median value of the distribution for the statement concerned was calculated with the help of following formula.

$$C_{50}/S = L + \frac{0.50 - \sum P_b}{P_W} \times i$$

Where,

S = the median or scale value of the statement

L = the lower limit of the interval in which the median falls

ΣPb = the sum of the proportion below the interval in which the median falls

Pw = the proportion within the interval in which the median falls

i = the width of the interval, which was assumed as equal to 1.0 (one)

The 75th centile value was calculated by using the following formula:

$$C_{75} = L + \frac{0.75 - \sum P_b}{P_w} \times i$$

Where,

C_{75} = 75th centile value of the statement

L = Lower limit of the interval in which the 75th centile falls

∑Pb = Sum of the proportion below the interval in which the 75th centile falls

Pw = Proportion within the interval in which the 75th centile falls

i = Width of the interval, which was assumed as equal to 1.0 (one)

The 25th centile value was calculated by using the following formula:

$$_{25} = L + \frac{0.25 - \sum P_b}{P_w} \times$$

Where,

C_{25} = 25th centile value of the statement

L = Lower limit of the interval in which the 25th centile falls

∑Pb = Sum of the proportion below the interval in which the 25th centile falls

Pw = Proportion within the interval in which the 25th centile falls

i = Width of the interval, which was assumed as equal to 1.0 (one)

Thereafter, the inter-quartile range for each statement was calculated by taking the difference between the C_{75} (Q_3) and C_{25} (Q_1).

$$Q = C_{75} - C_{25}$$

Procedure of selection of statements to measure attitude

Based on obtained median and quartile value, statements with greater median value than its quartile value

were selected, rest of them were rejected. In case of two or three similar median value, statements with smaller quartile value were selected. Following these criteria 12 statements were selected for the final scale.

Reliability of the scale

A scale is considered reliable when it consistently produces similar results when administered repeatedly under similar conditions. In the present study, the split-half method was used to test the reliability of the scale developed to measure farmers' attitude towards carbon farming.

The total statements included in the scale were divided into two halves consisting of odd-numbered and even-numbered statements. These two sets of statements were administered to 20 non-sample farmers. Each half was treated as a separate sub-scale and the scores obtained from both halves were correlated to determine the internal consistency of the scale.

The coefficient of reliability was calculated using Rulon's formula (Guilford, 1954).

$$rtt = 1 - \frac{\sigma^2 d}{\sigma^2 t}$$

The coefficient of reliability obtained through Rulon's formula was 0.998. Since reliability is directly related to the length of the scale, splitting the items into odd and even numbers provide the reliability coefficient for only half of the original scale. Therefore, a correction factor was applied using the Spearman-Brown prophecy formula to estimate the reliability of the full scale.

$$rtt = \frac{2roe}{1+roe}$$

Where,

rtt = coefficient of reliability of original test

roe = Reliability of coefficient of odd and even score

Coefficient of reliability of original test is 0.999, thus, the scale developed was found highly reliable.

Validity of the scale

The validity of the scale was assessed in terms of content validity to determine the extent to which the items represented the subject matter under study. The items included in the scale were selected through extensive review of literature, consultation with experts and strict adherence to the judges' ratings. Therefore, the scale was considered to possess satisfactory content validity.

Administration of the Scale

The statements selected for the final format of the attitude scale were randomly arranged to avoid response bias, which might otherwise contribute to lower reliability and reduce the validity of the scale. Out of the finally selected statements, 9 statements were positive, whereas 3 indicated negative attitude towards carbon farming practices.

Against each statement, five response categories representing a continuum of agreement and disagreement were provided, as suggested by Likert (1932) in his summated rating technique of attitude measurement. The five-point continuum consisted of strongly agree, agree, undecided, disagree and strongly disagree, with respective weights of 5, 4, 3, 2 and 1 for positive statements and reverse for negative statements.

Table 1: Final statements of the scale to measure attitude of farmers towards carbon farming

Sr. No.	Statements	Scale value (S)	Interquartile value (Q)
1	Carbon farming helps to improve soil fertility (+)	1.566	1.066
2	Carbon farming practices will benefit future generations (+)	1.690	0.262
3	Burning of crop residues is the biggest threat for carbon farming practices (+)	1.769	1.055
4	I trust in carbon farming practices (+)	1.727	1.170
5	Carbon farming practices lower crop yield (-)	2.416	1.831
6	Carbon farming increases productivity of soil (+)	3.687	2.007
7	Carbon farming increases the farm income in the long run (+)	2.312	1.531
8	I will promote carbon farming among my peers (+)	1.833	1.015
9	Carbon credits are only meant for highly educated farmers (-)	2.750	2.117
10	Agroforestry should be promoted as a part of carbon farming (+)	3.045	2.132
11	Tree-based farming practices stores more carbon (+)	1.847	0.942
12	Carbon farming requires too much labour (-)	2.863	1.933

ACKNOWLEDGEMENT

I extend my sincere appreciation to the individuals and institutions whose encouragement, expertise and assistance contributed substantially to the successful accomplishment of this research study.

CONFLICT OF INTEREST

The author declares "No conflict of interest".

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Received : April 2026 : Accepted : June 2026