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Construction and Validation of Instrument to Assess the Multifaceted Potential of School Vegetable Gardens

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HIGHLIGHTS

- Developed and standardized a 43-item Likert scale assessing multifaceted potential of school vegetable gardens across five dimensions.
- Items refined from 75 to 43 using relevancy (>80%) and t-value (>2.306) criteria with expert validation.
- Scale showed high reliability (Cronbach's $\alpha = 0.983$), strong split-half reliability, and satisfactory convergent validity (AVE).

ARTICLE INFO

Keywords: Multidimensional assessment, Reliability and validity, Scale development, School vegetable gardens, Student perception.

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ABSTRACT

The study is focused on developing and standardizing a scale to assess the multifaceted potential of school vegetable gardens as perceived by students. This instrumentation was carried out in the year 2025.The summated rating technique as proposed by Likert (1932) and refined by Edwards (1957) was employed for the construction of the instrument. Initially, a comprehensive literature analysis, conversations with subject matter experts, and field-level observations pertaining to school gardening programs produced a pool of 75 statements. After editing using standard criteria, 66 relevant statements were retained. Of these, 55 items were chosen based on a relevancy score of more than 80%. After item assessment, a total of forty three statements with t- values above 2.306 at the 5% level of threshold were incorporated and subjected to reliability and validity tests. Then, Factor Analysis (Exploratory) was carried out to confirm the dimensional structure and establish convergent validity. The final scale consisted of 43 items grouped under five dimensions: Economic, Environmental, Social, Governance, and Health & Well-being. The confirmed scale proved higher internal consistency with a Cronbach's value of 0.983 and satisfactory split-half reliability. Convergent validity was established by the Average Variance Extracted (AVE) values outstanding the threshold for each dimension.

INTRODUCTION

Education plays a crucial role in shaping socially responsible, environmentally conscious, and health-oriented citizens (Rieckmann, 2017). Schools, as foundational institutions of learning, provide an ideal platform for introducing sustainability-oriented practices that foster experiential learning and holistic development among students. In recent years, school vegetable gardens have gained increasing attention as an effective educational intervention that integrates academic learning with practical exposure to agriculture, environmental conservation, nutrition, and community engagement. These gardens are increasingly recognized as effective tools for promoting sustainability education and developing life skills among school children.

School vegetable gardens contribute beyond food production by serving as experimental laboratories where students actively

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participate in planting, nurturing, and harvesting crops (Blair, 2009). Through this process, students gain hands-on knowledge of ecological processes, sustainable resource use, and food systems. Such gardens have been reported to enhance environmental awareness, promote healthy dietary behaviours, strengthen social interaction, and encourage leadership and responsibility among students.

In addition to educational and environmental benefits, school vegetable gardens also contribute to economic and social development. Students learn concepts related to cost savings, efficient resource utilization, composting, recycling, and value addition through direct participation in garden management activities. In some schools, surplus produce from gardens is utilized for mid-day meal programmes or sold locally, thereby creating awareness regarding income generation and entrepreneurship. School gardens further strengthen community participation by involving teachers, parents, and local stakeholders in planning and maintenance activities. Such collaborative efforts promote collective responsibility, participatory governance, and stronger school-community relationships. Recent literature also suggests that engagement in gardening activities supports students' physical and mental well-being by reducing stress, encouraging physical activity, and promoting healthy food consumption habits.

As most existing studies focus on isolated outcomes such as nutrition or environmental awareness, with limited attention to the integrated economic, social, governance, and well-being dimensions. Moreover, there is a lack of standardized and validated instruments (Durlak et al., 2011) to systematically measure the multifaceted potential of school vegetable gardens, particularly from the students' perspective. A scientifically developed measurement scale can provide reliable insights into how effectively school vegetable gardens contribute to holistic development and sustainability education (DeVellis & Thorpe, 2021; Gupta et al., 2022; Kademani et al., 2025).

In view of these research gaps, the present study was undertaken to construct and standardize a comprehensive instrument for assessing the multifaceted potential of school vegetable gardens among students. The proposed scale aims to provide a reliable and valid framework encompassing economic, environmental, social, governance, and health & well-being dimensions. Such an instrument would facilitate systematic evaluation of school gardening initiatives and contribute to evidence-based planning, implementation, and policy formulation for strengthening sustainability-oriented educational practices.

METHODOLOGY

A structured and methodical approach was adopted to construct a scale designed to assess the multidimensional potential of school vegetable gardens. The development process was guided by established principles of attitude and perception scale construction (Edwards & Kilpatrick, 1948; Supe & Singh, 1976). In the initial stage, a comprehensive list of statements was generated through an in-depth review of relevant literature along with consultations with specialists in agricultural extension, urban agriculture, and school gardening to ensure inclusion of all important aspects.

Subsequently, the drafted items were subjected to content validation through expert review and focus group discussions to evaluate their clarity, relevance, and redundancy. Based on expert feedback, the statements were refined and screened according to the criteria proposed by Edwards and Kilpatrick (1948), including clarity of expression, singularity of meaning, and avoidance of ambiguous or extreme wording. A relevancy assessment (pilot study) was then conducted in which respondents rated each item on a five-point continuum ranging from "not at all relevant" to "highly relevant." After pilot testing the final refinement was carried out, followed by which reliability (Cronbach alpha and Spearmann coefficient) and validity (Average variance extracted) of each item was computed using RAISINS and SPSS software which led to the development of a theoretically sound and empirically reliable scale for measuring the diverse potential of school vegetable gardens.

RESULTS

Identification of dimension

The identification of dimensions to assess the multifaceted potential of vegetable garden were carried out using comprehensive review of literature and discussion with experts to have necessary modifications to suit the school vegetable garden context. Based on that, five major dimensions were found to be more appropriate for evaluating the multifaceted potential of vegetable garden in schools namely, economic, environment, social, governance and health & well-being dimensions.

Compilation and revision of items

A set of seventy-five items about the diverse potential of school vegetable gardens were gathered from a variety of sources, including recommendations from specialists in urban agriculture and extension education. The fourteen criteria as proponated by Likert (1932), Thurstone (1946); Edwards (1957) were then used to modify these statements. Of this, 66 statements that were unambiguous and clear were kept after modification.

Relevancy of the statements

Initially, 66 statements were created to assess the school vegetable garden's diverse potential. A panel of fifty specialists, including scientists, professors, and extension personnel from Universities in the discipline of agricultural extension, urban agriculture, and school gardening, reviewed these statements. A Likert scale of five point continuum was given to the experts to evaluate each statement's relevance: Highly Relevant (5) and Not Relevant at all (1) whereas Relevant (4), Undecided (3), Not Relevant (2) were scored this way. Each item was carefully reviewed and scored by 36 specialists of the 50 experts that were consulted based on their expertise in the area of this study. Following the principles as established by Edwards (1969); Raj and Thomas (2022); Sownthariya et al. (2026) those that were unspecific, unclear, or deemed to be irrelevant based on the relevance ratings were eliminated. The Relevancy Scores (%) of each item was then estimated by the formula:

$$\text{Relevancy score (\%)} = \frac{\text{Total scores obtained on each items}}{\text{Maximum possible score}} \times 100$$

The Item-Content Validity Index (I-CVI) approach was used to verify the 66 items (Lynn, 1986). As recommended by Polit and Beck (2006), items with a CVI value of 0.85 or above were kept. Following this, 55 statements with a relevancy score of 80% or more were finalised in five categories.

Analysis of item (Index of discrimination)

The t-statistic was determined in order to examine each aspect. Using the method described by Edwards (1957), this helps determine how well each statement distinguishes respondents with high felt potential of vegetable garden from those with low felt potential of vegetable garden. Fifty five statements were examined to determine whether they could possibly be employed to assess the school vegetable garden's diverse potential. 36 responders, including teachers and pupils from non-sample schools, were chosen for this. Each statement was given a five-point rating by the participants, ranging from Strongly Agree to Strongly Disagree. Negative comments were scored in the opposite sequence from positive items, which were scored as 5, 4, 3, 2, and 1. The responders were sorted from top to lowest based on their overall ratings. The low group consisted of the bottom 25% and the high group of the top 25%. The "t" value formulae was used to estimate which statements would effectively variate between groups with high and low perceptions. The following formula was then used to determine the t-value (critical ratio) for each item:

$$t = \frac{XH - XL}{\sqrt{\frac{\left(\left[\frac{(\Sigma XH^2 - (\Sigma XH)^2)}{N}\right] + \left[\frac{\Sigma XL^2 - (\Sigma XL)^2}{N}\right]\right)}{N(N-1)}}}$$

Where, XH = the mean score of a given statement from the high group, XL = The mean score of the same statement from the lowest group, ΣXH^2 = Sum of the squares of the individual scores on a given statement for high group, ΣXL^2 = Sum of the squares of the individual scores on a given statement for low group, ΣXH= Summation of the scores on given statement for high group, ΣXL= Summation of the scores on given statement for low group, N= Number of respondents in each group

As a consequence of the assessment, 43 statements with t-critical values greater than 2.306 at the 0.05 level of significance were refined for inclusion in the scale. Five major dimensions were used to finalise and classify these products of multifaceted potential of school vegetable garden: Economic (7 items), Environment (9 items), Social (7 items), Governance (5 items), and Health & well-being (15 items).

Reliability of the scale

To ensure the precision and consistency of the scores, the measurement tool's reliability was evaluated. Internal consistency was calculated using Cronbach's Alpha and the split-half method (Collins, 1996; Ray & Mondal, 2011; Shitu et al., 2018; Meethal & Thomas, 2024). The Spearman Brown formula was utilized to measure the split half reliability coefficient. The scale's great reliability was demonstrated by the results. In particular, a higher degree of internal consistency was shown by Cronbach's Alpha (α) of 0.983. For the 43-item test, Cronbach's alpha was computed by the following formula:

$$\alpha = (N / (N - 1)) \times [1 - (\Sigma\sigma i^2 / \sigma T^2)]$$

Where, N = Number of statements in the scale, σi^2 = Variance of each individual statement (i = 1 to N), $\Sigma\sigma i^2$ = Sum of the variances of all statements, σT^2 = Variance of the total score (sum of all items for each respondent)

The scale's reliability was further confirmed by the split-half reliability coefficients, which were 0.954 when determined using the Spearman-Brown and Guttmann formulas.

Split half reliability,

$$r1/2 = \frac{(N\,\Sigma XY - (\Sigma X)(\Sigma Y))}{\sqrt{\Sigma[N\Sigma X^2 - (\Sigma X)^2]\,[N\,\Sigma Y^2 - (\Sigma Y)^2]}}$$

Where, X = Scores of odd items, Y= Scores of even items, ΣX =sum of the scores of the odd items, ΣY = sum of the scores of the even items, ΣX^2 = sum of squares of the odd items, ΣY^2 = sum of squares of the even items.

Reliability co-efficient of the scale, (Spearman-brown formula)

$$R = 2\, r1/2 / 1 + r1/2$$

Where, R = Reliability coefficient of the test, r1/2 = Reliability coefficient of the half test

Table 1. Reliability Statistics (Split half reliability) 1

Cronbach's Alpha	Part 1	Value	.971
		N of Items	22[a]
	Part 2	Value	.966
		N of Items	21[b]
	Total N of Items		43
Correlation Between Forms			.913
Spearman-Brown Coefficient	Equal Length		.954
	Unequal Length		.954
Guttman Split-Half Coefficient			.954

[a]The items are: VAR00001 - VAR00022
[b]The items are: VAR00023- VAR00043.

Table 2. Reliability Statistics (Cronbach alpha) 2

Cronbach's Alpha	N of Items
0.983	43

Validity of the scale

Validity is vital to make sure a research instrument incorporates all the meant statements and enables credible and reliable results (Singh, 2019; Tripathy et al., 2026). Convergent validity was used here to ensure the validity of the instrument created to evaluate the diverse potential of school vegetable gardens. Principal component extraction with varimax rotation was used in an Exploratory Factor Analysis (EFA) to ensure the underlying categories of the construct and further confirm the validity of the scale. The convergent validity was confirmed by the EFA, which showed good loading coefficient across all the dimensions with loadings above 0.60 and an overall Average Variance Extracted (AVE) of 0.840. Based on this assessment, a final tool measuring the multifaceted potential of school vegetable garden was developed, which consisted of 43 statements.

Table 3. Descriptive statistics on multifaceted potential of vegetable garden

S.No.	Statements	t-value	Extraction	R2	AVE
I	Economic dimension				
1	The school garden helps to reduce expenditure on vegetable purchases	4.5355	0.867	0.752	0.849
2	Vegetables grown in the garden can be sold to generate income.	3.1081	0.817	0.667	
3	Budget allotted by the school for the garden is economically justified.	2.345	0.855	0.731	
4	I have started small gardening at home to reduce household vegetable expenses.	2.5298	0.896	0.803	
5	After working in the school garden, I consider gardening as a possible future career	2.4751	0.804	0.646	
6	The school garden does not help in saving or earning money.	4.6031	0.889	0.790	
7	The gardening skills I have learnt can help me earn pocket money.	4.8799	0.815	0.664	
II	Environment dimension				
1	I have learnt how plants grow and what they require	3.2771	0.896	0.803	0.855
2	The garden enhances the aesthetic environment of the school	4.4721	0.824	0.679	
3	I think gardening is a sustainable eco-friendly practice which all the other schools should adopt.	6.0999	0.882	0.778	
4	Gardening promotes efficient water use and recycling practices.	6.825	0.925	0.856	
5	Gardening helps to reduce heat in school premises and cities	4.8799	0.894	0.799	
6	Growing vegetables in school gardens reduces the need for transported food and helps lower greenhouse gas emissions.	5.3758	0.796	0.634	
7	School gardening supports biodiversity conservation by attracting insects, birds, and other beneficial organisms.	3.2771	0.847	0.717	
8	Increased vegetable production in the school makes the school self-reliant.	2.6666	0.75	0.563	
9	Urban school vegetable gardens do not contribute to sustainability	6.9282	0.877	0.769	
III	Social dimension				
1	The garden helped us learn about sharing.	7.2488	0.737	0.543	0.800
2	I made new friends while working in the garden	3.5000	0.734	0.539	
3	Gardening has promoted sense of belonging among us	5.4285	0.853	0.728	
4	Gardening has provided space for sharing our ideas	4.6031	0.755	0.570	
5	Gardening activity has increased my active participation in other school activities	3.2771	0.878	0.771	
6	We solved problems together during garden work.	6.0083	0.787	0.619	
7	I enjoyed when students from different classes worked together.	7.2335	0.853	0.728	
IV	Governance dimension				
1	I feel the decisions about the garden are made in a fair way.	6.0083	0.93	0.865	0.863
2	There are regular meetings or discussions about the garden	4.0971	0.837	0.701	
3	I feel responsible when I'm given a garden task	2.8168	0.78	0.608	
4	We have leaders among ourselves to take initiatives regarding garden	11.9392	0.92	0.846	
5	My teachers trusted me with garden responsibilities	2.4494	0.848	0.719	
V	Health and well being				
	Physical health				
1	Working in school garden increases my daily physical activity	11.3137	0.852	0.726	0.833
2	Gardening helps me stay physically active even in urban environment	5.547	0.779	0.607	
3	Gardening reduces the amount of time I spend sitting or using digital devices.	9.9469	0.929	0.863	
4	Gardening makes me feel tired without any benefits	14.5	0.864	0.746	
	Mental and emotional well-being				
5	Spending time in the school garden helps me feel relaxed	11.3137	0.812	0.659	
6	Gardening improves my mood during school day	11.0864	0.821	0.674	
7	Gardening helps to reduce my stress	8.3152	0.772	0.596	
8	Involvement in school garden improves my concentration in class	6.4874	0.778	0.605	
9	Gardening creates a sense of accomplishment in me	6.7823	0.86	0.740	
	Nutritional awareness and behaviour				
10	I am conscious about eating fresh vegetables after participating in gardening	3.092	0.767	0.588	
11	I understand the importance of safe and healthy food because of the garden	6.825	0.883	0.780	
12	I prefer fresh food items over processed snacks and junk food	4.8799	0.904	0.817	
13	I try to motivate my family to include vegetables in the meal and to grow vegetables at home	5.3758	0.797	0.635	
	Social, emotional integration				
14	Gardening helps me feel connected with other students	3.2771	0.879	0.773	
15	Working together in the garden improves my overall sense of well-being	2.6666	0.803	0.645	
	Overall AVE = 0.849 + 0.855 + 0.800 + 0.863 + 0.833 = 0.840				

Composite Reliability (CR) is calculated as follows:

$$CR = \frac{(\Sigma\lambda i)^2}{(\Sigma\lambda i)^2 + \Sigma(1-\lambda i^2)}$$

Where, λi = Standardized factor loading of item I, 1+ λi = Error variance of item, $\lambda^2 i$ = variance explained by the item

$$CR = \frac{(36.046)^2}{(36.046)^2 + 12.658} = 0.990$$

DISCUSSION

The present study resulted in the development of a scientifically validated and structured instrument for assessing the multifaceted potential of school vegetable gardens among students. The final scale consisted of 43 items grouped under five dimensions, namely Economic, Environmental, Social, Governance, and Health & Well-being. The emergence of these five dimensions reflects the inherently multidisciplinary nature of school vegetable gardens and their contribution to sustainability-oriented education. School gardens are not limited to agricultural learning alone; rather, they influence students' economic understanding, environmental responsibility, social interaction, participatory practices, and personal well-being simultaneously. The dimensional structure identified through factor analysis therefore confirms that school vegetable gardens function as holistic educational platforms capable of supporting multiple developmental outcomes.

Among the five dimensions, Health & Well-being emerged with the largest number of items (15 items). This is because of the broader and more visible direct influence of gardening activities on students' physical, mental, emotional, and behavioural development. Students involved in school gardening activities are exposed to healthy dietary practices, physical activity, stress reduction, emotional satisfaction, and improved social and psychological well-being. In addition, health and well-being aspects are often more observable and personally experienced by students compared to economic or governance dimensions, resulting in greater variability and representation during scale development. Previous studies have also highlighted that school gardens significantly influence students' nutritional awareness, food preferences, emotional balance, and overall quality of life, which may explain the higher concentration of valid items under this dimension.

The exploratory Factor Analysis (EFA) demonstrated better item loadings across the five dimensions, with all factor loadings exceeding the threshold of 0.60. Each sub-categories reported above the suggested benchmark for validity (Hair et al., 2020), indicating that the constructs adequately accounted for a substantial proportion of variance. The observed values were 0.849 for Economic, 0.855 for Environment, 0.800 for Social, 0.863 for Governance, and 0.833 for Health and Well-being. The overall Average Variance Extracted (AVE) was 0.840, further ensuring the convergent validity of the instrument (Fornell & Larcker, 1981). The final 43-item scale exhibited great internal consistency, as proven by a Cronbach's alpha of 0.983. In addition, split-half reliability analysis yielded strong results, with both the Spearman–Brown and Guttman split-half coefficients recording values of 0.954.

The final validation process lead to a robust forty- three item tool measuring multifaceted potential of vegetable gardens in schools under five dimensions: Economic (7 items), Environment (9 items), Social (7 items), Governance (5 items), and Health & well-being (15 items). The collective item's scientific and conceptual consistency was further ensured by extensive verification.

The developed scale has significant implications for extension education and sustainability-oriented programmes. Extension professionals, educators, and development agencies can utilize the instrument to assess students' perceptions regarding school vegetable gardens and evaluate programme effectiveness across schools and communities. The scale can serve as a diagnostic tool for identifying strengths and gaps in school gardening initiatives and for designing targeted interventions related to nutrition education, environmental awareness, student participation, and community engagement. Furthermore, the instrument may support evidence-based decision-making, resource allocation, policy formulation, and capacity-building efforts undertaken by government departments, schools, and non-governmental organizations involved in school sustainability programmes.

Despite its strengths, the study has certain limitations. The scale was developed and validated within a specific educational and socio-cultural context, which may limit its direct generalization to other regions or educational systems without further testing. In addition, the instrument primarily captures students' perceptions and does not include the perspectives of teachers, parents, or administrators.

CONCLUSION

The study developed and validated a comprehensive 43-item scale to assess the multifaceted potential of school vegetable gardens across five key dimensions: Economic, Environmental, Social, Governance, and Health & Well-being. These dimensions reflect the holistic contributions of school gardens to students' learning, behaviour, and overall development. The systematic scale construction process ensured strong content validity, high internal consistency, and satisfactory convergent validity, confirming the robustness and reliability of the instrument. The high Cronbach's alpha value and favourable Average Variance Extracted scores indicate that the scale effectively captures students' perceptions across multiple dimensions. The standardized scale serves as a psychometrically sound and holistic tool for systematic assessment and comparison across schools, helping to identify strengths and gaps in existing garden initiatives. It provides valuable insights for researchers, educators, and policymakers, thereby supporting evidence-based planning, decision-making, and effective implementation of school vegetable garden programs while contributing to sustainability-oriented educational research.

DECLARATIONS

Ethics approval and informed consent: Informed consent from the specialist possessing specialized knowledge in urban agriculture, extension education were sought to obtain validation. From their feedback, a pilot study was carried out with randomly selected students from non -sampling schools.

Conflict of interest: The authors declare that this research was carried out without any financial contribution that could be considered as potential conflicts of interest among. The authors further affirm that they independently reviewed, revised, and edited the manuscript throughout its preparation and accept the final content of this publication.

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REFERENCES

Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school universal interventions. *The Journal of Environmental Education, 40*(2), 15–38. https://doi.org/10.3200/JOEE.40.2.15-38

Collins, L. M. (1996). *Research design and methods*. In Encyclopedia of Gerontology (2nd ed., pp. 419–429). Pennsylvania State University, University Park, PA, USA.

DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage publications.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child development*, *82*(1), 405-432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Edwards, A. L. (1957). *Techniques of attitude scale construction*. Ardent Media.

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

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable gardening. *The Journal of Environmental Education, 40*(2), 15-38.

Gupta, S. K., Nain, M. S., Singh, R., & Mishra, J. R. (2022). Development of scale to measure agripreneurs attitude towards entrepreneurial climate. *Indian Journal of Extension Education*, *58*(2), 153-157. http://doi.org/10.48165/IJEE.2022.58237

Kademani, S., Nain, M. S., Singh, R., Roy, S. K., Prabhakar, I., Ranjan, A., Karjigi, D. K., Patil, M., Das, D., & Wasaful, Q. S. K. (2025). Quantifying support for agripreneurs: a multidimensional scale development and analysis of institutional mechanisms, *Journal of Global Entrepreneurship Research, 15*, 12. https://doi.org/10.1007/s40497-025-00429-4

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, *22*(140), 5–55.

Meethal, S. V. K., & Thomas, A. (2024). Construction of a scale to measure correlates of adoption of sustainable domains in on-farm testing interventions. *Indian Journal of Extension Education*, *60*(4), 112–117. https://doi.org/10.48165/IJEE.2024.604RT1

Raj, N., & Thomas, A. (2022). A scale to measure risk behaviour of vegetable farmers. *Journal of Tropical Agriculture*, *60*(1), 113-117. https://jtropag.kau.in/index.php/ojs2/article/view/1131

Ray, G. L., & Mondal, S. (2011). *Research methods in social sciences and extension education*. Ludhiana: Kalyani Publishers, 256-280.

Rieckmann, M. (2017). *Education for sustainable development goals: Learning objectives*. UNESCO publishing.

Shitu, G. A., Nain, M. S., & Kobba, F. (2018). Development of scale for assessing farmers' attitude towards precision conservation agricultural practices. *Indian Journal of Agricultural Sciences, 88*(3), 499-04. https://doi.org/10.56093/ijas.v88i3.78741

Singh, A. K. (2019). *Tests, measurements and research methods in behavioural sciences*. Bharati Bhawan Publishers & Distributors, New Delhi, pp 79–103.

Sownthariya, S., Meethal, S. V. K., & Thomas, A. (2026). Development and validation of AgTech-Enabled market access scale for Hi-Tech agriculture. *Indian Journal of Extension Education*, *62*(1), 176-181. https://doi.org/10.48165/IJEE.2026.621RT07

Supe, S. V., & Singh, R. (1976). Methods of scale construction in extension research. *Indian Journal of Extension Education*, *12*(1–2), 9–15.

Thurstone, L. L. (1928). Attitudes can be measured. *American journal of Sociology*, *33*(4), 529-554.

Tripathy, H., Somanath, G., Behera, S. R., & Neethu, J. S. (2025). Construction of a scale for measuring the level of satisfaction of the members of Farmer Producer Organizations (FPOs). *International Journal of Agriculture Extension and Social Development, 8*(11), 159–163.

Tripathy, H., Somanath, G., Thomas, A., & Smitha, S. (2026). Development of a standardized scale to assess marketing effectiveness of farmer-producer organisations (FPOs). *Indian Journal of Extension Education, 62*(2), 166-172. https://doi.org/10.48165/IJEE.2026.622RT06