A Scale to Measure Impact of Front Line Demonstrations on Food Security and Climate Resilience

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Krishi Vigyan Kendras (KVKs) were established to provide essential agricultural education and support to farmers at the grassroots level. These centers play a crucial role in disseminating advanced agricultural technologies and practices to improve the productivity and sustainability of farming. Front Line Demonstrations (FLDs) play a crucial role in agricultural extension programs of KVKs, providing a platform to demonstrate and validate new technologies, practices, and innovations directly in farmers' fields. They are an integral part of agricultural extension services, facilitating the smooth and effective transfer of knowledge and technology from research institutions to the farming community. The present study was conducted to develop a scale to measure the impact of Front Line Demonstrations on food security and climate resilience. We collected 107

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statements, out of these 42 statements were selected through relevancy test. Out of 42 statements, 28 statements were retained on the final scale. Reliability and validity of the scale indicates its consistency and precision of the results.

1. INTRODUCTION

"Front Line demonstrations (FLDs) is a unique approach to provide a direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and to get direct feedback from the farmers' field" (Parmar et al., 2017). This enables the scientists to improvise upon the research program accordingly. Farmers can witness firsthand the benefits of adopting new technologies, such as high-yielding crop varieties, efficient irrigation methods, or sustainable farming practices. This leads to increased crop productivity, contributing to food security. FLDs also focus on climate resilient practices like promotion of drought-resistant crops, water-conservation techniques, and soil management practices that help farmers adapt to changing climate conditions. By adopting these practices, farmers can mitigate the impact of climate change on their agricultural activities. Thus, Front Line Demonstrations play a pivotal role in promoting sustainable and climate-resilient agricultural practices, ultimately contributing to increased food security and the ability of farmers to cope with the challenges posed by climate change.

"KVKs conduct large number of technology demonstrations at farmers' fields for their adoption by the farmers. The KVKs conducted 12.12 lakh demonstrations on different technologies related to crops, livestock, fisheries, farm machinery and other enterprises during the last five years" (PIB 22 July 2022).

"The KVKs are down-to-earth institutions committed to vocational training, transfer of latest technologies, on farm research and thus, serving as the light house for overall rural development in the district" (Rajan et al., 2020). "The mandate of the KVK include technology assessment, refinement and transfer, aiming to bridge the gap between the technology developed at the research institutions and its adoption at the field level by the farmers" (Kokate, 2012). "The concept of technology assessment and refinement is based on participatory mode ensuring greater scientists- farmer linkage and access to agricultural technologies generated by research systems to the farming community. For this, the role of KVKs are of immense importance for overall agricultural and rural development through its various research and technology transfer mechanisms" (Jadhav & Pirabhu, 2019).

"Education Commission (1964-66) of the Government of India recommended that a vigorous effort be made to establish specialized institutions to provide vocational education in agriculture and allied fields. The recommendation of the Commission was thoroughly discussed during 1966-72 by the Ministry of Education, Ministry of Agriculture, Planning Commission, Indian Council of Agricultural Research (ICAR) and other allied institutions. Finally, ICAR mooted the idea of establishing KVKs also known as Farm Science Centers as innovative institutions for imparting vocational training to practicing farmers, school dropouts and field level extension functionaries" (Jadhav & Pirabhu, 2019). "The ICAR, therefore, constituted a committee in 1973 headed by Dr. Mohan Singh Mehta to work out a detailed plan for implementing this scheme. The Committee submitted its report in 1974. The first KVK, on a pilot basis, was established in 1974 at Puducherry (Pondicherry) under the administrative control of the Tamil Nadu Agricultural University, Coimbatore. At present there are 731 KVKs across the country under different host organizations" (Rana et al., 2023).

There was no scale available to measure the impact of these Front line demonstrations. Hence, the present study was contemplated to develop a scale to measure the impact of Front line demonstrations on food security and climate resilience.

2. METHODOLOGY

The Likert's technique was used for constructing the scale to study the impact of FLDs on food security and climate resilience. The details of the procedure followed in the construction of the

Likert type scale to study the impact of FLDs on food security and climate resilience have been discussed as below.

Based on the review of literature, 60 and 47 statements regarding food security and climate resilience, respectively were collected and revised based on criteria suggested by Edward (1983). After review 42 and 35 items were retained for scale construction under food security and climate resilience, respectively. The 77 items under two sub-dimensions were sent to 50 experts in the field of agricultural extension to determine its relevancy and screening for inclusion in the final scale. "The experts were requested to give their responses on a five-point continuum i.e., highly relevant, relevant, undecided, less relevant and not relevant with scores 5,4,3,2 and 1 respectively.

These experts were from the field of agricultural extension education and social science. They were requested to indicate their response by putting a tick mark in suitable continuum for each item. The experts were also requested to make necessary modifications and additions or deletions, if they desired so. Out of 50 experts, only 35 experts responded in a period of two months and their relevancy score was ascertained by adding the scores and a relevancy test was worked out using the formula" (Ravikishore and Seema, 2017)

Relevancy score =

$$\frac{\text{Total score obtained on each item}}{\text{Maximum Possible score}} \times 100$$

Those items, which secured a relevancy score of 80 and above, were selected and were suitably modified and rewritten as per the comments of experts. From the 77 statements, final 42 were selected under the 2 sub dimensions. The 42 statements selected after the relevancy test were then administrated to 40 non-sample respondents.

2.1 Calculation of 't' Value

The respondents were asked to indicate how much they agreed or disagreed with each statement on a five-point continuum ranging from "strongly agree" to "strongly disagree". The scoring pattern adopted was 5 to 1 where, 5 corresponds to strongly agree, 4 corresponds to agree, 3 corresponds to undecided, 2

corresponds to disagree and 1 corresponds to strongly disagree.

"The perception score of the respondent was obtained by adding up the scores of all statements in the scale. Based on the total summated scores, respondents were arranged in descending order. Respondents with highest total scores (top 25%) and lowest total scores (bottom 25%) were made into two groups. The two groups provided the criterion groups in terms of which item analysis was carried out as suggested by Edward (1957). Thus, out of 40 respondents, 10 respondents with high scores were considered as high group and 10 respondents with low scores were considered as low group to calculate the critical ratio i.e., 't' value for each of the selected statement. The critical ratio was calculated by t-test. The 't' values were calculated by using the formula" suggested by Edward (1957).

"The t value is calculated as a measure of the extent to which the statement differentiates between the respondents of high group and low group" (Kumar & Ratnakar, 2016).

$$t = \frac{X_H - X_L}{\sqrt{\sum \frac{(X_H - X_H)^{\overline{2}} + (X_L - X_L)^{\overline{2}}}{n(n-1)}}}$$

Where,

$t =$	the extent to witch a given statement differentiates between the high and low groups,
$X_H =$	the mean score on a given statement for the high group,
$X_L =$	the mean score on the same statement for the low group,
$(X_H - X_H)^2 =$	the variance of the distribution of responses of the high group to the statement,
$(X_L - X_L)^2 =$	The variance of the distribution of responses of the low group to the statement
$n(n-1) =$	number of subjects in low or high group;

2.2 Selection of Statements for Final Scale

After computing the 't' value for all the statements, 28 statements with 't' value equal to

or greater than 2.55 were finally selected and included in the scale.

"A scale should measure what it seeks to accomplish to measure and it should be consistent in its measurement. A scale thus has to be standardized before it administered. The scale developed was standardized by testing its reliability and validity. A scale is reliable when it will consistently produce the same results for the same individuals on different occasions or with different sets of equivalents. For testing the reliability, split half method was employed" (Garrett & Woodworth, 1973). "After getting back the responses, the scale was divided into two halves, all odd statements into one half and all even statements into another. One half (one set) contains the odd numbered items (1, 3, 5, 7 etc.) and the other half (other set) the even-numbered items (2, 4, 6, 8 etc.). Reliability coefficient (R.C) was computed using the Spearman-Brown formula" (Chandra et al., 2024)

RC of test $=$

$$\frac{2^* \text{ R.C of the half test, found experimentally}}{1 + \text{ R.C of the half test, found experimentally}}$$

3. RESULTS AND DISCUSSION

From the 77 statements, total of 42 statements were selected through relevancy score, based on judges rating under the two dimensions. After computing 't' values for all the 42 statements, the statements with 't' values more than 2.55 were selected for the final scale. Thus, out of 42 statements, 28 statements with 't' value more than 2.55 were selected in the scale. The correlation of reliability coefficient (r = 0.702) was significant at 0.05 level of significance.

3.1 Testing the Reliability of the Scale

"A scale is reliable when it will consistently produce the same results when applied on the same sample" (Kumar et al., 2018). The Coefficient of reliability was calculated between the two halves. The correlation of the reliability coefficient for both sets was worked out. The correlation of reliability coefficient (r = 0.702) was significant at 0.05 level of significance indicating the scale was highly suitable for administration to FLD farmers as the scale was stable and dependable in its measurement.

Table 1. Scale developed to measure the impact of Front Line Demonstration on food security and climate resilience

SI No.	Statements	t value
1.	FLDs enhanced resource use efficiency by popularizing better varieties and cutting-edge technology.	7.05
2.	FLDs increased farmers' awareness of varieties suitable for rainfed conditions	3.24
3.	FLDs led to an increase in acreage under biofortified varieties.	3.43
4.	FLDs led to an increase in acreage under disease-resistant varieties.	2.75
5.	FLDs encourage the active use of biofertilizers among farmers	5.35
6.	Frequent FLD interventions positively influenced farmers' willingness to adopt improved varieties	5.96
7.	FLDs enhance awareness of high-yielding varieties among farmers.	7.81
8.	Strong institutional linkages facilitated the horizontal spread of improved varieties through FLDs.	3.57
9.	Short-duration varieties are now being cultivated as a result of FLDs.	4.62
10.	FLDs emphasized the importance of crop diversification, resulting in a more resilient and diverse food production system.	2.74
11.	Timely interventions through FLDs paved the way for varietal replacement.	5.12
12.	FLDs provided farmers with high-quality seeds, supporting better agricultural outcomes.	4.02
13.	FLDs increased awareness about local products, and their dietary value and generated greater market demand from consumers.	2.72
14.	A well-established and coordinated research system contributed to developing improved varieties suitable for different agro-climatic zones.	3.83
15.	FLD interventions like nutri gardens and CFLDs can potentially tackle hunger and malnutrition.	3.34

SI No.	Statements	t value
16.	FLDs on kitchen gardens have contributed to increased diversity in food production.	2.63
17.	Through FLDs, households have acquired the knowledge to prepare nutritionally balanced meals.	3.85
18.	FLDs provide farmers access to the necessary resources to optimize food production.	5.53
19.	FLDs emphasized the importance of crop diversification, resulting in a more resilient and diverse food production system.	3.20
20.	FLDs played a significant role in aligning farmers' practices with eco-friendly approaches.	4.93
21.	Water-smart practices like micro-irrigation have been popularised through demonstrations.	5.12
22.	FLDs encouraged nitrogen-smart practice like precision farming.	2.62
23.	Through FLDs, Carbon smart practices such as the application of organic manures have become popular among farmers.	2.91
24.	FLDs contributed to the increased adoption of crop residue recycling practices.	3.62
25.	FLDs promoted the location-specific use of appropriate fertilizers, reducing the environmental impact associated with fertilizer use.	2.84
26.	Energy-smart activities like the use of fuel-efficient machines witnessed increased adoption through FLDs.	2.53
27.	FLDs help farmers make informed decisions by providing data on weather parameters.	4.09
28.	FLDs facilitated the fine-tuning of package of practices for diverse agroecological production systems.	2.94

3.2 Testing the Validity of the Scale

Content validity: The content validity is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument (Yibrah et al., 2017). This method was used in the study to determine the content validity of the scale. The validity of the scale was obtained through content validity by taking the judge's opinion. The statements selected for the scale were evaluated individually and as a whole by the experts. As the content of the scale was borne out by the method of collecting statements within the universe it may reasonably be assumed that the scale of impact of FLDs on food security and climate resilience, has content validity.

3.3 Administration of the Scale

The final scale to measure the impact of Front Line Demonstrations comprised of 28 statements under two dimensions viz. food security and climate resilience measured on a five-point continuum viz., Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) with scores of 5, 4, 3, 2 and 1. Obtained score on this scale ranges from 28 to 140.

4. CONCLUSION

The final scale developed and standardized to measure the impact of Front Line Demonstrations (FLDs), was again checked by subject matter specialists in the extension department of KAU and KVKs for their relevance and coverage. The scale can be used in any geographical area with suitable modification. Other parallel scales can also be derived and standardized from the results of the study.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/126310