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# Development of Multi-dimensional Scale to Measure Attitude of Farmers Towards Conservation Agricultural Practices

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**ABSTRACT**

Attitude exhibits a pivotal role in influencing one's behaviour towards any psychological object. The present study aimed at developing and validating a multi-dimensional attitude scale on Conservation Agricultural practices based on Maheshwari–Kumar–Jhamtani–Bhaskaran–Dandapani (M-K-J-B-D) method. The steps included item collection, item selection, item analysis, conducting Principal Component Analysis to extract the underlying dimensions and finally calculation of attitude scores. A total of 75 attitudinal items were pooled initially covering various aspects of Conservation Agriculture (CA) and were subjected to item relevancy checking and item analysis. The final scale contained 25 attitudinal statements under eight sub-dimensions. The reliability of the scale was measured by using Cronbach's Alpha and the reliability coefficient was found to be 0.80 which was satisfactory. The validity was assessed using content validity method by dispensing the finalized scale to 10 subject related experts. This standardized scale can be used by other academicians of related fields with or without modifications to measure attitude of farmers towards different aspects of Conservation Agriculture.

## INTRODUCTION

The multifaceted interaction of population growth, technological advancement and climate change have strongly impacted agricultural and environmental sustainability in the post Green Revolution era. In spite of a notable surge in global food grain production since 1960s in India, there are 795 million food-insecure and approximately 2 billion people predisposed to malnutrition (FAO, 2015). Additionally, the global population is projected to touch the mark of 9.7 billion by 2050 and this increase in population is negatively correlated with availability of per capita arable land (Lal, 2016). Besides this, other problems that crippled the post Green Revolution agriculture are extensive mono-cropping, climate change issues, different types of biotic and abiotic stress etc. The need of the hour is to lessen the anthropogenic pressure on the food systems in one hand, while producing more from less and for future generation also. To bring a paradigm shift in agriculture, National Agricultural Research Systems (NARS), the Food and Agricultural Organization (FAO) of the United Nations and Consultative Groups on International Agricultural Research (CGIAR) Centres have accepted Conservation Agriculture (CA) as a vehicle for change (CIMMYT, 2011). Practising CA will surely be advantageous to minimize the aforesaid problems and will make our farming system further resilient, conserve energy for our future generation, create cleaner environment, and bring biodiversity back to soil and ultimately

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improve ecosystem. But even after 15 years of introduction of CA technologies, majority of the Indian farmers are still partially adopting CA techniques. Small and marginal farmers are still the untouched segment with respect to adoption of CA practices (Krishna et al., 2022). Marginal and small farmers often hold-up in the technology diffusion process due to various factors like lack of awareness, unfavourable attitude, credit constraints *etc*. (Garcia & Krishna, 2021). Along with this, stereotypic mind set of the traditional farmers stand as a blocking factor in the way of smoother adoption of CA technologies (Bardhan & Bhardwaj, 2022).

Behavioural change among the farmers can be inculcated by altering the existing attitude of farmers towards CA practices. Till now, very few researches have been conducted on this aspect. A recent study by Ramu & Asokhan (2021) in Tamil Nadu explained the attitude scale construction methodology towards CA practices but lacked multi-dimensional perspectives. Another research study by Shitu et al., (2018), vividly described the attitude scale formation steps related to Precision Conservation Agriculture but the domain identification part lacked proper statistical support. Attitude towards CA practices have several multi-dimensional aspects. So, assessing attitude towards CA practices by uni-dimensional scale might give us incoherent results and lead to multi-collinearity effects due to higher degree of correlation among the statements. Considering the aforesaid issues, the present research was undertaken to construct and validate multi-dimensional attitude scale for measuring the attitude of farmers towards ca practices.

## METHODOLOGY

The step wise multi-dimensional attitude scale construction methodology developed by Maheshwari–Kumar–Jhamtani–Bhaskaran–Dandapani in 2006 was taken up by the researcher for the present study to construct a scale for measuring the attitude of farmers towards Conservation Agricultural (CA) practices in wheat (Mohanty et al., 2009). After doing in-depth review of relevant literature, discussion with the farmers, subject matter experts and from investigator's personal experience, a total of 75 relevant attitudinal items were pooled covering different aspects of CA. Out of 75 items, 59 items satisfying the criteria of constructing attitude scale by Edwards (1969) were retained for further analysis. A conscious effort was taken to include approximately equal number of positive and negative statements.

The 59 selected items were then administered to 45 judges for checking the relevancy on a 3 point continuum by conducting individual visits, sending online via email or WhatsApp or Google forms. The basic selection criterion for judges was they should be experts in the field of Conservation Agriculture with a minimum of three years' experience. Statements with relevancy score of more than 1.5 were retained for next round of analysis. 37 items passing the relevancy test were re-dispensed to 35 experts to measure their degree of agreement on a 5 point continuum ranging from 5= strongly agree to 1= strongly disagree. Individual respondents total score of all items were calculated and then based on their total score, rearrangement was done in descending order of scores. After that top 30 percent of the respondents with higher score and bottom 30 percent of respondents with lower score were selected. The t value for each item was then calculated with the selected respondents' score. The results of item analysis revealed t value of individual items. Items with a t value of more than 1.75 were further short-listed. Hence, a total of 25 items were retained for the final scale (Table 1). These 25 statements were presented to 240 non-sample respondents. Responses were recorded in 5 point continuum that ranged from strongly agree to strongly disagree and scores ranging from 5 to 1 were given accordingly.

Sampling adequacy and inter-correlation among variables (statements) were checked through Kaiser-Meyer-Olkin (KMO) test and Bartlett's test respectively. A score of 0.834 in KMO test indicated high sampling adequacy. Significant result in Bartlett's test led us to reject null hypothesis of non-collinearity. Therefore, there was inter-correlation among the variables making it a suitable case to construct a multidimensional scale by eliminating covariance effect in overall measurement of perception.

The validation of the attitude scale was done using content validity test approach and hence the developed attitude scale was sent to 10 field related experts for their opinions and suggestions. Due care was exercised in choosing and wording the items to cover all the important aspects. As stated by Anastasi (1968), content validity brings about a systematic analysis of test contents to find out whether it takes into account representative sample of the behaviour area to be assessed. Chandhana et al., (2022) also used this method for assessing the validity of the research tool.

Due to prevalence of COVID during data collection period, researcher took proper care and safety measures. Limited numbers of Focus Group Discussions were conducted along with personally interviewing the respondents. Computer aided techniques of data collection like Google forms and KoBo Toolkit were used during field survey.

## RESULTS AND DISCUSSION

### Finalizing of attitude scale items on the basis of relevancy test and item analysis

Table 1 vividly illustrates the selected attitude scale items passing the relevancy test (score greater than 1.5) and item analysis (calculated t value equal to or greater than 1.75). Out of 75 total pooled items, finally 25 items were retained in the developed tool. The maximum and minimum t scores of the selected attitudinal items was 5.15 and 1.83, respectively. In a line with Edwards (1969), any attitudinal item with t value more than 1.75 has higher discrimination power and that item could be kept in the final scale.

### Concluding the dimensions of the scale

In the next step, through factor analysis, communality value of each statement was checked and the value for all statements was found to be more than 0.6 which lead to acceptance of all the items (Bhattacharyya et al., 2021). Eight components were extracted through principal component method. Initial eigen values reduced to less than one after eighth component. Further, eight components could also explain total variance up to 57.078 per cent. The increment in total variation explained by subsequent components was marginal. Therefore the number of components in factor analysis was restricted to eight. Similar procedure was followed

**Table 1.** Result of relevancy test and item analysis (n= 35)

| S. No. | Attitude Statements | Relevancy test | t value |
|---|---|---|---|
| 1 | I feel practicing Zero Tillage (ZT) in wheat will help in conserving moisture as compared to conventional tillage. | 2.69 | 1.83 |
| 2 | I think practicing Conservation Agriculture (CA) will hardly assure food security. | 2.80 | 2.16 |
| 3 | I believe ZT will enhance the sustainability of the agro ecosystem by reducing the soil erosion. | 2.88 | 3.26 |
| 4 | I think yield reduction due to late sowing of wheat can be avoided by direct sowing in ZT condition. | 2.65 | 2.42 |
| 5 | Practicing ZT is environmentally safe as compared to conventional tillage due to reduction in the emission of greenhouse gases. | 1.66 | 1.94 |
| 6 | I think conventional tillage will result in enhancement of soil biological activities as compared to zero tillage. | 1.90 | 1.93 |
| 7 | I feel practicing conservation agriculture (CA) in wheat is not economically profitable. | 2.05 | 2.98 |
| 8 | In my opinion residue retention enhances the water holding capacity of the soil. | 2.70 | 1.96 |
| 9 | Mulching leads to maintain fluctuation in soil temperature. | 1.66 | 2.39 |
| 10 | Stubble burning leads to greater nutrient availability as compared to retention of stubble. | 1.73 | 2.62 |
| 11 | Crop rotation helps in removing yield stagnancy of mono-cropping. | 2.18 | 2.18 |
| 12 | ZT checks water infiltration and permeability of the soil. | 2.57 | 4.25 |
| 13 | Government subsidies help in easy access and availability of CA machineries. | 1.80 | 2.70 |
| 14 | In my opinion, Custom Hiring Centres play an important role in renting CA machineries. | 2.47 | 5.15 |
| 15 | Practicing CA in wheat will make farming system more resilient towards changing climate. | 1.56 | 1.77 |
| 16 | Laser land levelling (LLL) improves uniformity of crop maturity and yield. | 1.99 | 2.76 |
| 17 | Cultivating different crops serves as a better income source for small and marginal farmers. | 2.75 | 2.50 |
| 18 | LLL improves water application efficiency in the CA field | 2.01 | 3.32 |
| 19 | I feel weed infestation is more in case of Conservation Agriculture. | 1.75 | 1.96 |
| 20 | I feel grain quality of CA cultivated wheat is better as compared to conventionally cultivated wheat. | 1.66 | 2.45 |
| 21 | Conventional agriculture makes better utilization of inputs and resources than Conservation Agriculture (CA). | 2.25 | 1.88 |
| 22 | Site specific nutrient management in CA helps to lower the cost of cultivation. | 2.48 | 2.42 |
| 23 | I feel practicing CA reduces my stubble burning behaviour. | 1.99 | 3.03 |
| 24 | I believe that retaining crop residues in CA field compete with fodder availability of the livestock. | 1.57 | 4.70 |
| 25 | CA specific machineries are not timely available. | 2.66 | 3.13 |

by Singh et al., (2021) for identifying the underlying dimensions of constructed attitude scale zero tillage and reported that four factors with eigen score more than one were representing the total sets of attitudinal items selected.

**Regressing statements (variables) into factors**

The rotated component matrix obtained through Principal Component Analysis (PCA) demonstrated the factor loadings which explained contribution of each statement (variable) to the components (Table 4). On the basis of factor loadings of statements to a particular component (factor), the components were given a name to represent the group of statements that have major contribution to particular component (factor). Mathematically, the attitudinal statements with maximum contribution to a particular component were having higher β values than for other components.

A perusal of Table 2 reveals that for first component, higher contribution was from the statements numbered 2, 3,5, 6, 9 and 15. These statements mostly represented environmental aspects related to CA practices like “I believe ZT will enhance the sustainability of the agro ecosystem by reducing the soil erosion”. Hence, component $Y_1$ represented environmental dimension. Likewise, the other seven extracted factors were resource management aspects of CA, financial aspects, institutional role, yield aspects in CA, stubble burning issues, residue management and satisfaction. The seventh component was having maximum contribution from statements numbered 8 and 24 which were mainly focussed on residue management aspects of CA and the component was named accordingly.

The last column in Table 2 indicates the total component score of individual components extracted. Statistically, each component could be regressed using the beta scores of individual statements to attain the uncorrelated component value as shown in fourth column of Table 2. $X_1$, $X_2$, …, $X_{25}$ represent the scores obtained by the respondents which ranged between one to five.

**Table 2.** Extracted Components and components score

| S.No. | Component (Y) | Statement Number | Formula for Component score | Component Score |
|---|---|---|---|---|
| $Y_1$ | Environmental aspects of CA | 2,3,5,6,9,15 | 0.438*X1 + 0.406*X2 +.....+ 0.489*X25 | 8542.01 |
| $Y_2$ | Resource management aspects of CA | 1,12,18,21,22 | 0.129*X1 + 0.066*X2 +.....+ 0.025*X25 | 1447.01 |
| $Y_3$ | Financial aspects | 4,7,17 | (-0.055)*X1+ (-0.156)*X2 +.....+ 0.029*X25 | 1300.09 |
| $Y_4$ | Institutional role | 13,14,25 | 0.214*X1 + 0.135*X2 +.....+ 0.158*X25 | 687.93 |
| $Y_5$ | Yield aspects in CA | 11,16, 20 | (-0.051)*X1+(-0.290)*X2+.+ 0.056*X25 | 270.65 |
| $Y_6$ | Stubble burning issues | 10,23 | (-0.190)*X1+(-0.185)*X2+.+ 0.388*X25 | 1100.12 |
| $Y_7$ | Residue management | 8,24 | 0.472*X1+(-0.041)*X2+.....+0.268*X25 | 23.28 |
| $Y_8$ | Weed management | 19 | 0.233*X1+(-0.205)*X2+.....+0.030*X25 | 77.67 |

It can be inferred from the tabulated values that among the eight underlying dimensions of the present attitude scale, environmental dimension of Conservation Agriculture had maximum contribution (component score = 8542.01) towards formation of a favourable attitude of respondents regarding CA practices in wheat cultivation. Other major contributing factors were resource management aspects (component score = 1447.01) and financial aspects (component score = 1300.09). Among all factors, residue management aspects of CA least contributing factor towards developing a favourable outlook towards CA practices with a minimum component score of 23.28. Similar, methodology was followed by Som et al., (2019) & Bhattacharyya et al., (2021) in their respective studies to develop multi-dimensional perception scales.

**Reliability testing of the scale**

Reliability, according to Ray & Mondal (1999), recounts to the correctness or accuracy with which a measurement or score is taken. The reliability of the scale was measured by using Cronbach's Alpha and the reliability coefficient was found to be 0.80 which was satisfactory. A recent study on attitude scale construction by Gupta et al., (2022), mentioned that split half (odd-even) reliability testing method can also be used for assessing the reliability of the tools developed. Meeting all the criteria of scale reliability and validity, finally 25 items under 8 broad heads are considered to form a standardized attitude scale for assessing the attitude of farmers towards Conservation Agricultural practices in wheat. Finally developed attitude scale was measured on a five point continuum ranging from 1= Strongly Disagree to 5= Strongly Agree.

## CONCLUSION

The psychological construct of attitude with its evaluative nature plays a pivotal role in affecting the behaviour of the individuals directly. Identifying and measuring the degree of attitude of individuals towards any item, process or technology will help the stakeholders and policy makers to formulate appropriate policies to ensure speedy adoption of the respective technologies. So, developing a standardized attitude scale is of utmost importance. In social and behavioural sciences, the use of one-dimensional scales to measure different psychological constructs like attitude, perception *etc*. many a times leads to wrong and improper measurement as these constructions are often multi-dimensional with inter-correlated factors. Hence, the present study aimed at constructing a standardized multi-dimensional attitude scale to assess the degree of favourableness or unfavourableness of the CA adopters and non-adopter farmers towards CA practices. The step wise construction procedure of multi-dimensional scale as explained in this study can be helpful for the researchers from related fields to develop similar scales pertaining to other psychological attributes which cannot be measured using uni-dimensional scales.

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