The Pharma Innovation Journal 2021; SP-10(11): 486-491

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(11): 486-491

www.thepharmajournal.com
Received: 25-09-2021
Accepted: 27-10-2021

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A scale to measure the attitude of farmers towards conservation agriculture practices

Ganapathy Ramu M and M Asokhan

Abstract
Conservation Agriculture (CA) is relatively a new concept, and its technologies were not penetrated among the farming community across the State. However, a change in attitude of farmers may influence the uptake of CA practices at farmers' field. Attitude is a behavioural construct that cannot be measured by a single variable, hence there arises a need for developing a standardized instrument for its measurement. The present study has been conducted to develop a reliable and valid scale to measure the farmer's attitude towards CA practices. A method of Equal-Appearing Intervals was used to construct the attitude scale. A total of 82 attitude statements about conservation agriculture practices expressing varied degree of favourableness were collected and modified based on the Edward's criteria. These statements were subjected to judge's opinion by agricultural extension scientists of State Agricultural Universities and ICAR Research Institutes and field level extension workers. Based on expert's response a standardized scale has been developed with 10 statements which are having universe of content, uniform distribution of scale values along the psychological continuum and high "scale values" and lower "Q" values and more or less equal number of favourable and unfavourable attitude items.

Keywords: attitude, conservation agriculture and equal-appearing intervals

1. Introduction
Agricultural intensification based on tillage-based farming practices, results a negative effect on the quality of the essential natural resources such as soil, water, terrain, biodiversity and the associated ecosystem services provided by nature (Dumansky *et al*. 2014) [2]. Another concern is that agriculture is responsible for about 30% of the total greenhouse gas emissions of CO_2, N_2O and CH_4 and is directly affected by the consequences of a changing climate (IPCC 2014) [6]. In order to address the above concerns FAO has elaborated an alternative no-till system paradigm known as Conservation Agriculture (CA). Conservation Agriculture (CA) comprises the practical application of three interlinked principles, viz., no or minimum mechanical soil disturbance, biomass mulch soil cover and crop species diversification, in conjunction with other complementary good agricultural practices of integrated crop and production management (FAO 2009) [4]. This system helps to meet the objectives of saving energy and mineral nitrogen use in farming and thus reduces greenhouse gas emissions, enhancing biological activity in soils, resulting in long-term yield and factor productivity increases, as well as increases in overall system-level biomass production (FAO 2016) [5]. CA is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment (FAO 2016) [5]. In order to popularize CA practices among farmers, it is necessary to know the attitude of the farmers towards CA practices. In the present study, various psychological objects have been symbolized. For this purpose, the study was designed with the objective to develop a scale to measure the attitude of farmers towards CA practices.

2. Methodology
The attitude scale was constructed by using the equal appearing interval scaling technique developed by Thurstone & Chave (1927). Initially a set of items and statements related to the attitude of farmers towards conservation agriculture practices were collected and developed based on review of literature, consultation with the experts from State Agricultural Universities, ICAR Research Institutes and also based on the field experience of researcher. A tentative list of 100 statements were drafted keeping in view the applicability of statements suited to the area of study. The statements collected were cautiously edited by following the 14 informal criteria suggested by Edwards (1957) [3].

Maximum care was taken in editing the statements so that it could measure what is intended. As a result, a total of 82 statements were taken out of 100 statements. Finally, the 82 statements on a five-point continuum ranging from most unfavourable to most favourable with the score of 5, 4, 3, 2, 1 respectively and reverse for the negative statements were sent by Google form survey, by post and handed over personally to the total of 60 judges. The judges comprise the experts from ICAR institutions and Agricultural Extension scientist of State Agricultural Universities. The judges were also requested to make necessary modifications and addition or deletion of items if they desired. A total of 30 responses were obtained in time out of 60. The universe of statements related to the attitude of farmers towards CA practices is presented in the Table 1.

Table 1: Universe of statements related to the attitude of farmers towards Conservation Agricultural practices

S. No.	Statement
1.	Modern agriculture is a major cause of ecological problems.
2	Modern agriculture system shall be modified to become ecologically sound.
3.	Nature of farming practices has no role in ecological problem.
4.	Farming practices cause environmental pollution.
5.	Soil and water are the sources of life and should be strictly conserved.
6.	Conservation Agriculture (CA) is claimed to be a viable option for sustainable agriculture.
7.	CA practices mitigate the effects of climate change.
8.	CA practices improve efficient use of resources which benefits the environment.
9.	CA practices integrate traditional farming practices with modern farming system.
10.	CA practices keep environment free from pollution.
11.	Climatic condition plays an important role in adoption of CA practices.
12.	Continuous intensive ploughing leads to soil degradation.
13.	Intensive mechanized agriculture causes soil compaction.
14.	Use of excessive chemical fertilizer reduces long time soil fertility.
15.	CA practices maintain soil fertility better than conventional agriculture practices.
16.	CA practices enhance the natural biological processes above and below the ground.
17.	CA practices ensure cultivation of different species of crops at the same time.
18.	CA practices ensure the use of agrochemicals in an optimum level which does not disrupt the biological processes.
19.	CA practices ensure the use of inorganic fertilizers in an optimum level which does not disrupt the biological processes.
20.	CA practices reduce soil compaction.
21.	CA practices improve physical properties of the soil.
22.	CA practices allow soil carbon sequestration.
23.	CA practices help farmers earn carbon credits by sequestering additional carbon into the soil.
24.	CA practices increase crop productivity.
25.	CA practices increases farm profitability in the long-term.
26.	CA practices ensure balanced utilization of natural resources.
27.	CA practices balance the nutrient status and farm eco-system for long time.
28.	CA practices conserve water resources compared to conventional agriculture.
29.	CA practices retain and store more rain water compared to conventional agriculture practices.
30.	CA practices reduce toxic contamination of surface water.
31.	CA practices reduce toxic contamination of groundwater.
32.	CA practices reduce air pollution resulting from soil tillage machinery.
33.	CA practices decrease the production cost by reducing the input purchases.
34.	CA practices reduce farm pests.
35.	CA practices save the soil beneficial micro-organism.
36.	CA practices have no advantages over conventional farming practices.
37.	Conservation agriculture does not offer potential for food security.
38.	Changing to conservation agriculture is an exciting and new challenge.
39.	Adoption of CA practices changes the workload of farmers.
40.	CA practices address the problem of labour shortage in Agriculture.
41.	CA practices are difficult to adopt due to increased land fragmentation.
42.	I am the right kind of person to convince other farmers of my locality to adopt conservation agriculture practices.
43.	Complete adoption of CA practices is not practically feasible.
44.	CA practices engage farmers to do other productive work.
45.	CA practices are boon to agriculture.
46.	Young farmers should adopt CA practices to encourage the experienced farmers.
47.	Educated farmers adopt CA practices better than uneducated farmers.
48.	CA practices are better suitable for small landholders.
49.	CA practices are better suitable for medium landholders.
50.	CA practices are better suitable for large landholders.
51.	Creating awareness among farmers on adoption of CA practices is essential.
52.	Awareness about CA practices is outreached with the help of ICTs.
53.	CA practices are complex in nature.
54.	Stepwise adoption of CA practices can be achieved.
55.	CA practices improve the livelihood status of farmers.
56.	CA technologies offer good results when farmers operate in groups than individuals.

57.	Farmers need to be encouraged and supported proactively in practical ways to start and complete the transition to CA.
58.	Subsidies should be given to farmers to encourage the adoption of CA practices.
59.	Incentives should be given to farmers to encourage the adoption of CA practices.
60.	Farmer gets attracted towards CA practices only when seeing fellow farmers getting rewards from adoption of CA practices.
61.	CA technologies may pose greater operational uncertainty to farmers.
62.	CA technologies may pose greater financial uncertainty to farmers.
63.	It is difficult to change the mindset of farmers that cultivation of crops is less possible without the practice of ploughing.
64.	Owned land is better maintained by farmers than leased land.
65.	Knowledge and skills of farmers related to CA practices should be enhanced.
66.	Farmers need technical assistance to convert to conservation agriculture.
67.	Burning of left-over straw is the simplest way to handle crop residues after harvest.
68.	Burning of crop residues has significantly increases air pollution.
69.	Crop residues being used as livestock feed is a major limitation for residue use as soil cover.
70.	Scientist has insufficient knowledge regarding CA practices.
71.	Scientist has insufficient training regarding CA practices.
72.	Farmers have to be taken to visit fields where CA practices are being followed.
73.	Publications with adequate, practical and useful information about CA technologies were made available to farmers.
74.	Publications with adequate, practical and useful information about CA technologies were made available to extensionists.
75.	Success stories of farmers practicing CA technologies should be published.
76.	Adoption of CA practice leads to natural way of farming.
77.	Farmer's decisions to adopt CA practices seem to be influenced by their neighbour's behaviour.
78.	Adequate financial background is essential, especially if new equipment is required to implement a new technology.
79.	Owners of larger operations are more willing to invest in new technologies such as direct seed drills.
80.	Large farmers have comparative advantage in adopting CA practices than smallholders and resource-poor farmers.
81.	CA practices supports farmers from the risk of fluctuating prices.
82.	The Government should give top most priority for the adoption of CA practices.

(MUF- Most Unfavourable; UF- Unfavourable; N- Neutral; F-Favourable; MF- Most Favourable)

2.1. Calculations of Scale and Q values

The data obtained from 30 subjects for each statement are arranged in table as frequency and proportions in the first and second row respectively. The proportions are obtained by dividing each frequency by the total number of subjects. The 'S' and 'Q' values given in scale were judged on the basis of 30 respondent's opinion and equal appearing interval which were computed by calculating the median value (S) and their inter quartile range (Q). The objective was to have small number of statements evenly placed on the continuum. The median value is considered as scale value and it was calculated by using following formula.

$$S = l + \frac{0.50 - \sum Pb}{Pw} i$$

Where,

S = the median or scale value

l = the lower limit of the interval in which the scale value falls

Pb = the sum of the proportion below the interval in which the scale value falls

Pw = the proportion within the interval in which the scale value falls

l = the width of the interval and it is assumed to be equal to 1.00

Q = C75- C25

Q = inter quartile range; C75 = 75th centile; C25 = 25th Centile

$$25^{th} \text{ centile} = C25 = l + \frac{0.25 - \sum Pb}{Pw} i$$

$$75^{th} \text{ centile} = C75 = l + \frac{0.75 - \sum Pb}{Pw} i$$

When there is good agreement among the subjects in judging the degree of favourableness of a statement, Q value will be small. A large Q value indicates disagreement among the judges as to the degree of attribute possessed by a statement and it is, therefore, taken as an indication that there is some ambiguity in the statement. Thurstone & Chave (1929) [9] regard large Q values primarily as an indication that a statement is ambiguous. It is also may be since statement is interpreted in more than one way by the subjects.

2.2. Reliability of the scale

Reliability refers to the consistency of scores obtained by the same individuals when re-examined with the test on different occasions, or with different sets of equivalent items Anastasi (1968) [1]. The reliability of the scale was determined by 'split – half' method. The test is divided into two halves in which one half contains the odd-numbered items (1,3,5,7,9) and other half contains the even-numbered items (2,4,6,8,10). A single administration of the two sets of items to a sample of respondents, yields two sets of scores. A positive and significant correlation between the two sets of scores indicates that the test is reliable.

From the self-correlation of the half-tests, the reliability coefficient of the whole test may be estimated by the Spearman-Brown formula, as follows.

$$\text{Reliability coefficient of the whole test} = \frac{2 \times \text{reliability coefficient of the half test}}{1 + \text{reliability coefficient of the half test}}$$

2.3. Validity of the scale

Validity refers to the accuracy with which it measures that which is intended to measure (Lindquist 1951). To test the validity of the scale, content validity method is used. The content validity involves essentially the systematic examination of the test content to determine whether it covers a representative sample behaviour domain to be measured, Anastasi (1968) [1]. The content validity of the scale is measured using Experts Judgement method.

3. Findings and Discussion

Based on the calculation, Individual statements with "S" and "Q" values are presented in Table 2.

Table 2: Computation of Equal Appearing Interval Scale

S. No.	Statement No.	'Q' value	Scale value	Difference between Successive 'Scale' Value	Cumulative value	Interval	Compartments
1.	14	-4.00	9.50	-9.50	-2.50	0.70	I
2	70	3.69	2.36	0.14	0		
3.	32	0.89	2.50	0.00	0		
4.	64	1.81	2.50	0.00	0.00		
5.	67	1.33	2.50	0.20	0.20		
6.	4	3.13	2.70	0.13	0.33		
7.	3	2.68	2.83	0.17	0.50		
8.	69	1.69	3.00	0.00	0.50		
9.	81	0.69	3.00	0.00	0.50		
10.	36	2.40	3.00	0.00	0.50		
11.	53	3.09	3.00	0.13	0.62		
12.	37	2.19	3.13	0.04	0.67		
13.	43	-0.44	3.17	0.17	0.83	1.40	II
14.	71	1.92	3.33	0.02	0.86		
15.	13	1.44	3.36	0.00	0.86		
16.	31	0.89	3.36	0.00	0.86		
17.	63	2.39	3.36	0.00	0.86		
18.	34	1.83	3.36	0.00	0.86		
19.	40	1.76	3.36	0.14	1.00		
20	62	2.32	3.50	0.13	1.13		
21.	41	-0.11	3.63	0.00	1.13		
22.	47	0.31	3.63	0.00	1.13		
23.	48	1.56	3.63	0.04	1.17		
24.	50	2.15	3.63	0.00	1.17		
25	61	2.03	3.63	0.17	1.33		
26.	39	2.13	3.63	0.07	1.40		
27.	49	1.85	3.90	0.04	1.44		
28.	10	-0.47	3.94	0.06	1.50		
29.	30	1.55	4.00	0.00	1.50		
30.	68	2.01	4.00	0.10	1.60		
31.	12	1.34	4.10	0.07	1.67		
32.	1	1.54	4.17	0.17	1.83		
33.	18	0.18	4.33	0.00	1.83		
34.	52	1.37	4.33	0.17	2.00		
35.	22	-4.25	4.50	0.00	2.00		
36.	23	0.75	4.50	0.00	2.00		
37.	27	0.67	4.50	0.00	2.00		
38.	29	-0.08	4.50	0.00	2.00		
39.	42	1.30	4.50	0.00	2.00		
40.	44	1.69	4.50	0.00	2.00		
41.	79	1.56	4.50	0.14	2.14	2.80	IV
42.	80	0.00	4.64	0.02	2.17		
43.	24	-0.43	4.67	0.00	2.17		
44.	76	-0.43	4.67	0.08	2.25		
45.	2	1.43	4.75	0.08	2.33		
56.	16	-4.18	4.83	0.07	2.40		
47.	7	-0.32	4.90	0.00	2.40		
48.	38	0.20	4.90	0.10	2.50		
49.	65	1.62	5.00	0.10	2.60		
50.	45	-0.43	5.10	0.00	2.60		
51.	57	-0.58	5.10	0.00	2.60		
52.	5	0.00	5.10	0.07	2.67		
53.	19	1.48	5.17	0.13	2.80		
54.	35	-3.85	5.30	0.20	3.00	3.50	V
55.	8	0.00	5.50	0.00	3.00		
56.	11	-2.18	5.50	0.00	3.00		
57.	26	0.00	5.50	0.00	3.00		
58.	46	0.91	5.50	0.00	3.00		
59.	59	0.96	5.50	0.00	3.00		
60.	73	0.07	5.50	0.00	3.00		
61.	17	1.33	5.50	0.25	3.25		
62.	51	-0.43	5.75	0.00	3.25		
63.	66	-0.37	5.75	0.00	3.25		
64.	78	-3.13	5.75	0.08	3.33		
65.	74	1.42	5.83	0.17	3.50		

66.	55	-4.18	6.00	0.00	3.50		
67.	56	-4.18	6.00	0.17	3.67		
68.	58	1.31	6.17	0.33	4.00		
69.	33	0.67	6.50	0.00	4.00	4.20	VI
70.	75	0.31	6.50	0.00	4.00		
71.	77	0.07	6.50	0.00	4.00		
72.	82	-2.13	6.50	0.33	4.33		
73.	9	-0.69	6.83	0.00	4.33		
74.	20	-3.33	6.83	0.00	4.33		
75.	54	-0.58	6.83	0.00	4.33	4.90	VII
76.	60	-0.43	6.83	0.00	4.33		
77.	72	0.00	6.83	0.33	4.67		
78.	21	-4.25	7.17	0.00	4.67		
79.	28	0.00	7.17	0.33	5.00	5.60	VIII
80.	25	0.00	7.50	1.50	6.30	6.30	IX
81.	15	-3.18	9.00	0.00	7.00		
82.	6	-373	9.50	-9.50	7.00	7.00	X

3.1. Item selection

The final attitude items were selected based on the universe of content, uniform distribution of scale values along with the psychological continuum and high "scale values" and smaller "Q" values and more or less equal number of favourable and unfavourable attitude items. The scale values were arranged in descending order of magnitude and the difference between the successive scale values and the cumulative total of the computed differences were worked out. Since the selected scale values should have equal appearing interval and distributed uniformly along the psychological continuum it was necessary to form ten compartments so as to select ten statements with one statement from each of the compartment. The basis for forming the compartments was that, each compartment should be equally spaced in the continuum. For this purpose, the cumulative value (7.00) was divided by ten, which worked out to 0.70 and this formed the width of the first-class interval. The second interval was worked out by adding the value with the width of the first-class interval. Subsequently all the ten intervals were worked out and presented in Table 3.

Table 3: Computation of class interval values

S. No.	Compartments	Interval values
1.	I	0.70
2.	II	0.70 + 0.70 = 1.40
3.	III	1.40 +0.70 = 2.10
4.	IV	2.10 + 0.70 = 2.80
5.	V	2.80 + 0.70 = 3.50
6.	VI	3.50 + 0.70 = 4.20
7.	VII	4.20 + 0.70 = 4.90
8.	VIII	4.90 + 0.70 = 5.60
9.	IX	5.60 + 0.70 = 6.30
10.	X	6.30 + 0.70 = 7.00

To select the attitude items from the ten compartments the "scale values" and the corresponding "Q" values were considered. Based on the criteria already mentioned items having high "scale values" and low "Q" values were selected with one item from each compartment. Care was taken to ensure that the selected items represented the universe of content and covered the different aspects of conservation agriculture. Thereby ten items were selected with equal appearing interval and with a uniform distribution along the psychological continuum. The attitude scale thus constructed is given in Table 4.

Table 4: Selected Attitude Statements

Items	Statements	S value	Q value	Nature of statement
22	CA practices allow soil carbon sequestration.	-4.25	4.50	Favourable
21	CA practices improve physical properties of the soil.	-4.24	7.17	Favourable
55	CA practices improve the livelihood status of farmers.	-4.18	6.00	Favourable
6	Conservation Agriculture (CA) is claimed to be a viable option for sustainable agriculture.	-3.73	9.50	Favourable
41	CA practices are difficult to adopt due to increased land fragmentation.	-0.11	3.63	Favourable
28	CA practices conserve water resources compared to conventional agriculture practices.	0.01	7.17	Favourable
25	CA practices increases farm profitability in the long-term.	0.01	7.50	Favourable
77	Farmer's decisions to adopt CA practices seem to be influenced by their neighbour's behaviour.	0.07	6.50	Favourable
19	CA practices ensure the use of inorganic fertilizers in an optimum level which does not disrupt the biological processes.	1.48	5.17	Unfavourable
37	Conservation agriculture does not offer potential for food security.	2.19	3.13	Unfavourable

3.2. Scale Reliability

The reliability of the scale was determined by 'split – half' method. The ten selected attitude items were divided into two equal halves by odd even method. The two halves were administered separately to 30 farmers in a non-sample area. The scores were subjected to correlation test in order to find out the reliability of the half test by using SPSS software. The half-test reliability coefficient (r) was 0.638 which was significant at one per cent level of probability. Further the reliability coefficient of the whole test was computed using the Spearman-Brown Prophecy formula. The whole test reliability (rtt) was 0.778. When the purpose of the test is to compare the mean scores of two groups of narrow range a reliability coefficient of 0.50 or 0.60 would suffice. Hence,

the constructed scale is reliable as the reliable coefficient (rtt) was >0.60.

3.3. Content Validity of the Scale

Content validation was carried out by subjecting the selected ten items to judge's opinion. The judges were requested to indicate their presumed relevance to which the attitude items covered the different aspects of conservation agriculture practices. The responses were obtained on a four-point continuum of 'most adequately covered', 'more adequately covered', 'less adequately covered' and 'least adequately covered'. Scores of 4, 3, 2 and 1 were given for the points on the continuum respectively. Totally 30 judges responded by sending their judgments. The mean score 2.5 was fixed as the basis for deciding the content validity of the scale. If the overall mean score of the attitude items as rated by the judges was above 2.5 the scale will be declared as valid and if not otherwise. In the present case the overall mean score was worked out as 3.94 and therefore the constructed attitude scale is said to be valid.

3.4. Administration of the Scale Value

The ten attitude items selected were arranged randomly in order to avoid biased responses. The scale was administered on a five-point continuum as strongly agree, agree, undecided, strongly disagree and disagree. The score obtained for each statement was summed up to arrive at the attitude score for the respondents. The score ranged from 50 (maximum) to 10 (minimum). Maximum score revealed a favourable attitude, while a minimum score indicated unfavourable attitude towards conservation agriculture practices. The responses were grouped as unfavourable, moderately favourable and highly favourable based on the cumulative frequency method.

In conclusion, there are various methods available for construction of an attitude scale, Equal Appearing Interval method scaling technique was used in this study to measure the attitude of farmers towards conservation agriculture practices. The scale would be highly useful to study the attitude of conservation agriculture practices by the farmers and other agriculture stakeholders.

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