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A Standardized Scale to Measure the Attitude of Farmers Towards Zero-Till Drill

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ABSTRACT

A measurement instrument has been developed that can used to determine the attitude of farmers towards the use of zero-till drill in agriculture. Likert's summated rating scale technique was followed for the construction of the attitude scale. A total of 28 statements concerning experts' opinions were selected. Response for the selected statements was obtained from 100 adopter farmers of zero-till drill in Punjab state. The scale developed finally consisted of 13 items including positive and negative items. Three constructs were identified regarding zero till technology in the scale developed, obtained by using exploratory factor analysis. The reliability and validity of the scale indicate its precision and consistency of the results. The developed scale can be used to explore the attitude of farmers towards zero-till drill, which will be helpful to enhance the adoption of this conservation practice.

Keywords: Attitude, Likert's summated rating, Zero-till drill, Scale

INTRODUCTION

Conservation agriculture has risen as a route in achieving sustainable intensive crop production. The achievements in conservation agriculture have been possible with the continuous invasion of resource conservation technologies like zero tillage, happy seeder, laser leveller etc. (Singh *et al*., 2020; Singh and Kaur, 2019). In the conventional method of wheat sowing, rice stubbles are burned by most of the farmers, due to the short window period between the harvesting of rice and sowing of wheat. It leads to environmental pollution (Ali and Erenstein, 2013). In order to save sowing time and the tillage cost, a new seed drill was introduced in the early 1980s that made it possible to sow wheat in freshly harvested and untilled paddy fields utilizing residual moisture. The drill named as zero-tillage drill and the method of wheat sowing with this drill is called zero-tillage technology (Tripathi, 2014; Iqbal *et al*., 2002). Zero tillage is, in a way, a complete farm management system that should include many agricultural practices including planting, plant residue management, weed and pest control, harvesting and crop rotations (Kumar *et al.,* 2010; Kumari *et al.,* 2018). A number of studies have been conducted on adoption, agronomic and economic assessment of zero-till drill. Regarding the psychology of farmers behind the adoption of zero-till drill majority of the studies concluded that adopter of zero-till drill was highly innovative, risk-oriented and economically motivated (Singh *et al.,* 2020; Singh, 2011b; Singh, 2011a; Tiwari, 2008) but reasons for the same is still unclear. The attitude of farmers is one of the major factors behind such behaviour of farmers. So, it is considered imperative to construct an attitude scale that can help to access the attitude of farmers towards zero-till drill. Attitude refers to an organized predisposition to think, feel, perceive and behave towards a cognitive object. According to Thurstone and Chave, (1929),

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"Attitude is the degree of the positive or negative effect associated with some psychological object". Psychological object means any symbol, phrase, slogan, idea, person and institution towards which people can differ with respect to positive or negative effect. In the present study, the psychological object is "zero-till drill". The scale developed in the present study will be of great utility to researchers, agricultural planners, educators and administrators in general in formulating the relevant policies and programmes so that the maximum number of farmers could be benefitted while sustaining the environment.

METHODOLOGY

The method of summated rating suggested by Likert (1932) was followed in the development of a scale to measure the attitude of farmers towards zero-till drill. The attitude in this study was operationalized as the predisposition of the farmers towards zero-till drill.

After an area of content or universe of interest has been defined, then a number of statements relating to the sub-universe (dimension) were collected. A set of items and statements which elicits the attitude towards different dimensions of the use of zero-till drill in agriculture were collected through a survey of literature and in consultation with the experts in the discipline of Extension Education. A tentative list of 30 statements was drafted keeping in view the applicability of statements suited to the area of study.

Statements were drafted in the local language (Punjabi) keeping in view the applicability of statements suited to the area of study. These statements were carefully edited on the basis of 14 criteria (Edwards, 1957). The selected set of statements were carefully analyzed by a panel of experts consisting of Four experts in the field of scaling techniques, three senior professors of extension education and two experienced agronomists of the research area from the Punjab Agricultural University, Ludhiana. Some irrelevant statements to the psychological object were discarded from the final lists of statements for the raw scale. Twenty Eight statements were selected for attitude scale construction regarding zero-till drill.

The research population included farmers that implemented zero-till drill in their fields. For this study, 100 farmers were surveyed. The responses were obtained on a five-point continuum viz.- Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) with a score of 5, 4, 3, 2 and 1 respectively for the positive statement and for the negative statement, reverse scoring was adopted. The t-test analysis procedure was followed to calculate the t-value for the items. The scores obtained by the respondents were summed up and arranged in descending order. The 25 per cent of the respondents with the highest total score (the high group) and 25 per cent of the respondents with the lowest total score (the low group) were selected for the analysis to calculate the t-value. The mean score and variance of the high and the low group were calculated and the t-value for each of 28 statements was calculated.

The value of 't-test' is a measure to which each item differentiates between the high and the low group. In the method of summated ratings, the focus is to have a set of items that differentiate between the high and the low groups. The final statements were selected by calculating the t value for each item and rearranging the items in rank order according to their t-value. The statements with the t-value significant at 5% level of significance ($p< 0.05$) were selected for the attitude scale.

The scale developed was further standardized and purified by establishing its unidimensionality, reliability and validity. The unidimensionality was authorized along different constructs identified using exploratory factor analysis within the scale.Factor analysis using method of principal component with varimax rotation was used extract factors/constructs. The suitability of data for factor analysis was measured with use of Kaiser-Meyer-Olkin measure and Bartlett's test of sphericity. Kaiser-Meyer-Olkin measure indicates the suitability of data for factor detection and Bartlett's test of sphericity indicates the association between items variables. Associated items/variables point toward the suitability of data for the factor analysis. Kaiser criterion (Kaiser, 1960; i.e., eigenvalue >1) and scree test (Cattell, 1966) was used to determine the number of factors to retain.

Communality (h^2) is an aggregate measure of the strength of association between a given variable and a set of factors. The communalities were computed by summing the squared loadings across each of the factors for a given observed variable (item) and represented the proportion of variance in a variable that is due to the factors. A low communality value suggests that an observed variable is not related to any of the factors (Stevens, 2002).

In the present study, the split-half method and Cronbach's Alpha were used for testing reliability with the help of the Statistical Package for Social Sciences (SPSS 23.0). The reliability of the scale was determined by obtaining the Pearson's coefficient of correlation between the sums of the odd and even responses. The odd-even method was favoured because it assured parallelism and ensured that approximately the same amount of time was devoted to each half. Also, it tended to keep testing conditions more nearly constant for the two halves and avoided informant fatigue which might have altered the true correlation. Spearman-Brown Coefficient is used to estimate the reliability coefficient of the entire scale as the split half method calculates reliability for half scale only.

$$r_{xy} = \frac{nr_{xy/2}}{1 + (n - 1)\, r_{xy/2}}$$

Where, r_{xy} = Reliability coefficient for whole scale, $r_{xy/2}$ = correlation coefficient between two parts of the scale i.e. reliability of half-scale, n = proportion of increase in items i.e. n=2 for 2 halves

The reliability of the scale was also evaluated by means of the Cronbach's alpha coefficient. Various authors differ in agreement with respect to which alpha value covers an acceptable degree of internal consistency, with Di-Iorio (2005) recommending an alpha value near 1.0 and Streiner and Norman (2008) suggesting that values between 0.70 and 0.90 were sufficient. Construct and content validity of the scale was aimed to establish validity of the instrument. In the collection and selection of items for the construction of the present scale, sufficient care was taken by the researcher. At the same time, ambiguous items were rejected based on the judge's ratings as described earlier. Minor wording and structuring of the instrument were made based on the recommendation of the panel of experts selected in the present study. Moreover, validity usually is a matter of degree rather than an all-or-none property and validation is a non-ending process (Nunnally and Bernstein, 1994).

RESULTS AND DISCUSSION

Selection of attitude statements for final scale

After computing "t" value for all the items, 18 statements showing a significant difference between low and high groups at 5% level of significance ($p<0.05$) were selected. It has been concluded that 10 items (Sr. No. 1, 3, 5, 6, 8, 9, 13, 22, 24 and 26) having p-value more than 0.05 contribute to a very slight degree in the measurement of attitude expression demanded to be measured as these items were unable to differentiate low and high groups. It has been decided these to be removed from the scale. p-value of other items has been significant at 0.05 level of significance (Table 1). The range of t-values varied from 0.41 to 4.33. In this way, 18 out of 28 statements were retained for further analysis.

Item-to-total correlations (Table 2) were computed for 18 of the items. This practice is a commonly accepted procedure when developing a scale (Churchill, 1979). Each *r* value refers to the correlation of the respondents' scores on an item in relation to the sum of their scores on all of the items. To purify the scale, items that were poorly correlated ($p<0.01$) with the total score were eliminated. Following this, item no. 16 and 18 were eliminated. This procedure resulted in 16 items, out of the original 18, being retained.

Factor analysis

Factor analysis was used on remaining 16 statements to extract factors/constructs. A high value of Kaiser-Meyer-Olkin measure (0.83) and a small value ofBartlett's test of Sphericity ($p<0.05$) indicated the usefulness of data for factor analysis.

Examining the extraction, eigenvalues suggested (Table 3), applying Kaiser's rule, that four factors were

Table 1: Item analysis of the statements

S.No.	Statements	t-value	p-value
1.	All farmers can adopt zero till drill technology (+)	2.121	0.051
2.	The use of zero till drill has an adverse effect on soil productivity (-)	3.062	0.008
3.	I feel improved soil health after using zero till drill in my fields (+)	1.517	0.143
4.	Zero till drill has nothing to do with reducing environmental pollution (-)	2.721	0.013
5.	The crop looks much attractive after using zero till drill (+)	0.410	0.686
6.	Straw quality increases with the use of zero till drill (+)	0.883	0.387
7.	There is nothing new in zero till drill (-)	2.360	0.029
8.	Illiteracy cannot stop the farmers from adopting zero till drill (+)	1.472	0.155
9.	The current design of zero till drill is not enough to meet its goals (-)	1.941	0.068
10.	Only progressive farmers can adopt a zero till drill (-)	2.098	0.048
11.	Adoption of zero till drill is a wastage of recourses (-)	2.803	0.011
12.	The use of zero till drill is an additional burden on the farmers (-)	3.386	0.004
13.	zero till drill will not increase earnings significantly (-)	1.753	0.094
14.	I would recommend the use of zero till drill for other farmers (+)	2.930	0.010
15.	I will stop using zero till drill in coming years (-)	2.789	0.013
16.	The use of zero till drill provides less net worth (-)	2.828	0.011
17.	The use of zero till drill is a good alternative to preserving natural resources (+)	2.743	0.012
18.	The soil structure of my farm is not suitable for use of zero till drill (-)	4.331	0.000
19.	The disadvantages of zero till drill are more than worth it (-)	3.174	0.006
20.	zero till drill is meant for large farmers (-)	2.238	0.041
21.	The use of zero till drill involves too many tiring tasks (-)	2.178	0.042
22.	zero till drill is meant for high educated farmers (-)	1.043	0.309
23.	All farmers should use zero till drill (+)	2.098	0.050
24.	Shifting toward the use of zero till drill is a new challenge (+)	1.274	0.218
25.	I also recommend Zero till Drill for other crops (+)	3.023	0.007
26.	Adopting a zero till drill is a boon for agriculture (+)	2.055	0.054
27.	I can get my best produce by adopting zero till drill (+)	3.850	0.001
28.	I'll bring more area under zero till drill (+)	3.978	0.001

found to be strongly related to the set of items, and inspecting the scree plot (Figure 1) provided support for this solution. Out of these four factors, first two factors contributed more than fifty percent in explaining total variation.

Following guidelines appropriate for the present sample size (Stevens, 2002), items with factor loadings below the critical value of 0.40 have to be eliminated but no item was found to be having factor loading less than 0.40 on all the factors. Data in Table 4 indicates the factor loading of each item. It was found that two

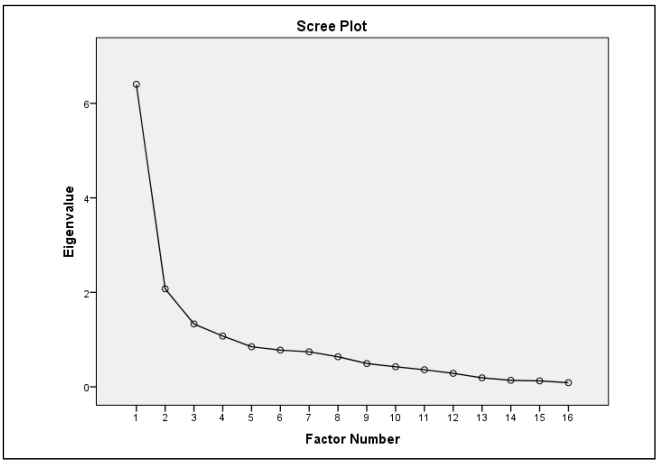

Figure 1: Scree plot

Table 2: Item-to-total correlations of the statements

S. No.	Statements	r value
2.	The use of zero till drill has an adverse effect on soil productivity.	0.584**
4.	zero till drill has nothing to do with reducing environmental pollution.	0.594**
7.	There is nothing new in zero till drill	0.395**
10.	Only progressive farmers can adopt a zero till drill	0.792**
11.	Adoption of zero till drill is a wastage of recourses	0.598**
12.	The use of zero till drill is an additional burden on the farmers	0.770**
14.	I would recommend the use of zero till drill for other farmers	0.732**
15.	I will stop using zero till drill in coming years	0.657**
16.	The use of zero till drill provides less net worth	0.143
17.	The use of zero till drill is a good alternative to preserving natural resources	0.562**
18.	The soil structure of my farm is not suitable for use of zero till drill	0.190
19.	The disadvantages of zero till drill are more than worth it	0.594**
20.	zero till drill is meant for large farmers	0.738**
21.	The use of zero till drill involves too many tiring tasks	0.373**
23.	All farmers should use zero till drill	0.729**
25.	I also recommend Zero Till Drill for other crops	0.488**
27.	I can get my best produce by adopting zero till drill	0.525**
28.	I'll bring more area under zero till drill	0.676**

***Correlation is significant at the 0.01 level (2-tailed)*

Table 3: Factor determination on the basis of eigenvalues

Factors	Eigenvalues		
	Total	% of Variance	Cumulative variance
1.	6.402	40.012	40.012
2.	2.074	12.960	52.972
3.	1.332	8.323	61.295
4.	1.076	6.723	68.018

items (Sr. No. 11 and 19) had high loading on more than one factors (cross loadings i.e. r > 0.40; Floyd and Widaman, 1995). Thus, these statements were further eliminated as they belong to more than one factor/ construct. Item number 21 was also eliminated as it was the only item in its belonging factor. No item had low communality (h^2) i.e. less than 0.40 (Table 4) (Costello and Osborne, 2005). Factor analysis was repeated on the remaining 13 statements to permit the obtained components to correlate.A final three-factor scale emerged, with the remaining 13 items accounting for 66.35% of the total variance (Table 5). Factor 1 involved the items measuring the attitude of farmers in the context of the target group (Sr. No. 2, 10, 12, 14, 20, 23 and 25), while factor 2 focused on the items measuring attitude regarding prospects of zero-till drill. Factor 3 contained the items measuring technological aspects.

Further reliability of instrument was established through split-half and Cronbach's alpha. The 'r' value was significant at one per cent level of significance, indicating the high reliability of the instrument. The Spearman-Brown Coefficient of the full scale was 0.893, which indicates the high reliability of the scale constructed (Table 5). A high value (0.887) of Cronbach's Alpha indicates the high internal consistency of the scale (Table 5).The scale was found to be reliable as both the reliability coefficients were more than 0.75. It may be said that the scale is reliable to measure the attitude of farmers toward the use of zero-till drill in agriculture.

Table 4: Factor matrix of items

S.No.	Items	Factor				h^2
.		1	2	3	4	
2.	The use of zero till drill has an adverse effect on soil productivity.	.556	.247	.001	.219	0.42
4.	Zero till drill has nothing to do with reducing environmental pollution.	.278	.522	.313	.082	0.46
7.	There is nothing new in zero till drill	.036	.725	.217	-.169	0.60
10.	Only progressive farmers can adopt a zero till drill	.887	.133	.176	.145	0.86
11.	*Adoption of zero till drill is a wastage of recourses*	.094	.497	.460	.343	0.59
12.	The use of zero till drill is an additional burden on the farmers	.815	.138	.077	.335	0.80
14.	I would recommend the use of zero till drill for other farmers	.889	.142	.167	-.082	0.85
15.	I will stop using zero till drill in coming years	.192	.227	.890	.059	0.88
17.	The use of zero till drill is a good alternative to preserving natural resources	.181	.523	.217	.368	0.49
19.	*The disadvantages of zero till drill are more than worth it*	.531	-.137	.248	.565	0.68
20.	Zero till drill is meant for large farmers	.808	.052	.291	.075	0.75
21.	The use of zero till drill involves too many tiring tasks	.081	.062	-.017	.926	0.87
23.	All farmers should use zero till drill	.753	.139	.342	.021	0.70
25.	I also recommend Zero Till Drill for other crops	.574	.327	-.208	.014	0.48
27.	I can get my best produce by adopting zero till drill	.189	.742	.075	.034	0.59
28.	I'll bring more area under zero till drill	.209	.327	.850	.024	0.87

Items in italic format had high loading on more than one factor; h^2- Communalities

Table 5: Factor structure of the final scale

S. No.	Items	Factor	Factor 1	Factor 2	3	h^2	Split half reliability	Cron-bach's Alpha
2	The use of zero till drill has an adverse effect on soil productivity*	**I**	**.598**	.041	.209	0.40	0.900	0.899
10	Only progressive farmers can adopt a zero till drill*		**.894**	.204	.127	0.86		
12	The use of zero till drill is an additional burden on the farmers*		**.875**	.108	.096	0.79		
14	I would recommend the use of zero till drill for other farmers		**.845**	.190	.165	0.78		
20	Zero till drill is meant for large farmers*		**.812**	.314	.023	0.76		
23	All farmers should use zero till drill		**.734**	.336	.145	0.67		
25	I also recommend Zero Till Drill for other crops		**.588**	-.233	.308	0.49		
15	I will stop using zero till drill in coming years*	**II**	.176	**.892**	.235	0.88	0.940	0.939
28	I'll bring more area under zero till drill		.196	**.858**	.325	0.88		
4	Zero till drill has nothing to do with reducing environmental pollution*	**III**	.297	.366	**.478**	0.45	0.670	0.681
7	There is nothing new in zero till drill*		-.004	.190	**.740**	0.58		
17	The use of zero till drill is a good alternative to preserving natural resources		.243	.255	**.531**	0.41		
27	I can get my best produce by adopting zero till drill		.173	.081	**.798**	0.67		
	Variance Explained (%)		**34.05**	**16.40**	**15.90**			
	Total			**66.35**			**0.893**	**0.887**

**Negative statements; h^2- Communalities*

CONCLUSION

An attitude scale has been developed using Likert's summated rating technique that can be used to evaluate the farmers' attitudes towards zero till. Tentative statements were drafted keeping in view the applicability of statements suited to the area of study. These statements were evaluated and reframed by the experts. Item analysis was administrated to identify the statements having high discrimination power, so a draft scale consisting of 18 items. Further factor analysis has been used to explore the latent structure of the scale. Initially four factor structure has been identified but one factor was eliminated due to presence of single item only. Two items having high loading on more than one factor were also eliminated from the final scale. Thus, a total of 13 items, consisting 7 negative items and 6 positive items take place in the final scale. The scale has been found to be reliable and valid by using quantitative and qualitative methods. The scale developed in the present study will be of great utility to researchers, agricultural planners, educators and administrators in general in formulating the relevant policies and programmes so that the maximum number of farmers could be benefitted while sustaining the environment.

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