Indian Journal of Extension Education
Vol. 53, No. 1, 2017 (1-6)

Development and Validation of Scale to Measure Risk Orientation of Farmers

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ABSTRACT

Understanding the preferences and aversion of famers towards risks in agriculture and their behaviour regarding adoption and rejection of risk adjustment technologies is essential for devising any extension strategy. An effort was made in this study to develop a scale to measure risk orientation of farmers using Thurs tone's Equal-Appearing Interval (EAI) technique. A pool of 36 statements was selected on basis of 4 levels of systemic risk as mentioned by OECD (2009). These statements were administered to experts on a 9-point continuum. Based upon the scale values and inter quartile range, 19 statements were selected. The scale was found to have a reliability coefficient of 0.80, which was obtained by split-half method followed by correction using Spearman Brown Prophecy formula. Scalogram analysis with Goodenough technique revealed a coefficient of reproducibility of 0.80 showing unidimensionality of the scale. Further the independent criteria (Technonet Asia scale of risk taking ability,1981) based validity assessment showed a significant correlation of 0.713. The final scale comprising of 19 statements was used to measure the risk orientation of the farmers.

Keywords: Development, validation, risk orientation and farmers.

INTRODUCTION

Agriculture is surrounded by several risks like production risk, market risk, financial & credit risk, institutional risk, technology risk, and personal risk. These risks put the farmers in an ambiguous condition where their decision making becomes highly critical as well as crucial,whether they should go for particular practise or not. Marra (2002) in his study on "The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve?", stated that risk, uncertainty and learning play a number of distinct roles in the process of adopting new technologies. Thus to know the technology acceptance behaviour of farmers, measurement of their risk orientation behaviour is important. Risk orientation is the one's general degree of comfort with facing uncertain gains or losses (Ehrlich and Maestas,2010). In prospect theory, risk orientation is defined as the expression of a preference for a risky versus certain outcome and depends upon the probabilistic framing of gains and losses as well as an individual's status-quo position relative to expected gains and losses (Kahneman and Tversky, 1979). Research demonstrates that risk orientation and risk-taking behaviour are both linked to a number of stable and well-studied personality traits including extroversion, openness, agreeableness, sensation seeking, conscientiousness, achievement orientation (Carducci & Wong, 1998; Kowart & Hermann, 1997; Nicholson *et al.,* 2005; Filbeck *et al.,* 2005; and Zuckerman & Kuhlman, 2000), and, recently, linked to genetic characteristics (Cesarini, 2009 and Rosier *et al.,* 2009). Also, individuals vary substantially in their response to risks, including physical risks, gambling risks, decision making risks, and investment choices. (Filbeck, Hatfield, & Hovarth, 2005; Kowert & Hermann, 1997; Meertens & Lion, 2008; Zaleskiewicz, 2001). These studies suggest that risk orientation is an underlying trait rather than wholly dependent on context. The risk orientation of the farmers combines risk preference and risk aversion which are opposite pole of an individual's trait. Ehrlich & Maestas (2010) suggest that risk orientation is an exogenous and stable personality trait and we expect it to influence how one defines subjectively, the choice problem. Therefore, this personality trait should be measured to know farmers' preferences or aversion about agricultural risks. Regarding all these circumstances this paper aims at developing Risk Orientation Scale to measure the risk orientation behaviour of farmers.

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METHODOLOGY

In the present study, risk orientation was conceptualised as the degree to which a farmer is oriented towards risk and uncertainty and had courage to face the problem at different levels of risk in farming. To measure the risk orientation of farmers, risk orientation scale was developed using the Thurstone's Equal Appearing Interval method. Equal appearing interval scale means a scale on which the distances between points on the measuring instruments are known, and on which equal numerical distances represent equal distances along the continuum being measured. The equal appearing method was used for selection of statements for final scale as this method is less time taking and allows us to take a large number of statements. Then Summated Rating method of Likert was followed due to its simplicity and easy to apply for administering it to respondents with five point continuum. To ensure the objectivity and validity of the scale, all care has been taken while scale development by using best available research tools.

As risk orientation has been substantially explained in literature, in the present study the items were written based upon the review of literature. Subsequently, the content validation was accomplished through judgment of experts' working in related areas. Though there is no specific written rule about the number of items to be retained, turnstone's guideline may be adopted according to which a measure needs to be internally consistent parsimonious and comprised of minimum number of statements that could adequately assess the domain of interest (Hinkin, *et.al.* 1997).The standard procedure of scale development *viz.,* item generation, item analysis, , assessment of internal consistency and validity, scalogram analysis *etc* were followed.

Item generation: Generation of items is the initial step of scale development process. Both inductive as well as deductive approaches are used for creation of items in behavioral research. Inductive approach is generally used when unfamiliar phenomenon is being explored where there is lack of theoretical background. Deductive approach is used where there is availability of theoretical definitions of the constructs. According to Schwab (1980), deductive scale development uses theoretical definitions as a guide for creation of items. The items for the study were created based on the systemic definition of risk as given by OECD (2009), which emphasizes upon three stages *viz.* risk assessment and evaluation, risk management and risk communication.

Risk assessment refers to a systematic processing of available information to identify the frequency and magnitude of specific events. Risk evaluation consists of fixing priorities and defining societal tolerance for some risks. Risk management is the system of measures by individuals and organizations that contribute to reducing, controlling and regulating risks. Risk communication is the exchange and sharing of information about risk between decision makers and other stakeholders (International Risk Governance Council, 2008). The conceptual framework of risk orientation consists of these 4 levels (here risk assessment and risk evaluation has been considered as different level) which are influenced by the different characteristics and factors of the farmers which determine the risk preferences and risk aversion that constitutes risk orientation.

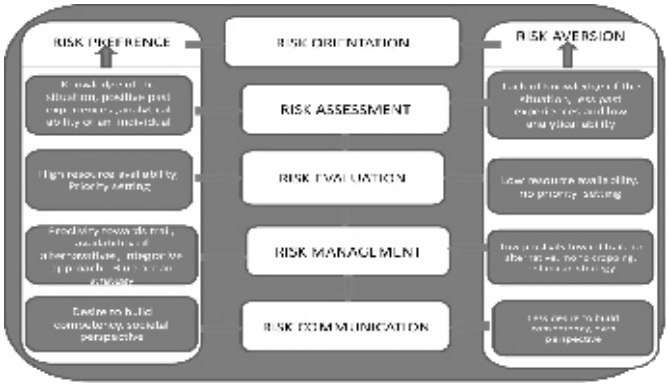

Figure-1: Theoretical framework of risk (OECD,2009)

Regarding these stages items were selected from multiple sources like research papers, theses, own thought, books, articles, consultation with experts and experienced farmers. Exploring all these sources finally. 36 items were created. Subsequently, the content validation was accomplished through judgment of experts working in related areas.

Judges' rating of risk orientation items: Each statement concerning the risk orientation behaviour was presented to the experts and asked to sort the statements into a 9- point psychological continuum ranging from 1to9. The judges were instructed that the two extremes of the intervals (1 and 9) represent the most unfavourable and favourable feeling along with middle one (5) as neutral. The distance from 1 to 9 was psychological continuum on which judges were asked to give their responses.

Calculation of Scale and Q- values: The frequency with which the statements were sorted in different intervals ranging from 1 to 9 was tabulated the proportions and cumulative proportions of experts' judgment for each statement were calculated. Scale value and Q-value for each statement were calculated using the formula:

$$\text{Scale value}(S) = L+[(0.50-\{Pb)/Pw]*I$$

Where, S= Median or scale value of statement

L= lower limit of the interval in which the median falls

P_b= sum of the proportion below the interval in which median falls

Pw= proportion within the interval in which median falls

I= Width of the interval and is assumed to be 1

The ambiguity, uncertainty or disagreement among the judges in sorting each statement in particular category was found out by computing interquartile range ('Q') which is an index of dispersion of the statements. For this 75^{th} centile (Q75) and 25th centile (Q25) were calculated using the formulae-

$$Q75= 1+ [(0.75- \Sigma P_b)/Pw]*I$$
$$Q25= 1+ [(0.25- \Sigma P_b)/Pw]*I$$
$$Q \text{ (inter quartile range)} = (Q_{75}-Q_{25})$$

Validation of risk orientation scale was done with its administration among two sets of farmers of district Hissar of Haryana state. One set of farmers was comprised of 90 randomly selected farmers participating in a Farmers' Field School (FFS), which was selected purposively from Haryana, while the second set of farmers comprised of 30 farmers who were non-participants in FFS. It was assumed that the farmers participating in Farmers' Field School and non-participants would differ in their risk orientation as FFS provided opportunity for better comprehension of risk and solution for its management.

RESULTS AND DISCUSSION

Scale values and Q values: With Equal Appearing technique the scale values and inter-quartile range values were worked out. With screening of higher scale values having low q values and also lying in a continuum item selection was done.

Though there is no specific written rule about number of items to be retained, Turnstone's (1947) guideline was adopted according to which a measure needed to be internally consistent parsimonious and comprised of minimum number of statements that could adequately assess the domain of interest (Hinkin, *et. al.,* 1997). The statements with Q-value > greater than Median (Q Value > 2.92) were eliminated from the final risk orientation scale because larger Q-value shows disagreement among judges and ambiguity. Finally, 19 statements were selected (Table 1).

Table 1: Scale value and Q value of this risk orientation scale

ITEMS	Scale value	Q value
I consider risk as an opportunity rather a constraint	6.962	2.627
Usually I guess the intensity of associated risk before adopting the technology	7.286	2.406
I carry out crop management practices only after having a full knowledge of weather forecast	6.259	2.896
I seek information about risk from different sources	7.357	2.769
Past experiences influence me in risk taking	7.444	2.172
Success makes me take higher risks	7.061	2.341
I take risk only for staple food crops	4.633	2.762
In this technological era, it is better to take risk rather than avoiding it	6.759	2.698
I eagerly follow scientist's advice without caring about any risk and I found it worthy	6.539	2.636
I do not adopt a technology for my entire farm, until I try on a small area	7.460	2.317
I take loan for using better inputs	6.833	2.831
I am always ready with alternative course of actions in conditions of risk	7.444	2.211
I go for integrated farming in order to mitigate risk	7.920	2.791
I use to take higher risk in order to have good position in the market	6.808	2.676
I keep farm records to know production and market return	7.138	2.821
Farmers with similar risk can be of great help to one another	6.920	2.839
I would like to adopt a new technology so as to demonstrate my competence in the community, despite the risk of making mistakes	6.633	2.642
If I get success in overcoming any risk, I communicate it to my relatives	7.280	2.857
I prefer to be involved in FPO to minimize my personal risk	7.087	2.938

Scalogram analysis: To check the unidimensionality of the scale, scalogram analysis was done. It says whether responses to a set of items are arranged in a specified way or not. It shows reproducibility of response pattern of a single score. Scalogram analysis revealed an error of 0.17 in the score pattern. Thus the coefficient of reproducibility was found to be 0.83. A minimum standard value of coefficient of reproducibility for its acceptance is 0.60. A high coefficient of reproducibility (0.83) of this scale reflects that the responses to scale items were arranged in a specified way and the scale items showed unidimensionality.

Internal consistency assessment: Working out the reliability assessment is an important part of scale development. The reliability of a scale signifies that its results are characterized by repetitiveness (Psarou and Zafiropoulos, 2004), while the results are free of measurement errors (Zafiropoulos, 2005).Reliability can be calculated in number of ways but the most acceptable way to calculate internal consistency of the scale is Cronbach alpha. It tells the degree to which items measures the same construct. A large value of Cronbach alpha (>.70) indicates strong item covariance or homogeneity and suggests that the sampling domain has adequately been captured (Churchill, 1979).

The reliability statistics (Table 2) showed that the value of the coefficient of Cronbach for the risk orientation scale is 0.793 (79.3%). It is very close to 80 per cent meaning a very high reliability. The scale statistics in table 2 gives the scores that are related to the scale's entirety, having a mean of 67.16 and a standard deviation

of 6.97.The last three columns of the Item –Total statistics (Table 3) are of vital importance. They give the important information with respect to the correlation between the respective item and the total sum score (without the respective item), the squared multiple correlation between the respective item and all others, and the internal consistency of the scale (coefficient alpha) if the respective item would be deleted. Item –Total statistics (Table 3) shows that the items number 3 and 14 have poor item –total correlations (0.046 and 0.088, respectively). From the right-most column, it is gathered that the reliability of the scale would be 0.798 and 0.799 if these two items were to be deleted.

Table 2: Reliability and scale statistics

Reliability statistics		Scale statistics			
Cronbach alpha	No. of items	Mean	Var	SD	No. of items
.793	19	67.16	48.67	6.97	19

Table 3: Item- total statistics

Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
64.6800	44.344	.300	.789
62.6800	45.283	.391	.784
62.7600	48.104	.046	.798
62.2800	46.287	.509	.785
64.5000	45.480	.226	.793
63.9600	46.774	.170	.794
62.5600	46.211	.329	.787
62.4000	45.918	.186	.796
64.0800	46.034	.203	.794
62.6200	47.302	.161	.794
64.8400	44.300	.354	.785
62.3000	47.316	.255	.791
63.6600	41.576	.476	.776
62.7600	47.411	.088	.799
64.5400	39.804	.633	.763
64.1600	38.015	.706	.755
64.6400	36.153	.643	.760
64.1600	43.647	.426	.780
65.3000	39.480	.677	.760

Validity of the scale: The validity of the scale is the degree to which scale is measuring what it is intended to measure. In the present study, independent criterion method was used to measure the validity of the scale, where the correlation with similar construct is obtained and judged for significance. Technonet Asia scale (1981) for the risk taking ability. construct was used as independent criterion.

Table 4: Scale statistics

Scale statistics			
	Mean	SD	N
Technonet Asia	3.78	0.285	50
RO scale	3.53	0.367	50

Table 5: Correlation between the two scales

Particulars		TechnonetAsia	RO scale
Technonet Asia	Pearson correlation	1	.713
	Sig(2-tailed)		.000
RO scale	Pearson correlation	.713	1
	Significance (2-tailed)	.000	

The correlation of scores obtained on the new scale and the Technonet Asia scale used as independent criterion is significant at 1per cent level of significance (Table 5), which signifies the significant level of the validity of the new scale.

Scoring technique: The selected 19 statements could be administered to the farmers using Likert's five-point continuum response category. The points on continuum could be strongly agree, agree, neutral, disagree and strongly disagree with a weightage of 5, 4, 3, 2 and 1, respectively, while the scores would be reversed for unfavourable or negative statement. To know risk orientation of farmers, scores of each statement will be summed up. The score for every statement could be obtained by multiplying the respective scale value and the response weight of the respondent and aggregation of the scores across all 19 statements would provide the score for risk orientation of the respondent.

Scale Validation: The Mann Whitney test revealed that both the sets of farmers *i.e.* the farmers participating in Farmers' Field School and non-participants differed significantly with respect to statements *viz.,* guessing the intensity of associated risk before adopting the technology; carrying out crop management practices only after having a full knowledge of weather forecast; seeking information about risk from different sources; influence of past experiences in risk taking; success making me take higher risks; taking risk only for staple food crops; taking risk rather than avoiding it In this technological era; eagerly following scientist's advice without caring about any risk and found it worthy; not adopting technology on entire farm, until tried on a small area; taking loan for using better inputs; being ready with alternative course of actions in conditions of risk; going for integrated farming in order to mitigate risk; taking higher risk in order to have

good position in the market; keeping farm records to know production and market return; farmers with similar risk can be of great help to one another; communicating to relatives after having success in overcoming any risk; and prefer to being involved in FPO to minimize personal risk (Table 6).

Table 6: Comparison of risk orientation of farmers of FFS and Non-FFS

Statement no.	Farmer Category	N	Mean of rank	M W U	W S R Test	Z value	P-value
S1	FFS	90	58.94	1.21	5.305	-.90	.368
	N-FSS	30	67.17				
S2	FFS	90	69	585	1.050	-7.652	.000
	N-FSS	30	35				
S3	FFS	90	71.60	351	816	-6.555	.000
	N-FSS	30	27.20				
S4	FFS	90	67.50	720	1.185	-6.854	.000
	N-FSS	30	39.50				
S5	FFS	90	69.34	554	1.019	-5.321	.000
	N-FSS	30	33.97				
S6	FFS	90	74.81	62	527	-10.18	.000
	N-FSS	30	17.57				
S7	FFS	90	64.04	1.031	1.496	-2.228	.000
	N-FSS	30	49.87				
S8	FFS	90	70.53	447	912	-6.115	.000
	N-FSS	30	30.40				
S9	FFS	90	70.99	405.5	870.5	-6.282	.000
	N-FSS	30	29.02				
S10	FFS	90	65	945	1.410	-5.380	.000
	N-FSS	30	47				
S11	FFS	90	67.39	729	1.194	-4.852	.000
	N-FSS	30	39.82				
S12	FFS	90	66	855	1.320	-6.002	.000
	N-FSS	30	44				
S13	FFS	90	68.62	619.5	1.084	-5.251	.000
	N-FSS	30	36.15				
S14	FFS	90	67	765	1.230	-6.576	.000
	N-FSS	30	41				
S15	FFS	90	70.91	413.5	878.50	-6.315	.000
	N-FSS	30	29.18				
S16	FFS	90	70.74	428.5	893.5	-6.166	.000
	N-FSS	30	29.78				
S17	FFS	90	58.52	1.172	5.266	-1.141	.254
	N-FSS	30	66.45				
S18	FFS	90	73.80	153	618.00	-7.838	.000
	N-FSS	30	20.60				
S19	FFS	90	74.97	48	513	-8.406	.000

The two sets of farmers did not differ with respect to two statements *i.e.* number 1st (considering risk as an opportunity rather a constraint) and 17th (adopting a new technology so as to demonstrate competence in the community, despite the risk of making mistakes). However the mean scores of the participants of FFS and non-participants were significantly different (Table 7).The significant difference between the participants of FFS and non-participants on 17 statements out of 19 statements of the scale reflects that the risk orientation was measured effectively by the scale.

Table 7: Mean scores of participants and non-participants on risk orientation scale

Category of farmers	Mean score on risk orientation scale	Standard deviation	Standard error mean	t-test	df	Level of significance
Participants in FFS (n=90)	31.03	1.1547	0.1217	21.022	18	0.01
Non-participants in FFS (n=30)	24.69	2.0573	0.3756			

CONCLUSION

Risk in agriculture is multi-faceted and therefore, to understand risk orientation it is pertinent to analyse the risk dimensions. Based upon the framework of OCED, a scale was developed to measure the risk orientation among the farmers. Using the Thurston's Equal Appearing Interval method and item analysis criterion of inter-quartile range besides internal consistency test, scalogram analysis and independent criterion validity, a highly reliable and valid scale was developed to measure risk orientation of farmers. The risk orientation was measured effectively by the scale as it could differentiate significantly the participants of FFS with respect to their risk orientation. It can help develop suitable extension strategy to promote risk adjustment technology by identifying the risk orientation among the subjects using this scale.

Paper received on : November 07, 2016
Accepted on : November 15, 2016

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