Original Research Article

Development of an Index to Measure the Conservation Behaviour of Farmers

ABSTRACT

Meeting the demand of rising population and sustaining the quality of the environment are the two major challenges of Indian agriculture system. The conservation practices have the potential to achieve food security while also have the capacity to retain the environmental sustainability. This article was focussed with the construction of an index to assess the adoption of conservation practices by farmers. Based on the review of literature and discussion with the expert's, indicators and sub-indicators were identified and enlisted. Relevancy test method was followed in the construction of an index. The list of sub-indicators was sent to 75 experts with the request, to critically evaluate each sub-indicator for its relevancy to be included in the Conservation Behaviour Index (CBI). Out of 75 experts, 30 experts responded in time and at the earliest. The criteria to be followed in this procedure was sub-indicators having relevancy percentage above 75, relevancy weightage above 0.75 and mean relevancy score above 2.25 was considered for inclusion in Conservation Behaviour Index. Based on the above three criteria 56 sub-indicators were retained. Further the index has been administered in the study area and the scores obtained were analysed using cumulative frequency method to classify farmers into three categories.

Keywords: Index, Conservation Behaviour and Relevancy test.

Highlights: This paper focuses on the aspect that the process involved in developing a tool to study the adoption of conservation practices and to assess the conservation behaviour of farmers.

1. Introduction

The complex interaction of population growth, technological advancement and climate change have impacted heavily on agricultural and environmental sustainability. Farmers adopting modern farming systems that are used throughout the industrialized world have traditionally been characterized by high use of inputs and mechanisation of agriculture involving tillage. Conventional intensive agriculture has been perceived to have potential to increase food production but it has been well documented that such agricultural systems are a source of significant environmental destruction *(Pretty, 2008).* Conservation practices are needed that will integrate biological and ecological processes into food production, minimize the use of those non-renewable inputs that cause harm to the environment or to the health of farmers and consumers. In order to ensure agricultural and environmental sustainability conservation practices needs to be given much importance and one main focus is on farmer's behaviour to adopt such practices. It is, therefore, important to develop a tool to study the adoption of conservation practices by the farmers. In the present study, various conservation practices have been identified to witness its adoption onto the farmer’s field. For this purpose, the study was designed with an objective to develop an index to measure the conservation behaviour of farmers.

2. METHODOLOGY

In the present study construction of index to measure conservation behaviour of farmers was done in various stages. According to Pedhazur and Schmelkin (1991), the first step in index construction is identification of an applicable theoretical framework addressing the phenomena of interest. An index may be defined as a technique of totalling or reducing a single composite series data on a number of distinct, but related variables expressed in different units of measurement (Hooda, 2001). The Conservation behaviour of farmers has been operationalised as the adoption of practices by the farmers which are aimed at sustainably increasing agricultural productivity, enhancing climate resilience and food security. In this study, Conservation Behaviour Index measures the extent to which the existence of selected practices was perceived by the respondents at the point of enquiry. The following steps were considered for constructing the index.

2. 1. Identification of Indicators and Sub-indicators

Identification of indicators to develop the index was carried out through detailed analysis of literature. Further scrutiny was done by discussion with Agricultural Extension experts from the Department of Agricultural Extension and Rural Sociology of TNAU, biological and extension scientists of ICAR Institutes. The index in the present study consisted of ten major indicators related to farming practices. Each indicator consists of number of sub-indicators, under it. Sub-indicators were selected after consultation with experts and review of literatures. In the first stage, 80 conservation practices (sub-indicators) were collected. During the second stage these practices were discussed with the Agricultural Scientists and at the end of this process 72 practices were retained.

2.2. Relevancy test

The identified sub-indicators were subjected to expert opinions to find out the relevancy of these 72 practices for inclusion in the index to measure the conservation behaviour of farmers. Relevancy test was administered in the process. The experts or judges were from the cadres of teaching faculty in Extension discipline of TNAU and scientists of ICAR Institutes. The items were subjected to judgment of 30 judges. The experts were requested to specify whether each of the identified sub-indicators were relevant and suitable for inclusion in Conservation Behaviour Index. The responses were obtained on a three-point continuum *viz.*, 'Most Relevant', 'Relevant' and 'Not Relevant' frequencies with scoring pattern as 3, 2 and 1 respectively. All the judges responded within two months. By summing up the score given by each respondent, total score of all the 72 practices was calculated. From this data, relevancy percentage, relevancy weightage and mean relevancy scores were calculated using the following method.

2.2.1. Relevancy Percentage (RP)

Relevancy percentage was obtained by summing up the scores of ‘very much relevant’, ‘relevant’ and not relevant categories, which were then converted into percentage.

2.2.2. Relevancy Weightage (RW)

The responses received from the judges were analysed and the Relevancy Weightage (RW) of ith indicator (RW_i) was worked out by using the following formula.

$$\textit{Relevancy Weightage for each indicator } (RW) = \frac{(\textit{Most Relevant}) + (\textit{Relevant}) + (\textit{Not Relevant})}{\textit{Maximum Possible Score}}$$

2.2.3. Mean Relevancy Score (MRS)

Further, the Mean Relevancy Score was obtained by using the following formula.

$$\textit{Mean Relevancy Score for each indicator } (MRS) = \frac{(\textit{Most Relevant}) + (\textit{Relevant}) + (\textit{Not Relevant})}{\textit{Number of judges}}$$

Using these above three criteria the sub-indicators was screened for their final relevancy rating. Sub-indicators having relevancy percentage above 75, relevancy weightage above 0.75 and mean relevancy score above 2.25 were included in the index. The final index consisted of 56 sub-indicators.

3. RESULTS AND DISCUSSION

The relevancy percentage, relevancy weightage and mean relevancy score for each sub-indicators under ten major selected indicators was presented in Table 1.

Table.1 The Relevancy Percentage, Relevancy Weightage and Mean Relevancy scores of conservation behaviour index

S. No.	Indicators	Relevancy Percentage	Relevancy Weightage	Relevancy Mean Score
I	**Conservation Tillage**			
	1) Mulch tillage	95.56	0.95	2.87
	2) Ridge tillage	88.89	0.88	2.67
	3) Zone or Strip Tillage	82.22	0.82	2.47
	4) Zero or No Tillage	90.00	0.90	2.70
	5) Conventional Tillage	70.00	0.70	2.10
	6) Intensive ploughing	71.11	0.71	2.13
	7) Chemical tillage	73.33	0.73	2.20
II	**Water conservation**			
	1) Construction of farm pond	96.67	0.96	2.90
	2) Rainwater Harvesting	93.33	0.93	2.80
	3) Recycling wastewater	86.67	0.86	2.60
	4) Bore well recharge	88.89	0.88	2.67
	5) Construction of check dam	68.89	0.68	2.06

	6) Infiltration pits	85.56	0.85	2.57
	7) Water meters	66.67	0.66	2.00
	8) Efficient water taps	68.89	0.68	2.06
III	**Irrigation Management**			
	1) Controlled flooding	85.56	0.85	2.57
	2) Drip irrigation	98.89	0.98	2.97
	3) Sprinkler irrigation	94.44	0.94	2.83
	4) Irrigation Scheduling	86.67	0.86	2.60
	5) Irrigation based on water recommendation of crops	76.67	0.76	2.30
	6) Drought-Tolerant crops	86.67	0.86	2.60
	7) Land Levelling	75.56	0.75	2.27
	8) Ridges and furrow	71.11	0.71	2.13
	9) Bunding	72.22	0.72	2.17
	10) Concrete canals	68.89	0.68	2.07
IV	**Soil Moisture Conservation**			
	1) Mulching	100	1.00	3.00
	2) Cover cropping	93.33	0.93	2.80
	3) Green Manuring	82.22	0.82	2.47
	4) Crop Rotation	90.00	0.90	2.70
	5) Mixed cropping	90.00	0.90	2.70
	6) Application of Tank silt	75.56	0.76	2.27
	7) Vetiver grass	68.89	0.68	2.07
	8) Stone bunds	71.11	0.71	2.13
V	**Nutrient management**			
	1) Practicing soil testing	93.33	0.93	2.80
	2) Optimum application of inorganic fertilizers	78.89	0.78	2.37
	3) Soil health card based nutrient application	86.67	0.86	2.60
	4) Application of Farm yard manure	92.22	0.92	2.77
	5) Application of natural and mineral fertilizers	86.67	0.86	2.60
	6) Application of compost	91.11	0.91	2.73
	7) Application of soil amendments	71.11	0.71	2.13
	8) Fertigation	90.00	0.90	2.70
VI	**Residue management**			
	1) Using crop residues as fodder	94.47	0.94	2.83
	2) Incorporation in soil by Mulching	95.56	0.95	2.87
	3) Burning of crop residues	85.56	0.85	2.57
	4) Removal of crop residues	85.56	0.85	2.57
	5) Using crop residues as fuel for industrial purpose	82.22	0.82	2.47
	6) Decaying of crop residues using microbes	68.89	0.68	2.07
	7) Burial of crop residues into wasteland	72.22	0.72	2.17
	8) Composting	71.11	0.71	2.13

VII	**Pest management**			
	1) Summer ploughing	93.33	0.93	2.80
	2) Spraying botanical pesticides	86.67	0.86	2.60
	3) Release of natural enemies	81.11	0.81	2.43
	4) Pest tolerant varieties	86.67	0.86	2.60
	5) Trap Cropping	94.44	0.94	2.83
	6) Handpicking	72.22	0.72	2.17
	7) Setting traps	93.33	0.93	2.80
	8) Poly house farming	70.00	0.70	2.10
VIII	**Disease management**			
	1) Selection of appropriate season and sowing time	94.44	0.94	2.83
	2) Bio fumigation	76.67	0.76	2.30
	3) Selection of disease resistant varieties.	90.00	0.90	2.70
	4) Selection of healthy and disease-free seeds	94.44	0.94	2.83
	5) Seed treatment before transplanting.	94.44	0.94	2.83
	6) Eradication of insect vectors.	73.33	0.73	2.20
	7) Heat treatment to kill harmful pathogens	72.22	0.72	2.17
	8) Selection of traditional varieties	71.11	0.71	2.13
IX	**Weed management**			
	1) Hand weeding	87.78	0.87	2.63
	2) Use of Mechanical weeders	85.56	0.85	2.57
	3) Using weeds as a mulch material	90.00	0.90	2.70
	4) Using weeds as a fodder	87.78	0.87	2.63
	5) Retention of weed biomass	71.11	0.71	2.13
	6) Spraying bio herbicides	81.11	0.81	2.43
	7) Using nematodes to kill weeds	72.22	0.72	2.17
	8) Burning	68.89	0.68	2.07
X	**Integrated farming system**			
	1) One component	94.44	0.94	2.83
	2) Two components	91.11	0.91	2.73
	3) Three components	87.78	0.87	2.63
	4) Four components	81.11	0.81	2.43
	5) Five components	97.78	0.97	2.93
	6) More than five components	80.00	0.80	2.40

Components: Agricultural crops, Horticultural crops, Fodder crops, Agroforestry crops, Animal husbandry, Poultry, Fisheries, Vermicomposting, Mushroom, Sericulture.

3.1. Standardization of index

In the next stage, reliability and validity of index was ascertained for standardization of the index.

3.1.1. Reliability

Reliability is the consistency or precision of measuring instrument. The index is said to be reliable when it produces results with high degree of consistency when administered to the same respondents at different items. In this study, the reliability of the index was determined by 'split – half' method. The 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 of the odd numbered items as well as scores of the even numbered items of same respondents were correlated using the Pearson's correlation coefficient. The coefficient of internal consistency was worked out using the following formula:

$$r_{oe} = N\sum xy - (\sum X)(\sum Y)/[(\sqrt{N}\sum X^2)(\sum X^2)][(N\sum Y^2)(\sum Y^2)]$$

Where,

N= Number of respondents
X= Value of odd numbered items score
Y = Value of even numbered items score

The r_{oe} value obtained was again correlated by using Spearman Brown formula and thus obtained the reliability. The formula used was

$$r_{tt} = 2r_{oe} / 1 + r_{oe}$$

The obtained r_{tt} value was 0.77. 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 index is highly reliable as the reliable coefficient (rtt) was >0.60.

3.1.2. Content Validity

It is the property that ensures the obtained test scores as valid, if and only if it measures what it is supposed to measure. The content validity is the representativeness or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. Content validity was used to determine the validity of the index. The opinion of the 30 judges were obtained to find out the whether the items suggested were suitable for inclusion in the index or not. 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 3.76 and therefore the constructed index is said to be valid.

Table 2: The final inventory of conservation behaviour index

S. No.	Indicators	Give (√) to appropriate category
I	**Conservation Tillage**	
	1) Mulch tillage	
	2) Ridge tillage	
	3) Zone or Strip Tillage	
	4) Zero or No Tillage	
II	**Water conservation**	
	1) Construction of farm pond	
	2) Rainwater Harvesting	
	3) Recycling wastewater	
	4) Bore well recharge	
	5) Infiltration pits	
III	**Irrigation Management**	
	1) Controlled flooding	
	2) Drip irrigation	
	3) Sprinkler irrigation	
	4) Irrigation Scheduling	
	5) Irrigation based on water recommendation of crops	
	6) Drought-Tolerant crops	
	7) Land Levelling	
IV	**Soil Moisture Conservation**	
	1) Mulching	
	2) Cover cropping	
	3) Green Manuring	
	4) Crop Rotation	
	5) Mixed cropping	
	6) Application of Tank silt	
V	**Nutrient management**	
	1) Practicing soil testing	
	2) Optimum application of inorganic fertilizers	
	3) Soil health card based nutrient application	
	4) Application of Farm yard manure	
	5) Application of natural and mineral fertilizers	
	6) Application of compost	
	7) Fertigation	
VI	**Residue management**	
	1) Using crop residues as fodder	

	2) Incorporation in soil by Mulching	
	3) Burning of crop residues	
	4) Removal of crop residues	
	5) Using crop residues as fuel for industrial purpose	
VII	**Pest management**	
	1) Summer ploughing	
	2) Spraying botanical pesticides	
	3) Release of natural enemies	
	4) Pest tolerant varieties	
	5) Trap Cropping	
	6) Setting traps	
VIII	**Disease management**	
	1) Selection of appropriate season and sowing time	
	2) Bio fumigation	
	3) Selection of disease resistant varieties.	
	4) Selection of healthy and disease-free seeds	
	5) Seed treatment before transplanting.	
	6) Eradication of insect vectors.	
IX	**Weed management**	
	1) Hand weeding	
	2) Use of Mechanical weeders	
	3) Using weeds as a mulch material	
	4) Using weeds as a fodder	
	5) Spraying bio herbicides	
X	**Integrated farming system**	
	1) One component	
	2) Two components	
	3) Three components	
	4) Four components	
	5) Five components	
	6) More than five components	

Components: Agricultural crops, Horticultural crops, Fodder crops, Agroforestry crops, Animal husbandry, Poultry, Fisheries, Vermicomposting, Mushroom, Sericulture.

3.2. Administration of the Index

The index included 56 items. Response to each item was recorded as Adopted and Not adopted and scores were assigned as 2 and 1 respectively. Further the index has been administered and the scores obtained were analysed using cumulative frequency method to classify farmers into three categories.

Table.3 Classification of conservation behaviour into categories

S.No.	Category

1)	Less conservative
2)	Moderately conservative
3)	Highly conservative

4. Conclusion

Conservation Behaviour Index was constructed keeping in mind the study area viz. Tamil Nadu. With the growing concern over environmental stability along with achieving food security, the Conservation Behaviour Index thus constructed can be administered upon the farmers on a large scale to get a wider picture of their status towards the conservation practices to be adopted in their farming system. The results obtained will be helpful in planning and implementing the programmes for farmers to increase the awareness and adoption of such practices. The index was found to be effective in assessing the adoption of conservation practices by farmers in the study area.

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