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Development of Index to Assess the Utilization Behaviour Pattern of Paddy Growers on Green Technologies

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ABSTRACT: Agricultural inputs serve as the heart of agricultural production. But, prolonged and excessive use of agricultural inputs, polluted and degraded the environment. Though agricultural inputs pollute, without them, production will start to decline. To save the environment, green technology fertilizers which were regarded as environment-friendly pesticides are being used. Rice being the major staple food crop, the utilization pattern of green technology fertilizers in a rice-based ecosystem needs to be understood. To serve this purpose, an utilization behavior index needs to be constructed. With the help of extension experts and previous studies, hundred statements were developed. Later, based on Edwards's criteria, it was revised and ninety-five statements were sent to the judges opinion. Based on the results from the judges opinion, relevancy percentage and weightage were calculated based on which final scale with fourteen statements was developed. The correlation coefficient was found to be 0.869 and the final scale satisfies the content validity which ensures the scale can be administered to assess the utilization behavior of green technology among the beneficiaries in the rice-based eco-system.

Keywords: Utilization behaviour, Green technology fertilizers, Rice-based ecosystem, Paddy growers, Scale construction, Utilization behaviour index.

INTRODUCTION

Now-a-days, the agriculture sector has emerged as an important enterprise in the world. Earlier, it was the process of producing food but, now it is an act that requires greater investment in every aspect of production practices. Since the Green revolution, agricultural inputs have been regarded as the important input of production and it is price intensive. But the prolonged and over usage of agricultural inputs has resulted in deteriorating human and environmental health. Now, the concern is to continue the usage of agricultural inputs or to shift to eco-friendly inputs; to conserve the environment and human health. Green technologies represents green pesticides which were environmentally safe and does not cause any harmful side effects to human and the environment. Meanwhile, it ensures food security and safeguards the environment by employing environment-safe practices.

Adnan *et al.* (2017) reported that in Malaysia, usage of green fertilizer technology in paddy production has increased the yield. Meanwhile, Suji and Sathish *et al.* (2020) mentioned that most of the farmers had medium level of utilization behaviour towards eco-friendly agricultural practices. Suji and Sathish (2020) commented that education and farming experience of the farmers had resulted in positive and significant relationship with the adoption level of the farmers regarding eco-friendly technologies. Naher *et al.* (2021) concluded that bio-organic fertilizer (green fertilizer technology) in paddy production reduce synthetic nitrogen and triple super phosphate content in soil; thereby improving the soil health. Since, green technology is an emerging technology, there arises a need to develop the certain package of practices according to its objectives. The development and transfer of eco-friendly technologies require government extension agencies. Hence, this study was proposed to develop an utilization behaviour index to assess the utilization pattern of green technology among the paddy farmers.

METHODOLOGY

To measure the utilization behaviour of green technologies among the beneficiaries in a rice-based ecosystem, a scale was developed as suggested by Likert (1932); Edwards (1957). The methodology used in the development of the utilization behaviour index was given as follows.

Collection and editing of items. Various practices followed in green technology were stated and discussed with the experts of Agronomy, Entomology, and Pathology. A set of 100 hundred practices were stated and revised according to fourteen criteria given by Thrustone & Chave (1938); Likert (1932); Edwards (1957). After revision, 95 statements were retained and sent to the judges opinion.

Relevancy test. The revised 95 statements/ practices were sent to judges opinion to 120 experts in the field of Agronomy, Entomology, Pathology, and senior faculty members of State Agricultural Universities, Programme co-ordinator, and Subject Matter Specialists of KVK, ICAR Scientists, and Scientists related to this domain. They were asked to indicate their for each statement as 'Most Relevant', 'Relevant', and 'Not relevant' with the scores of 3, 2, and 1 respectively. They were also requested to include statements if it was left. Hence, a total of 60 members responded to the index. Based on the responses received, for each statement, the relevancy weightage, relevancy percentage, and mean relevancy score was calculated by using the following formula;

i. Relevancy weightage

Indicates the relevancy of the statement to the impact index.

$$RW = \frac{MRR * 3 + RR * 2 + NRR * 1}{MO \quad (3 * 55 = 165)}$$

Where,

RW = Relevancy Weightage

MRR = Most Relevant Response

RR = Relevant Response

NRR = Not Relevant Response

MOS = Maximum Obtainable Score

ii. Relevancy percentage

Indicates the relevant percentage of the statement to the impact index.

$$RP = \frac{OS}{MO \quad (3 * 55 = 165)} \times 100$$

Where,

RP = Relevancy Percentage

OS = Obtained Score

MOS = Maximum Obtainable Score

iii. Mean relevancy score

Indicates the mean relevancy score of each statement to the impact index.

$$MR = \frac{MRR * 3 + RR * 2 + NRR * 1}{\text{No. of Judges } (55)}$$

Where,

MRS = Mean Relevancy Score

MRR = Most Relevant Response

RR = Relevant Response

NRR = Not Relevant Response

Based on the relevancy percentage (>66%), relevancy weightage (0.66) and mean relevancy score (>2); the final statements were selected.

Calculation of 't' value (Item analysis). The relevant 95 statements were subjected to item analysis to assess the statements based on their ability to differentiate the respondent with high impact and low impact (extent to differentiate) towards green technology beneficiaries. For this purpose, the selected 95 statements were sent to 60 farmers in non-sample area. The farmers were requested to indicate their response on a five point continuum ranging from 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with the scores of 5, 4, 3, 2 and 1 respectively for positive statements and vice versa for negative statements. Based on the responses obtained from the farmers, they were arranged in descending order according to their total scores. As suggested by Edwards (1957), the high group (top 25 per cent of farmers) and the low group (lowest 25 per cent of farmers) were identified to evaluate the individual statements. Finally, out of 60 farmers, the 20 farmers with highest and lowest scores were used as criterion groups to evaluate the individual statements.

As suggested by Edwards (1957), the 't' value is calculated by using the following formula,

$$t = \frac{\overline{X_H} - \overline{X_L}}{\sqrt{\frac{\sum(X_H - \bar{X}_H)^2 + (X_L - \bar{X}_L)^2}{n\,(n-1)}}}$$

Where,

$(X_H - \bar{X}_H)^2 = X_H{}^2 - (X_X)^2$

$(X_L - \bar{X}_L)^2 = X_L{}^2 - (X_L)^2$

X_H = The mean score on given statement of the high group

X_L = The mean score on given statement of the low group

$X_H{}^2$ = Sum of square of the individual score on a given statement for high group

$X_L{}^2$ = Sum of square of the individual score on a given statement for low group

X_H = Summation of scores on given statement for high group

X_L = Summation of scores on given statement for low group

n = Number of respondents in each group

$\sum$ = Summation

Selection of statements for final scale. According to the calculated 't' value, for the 90 statements, the statements with highest 't' value were selection for inclusion in scale. Thus, a total of 87 practices or statement were selected to develop the index; in order to assess the utilization behaviour of green technology among the paddy farmers. The relevancy percentage, relevancy weightage and mean relevancy score along with the t-value of the selected statements were presented in Table 1.

Table 1: Relevancy weightage, relevancy percentage and mean relevancy score and t-value of selected items in index.

Sr. No.	Practices to assess utilization behaviour	RW	RP	RMS	t-value
I	**Agronomic Practices**				
A	**Nursery**				
a)	**Seed treatment :** Azospirillum 3 packets and Phosphobacteria 3 packets or Azophos 6 packets/kg of seeds – Biofertilizer *Trichoderma* sp. 10g/kg –Biocontrol	0.920	92.03	2.76	3.52
b)	**Sowing:** Area 1/10th of total area	0.865	86.56	2.59	3.15
c)	**Nutrient Management:** Spraying of NSKE extract	0.885	88.55	2.65	3.44
d)	**Water Management:** Maintaining 1.5-2.5 cm of water depending on seedling height	0.711	71.14	2.13	2.84
B	**Main field**				
a.	**Main field preparation**				
	Puddling	0.830	83.08	2.49	4.00
	Levelling	0.875	87.56	2.62	3.06
*	Chiselling	0.741	74.10	2.91	-0.48
b.	**Organic Manure**				
	Application of FYM / Compost @ 12.5t/ha	0.796	79.60	2.38	2.20
	Incorporation of Green manure @ 6.25 t/ha (Daincha, Sunhemp, Agathi	0.805	80.59	2.41	1.68
*	Incorporation of GM at 45 DAS	0.681	68.52	2.14	-1.68
c.	**Biofertilizers**				
	Raising Azolla as dual crop	0.805	80.59	2.41	3.52
	Broadcast 10 kg of soil based powdered BGA flakes at 10 DAT	0.850	85.07	2.61	3.10
	Broadcast Azospirillum @ 10 packets/ha	0.736	73.63	2.20	2.58
*	Using Azotobacter @ 10packets/ha	0.432	43.20	1.59	NS
d.	**Transplanting:** Transplanting the seedlings at the right age (1 week for 1 month crop duration)	0.796	79.60	2.38	4.37
e.	**Water Management**				
	Avoid Stagnation	0.900	90.04	2.70	3.84
	Alternate wetting and drying – appearance of hairline crack	0.870	87.06	2.61	4.25
*	Tidal irrigation	0.600	60.00	1.95	NS
*	Adoption of drip irrigation	0.690	69.25	2.15	0.41
f.	**Nutrient Management**				
	Split application of fertilizer	0.875	87.50	2.52	3.05
	Application of nitrogen by using leaf colour chart	0.796	79.60	2.38	2.46
	Apply fertilizer nutrients as per STCR-IPNS	0.771	77.11	2.31	4.00
*	Follow indigenous practices	0.426	42.65	1.85	NS
*	Adopting regular method of nutrient application	0.532	53.24	1.75	NS
g.	**Weed management**				
	Usage of clean seeds	0.800	80.09	2.40	3.15
	Summer ploughing	0.890	89.05	2.67	3.84
	Well decomposed and enriched FYM	0.850	85.07	2.55	3.52
	Stale seed bed technique	0.845	84.57	2.53	4.00
*	Hand weeding	0.623	62.38	1.57	NS
II	**Pest Management**				
	Selection of healthy seeds or use of available	0.855	85.57	2.83	3.52
	Raising of bund crops like cowpea and blackgram	0.875	87.56	2.62	4.00
	Ecological Engineering crops like marigold ,sunflower	0.825	82.58	2.47	3.89
	Clipping of rice seedlings tips before transplanting	0.850	85.07	2.55	3.60
	Use of botanicals as basal or foliar spray	0.689	68.95	2.15	3.52
	Pheromone traps 15/ha	0.721	72.13	2.16	3.44
	Bird perches @ 15/ha	0.805	80.59	2.41	2.84
	Tanjore bow traps @ 100/ha	0.850	85.07	2.61	2.20
	Release of parasitoids like *T.chilonis* or *T.japonicum*	0.7363	73.63	2.20	6.81
	Conservation of biological agents such as spider, waterbug, wasp, dragon fly, damselfly.	0.746	74.62	2.23	4.37
	Early and timely sowing	0.900	90.04	2.70	3.0
	Applications of pesticides based on ETL	0.870	87.06	2.61	2.58
	Proper destruction of straws and stubbles	0.796	79.60	2.38	2.67
PEST MANAGEMENT					
a.	**Yellow stem borer**				
	Destruction of stubbles after harvest	0.920	92.03	2.76	6.29
	Clipping off tip of seedlings	0.865	86.56	2.59	2.59
	Release of *T.japonicum* @50,000-1,00,000 adult/ha	0.885	88.55	2.65	6.24
	Avoid high dose fertilizer	0.711	71.14	2.13	5.82
	Spraying NSKE	0.830	83.08	2.49	3.56
b.	**Rice plant hopper**				
	Avoid close planting	0.875	87.56	2.62	2.20
	Avoid stagnation of water	0.796	79.60	2.38	5.21
	Follow alternate drying and wetting of field	0.805	80.59	2.41	4.21
	Avoid high dose of N fertilizer application	0.850	85.07	2.61	4.38

	Release of mirid bug	0.7363	73.63	2.20	3.15
	Neem oil 3% 15lit/ha	0.746	74.62	2.23	4.33
	Light traps during night and yellow pan trap during day time	0.900	90.04	2.70	2.84
c.	**Gundhi bug**				
	Placing of dry fish in the field	0.870	87.06	2.61	4.37
	Notchi/ipomea/prosopis leaf extract 10% and NSKE 5%, 25 kg/ha	0.796	79.60	2.38	3.10
d.	**Leaf folder**				
	Removing of grass weeds from bunds	0.771	77.11	2.31	6.29
	Light traps (reduce pest population)	0.800	80.09	2.40	3.10
	Release of parasitoids *T. chilonis*	0.890	89.05	2.67	4.37
	Spray insecticides at ETL	0.850	85.07	2.55	2.20
	Avoid excess use of N fertilizer	0.845	84.57	2.53	2.84
	Keep the bunds clean	0.875	87.56	2.62	3.59
	Spray NSKE 5%	0.825	82.58	2.47	6.20
	Installation of bird perches	0.850	85.07	2.55	4.12
e.	**Rice thrips**				
	Clipping off leaf tips before transplantation	0.920	92.03	2.76	2.54
	Nursery bed to be flooded	0.865	86.56	2.59	4.12
	Spraying insecticides @ ETL	0.885	88.55	2.65	3.15
f.	**Termite**				
	Locate the termintorium and destroy	0.711	71.14	2.13	2.01
	Seedling dip with chloropyriphos	0.796	79.60	2.38	1.54
	Flooding the field	0.805	80.59	2.41	3.15
III	**Disease management**				
	Use of resistant varieties	0.900	90.04	2.70	2.20
	Avoid flowering coinciding with high atmospheric humidity	0.870	87.06	2.61	5.21
	Synchronised sowing and transplanting	0.796	79.60	2.38	4.21
	Using healthy or treated seeds	0.771	77.11	2.31	4.38
	Destruction of weeds and crop residues	0.800	80.09	2.40	3.15
	Balanced and reasonable fertilizer use	0.890	89.05	2.67	4.33
	Destruction of rice stubbles and vector hosts	0.850	85.07	2.55	2.84
	Cleaning of canals and borders of plots that can be reservoirs of Rice yellow mottle virus	0.845	84.57	2.53	4.00
	Seed treatment with *Pseudomonas fluorescens* @10g/kg of seed	0.875	87.56	2.62	5.48
	Seedling root dip with *Pseudomonas fluorescens* @500 ml/ha or 2.5 kg/ha of seed	0.825	82.58	2.47	6.35
	Soil application with *Pseudomonas fluorescens* @2.5 kg/ha	0.850	85.07	2.61	3.15
	Foliar spray *Pseudomonas fluorescens* @ 5ml/lit or 5 gm/lit	0.736	73.63	2.20	4.27
	Disease and its management				
a.	**Fungal diseases**				
	Deep ploughing	0.900	90.04	2.70	4.33
	Collection of infected stubbles	0.870	87.06	2.61	2.54
	Removal of alternate and collateral host	0.796	79.60	2.38	2.41
	Bund cleaning	0.771	77.11	2.31	3.47
	Selection of varieties	0.800	80.09	2.40	5.12
	Clipping off seedlings	0.890	89.05	2.67	2.14
b.	**Bacterial diseases**				
	Grow resistant varieties	0.850	85.07	2.55	5.12
	Avoid clipping off seedlings while transplanting	0.845	84.57	2.53	3.14
	Avoid excessive use of N fertilizers	0.875	87.56	2.62	6.00
	Spray neem oil 3% or NSKE 5%	0.825	82.58	2.47	2.57
	Spray streptomycin sulphate + tetracycline (300gm)+ COC 1250 g/ha	0.850	85.07	2.55	3.95
c.	**Viral diseases**				
	Use of resistant varieties	0.920	92.03	2.76	5.00
	Control the vectors by spraying two round with Imidacloprid 100 ml/ha	0.865	86.56	2.59	4.67
IV	**Harvesting:** Harvesting at 80% grain maturation stage	0.885	88.55	2.65	3.51

(* - Statements with low RW, RP, RMS and t-value were not included)

Thus, a total of 87 statements with highest 't' values were selected for the construction of final scale which differentiate between highest and lowest groups. The statements with low 't' value were deleted. The index procedure developed by Asokhan and Ganapathy Ramu (2021) was followed in the present study.

Reliability

Test-retest method. The final 87 statements which represents the utilization behaviour of green technology beneficiaries in rice based ecosystem were administered on a three point continuum scale to a 30 farmers in non-sample area. These 87 statement were identified based on many reviews consulted with experts and scientists. After a time period of 15 days, the scale was again administered to the same respondents and thus there were two set of scores obtained. For both sets of scores, the correlation co-efficient was calculated and the 'r' value was 0.869 which represents significant at 1 per cent level of probability. Thus, it indicates the impact index was highly suitable to assess the utilization behaviour of green technology among the beneficiaries in the rice based ecosystem. The index was stable and dependable in its measurement.

Validity

Content validity. Content validity refers to the sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. This method was adopted to determine the content validity of the developed index. As the content of the index examines the utilization behaviour of green technology beneficiaries in rice-based ecosystem, it was assumed that the present scale satisfies the content validity. As the scale value differs for each of the statement with a high discriminating value, this scale is said to be a valid measure of the impact.

CONCLUSION

Any technology intends to make our lives better. The evolution of green technologies became one end solution to environmental concerns and is creating ways of sustainable development. The current study can contribute to policymakers such as governments and organizations to plan and develop strategies emphasizing the utilization of green technologies in rice-based ecosystems. The final scale satisfies the content validity which deduces that the scale can be administered to assess the utilization behavior of green technology among the beneficiaries in the rice-based eco-system. This scale will be much useful for the researcher and extension worker. Assessment of utilization behaviour of farmers on green technology is very much needed to know the status of farmers on green technology and to develop strategies for sustainable eco friendly agriculture.

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