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Adoption of Pest Management Practice Wise Green Technologies Utilization Behaviour of Trichy and Madurai District Farmers in Rice-based Ecosystem

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The current study was carried out in Madurai and Trichy districts of Tamil Nadu. Two blocks from each district were chosen. For this study, a total sample size of 240 people was used. It was seen that 52.08 per cent of the respondents had fully adopted the destruction of stubbles after harvest in which 56.67 per cent of Trichy district farmers and 47.50 per cent of Madurai district farmers had fully adopted the above practice in order to avoid yellow stem borer. More than half (51.67%) of the

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farmers had adopted placing of dry fish in the field in which 56.67 per cent of Trichy district farmers and 46.66 per cent of Madurai district farmers had fully adopted this practice. It was observed that 50.00 per cent of Trichy district respondents and 27.50 per cent of Madurai district respondents had partially adopted the practice of dipping the seedlings with chloropyriphos to avoid the attack of termites.

Keywords: Paddy; green technologies; pest management; etc.

1. INTRODUCTION

More than 40.00 per cent of the global population regards rice as one of their staple foods. An estimate states that nearly 600 tonnes of rice were produced globally in 2000, and that by 2030, this production rate may have increased by 1.5 times.In India, rice is extensively cultivated throughout the year, with the period of growth influenced by the prevailing climate.The country relies heavily on rice production and any risk that lowers the yield that has a great impact on the respective economies. Paddy is the largest growing crop in Tamil Nadu contributing to about 21.59 lakh hectare area, 75.57 L.MT production and 35,000 kg/ha productivity in 2022-23 [1]. “In spite of considerable primary success, indiscriminate use of mineral fertilizers has often led to deterioration in the overall soil health of the country leading to stagnation of foodgrain production” [2]. The farmers worldwide are implementing higher plant densities in their crop management to meet the growing demand for higher rice grain yields, and moreover, this had led to an increase in the population of specific pests. Eco-friendly regulations are those that are simple, affordable, and reduce pollution while addressing social and economic concerns. In order to solve the problems of resource scarcity, climate change, food security and feeding a rising population, agriculture must embrace these green technologies [3,4] The farming systems and techniques are applied in such a way that it suits all aspect of the sustainable development. It might be possible to reduce environmental pollution and increase rice productivity by implementing eco-friendly management practices in order to conserve the prevailing ecosystem. The effectiveness of different eco-friendly pest management techniques was selected and evaluated to find and understand the reasoning behind the adoption of green technologies utilization behaviour of rice farmers in Trichy and Madurai districts.

2. METHODOLOGY

Extent of utilization of farmers using green technologies can be operationalized as the extent of green technologies adopted by the paddy growers in agronomic practices, main field preparation, pest management, disease management and harvesting. To measure the utilization behaviour of green technologies among the beneficiaries in rice based ecosystem, a scale was developed as suggested by Likert [5] and Edwards [6]. The methodology used in the development of green technologies utilization behaviour index was given as follows

2.1 Collection and Editing of Items

The 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 Thurstone [7], Likert [5] and Edwards [6]. After revision, 95 statements were retained and sent to judges opinion.

2.2 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, 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 were responded to the index” [3]. 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.

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

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.

$$RP = \frac{OS}{MOS\ (3 * 55 = 165)} X\ 100$$

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.

$$MRS = \frac{MRR * 3 + RR * 2 + NRR * 1}{No.ofJudges\ (55)}$$

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.

2.3 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 [6], 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". [3]

As suggested by Edwards [6], 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
∑ = Summation

2.4 Selection of Statements for Final Scale

According to the calculated 't' value, for the 95 statements, the statements with highest 't' value were selected 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.

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 final lists of selected statements were presented in Table 1.

Table 1. Green technologies utilization behaviour index in rice

S. No.	Practices to assess green technologies utilization behaviour in rice	Responses		
		Adopted	Partially adopted	Not adopted
I	**Pests and Its Management**			
a.	**Yellow stem borer**			
	Destruction of stubbles after harvest			
	Clipping off tip of seedlings			
	Release of *T.japonicum* @50,000-1,00,000 adult/ha			
	Avoid high dose fertilizer			
	Spraying NSKE			
b.	**Rice plant hopper**			
	Avoid close planting			
	Avoid stagnation of water			
	Follow alternate drying and wetting of field			
	Avoid high dose of N fertilizer application			
	Release of mirid bug			
	Neem oil 3% 15lit/ha			
	Light traps during night and yellow pan trap during day time			
c.	**Gundhi bug**			
	Placing of dry fish in the field			
	Notchi/ipomea/prosopis leaf extract 10% and NSKE 5%, 25 kg/ha			
d.	**Leaf folder**			
	Removing of grass weeds from bunds			
	Light traps (reduce pest population)			
	Release of parasitoids*T.chilonis*			
	Spray insecticides at ETL			
	Avoid excess use of N fertilizer			
	Keep the bunds clean			
	Spray NSKE 5%			
	Installation of bird perches			
e.	**Rice thrips**			
	Clipping off leaf tips before transplantation			
	Nursery bed to be flooded			
	Spraying insecticides @ ETL			
f.	**Termite**			
	Locate the termintorium and destroy			
	Seedling dip with chloropyriphos			
	Flooding the field			

Table 2. Pests management practice wise green technologies utilization behaviour of Trichy and Madurai district farmers in rice-based ecosystem

S. No.	Utilization behavior	Trichy n= 120						Madurai n= 120						Total n= 240					
		Fully Adopted		Partially adopted		Not adopted		Fully Adopted		Partially adopted		Not adopted		Fully adopted		Partially adopted		Not adopted	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No	%	No	%	No	%
I		Pests and Its Management																	
A.	**Yellow stem borer**																		
i.	Destruction of stubbles after harvest	68	56.67	32	26.67	20	16.67	57	47.50	25	20.83	38	31.66	125	52.08	57	23.75	58	24.17
ii.	Clipping off tip of seedlings	60	50.00	36	30.00	24	20.00	78	65.00	30	25.00	12	10.00	138	57.50	66	27.50	36	15.00
iii.	Release of *T.japonicum* @50,000-1,00,000 adult/ha	56	46.67	16	13.33	48	40.00	89	74.16	18	15.00	13	10.83	145	60.42	34	14.17	61	25.42
iv.	Avoid high dose fertilizer	32	26.67	64	53.33	24	20.00	40	33.33	27	22.50	53	44.16	72	30.00	91	37.92	77	32.08
v.	Spraying NSKE	44	36.67	48	40.00	28	23.33	31	25.83	22	18.33	67	55.83	75	31.25	70	29.17	95	39.58
B.	**Rice plant hopper**																		
i.	Avoid close planting	24	20.00	76	63.33	20	16.67	36	30.00	22	18.33	62	51.66	60	25.00	98	40.83	82	34.17
ii.	Avoid stagnation of water	64	53.33	48	40.00	8	6.67	49	40.83	25	20.83	46	38.33	113	47.08	73	30.42	54	22.50
iii.	Follow alternate drying and wetting of field	28	23.33	56	46.67	36	30.00	26	21.66	37	30.83	57	47.50	54	22.50	93	38.75	93	38.75
iv.	Avoid high dose of N fertilizer application	20	16.67	68	56.67	32	26.67	35	29.16	49	40.83	36	30.00	55	22.92	117	48.75	68	28.33
v.	Release of mirid bug	32	26.67	44	36.67	44	36.67	22	18.33	20	16.66	78	65.00	54	22.50	64	26.67	122	50.83
vi.	Neem oil 3% 15lit/ha	64	53.33	24	20.00	32	26.67	59	49.16	43	35.83	18	15.00	123	51.25	67	27.92	50	20.83
vii.	Light traps during night and yellow pan trap during day time	72	60.00	16	13.33	32	26.67	80	66.66	21	17.50	19	15.83	152	63.33	37	15.42	51	21.25
C	**Gundhi bug**																		
i.	Placing of dry fish in the field	68	56.67	36	30.00	16	13.33	56	46.66	30	25.00	34	28.33	124	51.67	66	27.50	50	20.83
ii.	Notchi/ipomea/prosopis leaf extract 10% and NSKE 5%, 25 kg/ha	44	36.67	60	50.00	16	13.33	37	30.83	59	49.16	24	20.00	81	33.75	119	49.58	40	16.67
D	**Leaf folder**																		
i.	Removing of grass weeds from bunds	56	46.67	48	40.00	16	13.33	70	58.33	37	30.83	13	10.83	126	52.50	85	35.42	29	12.08
ii.	Light traps (reduce pest population)	24	20.00	72	60.00	24	20.00	75	62.50	31	25.83	14	11.66	99	41.25	103	42.92	38	15.83
iii.	Release of parasitoids-*T.chilonis*	60	50.00	20	16.66	40	33.33	82	68.33	19	15.83	19	15.83	142	59.17	39	16.25	59	24.58
iv.	Spray insecticides at ETL	20	16.67	52	43.33	48	40.00	35	29.16	43	35.83	42	35.00	55	22.92	95	39.58	90	37.50
v.	Avoid excess use of N fertilizer	28	23.33	60	50.00	32	26.67	49	40.83	52	43.33	19	15.83	77	32.08	112	46.67	51	21.25
vi.	Keep the bunds clean	52	43.33	52	43.33	16	13.33	76	63.33	35	29.16	9	7.50	128	53.33	87	36.25	25	10.42

S. No.	Utilization behavior	Trichy n= 120						Madurai n= 120						Total n= 240					
		Fully Adopted		Partially adopted		Not adopted		Fully Adopted		Partially adopted		Not adopted		Fully adopted		Partially adopted		Not adopted	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No	%	No	%	No	%
vii.	Spray NSKE 5%	72	60.00	32	26.67	16	13.33	45	37.50	64	53.33	11	9.16	117	48.75	96	40.00	27	11.25
viii.	Installation of bird perches	64	53.33	28	23.33	28	23.33	53	44.16	23	19.16	44	36.66	117	48.75	51	21.25	72	30.00
E	**Rice thrips**																		
i.	Clipping off leaf tips before transplantation	60	50.00	40	33.33	20	16.67	67	55.83	32	26.66	21	17.50	127	52.92	72	30.00	41	17.08
ii.	Nursery bed to be flooded	60	50.00	40	33.33	20	16.67	49	40.83	53	44.16	18	15.00	109	45.42	93	38.75	38	15.83
iii.	Spraying insecticides @ ETL	20	16.67	64	53.33	36	30.00	35	29.16	47	39.16	38	31.66	55	22.92	111	46.25	74	30.83
F	**Termite**																		
i.	Locate the termintorium and destroy	60	50.00	40	33.33	20	16.67	74	61.66	21	17.50	25	20.83	134	55.83	61	25.42	45	18.75
ii.	Seedling dip with chloropyriphos	20	16.67	60	50.00	40	33.33	49	40.83	33	27.50	38	31.66	69	28.75	93	38.75	78	32.50
iii.	Flooding the field	56	46.67	40	33.33	24	20.00	45	37.50	34	28.33	41	34.16	101	42.08	74	30.83	65	27.08

3. RESULTS AND DISCUSSION

Practice Wise Green Technologies Utilization Behaviour of Trichy and Madurai District Farmers in Rice Based Ecosystem

The practice wise green technologies utilization behaviour of Trichy and Madurai district farmersin rice-based ecosystem were assessed by using green technologies behaviour index developed for study. The responses were obtained and are given in Table 2.

From the above Table 2, it was revealed that more than half of the respondents (52.08%) of the respondents had fully adopted the destruction of stubbles after harvest in which 56.67 per cent of Trichy district farmers and 47.50 per cent of Madurai district farmers had fully adopted the above practice in order to avoid yellow stem borer. It was also seen that more than half (53.33%) of Trichy district farmers had partially adopted the avoidance of high dose fertilizers followed by 33.33 per cent of Madurai district farmers to avoid the incidence of yellow stem borer.

More than one-third (40.83%) of the farmers had partially adopted the avoidance of close planting in which less than two-thirds (63.33%) and 18.33 per cent had partially adopted the above practice. In order to avoid the rice plant hopper, 50.83 per cent of farmers had not adopted the release of mired bugs in which 36.67 per cent of Trichy district farmers and two-thirds (65.00%) of Madurai district farmers had not adopted the above practice. The findings are in accordance with Deepika et al*.,* [8]

It could be stated that more than half (51.67%) of the farmers had adopted placing of dry fish in the field in which 56.67 per cent of Trichy district farmers and 46.66 per cent of Madurai district farmers had fully adopted this practice. Placing of dry fishes is a traditional method to avoid gundhi bug and hence the farmers were more aware of the practice and were practicing since a long period of time. It was also found that exactly half of the Trichy district respondents (50.00%) had partially adopted incorporation of Notchi and NSKE followed by less than half (49.16%) of Madurai district farmers to avoid the incidence of gundhi bug. The free availability and accessibility of Notchi and Neem seed kernels in the study area might be the reason quoted for partial adoption. The NGOs present in Trichy district provided trainings that were concerned towards conventional environment friendly practices.

To control the leaf folder incidence, 42.92 per cent of farmers had partially adopted light traps in which 60.00 per cent of Trichy district farmers and 62.50 per cent of Madurai district farmers had partially adopted the above practice. Exactly half (50.00%) of Trichy district farmers had fully adopted the release of parasitoids *Trichogramma chilonis* followed by 68.33 per cent of Madurai district farmers. It was also seen that 43.33 per cent of Trichy district farmers had partially adopted the practice of spraying insecticide at economic threshold level followed by 35.83 per cent of Madurai district farmers to avoid the incidence of leaf folder. Similar results were reported in the studies of Hassan et al*.,*[9]; Suji et al*.,*[10-12]

From the above Table 2, it could be noted that more than half (52.92%) of the farmers had fully adopted the practice of clipping of leaf tips before transplantation to avoid the rice thrips in the field. Exactly half (50.00%) of Trichy district farmers and 55.83 per cent of Madurai district farmers had fully adopted the above practice. It was also observed that 50.00 per cent of Trichy district farmers and 40.83 per cent of Madurai district farmers had fully adopted the practice of flooding the nursery bed to avoid the presence of rice thrips. The findings are in line with Rathod et al*.,* [13]; Adnan et al*.*, [14] & Adnan et al., [15]

Locating the termintorium of termites and destroying it as a major practice followed to elude the incidence of termites. Exactly half (50.00%) of the Trichy district respondents and 61.66 per cent of Madurai district respondents had fully adopted this practice. It was also observed that 50.00 per cent of Trichy district respondents and 27.50 per cent of Madurai district respondents had partially adopted the practice of dipping the seedlings with chloropyriphos to avoid the attack of termites.The results of the study is in accordance with Guna et al*.,*[16], Ince Et al. [17].

4. CONCLUSION

The availability of parasitoids and bio pesticides in Madurai district made it easy for the farmers to easily purchase it through subsidies and adopt it. The farming systems and techniques are applied in such a way that it suits all aspect of the

sustainable development. It might be possible to reduce environmental pollution and increase rice productivity by implementing eco-friendly management practices in order to conserve the prevailing ecosystem.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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