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ADOPTION OF SUSTAINABLE AGRICULTURAL PRACTICES BY TRADITIONAL RICE GROWERS

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Abstract: Farmer sustainability index (FSI) was developed to measure the adoption of sustainable practices by traditional rice growers of Kuttanad agro-ecosystem in Kerala. Based on the mean FSI scores of each group, the groups were named as conventional and sustainable. The results indicate a wide range between the mean FSI scores of conventional (23.95) and sustainable (70.06) adopter categories. The conventional and sustainable adopter categories maintained significantly distinct positions on all selected practices and also on the overall total FSI scores. It proved that the conventional and sustainable groups acted differently on all production practices in concordance with their technological allegiance.

Key words: Adoption, sustainable agriculture, and traditional rice grower.

INTRODUCTION

Recent years have witnessed a growing concern for environmental risks associated with modern agriculture. Many modern farming practices related to the control of pests and productivity of soils have been identified as having harmful effects on the long-term sustainability of agro-ecosystems. Strategies aimed at dealing with these problems were increasingly addressed under the term of sustainable agriculture. While there has been a great deal of research on related aspects like adoption of conservation practices, less attention has been given to adoption of sustainable agricultural practices as such. It was largely due to lack of success of the classic adoption-diffusion model for explaining the adoption of sustainable practices, which generally lacked the relative advantage in terms of profitability. It was in this context the present study was undertaken. It attempts to apply the adoption-diffusion model to the case of sustainable agricultural practices by employing a measure of farmer's attitude that shapes their perceptions of profitability and the current aspects of farming system theory.

MATERIALS AND METHODS

Kuttanad, the traditional rice bowl of Kerala, covers 53777 ha of low-lying reclaimed lands exclusively under paddy. It is a unique agro-ecosystem, which is reported to have one of the highest rice yields in the state (Elizabeth *et al.*, 1990). However, in recent times, the serious concern over the productivity and increased cost of cultivation has been forcing people out of rice cultivation in the region. Moreover, the manifold increase in the use of fertilizers and pesticides has caused recurring incidences of pest outbreaks and epidemics. The growing environmental degradation has also been a related externality of the intensive input use followed in the region. These indicate that there are reasons for speculations about the sustainability of the system in terms of productivity, ecological stability and related externalities on human life. Hence, the region was purposively selected for the study.

Among the three districts of Alappuzha, Kottayam and Pathanamthitta, which covered the entire Kuttanad tract, Alappuzha and Kottayam districts, which had the maximum share of area under paddy, were purposively selected. Random sampling was followed to select four panchayats from Alappuzha district and one panchayat from Kottayam district. The number of panchayats from each district was fixed proportionate to the number of blocks covering Kuttanad paddy in each district. Thirty farmers were randomly selected from each of the selected panchayat to form a total of 150 respondents for the study.

Daberkow and Reichelderfer (1988) reported that low-input sustainable agriculture (LISA) measured adoption of sustainable practices as the extent to which biologically based practices that resulted in less reliance on purchased inputs were used in farming. Based on this line, adoption of sustainable agricultural practices were operationalised as the integrated use

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of improved and indigenous practices from seed selection to harvest aimed at optimizing goals of production, natural resource conservation and reducing adverse impacts on human life. Therefore, to measure the adoption of sustainable agricultural practices by the paddy growers, a farmer sustainability index (FSI) was developed based on the methodology suggested by Taylor *et al.* (1993).

Seed to seed practices that affect sustainability were broadly classified into those related to plant protection and soil health. In developing FSI, 40 items covering insect control, disease control, weed control, soil fertility management, soil erosion control and related practices relevant under the local condition of the farmers were selected. Special emphasis was given to principles of integrated pest management practices for pest control and integrated nutrient management for effective fertilizer use. In determining the sustainability of various practices, attention was given to the joint implications of the practices to productivity, ecological stability and impact on natural resource base and human health as ascertained through discussions with experts. Plus values were assigned to practices believed to contribute to sustainability and minus values to practices detracting from sustainability. Zero value was assigned to neutral position. The values were assigned based on the standard procedure developed by Mohamad *et al.* (1994).

The selected practices were pretested on a sample of 20 farmers in a non-sampling area. In item selection for the final FSI, data on four of the 40 items, which were followed only by a minority, were dropped. Thus, 36 items related to production practices constituted the final FSI with scores ranging from -4 to +4 as described in the standard procedure.

The content validity of the instrument was ensured through expert consultation and literature scan. Reliability, which ensured the consistency of the instrument in measuring the variable was ascertained using coefficient alpha. The mean of all split half reliabilities was worked out as 0.87, which is indicative of the high consistency of the instrument.

The data on FSI was collected through personal interview. The cumulative score of all the items gave the unadjusted FSI score of a respondent. In order to facilitate interpretation of the FSI value for the different farmers in the study, the unadjusted FSI scores that ranged between -9 to +38 were adjusted so as to be in a range of 0 to 100 using the formulae:

Adjusted FSI score = [(Unadjusted score - minimum score) / (maximum score - minimum score)] x 100

Any score less than 50 was considered unsustainable and score more than fifty as sustainable. Fifty was considered as the neutral score. This was adopted from the procedure standardized by Mohammed *et al.* (1994).

Cluster analysis was used to identify the mutually exhaustive groups or clusters based on the similarities in rice production practices adopted. Simple statistical tools like mean, standard deviation and percentage analysis were also used in the analysis of the data.

RESULTS AND DISCUSSIONS

Classification of farmers based on FSI

It was found that all farmers included at least a few resource-conserving practices in their farming. Both chemical inputs and low input indigenous practices were bundled into a package by the farmer for adoption on his farm. Thus, differences in the extent of adoption of sustainable practices among farmers were mostly related to the type and number of sustainable practices adopted by individual farmers. Therefore, it was found logical to group farmers based on similarities in production practices employed by them using inductive cluster analysis. The resulted dendrogram grouped the farmers into two homogeneous classes. Based on the mean FSI scores of each group, the groups were named as conventional and sustainable. The distribution of farmers in the two groups is represented in Table 1. The results indicate a wide range between the mean FSI scores of conventional (23.95) and sustainable (70.06) adopter categories. The percentage of farmers under the two groups revealed that majority of farmers belonged to the conventional adopter category (57%). The over emphasis of high input technologies in development scheme aimed at improving rice production could be viewed as the probable reason for the high popularity of conventional farming among farmers. However, a sizeable

Table 1. Distribution of farmers based on FSI scores of adoption categories (N=150)

Category	n	Mean FSI	SD	Frequency (%)
Conventional	86	23.95	19.43	57
Sustainable	64	70.06	11.01	43
Total	150	43.16	26.30	100

Table 2. Practice wise mean FSI scores of the adopter categories

Sustainable practices related to	Adopter categories		t value
	Conventional	Sustainable	
Insect control	25.46	65.68	16.97**
Disease control	56.16	67.97	3.83**
Weed control	51.16	65.76	5.40**
Soil fertility maintenance	27.09	57.17	10.24**
Soil erosion control & related practices	14.83	54.30	11.20**
Total adoption	23.95	70.06	18.79**

** Significant at 1% level

43% belonged to the sustainable adopter category. This implied that the farmers have started integrating indigenous and improved practices in farming on their own. The recurring incidences of pest resurgence and epidemics reported to be the result of growing environmental degradation might be a compelling reason. Therefore, it is high time that the present extension strategies should be reoriented to integrate natural resource conservation goal also along with the present goals of production and profit to make sustainable agriculture a reality.

Practice-wise adoption of sustainable agricultural practices

The entire sustainable practices in rice production selected for the study from seed selection to harvest has been broadly categorized as those related to plant protection and soil health. The practice-wise mean FSI scores of the adopter groups are presented in Table 2.
The conspicuous finding in Table 2 was that the conventional and sustainable adopter categories maintained significantly distinct positions on all selected practices and also on the overall total FSI scores. The results confirmed the antithetical positions ascribed to the conventional and sustainable farmers in terms of input use and natural resource management by the theoretical propositions of Taylor *et al.* (1990). It proved that the conventional and sustainable groups acted differently on all production practices in concordance with their technological allegiance.

Practices related to plant protection

An in depth analysis of the plant protection practices in which the two adopter categories differed has been presented in Table 3. The results indicate that the conventional adopters had mean FSI scores lower than the sustainable adopters on all production aspects related to plant protection.

The only practices in non-chemical insect control where the two groups did not show any significant difference was related to the use of improved tolerant varieties and use of lime. The area being endemic to rice pests like brown plant hopper (BPH) and gall midge necessitates the use of tolerant varieties by all. Moreover, the high acidity of soils has made application of lime also indispensable for rice cultivation. Hence, the noted similarity on these practices between the two groups seemed logical.

Related to the chemical means of insect control, the two groups differed significantly on all aspects. However, the difference between the groups on mean FSI scores was highest for the change in quantity of insecticide used in last five years. Negative values are ascribed to practices like increased use of pesticides in the standard procedure for measuring FSI. Therefore, the very low mean FSI scores for the conventional adopters (4.92) indicate that there was an increase in the quantity of insecticides used by them over the past five years in contrast to the sustainable group whose mean FSI score was 56.25.

There were significant differences between the two groups on aspects of deciding the pesticide sprays. The sustainable group mostly resorted to economic threshold level of pest damage in deciding pesticide sprays as indicated by their higher mean FSI score of 90.63.

Table 3. Mean FSI scores of adopter categories on production practices related to plant protection

Plant protection practices	Mean FSI scores		V value
	Conventional adopters	Sustainable adopters	
I. Insect control	25.46	65.68	16.97**
A. Non-chemical means	43.20	73.32	8.52**
Use of biological or natural products	17.84	67.81	7.52**
Crop rotation	6.20	32.81	4.59**
Use of tolerant varieties	84.79	92.19	1.54
Adjusting sowing date	75.44	87.50	1.99**
Use of lime	76.58	85.94	1.57
Use of light traps and other mechanical means	9.01	75.00	11.48**
B. Chemical means	20.50	73.68	23.20
Use of same chemical continuously	31.86	72.92	6.54**
Nature and persistence of chemicals used	72.79 -	84.77	4.15**
Number of sprayings/ season	25.43	86.72	18.61**
Change in quantity of insecticides use in last 5 years	4.92	56.25	10.89**
C. Basis of deciding pesticide spray	44.96	78.65	6.97**
Calendar spray	67.39	95.31	4.55**
Occurrence of pests in field	5.83	1.56	1.31
When crop damage is observed	58.70	48.43	1.18
Based on economic threshold level of pests	5.70	90.63	7.51**
II. Disease control	56.98	67.97	3.38**
A. Chemical means	76.07	75.52	0.11
Number of sprayings / season	76.07	75.52	0.11
B. Non-chemical means	61.79	75.22	4.10
Crop rotation	16.52	20.31	0.63
Use of disease tolerant varieties	88.21	85.94	-0.23
Adjust crop planting date	69.57	82.81	1.99**
Use of lime	88.12	78.13	-1.48
Use of any other methods	43.59	48.44	0.65
III. Weed control	51.16	65.76	5.4**
A. Chemical means	41.28	52.34	3.25**
Number of sprayings / season	41.28	52.34	3.25**
B. Non-chemical mans	25.00	37.58	5.2**
Crop rotation	10.77	26.56	2.62**
Adjust crop planting date	70.31	79.31	-1.17
Mechanical control	87.05	85.94	-0.02

**Significant at 1 per cent level

In the case of disease control and also weed control, the two groups differed significantly except for chemical means of disease control. This suggested that the disease problem was not that serious in the area to have been treated differently by the two groups.

Table 4. Mean FSI scores of adopter categories on production characteristics related to soil health

Production practices	Mean FSI scores		t value
	Conventional adopters	Sustainable adopters	
I. Soil fertility maintenance and enhancement	27.09	57.17	10.24**
A. Chemical fertilizer use	29.75	55.21	9.30**
Per cent of inorganic N used	12.61	44.38	8.34**
No. of applications	76.41	71.88	-0.83
Change in quantity of fertilizer use in last 5 years	19.81	53.91	7.17**
Type of fertilizers used	69.55	81.25	1.75
B. Non-chemical means	25.44	51.17	8.20**
Crop rotation	31.40	50.00	5.62**
Use of lime	53.76	73.44	3.88**
Use of biofertilizers	01.84	24.48	5.88**
Summer fallowing	77.74	85.94	1.41
Use of fertilizer based soil testing	49.45	53.13	0.52
Use of organic manure	47.37	73.44	3.41**
II. Soil erosion control and related practices	14.83	54.30	18.79**
Construction of bunds and other erosion control structures	17.06	67.19	7.38
Integrated cropping	7.42	38.54	5.14**
Type of tillage follows	22.06	63.54	7.64**

**Significant at 1 per cent level

Practices related to soil health

Soil fertility management, soil erosion control and related practices were considered under soil health. The mean FSI scores for the conventional and sustainable adopters on these practices are given in Table 4.

The results revealed that the conventional and sustainable groups maintained significantly different positions on all aspects related to chemical fertilizer use except for the number of applications and the type of fertilizer used. It implied the dependence of both groups on inorganic fertilizer source. The high cost of organic manure and its non-availability in required quantities have made the use of chemical fertilizer indispensable even for sustainable adopters in higher quantities. Also in adopting summer fallowing and use of fertilizers based on soil testing, the two groups were similar. The use of biofertilizers was not common even among the sustainable group, which showed a FSI score of 24.48 indicating the need to popularize biofertilizers in the area. On all practices related to soil erosion control, the two-adopter categories showed significantly different mean FSI scores.

Thus from the overall picture drawn, it could be concluded that the conventional and sustainable adopters were significantly different on adoption of almost all sustainable practices related to rice cultivation. The adoption behaviour has conclusively proved that the majority of rice farmers selected a few sustainable practices and bundled them with conventional technologies. This implies that the production imperative had started integrating the ecological perspective in the agricultural production scenario at the operational level. Sustainability being a multifaceted concept, extension systems needed to change its emphasis from technological and economic orientation to a system based education approach through multidisciplinary teams.

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