

FACTORS OF AGRO-ECOSYSTEM SUSTAINABILITY - A VALUE PERSPECTIVE OF FARMERS

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Abstract: Sustainable agriculture has been accepted as a promising alternative to the high input agriculture. However, there has been no consensus as to what constituted sustainable agriculture. It encompassed everything from high economic returns to environmental conservation. Therefore, the study attempted to delineate the factors of agro-ecosystem sustainability based on the value perspective of farmers. The major factors evolved were production practices followed, community resource management and cost of cultivation.

Key words: Agro-ecosystem, sustainability, traditional rice grower.

INTRODUCTION

The basic right to the food that people need is the greatest challenge facing the agricultural development world over. The challenge is most critical in low income, resource constrained countries like India. Though the determined effort of agricultural research and extension in the country has succeeded in achieving commendable results in food production, poverty and malnutrition still persist in the country. Moreover, sustaining the production results over time has been threatened by reducing farm efficiency, shrinking resource base, problems of social equity and environmental degradation. These issues have prompted farm scientists and policy makers to seriously examine the alternatives for the high input agriculture hitherto followed. Sustainable agriculture backed by green technologies in an integrated farming system has been considered as a promising and potential pathway.

Despite the consensus in accepting sustainable agriculture paradigm in agriculture development, the concept remained ambiguous meaning different things to different people. It represented everything from organic farming to maximum economic yields (Francis, 1990). In fact, the inclusion of mutually contradicting attributes like economic viability, social equity and ecological integrity has made agro-ecosystem sustainability an unreliable and often unfeasible performance indicator of the system. Therefore, in evolving agro-ecosystem sustainability as a crucial performance indicator, it will be important to determine which of these dimensions the

farmers value. Delineation of these factors will allow farmers to manage inputs and processes in agricultural production systems so as to optimize the trade off between the valued dimensions. Hence, the present study was taken up to identify the dimensions in which the farmers value the concept of agro-ecosystem sustainability.

MATERIALS AND METHODS

Kuttanad, the traditional rice bowl of Kerala covers 53777 ha of low-lying reclaimed lands exclusively under paddy. Each reclaimed area varies in size from 4 ha to 960 ha and is bounded by waterways laid out for the movement of inputs. This unique agro-ecosystem is reported to have one of the highest rice yields of 4500 kg ha⁻¹ 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 many fold increase in the use of fertilizers and pesticides has caused recurring incidences of pest outbreak 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 Kotta-

yam 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 for the study. The number of panchayats from each district was fixed proportionate to the number of blocks covering Kuttanad paddy lands in each district. Thirty farmers were randomly selected from each of the selected five panchayats to form a total of 150 respondents for the study.

Agroecosystem sustainability was operationalised for the study in terms of perceived effect of production practices, labour availability, land tenure, trends and variability in rice price and yield, types of crop rotation and participation in government development programmes on the probability of continuation of the system on long term basis. Based on an exhaustive survey of literature, 32 factors that had established relation to agricultural sustainability were identified. These were subjected to ratings by 25 agricultural experts. The effects of these factors on the trade off between productivity, ecological stability and quality of human life were to be considered by the judges. Based on the overall rating, 22 items rated as relevant by more than 50% of the judges were included in the schedule.

Validity of the scale was examined for its content validity. This was ensured by including items that covered the full spectrum of issues addressed by sustainable agriculture and validation of the content through competent judges. Split-half method was used in measuring the reliability and was calculated to be 0.89. The responses for the selected 22 items were obtained through personal interview of the selected farmers on a four-point continuum fixed through summated rating method viz. definitely sustainable (5), probably sustainable (3), probably unsustainable (2) and definitely unsustainable (1). The scores were subjected to principal component analysis to unveil the major factors affecting the sustainability of the system.

RESULTS AND DISCUSSION

Principal component analysis extracted nine factors through varimax rotation, which to-

gether explained 66.3% of the total variation (Table 1). Factor Scree plot was used to split the factors into major and minor ones (Fig.1). The first three factors after which the curve plateaued were identified as the major factors and the other six were together treated as minor factors. Based on the items that constituted each of these dimensions, the major factors were named as production practices, community resource management and economics of cost of cultivation. The minor factors included policy regulation and support, energy consumption in farming, conservation based farming, diversification of income sources, knowledge of farmers in sustainable practices and training in sustainable practices.

Table 1. Factor statistics for farmers' perception of factors affecting sustainability of the agroecosystem (N=150)

Factors	Eigen value	% variance	Cummulative % variance
1	3.30	15.0	15.0
2	2.31	10.5	25.5
3	1.55	7.0	32.5
4	1.41	6.4	39.0
5	1.34	6.1	45.0
6	1.31	6.0	51.0
7	1.25	5.7	56.7
8	1.10	5.0	61.7
9	1.01	4.6	66.3

Items related to major factors along with their communality values and factor loadings are presented in Table 2. The results disclose uniformly high factor loadings and communality (h^2) score for all the items. This confirms the importance of each of these items in the overall sustainability of the system. The negative scores on item A and B of factor one indicate that the 'production practices' is a bipolar factor, which includes two opposite dimensions of production practices viz. improved and traditional.

Production practices and cost of cultivation were factors directly related to ecological and economic aspects of cultivation. The emphasis on the importance of ecological integrity and economic viability of the system, being the residents and the ultimate stakeholders seemed consistent.

Table 2. Perception of farmers about major factors of sustainability

Factors	h^2	Factor loadings
Factor 1. Production practices		
Introduction of double cropping	0.69	-0.79
High reliance on input	0.63	-0.70
Use of traditional production system	0.74	0.78
Factor 2. Community resource management		
Resource management through farmers associations	0.59	0.62
Participatory development programme	0.59	0.74
Factor 3. Economics of cost of cultivation		
Popularizing INM	0.73	0.74
Lowering agricultural wage rate	0.62	0.62
Increase in small farms	0.63	0.61

Table 3. Response percentage showing the perceived effect of major factors on the sustainability of the agro-ecosystem by farmers

Factors	Response categories (%)	
	Sustainable	Unsustainable
Introduction of double crops of rice	49	51
High reliance on purchased inputs	59	41
Use of traditional production system	55	45
Resource management through farmer associations	84	16
Participatory development programme	84	16
Integrated nutrient management	93	07
Lowering agricultural wage rate	58	42
Increase in the number of small farms	44	56

Indirectly the indicators implied a concern for the practices that produced higher yields and at the same time preserved the natural resources. The importance of community resource management in sustainable agriculture has been reiterated by many (Gupta, 1994; Pretty, 1996). The enforcement of community resource management had serious implications in the agro-ecosystem. Many resources with common access and utility like water, outer ring bunds of paddy fields are all managed through local farmer associations in the region. Hence they value the continuance of these participatory local organizations indispensable for the sustainability of the system.

The perceived effect of the individual items under each factor is presented as Table 3. A perusal of the table revealed that the farmers perceived most of the factors viz., high reliance on purchased inputs, use of traditional

production system, resource management through farmer associations, participatory development programme, integrated nutrient management and lowering agricultural wage rate to enhance the sustainability of the system. However, introduction of double crop and increase in the number of small farms was perceived to affect the agro-ecosystem sustainability adversely.

The input dependence in the region had the active support of subsidies and incentives from the State Agriculture Department. So phasing out of these benefits was perceived as a threat to the profitable continuance of rice production in the area by majority of farmers. Moreover, prior to 1970s, traditional production practices wherein no more than two crops were raised in two years were practiced in the area. It was perceived that the growing environmental degradation reported from the region has been the result of intensive agri-

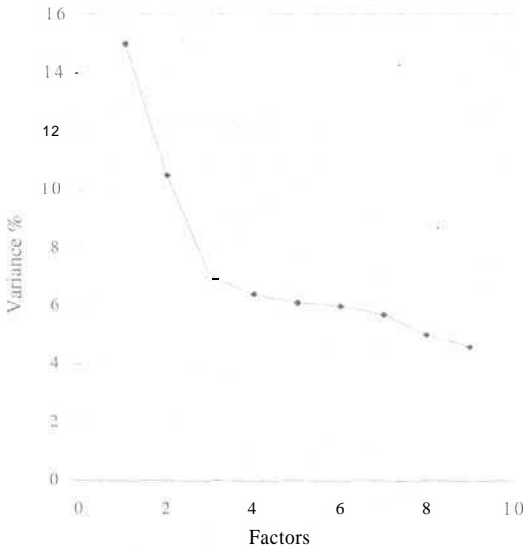


Fig 1. Factor Scree plot for factors affecting sustainability of the agro-ecosystem

cultural practices promoted by the present day agriculture. Therefore, the introduction of double cropping was viewed as unsustainable and the use of traditional practices as promoting sustainability.

The results of the study have conclusively proved that the much propagated conflict between the economic development and environmental conservation seemed to resonate only in the theoretical perspectives. There was clear indication that the production imperative had started integrating the ecological imperative in the agricultural production sce-

nario at the operational level. The main factors that would be instrumental in integrating these goals were related to revitalization of local institutions, participatory method, promotion of indigenous technology knowledge and a systems approach to technology development. In this context, we have to re-examine the economic policy and follow relevant procedures so that the pricing policies consider the environmental factors also. Another area that needed more concentrated effort was the development of environment friendly and economically viable technology. The available technology at present seemed to be missing either on productivity aspect or conservation aspect.

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