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Sustainability of Rice Cultivation: A Study of Manipur

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Abstract

When many states in India are gradually moving away from their traditional agriculture-based to industry or service-oriented economy, Manipur continues to depend on agricultural sector, especially the rice crop. The crop's yield level is found to be much higher than that of the national level, but its demand in the state is much higher that the supply having known this importance, the present paper attempts to assess sustainability of rice crop in Manipur With the help of primary data collected from 152 farmers and using PCA, the study found that 20 percent of farmer as sustainable, 64 percent as moderate and 16 as vulnerable. This implies that the rice cultivation in Manipur has not been very impressive, despite its favorable agro-climatic condition of the five dimensions included in measuring sustainability, social factor was igured out at the top, followed by the economic factor.

Keywords: Manipur; PCA; Rice cultivation; Sustainability

Introduction

Rice or paddy (Oryzasativa L) has not only been the staple food for more than half of the humanity [1] but also shaped the culture, diet and economy of the majority of the world's population, especially the east and south-east Asian continents. Its production primarily depends on good agronomic practices, and the most consistent and the highest yields of the crop can be harvested in irrigated systems [2]. Good agronomic practices include the effective fertilization, water and weed management, lower plant densities and sustainability of the farmers [3,4]. In the countries where rice is the dominant crop and staple food, the livelihood of the people depends on the crop's availability, quality and sustainability [1]. Consequently, sustainability of this crop has become one of the important issues in the world now. Sustainable rice farming is very important in any developing countries/region, reason being not only the staple food of the majority of the people, but also the country's food security, poverty alleviation and rural employment depend largely on rice production [4,5]. While many states in India are gradually moving away from their traditional agriculture-based to industry or service-oriented economy, Manipur (one of the north eastern states of India covers an area of 22,327 km2. It is bounded by Nagaland to the north, Mizoram to the south, and Assam to the west; Burma lies to its east) continues to be heavily dependent on the agricultural sector. More than half (52.19 percent) of its population depend upon the agriculture sector, especially the rice cultivation. Gross Cropped Area (GCA) is 3.3 lakh hectares; it is around 12.98 per cent. Around 90 percent of GCA of the state is covered by rice and average cropping intensity is accounted at 143.26 per cent in 2011-12 [6]. This implies that the average ratio of rice area sown is found to be 1.5 times annually. In term of rice yield level, as per the Directorate of Rice Development, Patna, Government of India, , Manipur ranked 8th in the country with 2369 kg/ha in 2006-07.

Though rice area had slightly declined from 1.6 lakh hectares in 1995-96 to 1.4 lakh hectares in 2002-03 [7] after 2002-03, it increased and recorded 2.2 lakh hectares in 2011-12. Despite this, demand for rice crop has increased significantly in the recent past, much higher than its supply capacity [2]. For instances, the shortage of rice in 2009-10 was around 116 thousand tonnes in the state. Growth of technology or improvement in yield performance did not show any respite to the ever increasing demand for it.

Conceptual Framework

Though the idea of sustainable development was conceived in the United Nation's (UN) first conference on Human Development, held in 1972 at Stockholm, it came to be prominence through the Brundtland Commission's report Our Common Future 1987. Thereafter, the UN has made a consciousness in the world on ecology, environment and poverty. These themes have been brought to the centre stage in the new development policies. In a broader sense, [8] defined sustainable development as a pattern of social and structural economic transformations which optimise the economic and other societal benefits available in the present without jeopardizing the likely potential for similar benefits in the future. Nevertheless, till today, concrete progress towards the goal of sustainable development has not been satisfactory. It is not so easy to specify and quantify true indicator of sustainable level and no specific statistical system or tool has been designed to quantify and assign weights to often conflicting indicators for operationalising the measurement and overall monitoring of the sustainability [5,9].

While conceptualising agricultural sustainability, the Department for International Development, University of Essex, UK viewed it as the resilience (capacity of the systems to adjust in buffer shocks and stresses) and persistence, means the capacity of systems to carry on [10]. It implies that the capacity to adjust as external and internal conditions gets changed. As of the rice farming sustainability, it may be understood as the process by which farmers manage soil, water and other basic inputs to enhance productivity and maintain it to meet farm and family needs, without adversely affecting the production environment and future resources [11]. Before them, [12] had reflected on two basic characteristics of sustainability - one, it is a people-centred concept that aims to improve the quality of human life and conservation-based concept that is conditioned by the need to respect nature's ability to provide resources and life-support services. In this perspective, sustainable development means improving the quality

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of human life while living within the carrying capacity of supporting ecosystems. Secondly, sustainable development is also a normative concept that embodies standard of judgement and behaviour to be respected as the human community and the society seeks to satisfy its needs of survival and well-being. It can also be interpreted in many different ways, but at its core, an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations we face as a society.

However, contemporary theories of agricultural development [4,5,13,14] broadened the basic parameters of sustainable development that had focussed more on environmental aspects, incorporated economic, social and political dimensions. In agriculture, it can also be defined as the common face of agronomic, ecologic, economic and social factors. Production is an important component for sustainability of agro-ecosystems, and improving agricultural production would result in increasing system of sustainability [15]. Moreover, a good and sustainable rice farming model requires a clear structural framework that includes essential indicators, strategy and goal definition of dimension, and should be supported by the social, political, economic (including technical) and environmental institutions [5,16]. Nevertheless, the central question raised by [1] on rice research is– how to balance the need for ever-greater food production at prices that poor consumers can afford and get reasonable profit without jeopardising natural resources and the environment for generations to come. Similarly, [11] also opined that it links to a range of problems that farmers face and should be addressed without disturbing or disrupting the usually healthy rhythms of rural life. Therefore, a devised strategy for sustainable rice farming should be a regional/country specific and that should address each region/country's economic, political, environmental and social conditions and objectives.

Objectives and Methodology

This study tries to analyse overall sustainability of rice farming in Manipur. While measuring sustainability, parameters include the resources available with the farmers, not necessarily the ecological or environmental component alone. How have the institutions–social, economic, political, technology and environment in a synergetic manner helped in making rice farming sustainable in Manipur is discussed. The specific objectives of the study are given as:

To measure overall sustainability of rice farmers in Manipur.

To identify institutional dimensions that impacted the most in rice farming sustainability.

Methodologically, the present study is based on primary data. Based on agro-climatic conditions and growth pattern of rice crop, two districts (Senapati and Thoubal) of Manipur have been selected and altogether 152 rice farmers were interviewed through a well-structured questionnaire. The primary field survey was conducted in the month of September to November 2013. To satisfy the two objectives mentioned above, the Principal Component Analysis (PCA) method was used. In the process, a combination of single indicators into a meaningful composite indicator was made under a fitness-for-purpose principle. Twenty-six indicators have been selected on the basis of their analytical soundness, measurability, relevance to the phenomenon and relationship to each other. Some proxy variables have also been used to make up data limitation. The normalized values ($\text{Normalisation} = 1 - \frac{ei - Min}{Max - Min}$; Where, ei=Actual Value) of the variables were multiplied with their respective PCA scores and the summation of the entire individual variables yielded an index value. The Composite Index of an individual dimension (institution) was arrived at by adding all individual index values social, economic, political, technology and environment. While normalising index value, all the indicators have been converted in a range of 0 to 1. The larger value influences more on sustainability of rice farming. Finally, using the criterion of "Mean ± Standard Deviation" of the index value [17-20] farmers have been categorized into three groups– sustainable, moderately sustainable and vulnerable (Table 1).

Result and Discussion

As of the sustainability, according to [21], it needs to define with respect to systems rather than doing singular analyses of inputs and outputs, because crop varieties and inputs produce nothing in isolation. The most relevant issue today is to design suitable technologies, as well as compatible strategies from the social, economic and ecological viewpoints that will bring about the necessary behavioural changes to achieve the objectives of sustainable agriculture. As [15] mentioned, rice sustainability is a composite effort of ecologic, economic and social factors, consequently, it can primarily be explained more by a composite index. As given in the methodology, the study categorised the paddy farmers of Manipur into three as:

Sustainable=House-holds with an index value ≥ Mean + SD;

Moderately Sustainable=House-holds with index value between Mean ± SD;

Vulnerable=House-holds with index value ≤ Mean – SD

Table 1 shows overall sustainability of rice farmers in Manipur. Using the formula of Mean± SD of the index value, of the total 152 sample, 30 rice farming households have been categorised as sustainable, 97 as moderate and 25 as vulnerable. This implies that the rice cultivation has been at the cross-road and majority of them are mainly cultivating at the subsistence level. As of the institutional impact, [11] endorsed that agricultural sustainability; particularly the rice farming requires technological support to social, economic, political and ecological realities. As an evidence of technological supports and modernisation, fertilizer consumption, irrigation and HYV seeds were found to have positively correlated with rice farming development [2,22,23]. Apart from the physical or economic variables, [23] identified the role of social institution and attitudinal environment of the society for agricultural development in Manipur. Another study in Assam by [2] found that institutional credit was found to be an important factor for enhancing paddy cultivation. According to [13] despite rice being a major staple crop, commonly grown in the NER, rice-based agriculture system has failed to provide required household income-security primarily due to weak institutional systems. They are– adherence to traditional agricultural practices, low adoption of modern rice varieties (HYVs), poorly defined of property right, small size of operational holdings, weak institutional credit facility, high vulnerability to natural calamities and over-dependence on monsoon rain with poor irrigation infrastructure (Table 2).

Table 2 explains the impact of various institutions and their indicators on Sustainability Index construction. Of the total, the share of social institution has been very great, composed of 30.80 per cent. This was followed by the economic institution with the share of 28.75 per cent. The institutions of technology and environmental system have also impacted more on the rice farming sustainability in Manipur, accounted for 13.11 per cent and 18.31 per cent respectively. As expected, the role of political institution has been very negligible

Dimension	Indicators	Sign	Definition and Measurement
Social– to develop the quality of life of society at large	Education	+	Education of the farmers is one of the key indicators of farm sustainability. Level of education is coded as: 0=Illiterate, 1=Primary(1-5), 2=Secondary/Higher Secondary (6-12), 3= Graduate and above
	Family size	+	Number of family member or size of the family is also one of the important indicators of agricultural development, as labour supply, social security. It is taken as absolute number of the family.
	Stability of the Farmer in the village	+	Recent settlers have some disadvantages. Stability of the farmers in a place or village has got certain advantages, like approach to agriculture department, local fellow farmers and leaders for agricultural assistance. If the farmer is a recent settler, it is coded as: 1= Yes; 2=No
	No of family (female) labour engaged	+	Engage family female labour force in the rice cultivation indicates that the importance and need of the crop in the family.
	Importance of the crop	+	How many times the farmer visited the paddy field or farm after transplantation for better harvest of rice/paddy
	Use of traditional implements	+	Traditional implements like wooden plough, wooden thresher, hoe, etc. are widely used by the farmers and it is a part of rural social culture: 1=Yes, 2=No.
Economic– to achieve economic feasibility in rice cultivation	Land productivity	+	Measurement of the productivity of rice per unit of land in physical units (collected during the survey) can reflect economic condition of the farmer. It is measured as kilogram of paddy per hectare of land. Kg/ha
	Net Sown Area	+	Net Sown Area under the crop in physical units, as measured in hectares during the field survey. It also determines the size of the farmer's economy.
	Availed/want to avail loan	+	To avail loan from the bank or any other financial institution by the farmers for cultivation is a sign of agricultural development: 1=Yes, 2=No.
	Insurance policy	+	Any of the insurance policy of the farmer indicates the safety. It is coded as 1=Yes; 2=No
	Irrigation	+	Irrigation or the assured water supply is one of the most important inputs in rice cultivation. Percentage of area irrigated of the farmer implies improvement of cultivation.
	Land brought	+	Land bought in the last five years for rice cultivation is considered as one of the indicators of development or sustainability of the sector.
	Usage of seeds	+	Good seed means good output. Seed usage is coded as: 1=Farm saved/own seed saved last year, 2=Local seeds, 3=HYV seeds/new varieties.
Technology– to identify the role of technology in agriculture/rice cultivation	Modern implements/power operated machines	+	Adoption modern techniques in cultivation imply development of agriculture. Modern implements like threshers, tractors, sprayers, etc. used by the farmers is coded as: 1=Used, 2=No.
	Availing facility of community warehouse	+	Getting community warehouse is one of the benefits of the farmers. As warehouse is a kind of public good and its investment is practically not possible by individual farmers, it is coded as: 1=Yes; 2=No
	Harvesting method	+	Using modern technology in harvesting is one of the indicators of advancement of the sector. It is coded as: 1= modern; 2= traditional method.
	Mode of transportation and harvesting	+	Application of modern techniques of harvesting and transportation in paddy cultivation imply development of the sector and is coded as: 1=Yes, 2=No
	Experience & knowledge of rice cultivation	+	Knowledge of the sector or occupation also depends on the year of experience. Number of years engage in rice cultivation–
Environment– to assess the awareness of environmental degradation	Flood/draught resistant variety	+	Whether the farmer can protect their crop from the flood or draught situation. Do they have flood resistant crop or different seed for different season, so as to survive from the calamities?
	Knowledge of application of fertilisers	+	Fertilizer is one of the most important inputs to developing agricultural sector. Knowledge about the application of fertiliser by the farmer indicates the usage of it. Whether farmer knows the appropriate dose of fertilizer: 1=Yes, 2=No.
	Amount of chemical fertilizer used	–	Larger the amount of chemical fertilizer used in the field more is degraded the environment, coded as: Kilogram per hectare of land.
	Diversification of crop	+	Whether the land is used only for one crop or other crops too along with the main crop (rice in this study)? It reflects the importance of the crop grown by the farmer. For measurement, crop diversification (from rice to other): 1=Yes, 2=No
Political– to build equitable access to the agricultural resources	Membership	+	If the farmer is a member of any organisation related to agriculture, definitely the farmer is considered as well informed or agriculturally alert farmer.
	Joint effort with fellow farmers or in group	+	Making an effort to work together with the fellow farmers is one of the political or group forces that makes in achieving unachievable individual effort made earlier: 1= Yes; 2= No
	Benefits received from the agriculture Department.	+	Ministry of agriculture has initiated a lot of provision and benefits for the rural farmers. But, often than not, many of the farmers do not aware of the benefits provided by the department. If benefited in the last one year (in cash or kind): 1= yes; 2= No
	Attended agriculture related meetings	+	Many of the rural farmers do not aware of the vital information and basic agricultural provisions provided by the department. If farmer attended agriculture related meetings in the last one year.

Table 1: Indicators of sustainable rice cultivation in Manipur.

impact on rice farming sustainability, estimated at 9.03 percent of the total score. Within the social institution, caste category and continuous cultivation of the crop played a major role in the farmer's sustainability. In the case of economic institution, net sown area and irrigation have influenced the most. Under the environment institution, amount of chemical fertiliser used has been very significant. The application of chemical fertiliser has been very influential in rice cultivation, though it affects environmentally. Within the political institution, joint effort with fellow farmers has impacted more in farmers' sustainability in Manipur (Table 3).

Conclusion

To conclude, of the total 152 sample, 30 rice farmers have been categorised as sustainable, 97 as moderate and 25 as vulnerable.

Categorisation	Status	Index Value	Households
Index Value ≥ Mean + SD	Sustainable	2.10 and above	30
Index value between Mean ± SD	Moderate	1.60 to 2.10	97
Index Value ≤ Mean - SD	Vulnerable	Below 1.60	25
Total Household (N)	-	**-**	**152**

Source: Authors' estimation

Table 2: Sustainability Categorisation of the Farmers.

Indicators	Effect (%) of Indicators on Index
1. Social	**30.80**
a) Education	3.50
b) Family Size	2.51
c) Caste	11.48
d) Credibility of the Farmer (social respect)	2.66
e) Importance of Crop (continuity of rice cultivation)	10.24
f) Usage of Traditional Implements	0.41
2. Economic	**28.75**
a) Land Productivity (fertility)	5.47
b) Net Sown Area	8.74
c) Availed/Want to avail Loan	0.07
d) Insurance Policy	2.50
e) Irrigation	6.09
f) Usage of Seeds	5.89
3. Technology	**13.11**
a) Usage of Modern Implements	0.57
b) Harvesting Method/post-harvest care	6.55
c) Mode of Transportation & Harvesting	0.05
d) Experience & Knowledge of Rice Cultivation	5.93
4. Environment	**18.31**
a) Flood/Draught resistant variety	0.28
b) Knowledge of Application of Fertilizers	5.70
c) Amount of Chemical Fertilizer used	11.08
d) Diversification of Crop	1.24
5. Political	**9.03**
a) Membership in social organisation	4.02
b) Joint effort with Fellow Farmers	4.22
c) Attended agricultural related meetings	0.79
Total	**100.00**

Source: Authors' estimation

Table 3: Influence of the Indicators/Dimensions on Sustainability.

In percentage term, it is 20 per cent, 64 per cent and 16 per cent respectively. This implies that the rice cultivation in Manipur has not been very impressive, despite its favourable agro-climatic condition. Of the different dimensions/institutions that influenced rice farming sustainability the most has been the social institution, followed by the economic institution. The institution of technology has been very negligible role on rice farming sustainability in Manipur. Nevertheless, the role of environment institution on rice farming economy still occupies some significant impacts, while the role political institution has been very negligible.

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