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AN ECONOMIC ANALYSIS OF CROP DIVERSIFICATION IN TAMIL NADU INDIA

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ABSTRACT

The changes in the cropping pattern occur periodically depending upon the market forces and agro climatic conditions. It is assumed that both climatic and technological factors are crucial in determining the cropping pattern. Many regions of Tamil Nadu, specifically delta region, have changed the cropping pattern due to inadequate rainfall and heavy downpour. To improve the income, to provide gainful employment and to stabilize the income flow, diversification of crops emerges as a major strategy. This study on crop diversification was undertaken to analyse the extent of diversification and to find the factors influencing the crop diversification. A multistage stratified random sampling technique was adopted in this study. Diversification indices were calculated to find the extent if diversification. A linear regression model was also employed to examine the factors influencing crop diversification in the study area.

The results imply that the sample households diversified their crop activities and it could be correlated with the crop diversification indices calculated for the study area. It is understood that the sample farmers cultivated a maximum of eight crops. On an average, each household maintained about three crops, which reveals the prevalence of crop diversification at the farm level also. From the above results, it is evident that there have been gradual shifts in the cropping pattern towards high value crops in the study area. This might be due to the availability of market, increased demand of products and export facilities.

Keywords: Crop diversification, Concentration

Introduction

The changes in the cropping pattern occur periodically depending upon the market forces and agro climatic conditions. These changes bring about a chain of effects on different aspects of farming and farm economy along with some changes in social and economic aspects of farming families.

The cropping pattern has been changed considerably in Tamil Nadu state. Though it is an agrarian state, the share of net sown area to total geographical area had been continuously declined from 45 per cent in 1960-61 to around 37 per cent in 2016-17. Among the major crops, the area under rice has also registered a declining share to the gross cropped area in the state. It is assumed that both climatic and technological factors are crucial in determining the cropping pattern. Many regions of Tamil Nadu, specifically delta region, have changed the cropping pattern due to inadequate rainfall and heavy downpour. Cuddalore, Villupuram, Nagapattinam, Thiruvarur and Thanjavur are the major delta districts, which have frequently undergone many structural changes due to climatic and technological factors (Paramasivam *et al.,* 2017).

Agricultural diversification really started in the early eighties in India and it has picked up momentum over the recent past and farmers were always quick to diversify into higher value crops as market opportunities developed. To improve the income, to provide gainful employment and to stabilize the income flow, diversification of crops emerges as a major strategy. In several instances, cropping systems have been diversified or new cropping systems have been introduced to retain or to enhance the value of natural resources principally land and water. There is also the claim that diversification tends to stabilize farm income at a higher level. This happens when the pattern of diversification is such as to accommodate more and more rewarding crops. This is particularly important for the small farmers who strive to make their farms viable. Given the importance of changing scenarios in cropping pattern, this study was undertaken to analyse the extent of crop diversification in the study area and the factors influencing the crop diversification.

Materials and Methods

A multistage stratified random sampling technique with Tamil Nadu state as the universe, the districts as the first stage unit, the blocks in the districts as the second stage unit, the villages in the blocks as the third stage unit and the households as the fourth and ultimate unit of sampling, was adopted in this study.

Out of the 32 districts in Tamil Nadu, by considering the net area sown, the first two districts namely, Villupuram and Cuddalore were selected for the study. From each district, first two blocks were selected based on net area sown. Four villages were selected randomly from each of the selected four blocks. The ultimate sample size was fixed as 240 and was distributed equally at the rate of 15 households per village.

A well-structured and pre-tested interview schedule was used to collect the primary data from the sample households. All the required primary data were collected from the sample respondents during the months of October - December, 2018 and the data collected is pertained to the agriculture year 2017-18.

All the required time series data was collected from the published sources for a period of 47 years, from 1970-71 to 2016-17, and it has further been divided into two sub periods, namely, pre-liberalisation period (1970-71 to 1991-92) and post-liberalisation period (1992-93 to 2016- 17). The time series data for the period before 1993 (i.e., before bifurcation of districts) was pertaining to the *erstwhile* South Arcort district and for the period after 1993 (i.e., after bifurcation of districts), the clubbed data of Cuddalore and Villupuram districts was considered.

Tools of Analysis

Diversification Indices

There are quite a few methods, which explain either concentration (i.e. specialization) or diversification of crops or activities in a given time and space. Each method has some limitations and/or superiority over the others. The following indices were used in the study to measure the extent of diversification.

(a) Herfindahl Index (HI)

Herfindahl index is the sum of square of the acreage proportion of each crop in the total cropped area. The index is computed as

$HI = \sum_{i=1}^{N} P_i^2$ where, P_i represents acreage proportion of the i^{th} crop in total cropped area.

With an increase in diversification, the sum of square of the proportion of activities decreases, so also the indices. The Herfindahl Index takes the value one, when there is complete specialization and approaches to zero as N gets large, i.e., if diversification is perfect. Since the index is a measure of concentration, it was transformed by subtracting it from one, i.e., 1-HI.

The transformed value of Herfindahl Index will avoid confusion to compare it with other indices. The major limitation of the index is that it cannot assume the theoretical minimum, i.e., zero for smaller values of N.

(b) Simpson Index (SI)

The Simpson Index (SI) is the most suitable index of measuring diversification in a particular geographical region. Mathematically, SI is defined as

$$SI = 1-\Sigma^{N}_{i=1} P_i^2$$

Where,

$P_i = A_i / \Sigma A_i$ is the proportion of the i^{th} activity in acreage.

If Simpson Index is nearer to zero, it indicates that the zone or region is near to the specialization in growing of a particular crop and if it is close to one, then the zone is fully diversified in terms of crops.

(c) Entropy Index (EI)

The Entropy index is a direct measure of diversification having a logarithmic character. The index is computed as:

$EI = \sum_{i=1}^{N} P_i * \log (1/P_i)$, where, P_i represents acreage proportion of the i^{th} crop in total cropped area.

The Entropy index increases with diversification. The Entropy index approaches zero when the farm is specialized and there is perfect specialization, i.e., P_i equals one and takes a maximum value when there is perfect diversification. The upper limit of the Entropy Index is determined by the base of logarithms and the number of crops. The upper value of the index can exceed one, when the number of total crops is higher than the value of the logarithm's base, and it is less than one when the number of crops is lower than the base of logarithm. The major limitation of the Entropy Index is that it does not give a standard scale for assessing the degree of diversification.

Factors Influencing Crop Diversification

A linear regression model was employed to examine the factors influencing crop diversification in the study area, though the following equation.

$$Y_t = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + u$$

Where,

Y_t = Household crop richness index

α = Constant

X_1 = Gross irrigated area (acres)

X_2 = Income of family (Rs.)

X_3 = Size of holding (acres)

β_i's = Parameters to be estimated

μ = Error term

Garrett Ranking Technique

Garrett ranking technique was used to rank the constraints faced by the farmers in crop diversification.

As a first step, the per cent position of each rank was found out by the following formula:

$$\text{Per cent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} = Rank given to the i^{th} item by the j^{th} individual

N_j = Number of items ranked by the j^{th} individual

The per cent position of each rank, thus, obtained was then converted into scores by referring to the Table given by Garrett in 1959. The respondents were requested to rank the opinions / reasons relevant to them according to the degree of importance. The rank given by each of the respondent was converted into scores. Then for each reason, the scores of

individual respondents were added together and divided by the total number of respondents. These mean scores for all the reasons were arranged in the descending order and ranks were given. By this method, the accuracy in determining the preference was obtained.

Results and Discussion

Crop Diversification in the Study Area

Crop diversification based on proportion of area under major crop categories is measured and quantified using Herfindhal Index (HI), Simpson Index (SI) and Entropy Index (EI) for the five decadal periods, i.e., Period I to Period V. The average values of these indices for different crop categories in the study area are presented in Table1.

The Herfindahl index would decrease with increase in diversification. It could be seen from Table 1 that the calculated average values of Herfindahl Index for different crop categories decreased in the study area over the five decadal periods, from 1970-71 to 2016-17, i.e., from 0.3203 in Period I to 0.2251 in Period V, which indicated movement towards diversification.

Table 1 : Crop Diversification Indices in the Study Area

S. No	Year	Herfindahl Index	Simpson Index	Entropy Index
1.	Period I (1970-71 to 1979-80)	0.3203	0.6797	1.3999
2.	Period II (1980-81 to 1989-90)	0.2524	0.7476	1.6139
3.	Period III (1990-91 to 1999-2000)	0.2352	0.7679	1.7086
4.	Period IV (2000-01 to 2009-10)	0.2352	0.7698	1.7906
5.	Period V (2010-01 to 2016-17)	0.2251	0.7749	1.8158
	Overall	**0.2647**	**0.7463**	**1.6749**

The Simpson index would increase with the increase in diversification and vice versa**.** The results revealed that the calculated average values of Simpson Index moved up from 0.6797 in Period I to 0.7749 Period V in the study area, implying a gradual shift in the cropping pattern towards high values crops like fruits, flowers and plantation crops.

The Entropy index increases with increase in diversification and vice-versa. The entropy index of crop diversification on the proportion of area under major crops in the study area during Period I to Period V, clearly revealed that this index of crop diversification varied from 1.3999 to 1.8158, indicating increased diversification in the study area over the decadal periods.

Farm Level Crop Diversification

An attempt was made to analyse crop diversification at the farm level based on the crops grown by the sample households in the study area. The major crops grown in the study area, viz., paddy, black gram, cowpea, groundnut, tapioca, sugarcane, brinjal and flowers were considered for the analysis using Herfindahl index, Simpson index and Entrophy index. The results are presented in Table 2.

Table 2 : Crop Diversification Indices for the Sample Households

S. No	Indices	Values
1.	Herfindahl index (HH)	0.3765***
2.	Simpson index (HH)	0.6235**
3.	Entrophy index (HH)	0.9216**
4.	Crop richness (Study Area)	8
5.	Household crop richness	3.37

(** and *** indicate significance at 5 per cent and 1 per cent levels respectively)

It could be seen from Table 2 that the Simpson index and Entrophy index indices have indicated significantly higher values in the sample households (0.6235 and 0.9216, respectively), whereas the Herfindahl index showed a lower value (0.3765). The results imply that the sample households also diversified their crop activities, and it could be correlated with the crop diversification indices calculated for the district. It could be understood during the survey that the sample farmers cultivated a maximum of eight crops. On an average, each household maintained about three crops, which reveals the prevalence of crop diversification at the farm level also.

Factors Influencing Crop Diversification

The factors influencing crop diversification in the study area were identified using regression analysis, wherein the household crop richness was regressed on factors like size of holding, farm income and gross area irrigated (as a linear measure for extent of irrigation). The results are presented in Table 3.

Table 3 : Factors Influencing Crop Diversification in the Sample Households

S. No	Variables	Co-efficients	P values
1.	Constant	12.753	0.025
2.	Size of holding	0.028**	0.05
3.	Income of the family	0.006***	0.01
4.	Gross irrigated area	0.051**	0.05
	R^2	**0.78**	
	F values	**36.53**	

(**and*** indicate significance at 5 per cent and 1 per cent respectively)

The co-efficient of Multiple Determination (R^2= 0.78) revealed that 78 per cent of variation in the crop diversification was explained by the included variables in the model and F value indicates the best fit of regression. All the variables, viz., size of land holding, family income and area under irrigation were found to have positive effect on crop diversification. The co-efficient for the variable, size of

holding was 0.028, indicating that for every one acre increase in the size of holding, the crop richness would increase by 0.028 times.

The income of the family was also a variable with a significant co-efficient, implying that every one rupee increase in the family income, would increase the crop richness by 0.006 times. So also, the variable gross irrigated area would indicate that for increase in the area by acre, the crop richness increases by 0.051 times. The average landholding in the study area was 2.8 acres and the average farm income was Rs. 27,640 per acre. Hence, it could be concluded that the crop diversification was influenced by all the three variables included in the model.

Constraints in Crop Diversification

The major constraints faced by the sample households in crop diversification at farm level were captured using Garrett ranking technique. The results are presented in Table 4.

Table 4 : Constraints for Crop Diversification in the Sample Households

S. No	Constraints	Mean Score	Rank
1.	Price risk	87.52	I
2.	Lack of water availability	79.05	II
3.	Lack of input availability	76.18	III
4.	Low household income	67.49	IV
5.	Yield risk	61.27	V
6.	Lack of access to market	59.73	VI

The price risk was regarded as the major factor influencing diversification of crop enterprises, as the farmers expect higher prices for their crops. The lack of availability of irrigation water was the second most important factor responsible for crop diversification, as stated by the respondents. Lack of input availability and low household income also influence the crop diversification, which were ranked as third and fourth constraints. Yield risk and lack of market access were also ranked as important constraints for crop diversification.

Conclusion

From the above results, it is evident that there have been gradual shifts in the cropping pattern towards high value crops in the study area. This might be due to the availability of market, increased demand of products and export facilities.

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