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THE LEVEL OF CROP DIVERSIFICATION AND CROPPING PATTERN SHIFT IN THIRUVARUR DISTRICT OF TAMILNADU, INDIA

Y. Shelton Peter and C. Prabakar*
Department of Agricultural Economics, Faculty of Agriculture, Annamalai University, Annamalainagar – 608 002. Tamil Nadu, India
*E-mail: prabakaragri@yahoo.co.in

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ABSTRACT

Crop diversification provides the farmers a wider choice in cultivation so that profit would be maximised and the risks would be minimised. Understanding the merits of the concept of crop diversification a study was undertaken to analyse the level of crop diversification and cropping pattern shift and to rank the reasons for non – adoption of crop diversification in Thiruvarur district of Tamilnadu. Thiruvarur district was considered as universe of the study. The analyses relied on both preliminary and secondary data. Simple random sampling techniques were adopted for collection of primary data. The estimated Herfindhal and Simpson indices revealed that the crop diversification was much limited in Thiruvarur district. Further the Garrett ranking analysis revealed that "Lack of awareness on the relevance of crop diversification in risk management" was the prime reason for non - adoption of crop diversification in Thiruvarur district. Needed efforts should be initiated by the relevant institutional authorities to improve the awareness among the farmers of Thiruvarur district on crop diversification and its relevance in risk mitigation and the technical know – how on cultivation of new crops should also be provided to the farmers.

Keywords: Crop diversification, cropping pattern, Thiruvarur district

INTRODUCTION

Tamil Nadu is a state which gives immense importance to agriculture and allied industries. It is a state with adequate cultivatable lands and irrigation facilities. Tamil Nadu is irrigated by many rivers and the very important one being the Cauvery river. Cauvery delta is considered as land of paddy cultivation and called the rice bowl of Tamil Nadu. The district of Thiruvarur is one among the few districts which fully depend on Cauvery river for its agricultural activities. In Thiruvarur district more than 70 percentage of the total population is dependent upon agriculture, out of which around 14 per cent are cultivators and the rest are agricultural labourers. Normal area under cultivation is around 74 percentage of the total geographical area of this district. Paddy is the principal crop, accounting for nearly 65 percentage of the gross cropped area. The entire district contains plain land only. Predominant soil types in the district are sandy, coastal alluvium and red loam. Vennar, Vettar, Koraiyar, Paminiyar, Mullaiyar, Harichandra Nadhi, Arasalar, Vanchiar, Nattar are some of the seasonal rivers flowing in this district. Canals extending to a length of around 612 kms supported by the Cauvery system irrigate the entire district. But in recent years, there is a wide spread concern in the district over the inconsistent release of water from the mettur dam which pushes the agricultural activities in doldrums in the district.

Crop diversification nowadays has emerged as an important remedy to mitigate production risks, to meet the challenges of a globalizing market and to satisfy the changing needs of the population. Many countries in South East Asia have undertaken crop diversification to enhance productivity and cultivate high value crop with positive outcome. These countries are gradually diversifying their crop sector in favor of high value commodities, especially fruits, vegetables and spices. Diversification is taking place either through area augmentation or by crop substitution. If carried out appropriately, diversification can be used as a tool to augment farm income, generate employment, alleviate poverty and conserve precious soil and water resources. With this preliminary understanding the study was carried out with the following specific objectives.

Objectives

- To assess the existing level of crop diversification in Thiruvarur district of Tamil Nadu.
- To analyse the shift in cropping pattern in the district, in the last two decades.
- To rank the reasons for the non – adoption of crop diversification in Thiruvarur district.

MATERIALS AND METHODS

Selection of Study Area

With regard to the selection of study area Thiruvarur district was considered as universe of the study. The district has ten blocks and from each block ten farmers were selected by simple random sampling method. The ultimate sample size was 100. The primary data on crop wise area at farm level and reasons for non – adoption of crop diversification were collected from the sample farmer respondents. The secondary data on district level crop coverage for last twenty two years was collected from

Table I. Farm level Crop Diversification Indices for Thiruvarur District

Sl. No	Name of the Block	Herfindahl Index			Simpson Index		
		2017	2018	2019	2017	2018	2019
1	Thiruvarur	0.798	0.782	0.801	0.202	0.218	0.199

Table -2 Transitional Probability Matrix for Area under Major Crops in Thiruvarur District – 1997 - 2019

Major Crops	Paddy	Gingelly	Groundnut	Sugarcane	Cotton	Tapioca	Coconut	Mango	Banana	Other Crops
Paddy	0.940774	0.00056	0.00945	0.00037	0.0128	0.00070	0.0247	0.00108	0.00199	0.00754
Gingelly	0.893884	0.05356	0.00156	0.0134	0.00605	0.00065	0.0227	0.00097	0.00143	0.00579
Ground nut	0.825507	0.00269	0.00163	0.00969	0.13107	0.00058	0.02045	0.0009	0.0014	0.00607
Sugar cane	0.326723	0.32937	0.0000	0.32597	0.0000	0.00297	0.00618	0.00375	0.00503	0.0000
Cotton	0.552395	0.0294	0.00073	0.0531	0.35029	0.0005	0.00932	0.00071	0.00087	0.00271
Tapioca	0.847225	0.13303	0.0000	0.01062	0.0000	0.0000	0.00913	0.0000	0.0000	0.0000
Coconut	0.952605	0.0000	0.00207	0.0000	0.00803	0.00074	0.02594	0.00114	0.00178	0.0077
Mango	0.952605	0.0000	0.00207	0.0000	0.00803	0.00074	0.02594	0.00114	0.00178	0.0077
Banana	0.952605	0.0000	0.00207	0.0000	0.00803	0.00074	0.02594	0.00114	0.00178	0.0077
Other Crops	0.767462	0.0000	0.02612	0.0000	0.20567	0.0000	0.0000	0.0000	0.00003	0.00072
Steady State Probability	0.928212	0.00225	0.00906	0.00249	0.02283	0.0007	0.02411	0.00107	0.00194	0.00734
Current Year Share of Major Crops (%)	92.68	0.22	0.58	0.24	2.86	0.065	2.42	0.11	0.21	0.63

Table: 3. Reasons for Non – Adoption of Crop Diversification in Thiruvarur District

Sl. No	Statements	Rank
1	Lack of awareness on the relevance of crop diversification in risk mitigation	I
2	Not willing to shift from conventional farming systems	II
3	Lack of technical know - how	III
4	Fear of on marketing risk with new crops	IV
5	Fear of production failure	V
6	Lack of financial back up to face the uncertainties	VI

Department of Statistics and District agricultural office of Thiruvarur district.

Tools of Analysis

Herfindahl Index (HI)

The Herfindahl index is a measure of concentration. The degree of crop diversification in a region could be assessed using the Herfindahl index. Index was computed by taking the sum of square of area proportion of each crop in the gross cropped area of the farm. This index was worked out by the following formula

$$HI = \sum_{i=1}^{N} Pi^2$$

Where, N = Total number of crops

P_i = Average proportion of the i^{th} crop in gross cropped area

With increase in diversification, the index decreases. The index takes a value of one when there is a complete specialization and approach to zero as N is large, i.e. diversification is perfect. The Herfindahl index was estimated separately for each farm and the average value of the farm level indices was considered for district level interpretation.

Simpson Index (SI)

The Simpson Index (SI) is also a 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. The Simpson index was estimated separately for each farm and the average value of the farm level indices was considered for district level interpretation.

Markov Chain Analysis

The direction of shift in cropping pattern in the district was analyzed using the first order Markov chain approach

using LINGO software. Central to Markov chain analysis is the estimation of the transitional probability matrix 'P' whose elements, P_{ij} indicate the probability (share) of crop categories switching from i^{th} crop category to j^{th} crop category over time. The diagonal element P_{ij}, where i=j, represents the retention share of respective crop category in terms of area under crops.

This can be denoted algebraically as

$E_{jt} = P_{ij} + e_{jt}$

Where,

E_{jt} = Area under major crops to the j^{th} crop in the year t

E_{it-1} = Area under i^{th} crop during the year t-1

P_{ij} = The probability of shift in area under i^{th} crop to j^{th} crop

e_{jt} = The error term which is statistically independent of $E_{i\ t-1}$ n = The number of major crops The transitional probabilities P_{ij}, which can be arranged in a (m x n) matrix, have the following properties: = 1And $0 \leq P_{ij} \leq 1$ Thus, the expected share of each crop during period 't' is obtained by multiplying the share of these crops in the previous period (t-1) with the transitional probability matrix.

The transitional probability matrix is estimated using linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD), the formulation is stated as

Min, OP* + I e

Subject to,

X P* + V = Y

GP* = 1

P* ≥ 0

Where,

P* is a vector of the transitional probabilities P_{ij} to be estimated

O is the vector of zeros

I is an appropriately dimensional vector of areas

e is the vector of absolute errors

Y is the proportion of area to each crop category.

X is a block diagonal matrix of lagged values of Y

V is the vector of errors

G is a grouping matrix to add the row elements of P arranged in P* to unity.

This Markov Probability model was used to study the changes in the cropping pattern in the study area.

Garrett's Ranking Technique

To study the reasons for non-adoption of crop diversification, Garrett's ranking technique was employed. The order of merit assigned by the respondents were converted in to ranks using the formula,

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

Where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

By referring to Garrett's table, the percentage positions estimated were converted in to scores and then for each factor the scores of various respondents were added and mean value was arrived at. These means were arranged in descending order. The problem having the highest mean value was considered as the most important and was given the highest rank and vice versa.

RESULT AND DISCUSSION

Level of Crop Diversification

The degree of farm level diversification in Thiruvarur district was calculated using Herfindhal Index and Simpson Index. The indices were calculated for each farm separately and average value of these farm level indices is presented in table 1.

The Herfindhal Index would decrease with increase in diversification. The result revealed that the calculated values of Herfindhal Index for the three consecutive years viz., 2017, 2018 and 2019 were relatively higher and almost same with only small variations. The values of indices(i.e.,0.798, 0.782, 0.801) very clearly confirm the fact that farm level crop diversification is at very minimum level, in Thiruvarur district.

With regard to Simpson Index, the lower values indicate a decreased level of diversification and the higher vales indicate an increased level of crop diversification. The estimated Simpson Indices (i.e., 0.202, 0.218, 0.199) also confirm that crop diversification is not up to the needed level in Thiruvarur district.

From the above results, it is evident that the farmers' of Thiruvarur district do not consider the concept of crop diversification as a tool of risk mitigation even though, they encounter with several production and marketing risks every year.

Shift in Cropping Pattern

Markov Chain Analysis was used to study the shift in cropping pattern in Thiruvarur district. The probability of retaining the particular crop and the shift was interpreted by studying the diagonal and off diagonal elements of transitional matrix. The transitional probability matrix and steady state probabilities pertaining to shift in cropping pattern in the study area were estimated and presented in Table 2.

The transitional and steady state probabilities for the shift in cropping pattern was computed based on the area under major crops between 1997 - 98 and 2018 - 19. Out of this twenty two years of temporal data available on cropping pattern, only the intermittent values with an interval of two years i.e., every third year was only considered for the analysis. The results reveal the following inferences,

- The probability of retention of existing area under Paddy was estimated at 94.07 per cent, Cotton - 35.02 per cent, Sugarcane - 32.59 per cent, Gingelly - 5.35 per cent and Coconut - 2.59 per cent.
- Tapioca area is found to be unstable with zero retention probability. Gingelly, Ground nut and coconut

were also identified to be less stable with retention probabilities 5.35, 0.16 and 2.59 per cent respectively.

- The probable shift in area from paddy to other crops is estimated to be very low, but the reverse probabilities i.e., shift from other crops to Paddy, are very high.

- Next to Paddy, Gingelly and Cotton crops seem to enjoy a favourable shift towards them, in future. The probable shifts from Sugarcane and Tapioca to Gingelly are 32.9 per cent and 13.3 per cent respectively. The probable shift from 'other crops' and Groundnut to Cotton are 20.56 per cent and 13.1 per cent respectively.

The steady state probability reveals that if the trend continues like this, in future 92.82 percent of the gross cropped area would be under Paddy, 2.28 percent under Cotton, 2.41 percent under coconut. The other crops will be in meagre percentages only.

Further, the forecasted share of area under different crops predicted vide steady state probabilities tend to deviate only a little away from the current share of area under the respective crops. The estimates vividly reveal that the cultivation is and will be more focussed on Paddy only. Though the importance to crops Cotton and Gingelly seems to increase a little, in absolute terms i.e., in terms of acerage it is found to be very meagre. Hence by and large in the perspective of crop diversification, the shift observed does not support the concept of crop diversification.

Major reason for non – Adoption of Crop diversification

Garrett ranking techniques was employed to find out the reasons for non – adoption of crop diversification in Thiruvarur district and the results are presented in table 3. It could be observed from the table that the reason "Lack of awareness on the relevance of crop diversification in risk mitigation" ranked first, followed by "Not willing to shift from conventional farming system" as rank second. "Lack of technical know – how" is found to be the third major reason.

Policy Suggestions

- Needed efforts should be initiated by the relevant institutional authorities to improve the awareness among the farmers of Thiruvarur district on crop diversification and its relevance in risk mitigation.

- Training to impart the technical know – how on cultivation of new crops may be organised.

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