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Determinants of Agricultural Production Diversification among Marginal and Small Farmers of Kanyakumari and Perambalur

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To assess the influence of agricultural production diversity of marginal and small farmers
Study Design: Purposive Random Sampling
Place and Duration of Study: Kanyakumari and Perambalur districts in Tamil Nadu were purposefully chosen for the survey, which was conducted through primary data collection from July to August 2020.
Methodology: According to the Tamil Nadu state planning commission report 2017, Kanyakumari and Perambalur districts were chosen at random from the top five and bottom five districts of the food security index to analyze dietary diversity. The crop diversification index was calculated using the entropy index. The Tobit model is used to investigate the impact of diverse agriculture production among marginal and small farming households.
Results: The findings clearly show that, of the two districts, Perambalur has diversified more than Kanyakumari. Farmers in Perambalur district cultivate agricultural crops, whereas farmers in Kanyakumari district selected block cultivate horticultural crops, particularly plantation crops.

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According to the Tobit results, the number of cattle, farm size, credit available, and distance from the market all had a positive and significant influence on crop diversification. Improving female-headed household decision-making, promoting household investment and infrastructure facilities, and suggesting crop development as crop diversification measures.
Conclusion: The results conclude that farmers in Perambalur district have highly diversified cropping than Kanyakumari district.

Keywords: Agricultural production; entropy index; crop diversification index; to bit model.

1. INTRODUCTION

Growth in agricultural productivity and food production has significantly contributed to a reduction in global hunger over the last few decades [1]. Malnutrition in all of its forms is a critical component of the United Nations Development Goals. Smallholder farmers account for a large proportion of the worlds malnourished [2]. As a result, it is critical to consider how to make smallholder agriculture more nutrition- sensitive [3-5]. Agriculture and nutrition are inextricably linked, not only because agriculture is the sector that produces food, but also because smallholder farmer's account for a large proportion of the world undernourished population [6, 7].

Crop diversification is commonly defined as the incorporation of new crops into an existing cropping system [8]. Diversification of agricultural and food systems has the potential to improve diet quality and nutrition [9-11]. However, there is a scarcity of empirical evidence on the effects of diversification strategies for dietary improvement in smallholder households [12]. Agricultural sector growth and development, according to the World Bank [13], is a determinant of escaping poverty traps in many developing countries. Crop diversification is one of the agricultural strategies proposed for poverty alleviation [14, 15]. It is considered as one of the most environmentally feasible, cost- effective and straightforward methods of mitigating the impact of uncertainties, particularly among small scale farmers [16].

Agriculture can have an impact on nutrition in a variety of ways, including increased food intake from own production, increased income from crop diversification towards high value crops, livestock rearing and lower food prices [6, 17-19]. On the other hand, the evidence on the link between agriculture and nutrition has been blurry. Undernourishment is a serious and widespread issue in farming households. When agricultural households are compared to non-agricultural regions, this evidence becomes clear [20]. This study is a contribution of direction and focuses on the selected marginal and small farmers of Kanyakumari and Perambalur districts. It attempts to connect the influence of agricultural production diversity of marginal and small farmers.

2. METHODOLOGY

Only primary data have been used in this study. The data for the analysis consisted of gender, age, family size, cultivable land area allotted under different crops, number of cattle, farm size, credit availed etc., for both marginal and small farmers in the sample districts of Kanyakumari and Perambalur during july to august 2020.

2.1 Sampling Design and Methods of Data Collection

For the purpose of analysis of diversification, two districts were selected according to Tamil Nadu state planning commission report 2017, from the top five and bottom five food security indexes Kanyakumari and Perambalur districts was selected as purposively. In the second stage, four blocks were chosen at random, two from each district. In the third stage, four villages were chosen, one from each block. Each district had two villages chosen at random. Using stratified random sampling, 120 farmers (60 marginal farmers + 60 small farmers) were chosen from each village in the final stage. Thus, total 480 respondents (240 marginal farmers+ 240 small farmers) from Kanyakumari and Perambalur districts have been selected.

2.2 Methods of Data Analysis

In order to address the degree of agricultural diversification, following statistical analysis were employed in this study.

2.2.1 Crop diversification index

A variety of statistical methods can be used to assess the magnitude of diversification, including the Index of maximum proportion, Simpson index, Modified entropy index, Composite

entropy index, Ogive index, Herfindahl-Hirschman index, etc., [21,22]. Every tool has its own advantages and disadvantages in terms of data collection, computation and interpretation of results. However, the results of the entire index are more or less same.

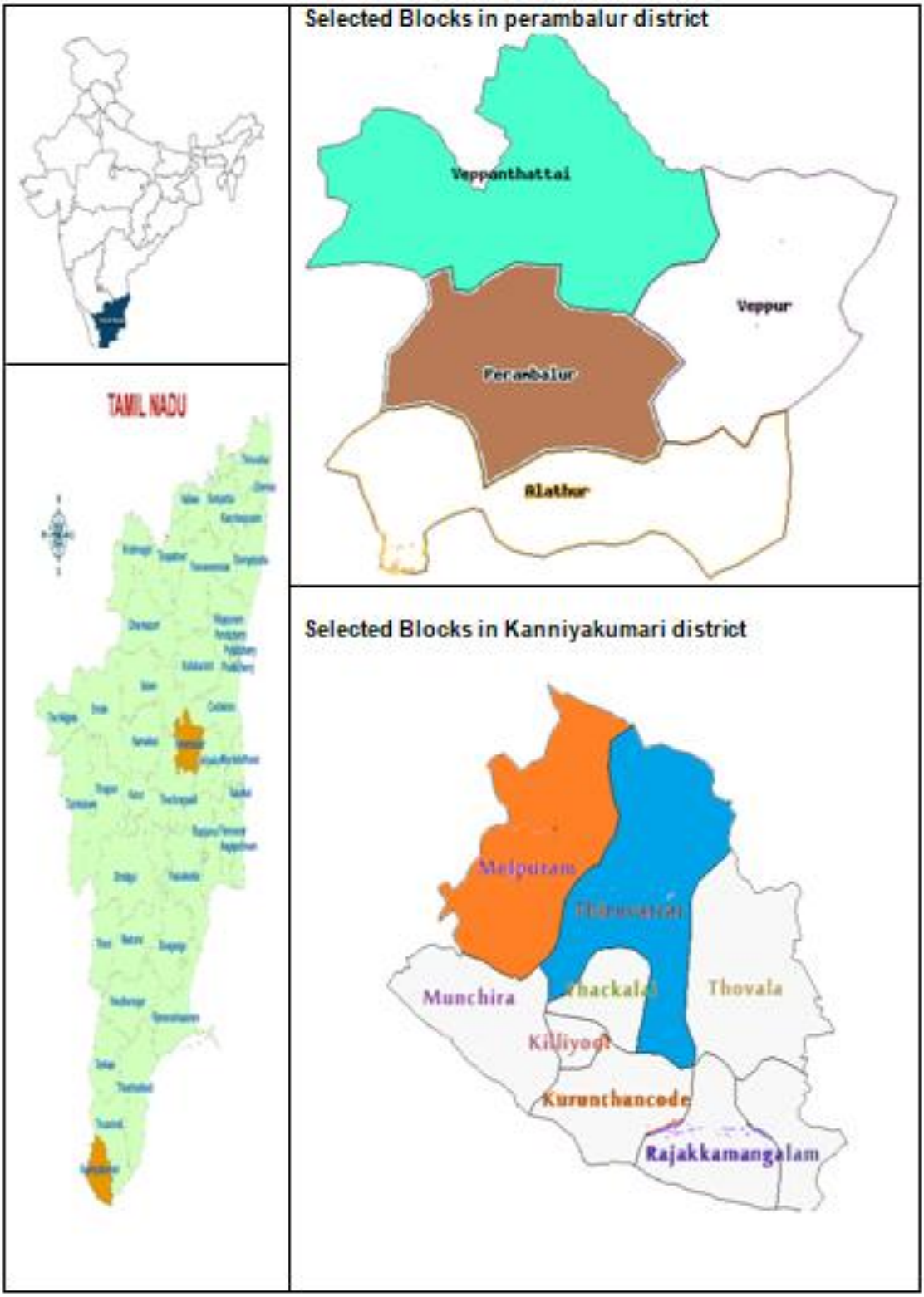

Fig. 1. Map Showing selected blocks of Perambalur and Kanyakumari district

In this research paper, the Entropy index was used to calculate the crop diversification index. This is a popular measurement used by many researchers. Unlike herfindahl index, the entropy index increases as diversification increases. It is a direct measure of diversification with a logarithmic scale [23, 24,25,26].It is defined as:

$$EI = -\sum_{i=1}^{N} P_i^* \ln(\frac{1}{P_i})$$

P_i = Proportion of area under i^{th} crop and
N = Total number of crops.
i=1, 2, 3...n, (Number of crops)

The entropy index ranges from zero to log n. when there is complete specialization, 'EI' equals zero, and when there is perfect diversification 'EI' equals log N (which depends on N). The crops which are cultivated in selected blocks of Kanyakumari district are Rubber, Banana and Coconut and also crops which are Paddy, Onion, Maize, Cotton and Groundnut were cultivated in Perambalur district.

2.2.2 Econometric model

Tobit model is used to study the influence of agriculture production diversified among the marginal and small farming households. [27]Defines the Tobit model as;

$$Yi = \beta x_i + \mu_i$$

Where, μ_i is normally distributed with constant variance and zero mean.

Y_i is the crop diversification index, which is the number of crops grown in the study area divided by the proportion of the area under the crops available in the study area. The entropy index is used to measure the crop diversification index. It ranges between zero to one. Zero means no diversification. A value one indicates a higher level of diversification.

To investigate the impact of crop diversification, Tobit regression model is used which allows for a linear relationship between the variables. In the present study, the regression model is developed by taking crop diversification a dependent variable and socioeconomic characteristics as independent variables. The influence of various socioeconomic characteristics on crop diversification is assessed by Tobit regression function where the marginal effect of the explanatory variables on crop diversification is derived.

$$CDI = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + e_i$$

X_1 –Gender (male-1, female-0)
X_2 – Age (years)
X_3 – Family Size (no of peoples in the households)
X_4 – Number of Cattle (numbers)
X_5 – Farm Size (acre)
X_6 – Credit Availed (access-1, not access-0)
X_7 – Market Distance (km)
e_i – error term

3. RESULTS AND DISCUSSION

3.1 Entropy Index

Crop Diversification Index (CDI) was studied using the Entropy Index. Table 1 show that marginal and small farmers have a high level of crop diversification. Diversification increases as the entropy index rises, and vice versa. The results have clearly shown that among the two districts, Perambalur district has diversified more than Kanyakumari district. Because in Perambalur, farmers are cultivating agricultural crops and farmers of Kanyakumari district the selected block is cultivating horticultural crops particularly plantation crops.

Table 1. Diversification Index at Household level

Farmer	Districts	
	Kanyakumari	Perambalur
Marginal	0.39	1.16
Small	0.30	1.30
Average	0.34	1.23

Source: Field Survey

Crop diversification, as measured by the entropy index, was higher in Perambalur district for both marginal and small farmers, but lower in Kanyakumari district. In both districts, small farmers are more diversified than marginal farmers. Because the small farmers are cultivating under both irrigated and non-irrigated systems, but marginal farmers are cultivated under only rainfed.

3.1.1 Factors influencing crop diversification of Kanyakumari district

The STATA 15 software is used to assess the Tobit model to identify the drivers of crop diversification. The results of Kanyakumari district were summarized and presented in

Table.2. The log likelihood for the fitted model of marginal farmer was 142.29 and small farmer was 255.88 and the chi-square value of marginal farmer was 463.55 and small farmer was 622.87. At the 1% level, they were found to be highly significant. The results showed that the overall model was significant and the explanatory variables used in the model can explain the variation in crop diversification as a whole.

It could be seen from the Table 2 that the coefficients of the gender were positively significant for marginal and small farmer. It was inferred that a one percent increase in gender will increase the crop diversification by 0.041 and 0.014 per cent respectively. The male headed households had a higher propensity to diversify towards agricultural production. [28] has found that female headed households are less likely to engage in labour intensive agriculture. Moreover, the marginal farmer in the district has a negative influence (-0.001) with the age of household head indicates that the crop diversification tends to fall as the age of household head increases when the farmers faces extreme agricultural production diversity. The age of small farmer has a positive influence and it did not significantly affect on farmers' decision to diversify the agricultural production.

Family size of both the marginal and small farmer was not significant to influence the agricultural diversification. It was empirically showed that [29] the underutilization of labour in the field, family size has a negative impact.

Further, a number of cattle were found to be significantly positive at one per cent level. It implies that a one percent increase in the number of cattle would increase the crop diversification for both the marginal farmers (0.093) and small farmers (0.46). [30, 31] concluded that cattle ownership has a positive and significant effect on household food consumption with a significant level of 5 per cent. The amount of cultivable land turned out to a significant factor in the decision of the household to allocate the land for cultivation. The cultivable land size had a negative influence on both the farmer decision to allocate their land for cultivation of crops. The cultivation of these crops is labour intensive, but it provides a consistent source of income.

Credit availed and distance to market was positively significant for both the farmers. Credit increases households' financial capacity to purchase productivity boosting inputs, smooth consumption and easily diversifying the agriculture. The past results of [31] who found that higher income increases access to a wider range of foods implying that credit has a positive impact on dietary diversity in Central Malawi. The extent of commercialization was discovered to significantly increase dietary diversity because improvements in the extent of commercialization among farming households will lead to increase in farm income which in turn improves household's economic access to food. In terms of distance to market proximity to a main road allows for quick access to the market, lowers marketing costs and aids in the quick disposal of the product.

3.1.2 Factors influencing crop diversification of Perambalur district

The results of Perambalur district are summarized and presented in Table.3. The log likelihood for the fitted model for the marginal farmer was 107.93 and small farmer was 125.23, as well as the chi-square value of marginal farmer (482.74) and small farmer (521.62), indicated that it was highly significant at the 1% level. As a result, the overall model is significant, and the explanatory variables used in the model can explain the variation in crop diversification collectively.

Crop diversification has positively significant effect for marginal farmers and it did not have a significant influence on farmer's decision to diversify for small farmers with dietary diversity in the gender. As a result male farmers diversify their crop production more than female counterparts. This was clearly supported by male farmers having greater access to agricultural production resources than female farmers which increased their level of diversification. This result was consistent with [26] in Zimbabwe having a male household head increased crop diversification.

On the other hand, age was found to be positively significant with dietary diversity of farming households for marginal farmer. Crop diversification broadens the range of food crops available to households. Crop diversification was found to increase in dietary diversity by 0.003 per cent. This result was consistent with similar findings of [31] that crop diversification increases dietary diversity, particularly in the developing countries. For small farmers, age of the household head significantly reduces crop

Table 2. Tobit regression estimates of factors influencing crop diversification in Kanyakumari district

Variable name	Marginal Farmer	Small Farmer
Gender of the household head (Male=1, Female=0)	0.041** (0.07)	0.014** (0.007)
Age of the household head (Years)	-0.001 (0.001)	0.004 (0.000)
Family size (Numbers)	-0.011(0.007)	0.001(0.003)
Ownership of cattle (Yes-1, No- 0)	0.093***(0.015)	0.046***(0.012)
Farm size (ha)	-0.053***(0.011)	-0.006**(0.003)
Credit Availed (Yes-1, No-0)	0.097*** (0.025)	0.042* (0.023)
Market Distance (Km)	0.024**(0.016)	0.062***(0.004)
Constant	0.375(0.064)	0.207(0.026)
Log Likelihood	142.299	255.881
No of Observation	120	120

*Note: ***, ** and * denote significance at 1%, 5% and 10 % respectively figures in parenthesis are standard errors*

Table 3. Tobit regression estimates of factors influencing crop diversification in Perambalur district

Variable name	Marginal Farmer	Small Farmer
Gender of the household head (Male=1, Female=0)	0.053** (0.023)	0.003 (0.022)
Age of the household head (Years)	0.003***(0.001)	-0.001 (0.001)
Family size (Numbers)	-0.002(0.010)	0.001 (0.008)
Ownership of cattle (Yes-1, No- 0)	0.065***(0.014)	0.017 (0.010)
Farm size (ha)	0.003(0.019)	0.028** (0.012)
Credit Availed (access-1, not access-0)	0.209***(0.031)	0.324*** (0.022)
Market Distance (Km)	0.033***(0.009)	0.024*** (0.005)
Constant	0.742(0.066)	0.832 (0.079)
Log Likelihood	107.935	125.238
No of Observation	120	120

*Note: ***, ** and * denote significance at 1%, 5% and 10 % respectively figures in parenthesis are standard errors*

diversification as observed in Table.3. From the results, a unit increase in age of household head will reduce the crop diversification by 0.001; as farmers get older, they tend to specialize in producing a specific crop based on their production experience. Farmers' risk bearing capacity was also found to decrease with age. This result supported by previous findings of [32] that farmers' age has a negative impact on crop diversification in North-Central Nigeria.

Family size, which indicates that both the marginal and small farmers are not significantly influence the agricultural diversification. It was shown that a one per cent increase in family size would decrease the agricultural diversification by -0.002 per cent of marginal farmers and increases by 0.001 per cent of small farmers. It could be seen from the Table.3 that the impact of the number of cattle for both marginal and small farmers was positive and it was significant for the marginal farmer at one per cent level. It showed that a one percent increase in cattle number would increase the crop diversification in 0.065 and 0.010 per cent.

Farm size was found to have a positive influence on marginal and small farmers at the 5 per cent level for small farmers, which indicates that access to land resources gives a boost to the practice of crop diversification which also agrees with the findings from [33, 34] in Southeastern Nigeria, Zambia and Ethiopia who demonstrated that farm size has a significant and positive effect on crop diversification.

Credit availed and distance to market has positive and significant influence for both the marginal and small farmers. One per cent increase in credit availed and distance to market will increase by one per cent. This implies that credit made available to farmers will increase their profit and encourage them to engage in more cropping systems, thereby increasing their farm income. The past studies by [21, 34] found that crop diversification was positively influenced by access to agricultural markets.

4. CONCLUSION

This study has identified the determinants of crop diversification among marginal and small farmers of Kanyakumari and Perambalur district using entropy index and the Tobit regression model. The two districts have been diversifying towards agricultural production diversity and dietary diversity. Also, there are considerable variations in the crop diversification under two districts. The study found that the farmers at Perambalur district have highly diversified than Kanyakumari district. The Tobit results showed that number of cattle, farm size, credit availed and distance from the market had positive and significant determinants on the crop diversification for Kanyakumari district. While the gender, age, family size was found to negatively influence the crop diversification of Kanyakumari district farms. The results have brought out the credit availed and distance from the market was positive and significant determinants on the crop diversification for Perambalur district. Whereas, all other variable such as age, gender, family size, number of cattle and farm size for marginal and small farmers were negative and significantly influence the crop diversification of Perambalur district. The study confirmed that the determinants of agricultural production diversification and dietary diversity are fairly strong among the Perambalur district than Kanyakumari district. The study recommends that improving female headed household's decision making, promoting household investment and infrastructure facilities, suggesting crop development as measures to promoting crop diversification.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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