Original Research Article

Determinants of income diversification among dairy farm households in Tamil Nadu

Abstract

Dairy farming is the subsidiary occupation for millions of farmers in India. Due to risks and uncertainties in rainfed areas, crop production alone was not much remunerative. Diversifying dairy with the crop and allied activities would generate better income, nutritional security, and regular employment to the farming community and ensure risk reduction. This study investigates the extent and determinants of income diversification among dairy farm households in Tamil Nadu using the Simpson Index of Diversity (SID) and the Tobit regression model. Primary data were collected from dairy farm households during the year 2021-22. The results show that two-thirds of the total household income was shared by on-farm income and the remaining one-third by off-farm and non-farm activities to the total household income. Simpson Index of Diversity (0.38) indicated that the households were diversified with milch animals, but the degree of the diversification was low since high degree of diversification requires more labour and high cost. Further, education, family size, landholding size, herd size, proximity to agricultural or allied industry, access to credit, and membership in farmer producer organizations were the important determinants of income diversification. This study indicates that farm households should adopt a concentric approach that requires targeted research, information dissemination, infrastructure development, and agricultural technical institution establishments to boost income diversification and livelihood.

Keywords: *Globalization, Simpson Index of Diversity, Tobit regression, agriculture*

1. INTRODUCTION

Globalization and market liberalization have created new hurdles to smallholders' viability who are 85 percent of the Indian farming population. Despite a decline in agriculture's contribution in gross domestic product (GDP) to 19.9 percent in 2019-20 from 29.5 percent in 1990-1991, agriculture employs more than half of the country's workforce [1]. There has been a decline in area, production, and productivity of seasonal crops in rainfed areas due to various risks and uncertainties, making agricultural activities not much remunerative. This crisis has decreased the farm income which worsens the living standards

of the farm households [2]. During 2012-13 and 2018-19, farm incomes has increased by 57 percent with a growth rate of 7.8 percent, while inflation-adjusted income equal 16 percent at a CAGR of 2.5 percent. Interestingly, most of the income growth was contributed by dairy and agricultural wages, while the share of income from farm activities declined from 48 to 38 percent [3]. Moreover, India's total number of operational holdings was 138.85 million with an average size of 1.15 hectares in 2015. By 2030, 91 percent of the total farm holding would belong to small and marginal farmers [1]. The continuous declining trend in landholding size makes a largely dominated small and fragmented holdings would create a severe challenge to the profitability and sustainability of farming. These scenarios add to the farmer's debt and deteriorate their livelihood, driving them into poverty and food insecurity. Diversification of income opportunities through dairy and off-farm activities has been viewed as a critical component of sustainable economic transformation. The non-farm sector is considered a remnant and an agent of structural transformation of the rural economy. Additionally, it is well known that the rural non-farm sector offers alternate sources of income for rural households and promotes income diversification. Income diversification may happen due to a survival or accumulation strategy that increases nutritional security, regular employment, and enhanced household income [4]. Thus, several factors influence households' decision to diversify. This study (i) examines income sources or extent of income diversification across the farm households and (ii) identifies the determinants underlying households' decisions to diversify.

2. METHODOLOGY

The study was conducted in Tamil Nadu State using random sampling method during the year 2021-22. At first, two districts viz., Namakkal and Salem were purposefully selected because of socio-economic heterogeneity of the dairy farms in Tamil Nadu as most of the farms were in the rainfed zone. Then, two blocks in each district and three villages in each block were selected randomly in the successive stages. Finally, a random sample of 407 dairy farm households was chosen and data on socio-economic and socio-demographic characteristics and household engagement in farm and non-farm activities were obtained using a pretested questionnaire.

2.1 Simpson Index of Diversity – Degree of income diversification

To determine the degree or extent of income diversification, Simpson's Index of Diversity (SID) was used. It is the distribution of total household income from all revenue sources and considers both the number of income sources and the degree to which revenue is

distributed equitably among them [5,6,7]. The index value lies between 0 and 1; the value zero indicates that the farm household is completely specialized, while a value of one indicates higher degree of income diversification. The formula of Simpson's Index of Diversity is given in equation (1).

$$SID = 1 - \sum_{i=1}^{n} P_i^2 \quad (1)$$

where 'n' is the number of sources of income, P_i is the share of income from the i^{th} source.

2.2 Tobit regression – Determinants of income diversification

To assess the determinants of farm household's income diversity tobit regression model was used. Simpson's Index of Diversity was considered as the dependent variable. Due to the existence of zeros in the dependent variable (indicating a lack of diversity) for certain respondents, the Tobit regression was used. The equation for the Tobit model is given as [8]

$$y_i^* = x_i'\beta + \varepsilon_i \quad (2)$$

$$y_i = 0 \;\; if \; y_i^* =\leq 0$$

$$y_i = y_i^* \; if \; y_i^* > 0$$

where y_i^* is the degree of income diversification with a value that lies between 0 and 1, β is the parameter to be estimated, x is the matrix of the independent variables. The empirical model to identify the determinants of income diversification is described as

$$SID = \beta_0 + \beta_1 Age + \beta_2 Edn + \beta_3 FS + \beta_4 LH + \beta_5 HS + \beta_6 MarkDist + \beta_7 IndusDist + \beta_8 Credit + \beta_9 Extension + \beta_{10} Membership + \varepsilon \quad (3)$$

where 'Age' is the age of the respondents in years; 'Edn' is the education status of the family head in years; 'FS' is the family size; 'LH' is the landholding in hectares; 'HS' is the herd size; 'MarkDist' is the distance to the nearby marketplace in km; 'IndusDist' is the distance to the nearby agricultural or allied industry in km; 'Credit' is the access to the credit (1=access to credit, 0 otherwise); 'Extension' is the contact of the extension agent (1 = contact, 0 otherwise); 'Membership' is the membership of the respondent in a farmer producer organization (1 = membership, 0 otherwise) and ε is the error term.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic and socio-economic profile

The factors associated with income diversification were identified, which includes personal and household characteristics (age, education, family size), resource endowments (herd size, landholding size), access to infrastructure (distance to the nearby markets and industries) and institutions (access to credit, extension agent contact and membership in FPO). The descriptive statistics of the socio-demographic and socio-economic profile of the

farm households are furnished in Table 1. According to the results, the respondents were middle-aged (48 years) and small farmers (3.81 ha) with a secondary level of education. The majority of farm households have a herd of 3 cattle animals. In case of infrastructural access, farm households were 8 and 13 km away from markets and agricultural industries, respectively. Regarding institutional linkages, 32, 26 and 19 percent of the farm households have access to credit, extension agent contact and membership in farmer producer organizations (FPO), respectively.

Table 1. Socio-demographic and socio-economic profile of the farm households

Variables		Nature of variables	Mean	Minimum	Maximum	Std. Dev.
Age (Years)		Continuous	48.32	28.00	75.00	12.28
Education (Years)		Continuous	10.27	0.00	18.00	4.78
Level of education (number of farmers)	Primary	Continuous	64	-	-	-
	Secondary school	Continuous	134	-	-	-
	High school	Continuous	107	-	-	-
	Under graduates	Continuous	62	-	-	-
	Postgraduates	Continuous	40	-	-	-
Family size (No.s)		Continuous	3.81	1.00	7.00	1.34
Landholding size (Hectare)		Continuous	1.29	0.08	12.14	0.86
Herd size (No.s)		Continuous	3.18	1.00	34.00	10.17
Distance to market (km)		Continuous	8.65	1.00	15.00	3.69
Distance to industry (km)		Continuous	12.91	0.50	35.00	9.30
Access to credit		Categorical	0.32	0.00	1.00	0.47
Extension agent contact		Categorical	0.26	0.00	1.00	0.44

Membership in FPO	Categorical	0.19	0.00	1.00	0.39
On-farm income (Lakh Rs./year)	Continuous	2.86	1.00	10.00	5.24
Off-farm income (Lakh Rs./year)	Continuous	0.25	0.00	3.50	0.52
Non-farm income (Lakh Rs./year)	Continuous	1.37	0.00	25	2.22
Simpson Index of Diversity	Continuous	0.38	0.00	1.00	0.35

3.2 Nature of Income Diversification of Farm Households

The sources of income were categorized into on-farm, off-farm and non-farm incomes. Further, on-farm were sub-categorized into income from the crop, livestock (dairy, sheep, goats and poultry) and other sources (honeybees and composts); off-farm income into rent from leased out land, hiring out family labourers and hiring out owned machine powers and non-farm income into formal sources (teaching and other government officials) and informal sources (self-employment, non-farm wages and remittance). The key reasons given for the entry into non-farm activities include the ability to cater to the household's needs in terms of food security, payment of school fees, and accumulation of income to address risks associated with farming, among other reasons [9].

Food crop production has been followed by 387 farms (95.09 percent) which produces maize, sorghum, groundnut, gingelly, pearl millet and vegetables. There were 57 (14 per cent) farm households engaged in producing cash crops production which includes coconut and sugarcane. Meanwhile, 37 farm households (9.09 per cent) have earned their income from other on-farm production sources like apiculture, fish and composts. In the case of off-farm activities, households were extensively engaged in hiring out family labour (39.06 per cent) followed by hiring out machinery (14. 5 per cent) and rent from leased out land (10. 56 per cent). As the study area is in rainfed region, the crop production solely depends on the monsoon, which led the smallholders to hire their family labourers to the larger farm holders. In non-farm income sources, one-fourth of the farm households were attached to self-employment as it gives more returns to them and in turn, they could be utilized for upgrading the farm activities. It was followed by non-farm wages (19.16 per cent) and remittance (8.35

per cent). The results from Table 1 showed that the share of the on-farm income sources was the most significant contributor (63.65 per cent) in the share of total household income followed by non-farm sources (30.68 per cent) and off-farm sources (5.67 per cent). It is noted that one-third of the on-farm income was from the dairy indicating that the dairy sector remains vital to farm households in the study region since most of the income was obtained from the dairying operations despite the region's continuous monsoon failure and decreased groundwater levels. The promotion of dairying as a viable enterprise in the country's remote rural areas can boost rural income and employment to a great extent. This can go a long way in reducing the poverty, unemployment, food insecurity and provides a continuous flow of income to rural areas.

Table 2. Mean share of income sources in total household income in Tamil Nadu

Source of Income	**Mean share income (%)**
On-farm income	
Food crop	13.65
Cash crop	9.23
Dairy	33.75
Other livestock	6.49
Honeybees and composts	0.53
Subtotal (A)	**63.65**
Off-farm income	
Rent from leased out land	0.49
Hiring out family labour	3.92
Hiring out machine power	1.26
Subtotal (B)	**5.67**
Non-farm income	
Teaching and other government officials	10.12
Self-employment	11.21
Non-farm wages	9.22
Remittance	0.13
Subtotal (C)	**30.68**
Total (A+B+C)	**100.00**

3.3 Factors affecting Income Diversification-Simpsons Index of Diversity (SID)

The study showed a mean income diversity of 0.3807 (38.07 percent) which may be attributed to less education of the farmers and less accessibility of nearby allied industries to the farm households [10]. As a result, there is a need to assist farm households to diversify their household income by providing various opportunities. Furthermore, this approach may enable a farmhouse to maintain a steady revenue stream throughout the year [9].

The Tobit regression estimates of the determinants of income diversification (SID) are presented in Table 3. The educational status, family size, landholding size, herd size, distance to nearby agricultural and allied industry, access to credit and membership in FPO were found significant. The study revealed that the education level of the household head was positively significant at one per cent level implying that farmers with a higher education level had the potential for higher-paying professions therefore, they began to diversify their revenue streams. Similarly, family size positively influences income diversification as it was significant at one per cent level, implying that larger families have more options for income diversification. This denotes that the larger family size would generate higher degree of income diversification family which was attributed due to fulfil the family needs and also to increase the living standards. The landholding size negatively influenced the amount of income diversification, indicating that larger farm families diversified less because a more significant proportion of their income is allocated to a single enterprise that provides acceptable returns [11]. Similar results were seen when the farm home had a larger herd size because the major portion of their time would have been devoted for the cattle maintenance which might restrict the farmer to diversify their source of income. The distance to the agriculture and allied industries was negatively significant at 5 per cent level of significance, and the results emphasized that the distance to the industry from the farm is lesser, the farm household tends to diversify more as much. Access to credit and membership of the farmer in FPO were positively significant at 5 and 1 per cent level of significance, respectively. The study revealed that farmers who have access to credit from the financial institutions would diversify their income more than those who do not, since they may engage in various activities that provide several revenue streams, both on and off the farm. When farmers form a team through a farmer-based organization like FPO, they could collaboratively analyze alternative sources of income in order to enhance their well-being through farmer-to-farmer teaching and learning [12]. Farmers can benefit from FPOs when bargaining with large

corporate enterprises. It enables farmer members to bargain collectively and assist small farmers in both output and input markets. FPOs can provide member farmers with high-quality, low-cost inputs such as machinery purchases, crop loans, agri-inputs (pesticides, fertilisers, etc.), and direct marketing after agricultural produce procurement. It will allow members to save time, money, transaction costs, price fluctuations, quality maintenance, transportation, and so on.

Table 3. Determinants of income diversification in Tamil Nadu

Variable	**Coefficient(β)**	**Std. Error**	**P-value**
Age	-0.023	0.049	0.128
Education	0.249***	0.09	0.006
Family size	0.168***	0.051	0.000
Landholding size	-0.419**	0.189	0.022
Herd Size	-0.092***	0.026	0.000
Distance to market	-0.638	0.396	0.119
Distance to industry	-0.789***	0.32	0.006
Access to credit	0.087**	0.044	0.042
Extension Agent Contact	0.431	0.472	0.158
Membership in an association	0.045***	0.001	0.002
Constant	0.055	0.951	0.607
Log likelihood	224.192		
Pseudo R square	0.695		
Observations	407		

***** *Significant at 0.01 per cent level*

** *Significant at 0.05 per cent level*

* *Significant at 0.01 per cent level*

4. CONCLUSION

This study investigates income diversification as a potential risk management strategy, income and welfare improvement for dairy farm households. The results indicate

that the farm households were less diversified as Simpson Index of Diversity was 0.38 and the share of farm income was nearly three-fourths of the mean total household income which indicated that farm families earn their income through a limited number of livelihood activities. One-third of on-farm income comes from dairy, indicating that the milch animals continue to be critical to farm households. The factors that affected the income diversification were education, family size, land size, herd size, proximity to the agriculture and allied industries, access to credit and membership in FPO. Market accessibility may give competitive prices, investment opportunities, job prospects, and future ideas to perform better income diversification. In order to diversify the income of dairy farm households, efforts should be made by the government and other stakeholders to build the capacity of the farmers through training that enables them to accumulate income for investment and sustain the farm industry. The policy should emphasize tie-ups of industrial agriculture and allied sectors with the farmers to provide a regular flow of income throughout the year. Linking the farmers with the formal financial institutions, providing marketing and infrastructure facilities through proper roadways and transportation, and membership in farmer producer organizations would diversify the farm income, making them invest in competitive markets.

References

1. Government of India. All India report on agricultural census 2015-16. Department of Agriculture, Cooperation and Farmers Welfare, Ministry Of Agriculture and Farmers Welfare, New Delhi. 2020. Accessed 15 January 2021. Available: http://www.agcensus.nic.in/document/agcen1516/ac_1516_report_final-220221.pdf
2. Rathore VS, Tanwar SPS, Kumar P, Yadav OP. Integrated Farming System: Key to sustainability in arid and semiarid regions. Indian Journal of Agricultural Science. 2019; 89(2):181-192.
3. NSSO. Situation Assessment of Agricultural Households and Land and Livestock Holdings of Households in Rural India, NSS Report no 587, National Sample Survey Office, Ministry of Statistics and Programme Implementation, New Delhi. 2021. Accessed 25 November 2021. Available: http://www.pib.gov.in/PressReleasePage.aspx?PRID=1753856
4. Ellis F. Household strategies and rural livelihood diversification. The Journal of Development Studies. 1998;35(1):1-38.

5. Minot N, Epprecht M, Anh T, Trung LQ. Income diversification and poverty in the Northern Uplands of Vietnam, Research Report No. 145, International Food Policy Research Institute, Washington, DC. 2006.
6. Joshi PK, Ashok G, Ralph C. Agricultural diversification and smallholders in South Asia. Academic Foundation, New Delhi. 2007.
7. Judit J, Bruno W, Brent MS. Characterizing social networks and their effects on income diversification in rural Kerala, India. World Development. 2017;94:375–392.
8. Greene W. Econometrics Analysis. Prentice Analysis, New Jersey. 2003.
9. Waseem K, Mohammed J, Sana F, Aruna D. Determinants of income diversification of farm households' in Uttar Pradesh, India. Forum for Social Economics. 2020;49(4):465-483.
10. Kamal V, Gurpreet S, Nivedita S, Priya BB. Regional dimensions and determinants of income diversification in rural India. Agricultural Economics Research Review. 2018; 31:33-46.
11. Sukhwindher S, Andrew DJ, Ruth SD, Meha J. The association between crop and income diversity and farmer intra-household dietary diversity in India. Food Security. 2020;12:369-390
12. Benard AS, Samuel AB, Edward EO. Determinants of income diversification of farm households in the western region of Ghana. Quarterly Journal of International Agriculture. 2014;53(1):55-72.