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Socio-economic analysis and strategic assessment of tapioca cultivation among tribal farmers in the Pachamalai hills of Tamil Nadu

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Abstract

Tapioca (*Manihot esculenta* Crantz) is an important livelihood crop among tribal farmers in the Pachamalai Hills of Tiruchirappalli district, Tamil Nadu due to its adaptability to rainfed conditions, drought tolerance, low input requirement, and industrial importance. The present study was undertaken to analyse the socio-economic characteristics, determinants of household income, cultivation practices and strategic opportunities associated with tapioca cultivation among tribal farmers. Primary data were collected from 160 tribal tapioca farmers using a structured interview schedule, while secondary data were collected from relevant published sources. The collected data were analysed using descriptive statistics, Multiple Linear Regression (MLR), Garrett Ranking Technique and SWOT analysis. The Multiple Linear Regression results revealed that tapioca farm income, agricultural labour income, and MGNREGA income had a positive and significant influence on the annual household income of tribal farmers, highlighting the importance of tapioca cultivation and employment opportunities in enhancing livelihood security. The study identified fertile soil conditions, low water requirement, availability of family labour and traditional knowledge as major strengths of tapioca cultivation. However, farmers faced several constraints, including pest incidence, price fluctuations, inadequate access to institutional credit, limited technical support and climatic uncertainties. The SWOT analysis revealed significant opportunities for improving tapioca cultivation through the promotion of improved varieties, value addition, processing facilities, and strengthened institutional support. The study concludes that enhancing access to credit facilities, strengthening extension services, promoting scientific cultivation practices, and implementing suitable policy interventions can improve the productivity, profitability and livelihood security of tribal tapioca farmers in the Pachamalai Hills of Tamil Nadu.

Keywords: Tapioca, tribal farmers, socio-economic analysis, multiple linear regression, income determinants, SWOT analysis, Pachamalai Hills

1. Introduction

Agriculture continues to play a vital role in the Indian economy by contributing significantly to employment generation, food security, and rural livelihoods. Although the contribution of agriculture to the Gross Domestic Product (GDP) has gradually declined with economic transformation, a large proportion of the rural population still depends on agriculture for their livelihood. Among rural communities, tribal households are highly dependent on agriculture, forest resources, and traditional farming practices. However, limited access to irrigation facilities, institutional credit, improved technologies, extension services and organized markets continues to restrict agricultural productivity and income enhancement among tribal farmers.

Cassava (*Manihot esculenta* Crantz), commonly known as tapioca, is an important tropical tuber crop cultivated extensively due to its drought tolerance, adaptability to marginal soils and low input requirements. The crop plays a significant role in food security and income generation among small and marginal farmers. Apart from its use as a food crop, tapioca has considerable industrial importance, as

cassava starch is widely utilized in food processing, textiles, paper manufacturing, pharmaceuticals, adhesives, bioethanol production and other value-added industries. Therefore, tapioca cultivation contributes to employment generation, rural income enhancement and industrial development.

India is one of the major cassava-producing countries, with Tamil Nadu and Kerala accounting for a significant share of national production. In Tamil Nadu, tapioca is cultivated mainly in Salem, Namakkal, Dharmapuri, Villupuram, and Tiruchirappalli districts. The Pachamalai Hills of Tiruchirappalli district are predominantly inhabited by the Malayali tribal community, whose primary occupation is agriculture. Tapioca has traditionally been an important crop in this region due to its suitability to rainfed conditions, hilly terrain and varying soil conditions. The crop provides both household food security and a source of cash income for tribal farming households.

Despite its importance, tapioca cultivation in the Pachamalai Hills faces several challenges, including unstable market prices, climatic uncertainties, dependence on rainfall, limited access to institutional finance, inadequate extension support,

poor infrastructure and weak market linkages. In recent years, changes in cropping patterns and increasing cultivation of high-value vegetable crops have contributed to a decline in tapioca cultivation area in some parts of the region. These challenges have affected the profitability and sustainability of tapioca-based farming systems.

Although several studies have examined cassava production and marketing systems, limited research has focused on the socio-economic conditions, income determinants, supply chain performance, marketing efficiency and strategic development opportunities of tribal tapioca farmers in the Pachamalai Hills. A comprehensive understanding of these factors is necessary for developing suitable policy measures to improve farmers' income, strengthen market access and promote sustainable tapioca cultivation in tribal regions. Therefore, the present study was conducted to analyse the socio-economic characteristics, supply chain performance, marketing efficiency and strategic opportunities of tapioca cultivation among tribal farmers in the Pachamalai Hills of Tamil Nadu.

2. Objectives

- To analyse the socio-economic characteristics and identify the factors influencing the annual household income of tribal tapioca farmers using Multiple Linear Regression (MLR) analysis.
- To identify the major constraints faced by tribal farmers in tapioca cultivation using Garrett Ranking Technique and assess strategic development opportunities through SWOT analysis.

3. Methodology

3.1 Research Design and Data Collection

Research methodology provides a systematic framework for collecting, analysing and interpreting data to achieve the objectives of a study. The present study adopted a descriptive research design to analyse the socio-economic conditions, cultivation practices, supply chain performance and constraints faced by tribal tapioca farmers in the Pachamalai Hills of Tamil Nadu.

The study was based on both primary and secondary data. Primary data were collected from tribal tapioca farmers through a structured interview schedule. A total of 160 tribal farmers were selected as respondents for the study. Information related to socio-economic characteristics, tapioca cultivation practices, income sources, marketing channels, production constraints and farmers' perceptions was collected through personal interviews. Secondary data were collected from published sources, including government reports, agricultural department records, research publications, journals, websites and other relevant sources.

3.1.1 Multiple Linear Regression (MLR)

Multiple Linear Regression (MLR) analysis was employed to identify the factors influencing the annual household income of tribal tapioca farmers. The model explains the relationship between one dependent variable and multiple independent variables.

The functional form of the regression model is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

Where

- Y = Annual household income (dependent variable)
- $X_1, X_2, \dots, X_n$ = Independent variables (predictors)
- β_0 = Intercept
- $\beta_1, \beta_2, \dots, \beta_n$ = Regression coefficients
- ε = Error term

3.2. Garrett Ranking Technique

It is used to convert ranks into scores used to examine the issues that respondents encountered in tapioca production. The following algorithm will be used to determine each rank's percentage position as a first step:

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

Where

- R_{ij} is the rank given to i th item by the j th individual.
- N_j is the number of item ranked by the j th individual.

The table provided by Garrett will then be used to translate the % position into scores. Following this process, scores will be generated based on the order of merit provided by each respondent regarding the onion marketing issues. The scores of each respondent will then be totalled and divided by the total number of respondents for each reason. Ranks will be assigned after these mean scores for all causes are sorted in descending order. This approach will yield an accurate preference determination. The above study was done by the reference of Danmusa.

4. Results and Discussion

4.1 Determinants of Annual Household Income of Tribal Tapioca Farmers: Multiple Linear Regression Analysis

Multiple Linear Regression (MLR) analysis was performed to examine the influence of different income sources on the annual household income of tribal tapioca farmers in the Pachamalai Hills. The dependent variable considered in the model was annual household income, while tapioca farm income, agricultural labour income, MGNREGA income, non-agricultural income and horticultural income were included as explanatory variables. Multiple Linear Regression

Table 1: Determinants of Annual Household Income: Multiple Linear Regression Results

Variables	Coefficient	Standard Error	t-value	p-value
Intercept	-1107465	452275.5	-2.448	0.015*
Tapioca Farm Income	1.903	0.681	2.797	0.006*
Agricultural Labour Income	1.792	0.805	2.227	0.027*
MGNREGA Income	38.404	15.017	2.557	0.012*
Non-agricultural Income	-5.513	2.099	-2.627	0.009*
Horticultural Income	-0.028	1.540	-0.018	0.986 ^{NS}

Significant at 5 per cent level; NS – Not significant

The regression results revealed that tapioca farm income had a positive and significant influence on annual household income ($\beta = 1.903$, $p = 0.0058$). This indicates that an increase in tapioca income contributes significantly to improving the overall economic status of tribal farming households. The result highlights the importance of tapioca cultivation as a major livelihood source in the Pachamalai Hills. Similarly, agricultural labour income showed a positive and significant relationship with annual household income ($\beta = 1.792$, $p = 0.0274$). This indicates that employment opportunities generated through agricultural activities contribute substantially to household earnings. The income received through MGNREGA employment was also positive and statistically significant ($\beta = 38.404$, $p = 0.0115$). This indicates that government employment programmes play an important role in providing additional income support and improving livelihood security among tribal households. In contrast, non-agricultural income showed a significant negative relationship with annual household income ($\beta = -5.513$, $p = 0.0095$). This inverse relationship may be due to differences in household characteristics, employment patterns or interaction among income sources. Therefore, this result should be interpreted with caution. The coefficient of horticultural income was negative and statistically non-significant ($\beta = -0.028$, $p = 0.9857$), indicating that income from horticultural crops did not have a measurable influence on annual household income in the study area. Overall, the regression analysis confirms that tapioca cultivation, agricultural labour employment, and MGNREGA income are the major positive contributors to household income among tribal tapioca farmers. Strengthening tapioca production systems and improving employment opportunities can enhance the economic well-being of tribal farming households.

4.2 SWOT Analysis of Tapioca Cultivation among Tribal Farmers in the Pachamalai Hills

4.2.1 Strength

- Soil fertility is a major strength of tapioca cultivation in the Pachamalai Hills, as the fertile soil supports healthy plant growth and higher tuber yield.
- Water saving is an important advantage of tapioca cultivation because the crop performs well under limited water availability and rainfed conditions.
- Ownership of land provides farmers with confidence to invest in tapioca cultivation and adopt better crop management practices.
- The availability of quality seeds ensures timely planting and promotes better crop establishment and productivity.
- Family labour reduces the dependence on hired labour, thereby lowering the overall cost of tapioca cultivation.
- The minimal requirement for herbicides makes tapioca cultivation more economical and environmentally sustainable.
- Farmers' knowledge and experience in cultivating tapioca help them manage the crop efficiently and improve productivity.
- The low fertilizer requirement of tapioca reduces input costs and supports sustainable cultivation in the Pachamalai Hills.

4.2.2. Weakness

- **Pest Incidence:** Pest incidence reduces tapioca yield and quality, leading to increased production costs and economic losses for farmers.
- **Market Unavailability:** Limited access to reliable markets restricts farmers from selling their produce at the right time and at remunerative prices.
- **Failure of Monsoon:** Failure of the monsoon adversely affects crop growth and tuber development due to inadequate soil moisture during the cultivation period.
- **Price Fluctuation:** Frequent fluctuations in market prices create uncertainty in farm income and reduce the profitability of tapioca cultivation.
- **Lack of Finance:** Inadequate access to financial resources limits farmers' ability to purchase quality inputs and adopt improved cultivation practices.

4.2.3. Opportunity

- **Variety Uniqueness:** The unique characteristics of local tapioca varieties provide opportunities to develop niche markets and increase their commercial value.
- **Cumulative Harvesting:** The flexibility of harvesting over an extended period allows farmers to sell produce based on favourable market conditions and reduce marketing risks.
- **Employment Opportunity:** Tapioca cultivation offers opportunities to generate year-round employment and improve the livelihoods of rural households.
- **Low Irrigation:** The low irrigation requirement of tapioca creates opportunities to expand cultivation in water-scarce and rainfed areas while conserving water resources.

4.2.4. Threats

- **Brokerage:** Dependence on intermediaries reduces farmers' bargaining power and limits their share of the market price.
- **Lack of Knowledge about HYV:** Limited awareness of High-Yielding Varieties (HYV) restricts the adoption of improved technologies and higher productivity.
- **Monocropping:** Continuous cultivation of tapioca as a single crop may lead to soil nutrient depletion and increased pest and disease incidence.
- **Lack of Agricultural Extension Services:** Inadequate agricultural extension support limits farmers' access to improved cultivation practices, technologies and timely technical guidance.
- **Less Profit:** Low profit margins discourage farmers from investing in improved production practices and expanding tapioca cultivation.
- **Climate:** Unpredictable climatic conditions, such as irregular rainfall and temperature fluctuations, pose a serious threat to sustainable tapioca production.
- **Low Cost:** The low market value of tapioca despite its relatively low production cost reduces the overall income earned by farmers.
- **No Special Schemes:** The absence of dedicated government schemes and financial support for tapioca cultivation limits farmers' opportunities for modernization and expansion.

5. Conclusion

The present study analysed the socio-economic characteristics, income determinants, cultivation constraints, and strategic opportunities of tapioca cultivation among tribal farmers in the Pachamalai Hills of Tiruchirappalli district, Tamil Nadu. Tapioca continues to be an important livelihood crop for the Malayali tribal community due to its adaptability to rainfed conditions, drought tolerance, low input requirement and industrial demand.

The Multiple Linear Regression analysis revealed that tapioca farm income, agricultural labour income, and MGNREGA income had a positive and significant influence on annual household income, indicating the important role of tapioca cultivation and employment opportunities in enhancing the livelihood security of tribal households. The findings emphasize the need to improve productivity, profitability and income-generating opportunities associated with tapioca cultivation.

The Garrett Ranking Technique identified major constraints faced by tribal farmers, including pest incidence, price fluctuations, inadequate access to institutional finance, limited technical guidance, and climatic uncertainties, which adversely affect sustainable tapioca production.

The SWOT analysis revealed that fertile soil conditions, low water requirement, availability of family labour and traditional farming knowledge are the major strengths of tapioca cultivation. However, challenges such as limited extension support, lack of awareness about improved varieties and inadequate value-addition facilities restrict further development. The study suggests that strengthening credit facilities, promoting improved cultivation technologies, enhancing extension services, encouraging processing and value-addition activities and implementing targeted government interventions can improve the productivity, profitability and livelihood security of tribal tapioca farmers in the Pachamalai Hills of Tamil Nadu.

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