An Economic Analysis of Grape Cultivation and Supply-Chain Related Constraints in Theni District, Tamil Nadu

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Abstract

The study examined the economics of grape cultivation in Theni district, Tamil Nadu, focusing on socio-economic characteristics, profitability, farm-size differences, factors influencing output and net returns, and major marketing and supply-chain constraints. Primary data were collected from grape growers using a structured interview schedule and analysed using descriptive statistics, cost and return analysis, benefit-cost ratio, farm-size comparison, multiple linear regression, and weighted rank score analysis. The findings showed that grape cultivation was mainly undertaken by middle-aged and experienced farmers with moderate landholding and varied income levels. The average total cost of cultivation was Rs. 2,84,884.25, while gross returns and net returns were Rs. 17,80,645.16 and Rs. 14,95,730.81, respectively. The benefit-cost ratio of 6.35 indicated that grape cultivation was highly profitable. Farm-size analysis revealed that larger farms earned higher absolute net returns, whereas smaller farms showed slightly better per-unit profitability. Regression results showed that education level, total landholding, and farming experience significantly influenced both grape output and net returns. Annual income was excluded from the final model due to multicollinearity with total landholding. Constraint analysis identified pests and diseases, delayed payment, and lack of storage as major problems. The study concludes that grape cultivation is economically viable, but improved technical, marketing, and institutional support is needed to sustain farmer profitability and resilience.

Keywords: Grape cultivation, Profitability, Farm-size analysis, Regression analysis, Supply-chain constraints

1. Introduction

Horticulture is a vital sector of Indian agriculture and a significant source of income, employment, and nutrition, particularly from high-value fruit crops. Grapes are one such high-value, high-income-generating commercial crop with high market value, value addition, and domestic consumption and export potential. Globally, grape cultivation is considered an important horticultural activity associated with farm profitability, processing, fresh fruit marketing, and trade, which emphasises its importance in agriculture and the economy at large (Khan et al., 2020). In Theni district, Tamil Nadu, areas around grape-growing regions like Cumbum have seen the emergence of the crop as an important livelihood and farm income source. This is not only supported by suitable agro-climatic conditions and farmers' experience in grape cultivation, but is a significant part of the regional rural economy (Bharathidasan Institute of Management, 2019).

Grape growing has the potential to generate high economic returns, but it comes with a range of production and marketing challenges that limit profitability. In particular, increasing production costs are due to higher costs of labour, water, fertilisers, pesticides, and other production inputs. Meanwhile, income is uncertain due to price variability, market demand, pest and disease problems, and post-harvest losses. Moreover, delayed payments, storage and transport problems, and high marketing costs also undermine grape farmers' economic status. These problems are more pronounced when it comes to perishable crops such as grapes, in which time and quality are crucial to obtaining higher prices. Even with

access to new technologies, farmers may not be able to benefit from them without institutional and market support (Rashtriya Krishi Vikas Yojana, 2018).

It is against this context that a region-specific economic analysis of the grape cultivation in the Theni district, Tamil Nadu, is required. Grapes are a significant crop in the agricultural economy of the district, but little farm-level data exists on the cost of production, yields, socio-economic factors, and supply-chain limitations. Such a study can assist in determining the key variables that affect output and profitability and offer location-specific information to enhance the livelihoods of farmers.

Objectives of the Study

1. To estimate the cost and returns of grape cultivation in Tamil Nadu
2. To analyse the socio-economic factors influencing grape output and net returns
3. To identify the major marketing and supply-chain related constraints faced by grape growers
4. To suggest suitable policy recommendations for improving the economic performance of grape cultivation

2. Review of Literature

Previous studies on the economics of grape cultivation reveal that grape cultivation is a capital-intensive activity with significant income opportunity when growing and marketing conditions are ideal. Shah (2007) noted that grape cultivation in India is costly due to high production costs, but is economically viable because of the high returns relative to many other crops. Likewise, Narayanamoorthy (1997) highlighted the economic significance of efficient irrigation in Maharashtra and demonstrated that better water management has a positive impact on the profitability of horticultural crops like grapes. In Tamil Nadu, Keerthana et al. (2021) observed that grape cultivation in Theni district resulted in satisfactory gross and net returns, but the profitability varied with the intensity of input use and management practices. These findings suggest that the profitability of grape production is influenced not only by the yield and price obtained, but also by the efficiency of production, resource inputs used, and cost of production.

Several studies have investigated the influence of socio-economic factors on farm performance and adoption by grape growers. Adityan et al. (2021) revealed that the knowledge and adoption status of grape growers in the Theni district were impacted by individual farmer characteristics, including experience, information, and exposure to improved practices. Jebapreetha and Selvin (2015) also highlighted the importance of the adoption of recommended cultivation practices in improving farm outcomes among grape growers. Kumar et al. (2015) demonstrated the role of education, knowledge, and adoption of improved cultivation practices in grape growers' adoption behaviour in Haryana. Priyanka (2024) observed that the socio-economic status of grape growers in Dindigul district was tied to their farming involvement and economic status. These studies show that age, education, landholdings, farming experience, family background, institutional support, and advice-seeking behaviour can impact farm productivity, income, and profitability.

The literature also suggests that marketing and supply chain constraints are significant in grape production, as grapes are a perishable commodity. Babybowna (2018) highlighted some major production constraints faced by grape farmers in Dindigul district, which indirectly impact marketing and income. Vasanthi and Angadi (2020) found that farmers had constraints in adopting market-led extension, which prevented them from adapting to changes in market conditions. Ravi Kumar and Babu (2021) noted that grape value-chain disruptions had an impact on production, marketing, transportation, and farmers' income, and demonstrated the need for improved coordination, logistics, and institutional mechanisms in times of crisis. These studies indicate that farmers may experience issues such as a lack of market information and institutional and production-marketing linkages, which may limit the returns from grape farming.

The studies reviewed in this paper give some insights into the economics of grape cultivation, technology adoption, socio-economic factors, and some production or marketing-related constraints. However, the studies have mostly looked at these issues in isolation, with a focus on either grape profitability, technology adoption, advisory services, or marketing constraints. There is little evidence on integrated analysis of cost and return, socio-economic factors affecting output and net returns, and supply-chain related constraints in Theni district, Tamil Nadu, more particularly the Theni district, which is one of the important grape-growing areas in Tamil Nadu due to its favourable agro-climatic conditions, well-drained soils, and availability of irrigation facilities. Hence, this current study seeks to address this gap by offering a regional and comprehensive picture of grape cultivation economics and other marketing constraints in the study region.

3. Materials and Methods

3.1 Study Area

The study was carried out in Theni district, Tamil Nadu, an important agricultural zone in which grape cultivation is an important part of commercial horticulture. The study blocks were Cumbum, Uthamapalayam, and Chinnamanur. These were chosen due to their climatic suitability for grape cultivation, specialisation in grape production, and the growing importance of grape cultivation as an income source. It is an ideal location to study farmer-level production economics and marketing problems. The region's climatic suitability, specialisation, and market access are relevant to a study of profitability and bottlenecks in grape cultivation. Further, the region captures the link between production choices, farm size, and market factors, which is the focus of the current study. Therefore, the region was thought suitable to assess socio-economic profiles, cost structure and returns, farm-level profitability, and key production and marketing constraints affecting grape growers.

3.2 Nature and Source of Data

The research was conducted using mainly primary data obtained from grape growers through an interview schedule. The schedule was prepared to gather information about demographic characteristics, socio-economic status, landholding

pattern, farming experience, family details, income, grape production, price, cost of production, gross returns, and net returns. Apart from economic data, information on production and marketing constraints was gathered using a ranking method. The secondary data were used as and when required to complement the interpretation of findings and place them in a regional context. The primary data set was used for empirical analysis, while the secondary data set was used for comparative purposes. Observations were coded and organised for analysis.

3.3 Sampling Design

The blocks Cumbum, Uthamapalayam, and Chinnamanur were selected purposively, as they are among the important grape-growing blocks in the district with a higher area under grape cultivation. A purposive sampling method was adopted for the selection of respondents (Palinkas et al., 2015). Grape growers were selected from these blocks for primary data collection. For analysis, 60 final samples were taken. The sample size was also considered adequate for descriptive analysis, size-wise comparison, and regression analysis of the determinants of grape production and profitability. The sample was drawn to represent the diversity of farm size, years of experience, and income for grape growers. This variation was significant for assessing differences among grape growers in production economics and constraints.

3.4 Variables Considered

The study employed three levels of variables, namely socio-economic variables, economic variables, and constraints. The socio-economic variables used were age, education, size of land, years of farming experience, family size, and annual income. These were used to characterise grape growers and their association with production and profitability. The economic variables were the production of grapes, price/kg, total cost, gross returns, and net returns. These were then converted into other variables such as cost per kilogram, net return per kg, and the benefit-cost ratio. The constraint variables were: Late payment, low price fixation, high transport cost, high commission, no storage facility, price fluctuation, and pest and disease attack.

3.5 Analytical Tools

Both descriptive and inferential methods were used in the study. Frequency, percentage, mean, standard deviation, minimum, and maximum were used to describe the socio-economic profile of grape growers. A cost and return analysis was conducted to determine the total cost, gross return, and net return to grape cultivation. Measures of profitability (cost per kilogram, net return per kilogram, and Benefit-Cost Ratio (BCR)) were estimated to determine the economic feasibility of the business. To compare across farm sizes, the grape growers were classified by farm size (ha), and the average production, cost, and profitability measures were compared. Multiple linear regression was used to measure the influence of the socio-economic factors on grape production and net returns. Collinearity diagnostics, Durbin-Watson statistics, residual plots, and normal probability plots were used to measure model reliability. The variable annual income was not considered in the final regression model because it was highly correlated with total landholding.

3.6 Software Used

The data were coded, edited, and analysed by using Microsoft Excel and IBM SPSS Statistics. Data cleaning and coding were done using Excel. SPSS was used to generate descriptive statistics, frequency distributions, profitability indicators, farm-size comparisons, and multiple linear regression (IBM Corp, 2017). The linear regression procedure in SPSS was used to perform regression analysis and diagnostic checks, such as collinearity statistics, Durbin-Watson values, residual plots, and normal probability plots, to assess the reliability of the models. Overall, Excel and SPSS provided a consistent and reliable approach for conducting the empirical analysis.

4. Results and Discussion

4.1 Socio-Economic Profile of Grape Growers

The socio-economic profile of the grape growers indicated that middle-aged and experienced farmers dominated the sample. The age of the sample ranged from 22 to 70 years, with a mean age of 47.55 years, showing that grape growing was mostly engaged in by middle-aged and economically active farmers. Average total landholding was 2.47 hectares with a range of 0.65-8.39 hectares, which indicates the presence of small, medium, and large farms. The average farming experience was 19.83 years, revealing considerable expertise in grape growing. The average size of the family was 2.63 people, and the average annual income was ₹7,80,000, with a wide range and high variability in income among farmers. Literacy was concentrated in the middle-coded categories, with the mode at category 2. In sum, grape cultivation in the region is carried out by relatively experienced farmers with medium land holdings and varied income, as presented in Table 1.

Table 1. Socio-Economic Profile of Grape Growers

Variable / Category	N / Frequency	Percent	Mean	Std. Deviation	Minimum	Maximum
Age (years)	60	—	47.55	10.598	22	70
Total landholding (hectares)	60	—	2.473	1.7272	0.645	8.387
Farming experience (years)	60	—	19.83	11.624	2	45
Family size (members)	60	—	2.63	0.712	1	4

Annual income (Rs.)	60	—	780,000.00	546,731.428	200,000	2,600,000
Education level						
Illiterate	6	10.0	—	—	—	—
Primary	4	6.7	—	—	—	—
Middle school	21	35.0	—	—	—	—
High school	14	23.3	—	—	—	—
Higher secondary	14	23.3	—	—	—	—
College level	1	1.7	—	—	—	—
Total	60	100.0	—	—	—	—

4.2 Cost and Returns of Grape Cultivation

The cost and return analysis aimed to evaluate the feasibility of grape cultivation by measuring the total costs, gross returns, net returns, cost per kilogram, net return per kilogram, and the benefit-cost ratio. In this type of study, this set of indicators together shows whether grape cultivation offers an acceptable return on the cost of culturing grapes and whether growers can make profits under current market conditions. When net returns are positive and the benefit-cost ratio is greater than 1, grape production can be considered profitable. Likewise, the lower cost/kg and higher net return/kg indicate that the production and marketing of grapes is efficient. The overall cost, returns, and profitability of the cultivation of grapes per acre in the sample area are presented in Table 2. It shows that grape cultivation brought a good return over the cost of cultivation. The profitability indicators also show the profitability of grape production. For every rupee invested in grape cultivation, the return is over and above 6 rupees; the Benefit-Cost Ratio (BCR) is 6.35. The low standard deviation for cost per kg, net return per kg, and BCR shows that the level of profitability of all farmers in the sample was high.

Table 2. Cost, returns, and profitability indicators of grape cultivation

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Grape production (kg)	60	29,677.42	20,725.65	7,741.94	100,645.16
Price received (Rs./kg)	60	60.00	0.00	60.00	60.00
Total cost (Rs.)	60	284,884.25	205,152.40	69,751.61	993,451.61
Gross returns (Rs.)	60	1,780,645.16	1,243,538.97	464,516.13	6,038,709.68
Net returns (Rs.)	60	1,495,730.81	1,038,814.86	388,096.77	5,045,258.06
Cost per kg (Rs.)	60	9.49	0.54	6.24	9.87
Net return per kg (Rs.)	60	50.51	0.54	50.12	53.76
Benefit-Cost Ratio	60	6.35	0.49	6.08	9.62

4.3 Farm-Size-Wise Economic Analysis

Economic analysis of farm sizes assists in determining whether the profitability of grape cultivation depends on the size of the farm. The farmers in this study were classified by the average size of farmers' group and compared against measures of grape production, total cost, gross returns, net returns, cost per kilogram, net return per kilogram, and benefit-cost ratio (BCR). This kind of analysis is valuable since larger farms might enjoy economies of scale, improved market access, and more effective utilisation of resources, whereas small farms might experience increased unit costs and exposure to economic risks.

Table 3 results indicate that grape production, total cost, gross returns, and net returns increased with farm size. Small farms, with an average size of farmers' group of 0.38 hectares, recorded an average grape production of 7,171.78 kg, total cost of Rs. 66,460.09, gross returns of Rs. 4,30,306.53, and net returns of Rs. 3,63,848.18. The cost per kg was Rs. 3.76, the net return per kg was Rs. 20.53, and the BCR was 2.64.

Medium farms, with an average size of farmers' group of 0.89 hectares, recorded grape production of 16,518.22 kg, total cost of Rs. 1,58,581.68, gross returns of Rs. 9,91,093.12, and net returns of Rs. 8,32,452.73. The cost per kg was Rs. 3.88, the net return per kg was Rs. 20.41, and the BCR was 2.53.

Large farms, with an average size of farmers' group of 1.80 hectares, recorded the highest grape production of 33,496.70 kg, total cost of Rs. 3,24,163.97, gross returns of Rs. 20,09,801.83, and net returns of Rs. 16,85,637.87. The cost per kg was Rs. 3.90, the net return per kg was Rs. 20.39, and the BCR was 2.53.

Table 3. Farm-Size-Wise Economic Analysis

Farm-size group	N	Average size of farmers' group (hectares)	Grape production (kg)	Total cost (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	Cost per kg (Rs.)	Net return per kg (Rs.)	BCR
Small	21	0.38	7,171.78	66,460.09	430,306.53	363,848.18	3.76	20.53	2.64
Medium	20	0.89	16,518.22	158,581.68	991,093.12	832,452.73	3.88	20.41	2.53
Large	19	1.80	33,496.70	324,163.97	2,009,801.83	1,685,637.87	3.90	20.39	2.53

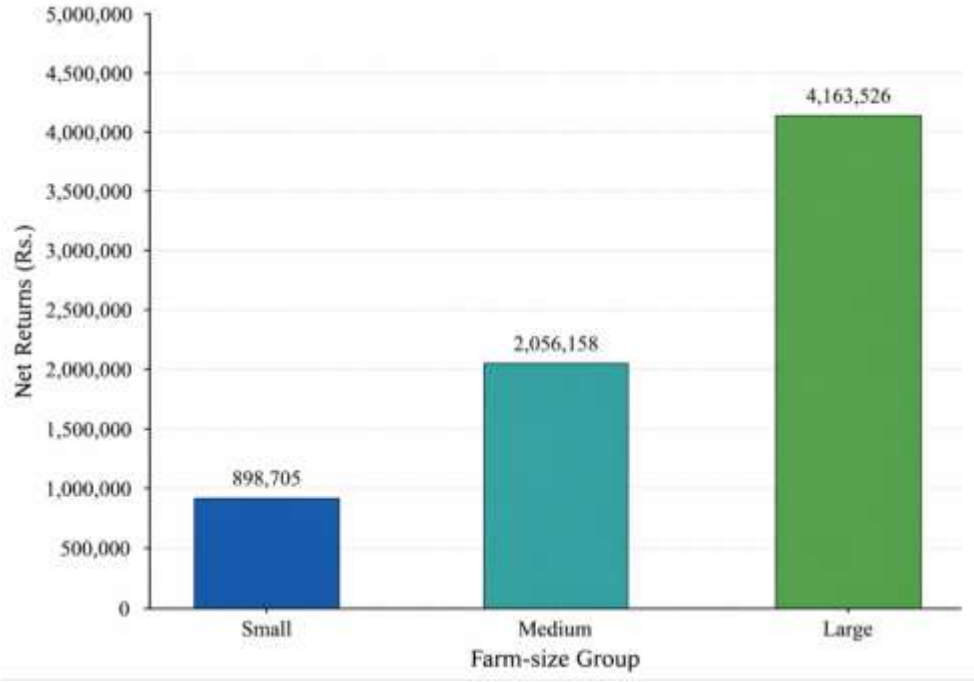

Figure 1. Farm-size-wise comparison of net returns from grape cultivation

The differences in net returns across farm sizes of grape growers are shown in Figure 1. It can be seen that net returns were positively correlated with farm size, with large farms earning the highest net returns, followed by medium and small farms.

4.4 Factors Influencing Grape Output and Net Returns

The socio-economic factors influencing grape output and net returns were determined by multiple linear regression analysis. The education level, total landholding, farming experience, and family size were employed as independent variables in the final model. Annual income was not included on the final model because it was found to be multicollinear with total landholding in the preliminary analysis. Results indicated that the grape production model was statistically significant (F-value = 6.736; $p < 0.001$). The adjusted R^2 value was 0.280, which means that the combination of the selected variables accounted for 28.0 per cent of the variation in grape production. The educational level, total land holding, and farming experience positively and significantly affected grape yield. This means that better-educated farmers, larger and more experienced farmers, were able to produce more grapes.

In a similar way, the net returns model proved statistically significant as well, with $F = 5.480$ and $p < 0.001$. The adjusted R^2 value was 0.233, indicating that the selected variables accounted for 23.3 per cent of the variation in net returns. Net returns were significantly and positively affected by education level, total land holding, and farming experience. This indicates that increased profitability from grape cultivation was associated with increases in education, land, and farming experience. The size of the family was found to be insignificant in both of the models. The VIF values were within the acceptable limit, confirming that the final models did not suffer from multicollinearity, as shown in Table 4(a) and Table 4(b).

Table 4 (a): Factors Influencing Grape Output and Net Returns

Dependent variable	Significant factor	B	Std. Error	Beta	t-value	p-value	VIF
Grape production	Education level	1,751.962	768.879	0.275	2.279	0.027	1.193
Grape production	Total landholding	1,167.287	331.801	0.391	3.518	<0.001	1.010
Grape production	Farming experience	248.386	83.945	0.361	2.959	0.005	1.219
Net returns	Education level	99,974.686	39,597.056	0.314	2.525	0.014	1.193
Net returns	Total landholding	58,933.524	17,087.648	0.395	3.449	0.001	1.010
Net returns	Farming experience	8,924.142	4,323.139	0.260	2.064	0.044	1.219

Table 4 (b): Model statistics

Dependent variable	R	R^2	Adjusted R^2	F-value	p-value	Durbin-Watson
Grape production	0.573	0.329	0.280	6.736	<0.001	2.300
Net returns	0.534	0.285	0.233	5.480	<0.001	2.209

Note: Annual income was excluded from the final model due to multicollinearity with total landholding. Significance level: $p < 0.05$.

4.5 Marketing and Supply-Chain Related Constraints

A constraint analysis was conducted to determine the rank of major production and marketing constraints of grape growers by applying the Weighted Rank Score. The major constraints identified were delayed payment, low price fixation, high transportation cost, high commission, lack of storage, price fluctuation, and pests and diseases. Generally, the higher the weighted score, the higher the perceived severity of the constraint. Table 5 presents the level of the marketing and supply-chain constraints perceived by the grape growers using the weighted rank score method. The findings suggest that pests and diseases were the most severe constraint with the highest weighted score of 402 and weighted mean of 6.70, followed by delayed payment (332) and lack of storage (266). Price variability and low-price fixation were also significant issues related to growers' revenues and market uncertainty. On the other hand, high transportation and high commission were less severe problems, given their relatively low scores. Overall, the table suggests that grape growers suffered from a range of production and marketing problems that decreased their profitability and introduced uncertainty in grape cultivation and marketing.

Table 5. Marketing and Supply-Chain Related Constraints

Constraint	Weighted Score	Weighted Mean	Final Rank
Pest and Diseases	402	6.70	1
Delayed Payment	332	5.53	2
Lack of Storage	266	4.43	3
Price Fluctuation	254	4.23	4
Low Price Fixation	180	3.00	5
High Transportation Cost	131	2.18	6
High Commission	116	1.93	7

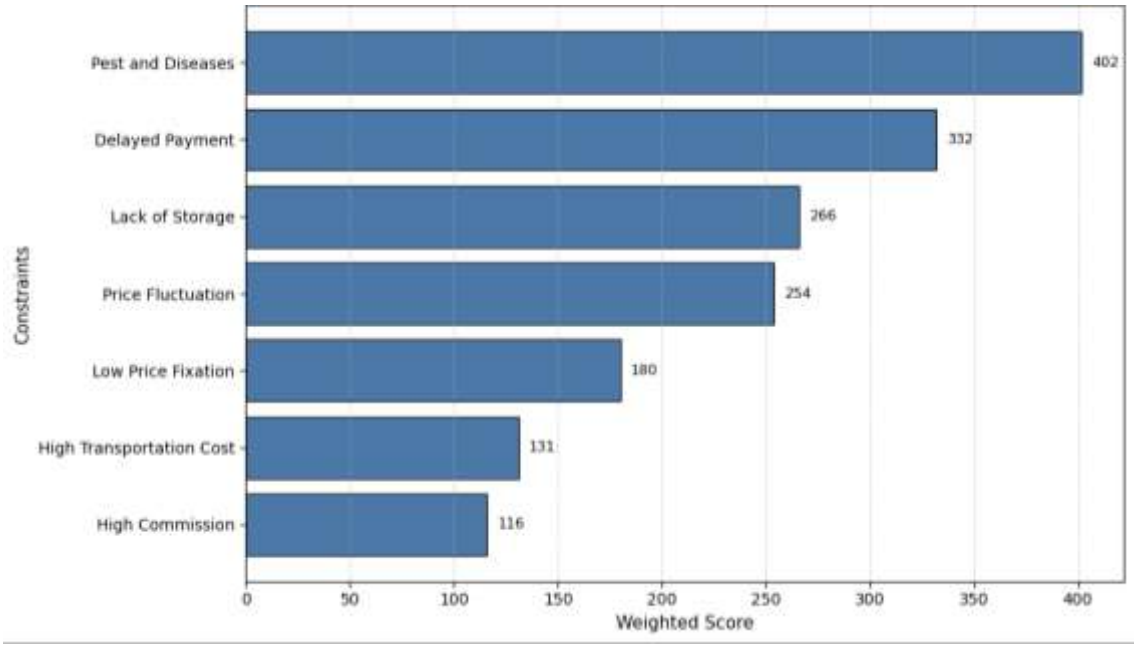

Figure 2. Severity ranking of major constraints faced by grape growers

Figure 2 shows the ranking of major constraints faced by grape growers, according to weighted scores. It can be seen that pests and diseases were the most severe, followed by delayed payment and lack of storage, while high transportation cost and high commission were relatively lower.

5. Discussion of Findings

The grape growers were generally middle-aged, experienced, and well-educated farmers with medium-sized landholdings and diverse incomes. In the regression analysis, the education level, total land holding, and farming experience were found to have a significant effect on grape production and the net returns. The positive impact of total landholding was that the production capacity and farm returns were higher with higher land areas under cultivation. Education level was also important, as it could be assumed that farmers with higher education are more likely to adopt better cultivation methods, efficiently manage inputs, and make better decisions on their farms. Farming experience had a positive impact on grape output and net returns, which suggests that the more experience farmers get in practicing farming, the better they become in terms of productivity and profitability. Government intervention needs to build farmers' managerial and technical capacity and address resource access inequalities. Extension services may be particularly useful to help farmers with small landholdings and low incomes in adopting productive and efficient practices of production and marketing, which in turn enhance farm productivity and long-term economic sustainability. The current study is consistent with previous reports on grape economics and constraints in India. The profitability of grape farming in this study is in line with the economic analysis reported for Theni district in Tamil Nadu, which also highlighted the income prospects of grape farming (Keerthana et al., 2021). The prominence of production and marketing problems in the current study is

similar to the constraints reported for grape growers and export farmers in Maharashtra (Babar and Satpute, 2025; Pradhan et al., 2024). The importance of production and market constraints is also in line with results for dry grape growers of Karnataka (Yarazari et al., 2022). Vasanthi and Angadi (2024) also reported that farmers in Northern Karnataka had gaps in knowledge related to market-led extension practices, which affected their market orientation and decision-making. While Weather conditions also play an important role in determining grape growth, productivity, and disease occurrence (Maheswari et al., 2025). However, some limitations must be considered for better interpretation of the results. A limited sample of grape farmers from the Theni district of Tamil Nadu was considered in this study, and thus, the results may not apply to a wider population. Further, some of the variables related to constraints were based on farmers' perceptions and rankings, which may be subjective. The cross-sectional design of the study did not allow variations in production, prices, costs, and returns across seasons and years to be examined. More research could therefore include a larger sample of grape growers from different regions for comparison. Longitudinal research may also be useful to explore variations in profitability and constraints. Future work may also investigate value-chain efficiency, storage, exports, and institutional support to understand the sustainability of grape production.

6. Policy Recommendations

Timely technical advice should be given to grape growers on pest and disease management, as this is a major constraint on production. Awareness of better cultivation practices, judicious use of inputs, canopy management, irrigation scheduling, and scientific plant protection should be enhanced through demonstrations and timely advice. Promoting integrated pest and disease management can help reduce crop losses and improve productivity. Education on better cultivation practices, integrated use of inputs, pruning, irrigation scheduling, and scientific plant protection should be promoted through field demonstrations and periodic advisory services. Emphasis should be placed on integrated pest and disease management to decrease crop losses and increase productivity. Integrated pest and disease management can help minimise losses and increase production. Attention should be given to minimising the cost of production by promoting resource-efficient use of labour, fertilisers, pesticides, and water. Subsidies on institutional credit and agricultural inputs can also help farmers reduce costs. Increasing farm-level efficiency and resource-use efficiency can increase net returns and help maintain grape production profitability. There should be mechanisms to ensure timely payment to farmers. Improved post-harvest and storage facilities are needed to avoid distress sales and better time their sales. Efforts should also be made to minimise high transport and commission costs and to facilitate direct access to markets, thus improving the bargaining power of farmers.

7. Conclusion

The study analysed the socio-economic status, cost and returns, farm size-wise efficiency, factors affecting production and profitability, and constraints faced by grape growers in **Theni** district, Tamil Nadu. Results revealed that grape farming was generally practised by middle-aged and skilled farmers with medium farm size and with varying income status. The economic performance of grape cultivation was found to be profitable with positive gross returns, net returns, and benefit-cost ratio, suggesting that grape cultivation was a lucrative horticultural crop in the Theni district. Farm size analysis revealed that larger farms recorded higher absolute returns and smaller farms had slightly higher efficiency in terms of per-unit return. Results of the regression indicated that education level, total landholding, and farming experience had a significant effect on grape output and net returns. These results suggest that the size of farms, educational level, and practical farming experience have an impact on grape crop performance in the study area. Constraints analysis also identified pests and diseases, timely payment, and storage as key production and market constraints. In all, the study confirms the economic feasibility of grape cultivation in the Theni district of Tamil Nadu, but its sustainability requires overcoming production and market constraints. Improved technical support, resource allocation, on-time payment, storage, and institutional support are vital to improve farmer welfare. Hence, farm and market management are key to enhancing the long-term profitability and sustainability of grape growers.

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