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Research Article

An Analysis Of Production, Productivity And Profitability Performances Of Select Co-Operative Sugar Mills In Tamil Nadu

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ABSTRACT

Indian sugar Industry supports 5 crore farmers and their families and plays a vital role in the development of India. It has been instrumental in providing income, employment generation and creating social infrastructure in rural areas. Hence, successful performance of sugar mills is most essential for its growth and survival for bring out social economic changes in rural India. Sugar mill's overall successful performance depends on its production, productivity and Profitability. This article focuses on production, productivity and Profitability of three select co-operative sugar mills in Tamil Nadu. The regression analysis shows that sugar production depends on cane crushed and recovery percentage. It also shows that the total Cost Productivity depends on material cost productivity, Conversion Cost Productivity and Overhead Cost Productivity. Financial performance shows that there is significant association between ROA and Asset Efficiency. It also shows that there is significant difference in Overhead Cost productivity. It is inferred from the study that sugar production, productivity and profitability can be significantly tuned with the associated variables so as to achieve the goal of enhancing profitability.

Key words: Productivity – ROA-Return on Assets -Asset Efficiency

INTRODUCTION

Agricultural sector in India plays a significant role by contributing around 15-16 per cent of Indian GDP. This sector has to be transformed to achieve sustainable development goals in the area ofindustry, innovation and infrastructure. Its harmony with all other sectors would bring national development at a greater speed. Sugar industry in India being an agro based industry, it provides directand indirect employment to people living in rural areas and promotes other allied industrial activities like poultry, fisheries, banking, insurance, etc.,. Besides this, sugar industry has been facing various challenges and constraints due to mismatch of cost of production and selling price of sugar. Solving the problems of sugar mills would improve the share of sugar production of Tamil Nadu and also for the development of the agricultural economy. Hence, it is worth to study the production, productivity and profitability operations of sugar mills to bring out a valuable solution for the problems and also to improve the sugar mill's performances.

STATEMENT OF THE PROBLEM

India is the largest producer of sugar cane and sugar. Sugar mills in Tamil Nadu contribute about 9 percent of the total sugar production of India. The Sugar production fluctuates with variationsof monsoons. Cost of sugar cane is the most influencing factor in the sugar production. Sugar mills in India are facing major problems such as high production cost of sugar due to underutilization of capacity, high cost of sugar cane due to competition from gur and khandsari production, low recovery rate of sugar cane , short crushing season, low milling efficiency, old machineries, high interest costs and no control over the quantity and quality of sugar cane, Statutory Minimum Price (SMP) fixed by Government for sugar cane and levy sugar allotment due to the Government for Public Distribution System(PDS) and low economic size of sugar crushing per day in India (2500 tonnes crushing per day) when compared with other countries (Thailand 10,000 tonnes per day).[1]

[1] Venkateswara Rao,"problems of sugar Industry " Volume 3,issue 1 ,jan 2014
Therefore, it is the immense need to measure the production, productivity and profitability performances of select co-operative sugar mills in Tamil Nadu to bring out a remedy for these problems to a great extent. In this paper as a test check, three sample sugar mills Cheyyar ,**S.Siva** and **Kallakurichi-II** have been selected for analyzing the performances.

OBJECTIVES OF THE STUDY

Based on the issues stated above, the following objectives are framed:

1. To analyze the relationship between sugar production and cane crushed and recovery rate.
2. To analyze the relationship between Total productivity and Material Cost Productivity, Conversion Cost Productivity and Overhead Cost Productivity.
3. To analyze the significant differences of Total productivity between the select sugar mills.
4. To analyze the association between ROA and Interest Coverage, Asset Efficiency, Asset leverage and Asset Turn Over Ratios.
5. To offer suggestions for the improvement of performances.

RESEARCH METHODOLOGY

The methodology proposed in the study is to analyze the impact of sugar production on the inputs such as cane crushed, capacity of operation, recovery rate, productivities and profitability to build a regression model for the production, productivity and profitability sides. The association between the production and Cane crushed and recovery rate for production phase ;Total Productivity and Material, Conversion and Overhead productivities for productivity phase and ROA and interest coverage ratio, Asset leverage ratio, Asset Efficiency and Asset Turn Over ratios for the profitability Phase are analyzed using the regression model. The study also examined the significant differences in the productivities of the select sugar mills. The findings from the study are collected to render few suggestions for the effective improvement of production, productivity and profitability of the select sugar mills.

Period of Data

Data related to the study of select co-operative sugar mills in Tamil Nadu have been taken from Annual reports for the 15 years from 2006-2007 to 2020-2021.

Frame work of Analysis

After the collection of secondary data of select sugar mills **Cheyyar**, **S.Siva** and **Kallakurichi-II** various statistical tools such as Descriptive analysis, Regression and **Kruskal-Wallis H Test** are employed in the study.

Selection of co-operative sugar mills

Three co-operative sugar mills having complete data of 15 years have been taken for analysis.

REVIEW OF LITERATURE

The reports, books and articles have been studied to find out the findings of the earlier research outcome. Most of the papers are on working capital, capital structure, sugar production, productivity and profitability. In this paper, sugar production and the dependent variables causing such production and cost of sugar production and its related variables causing such cost and operating profits its association with sales, working capital, total assets and total expenses are analyzed. The research gap is fulfilled by analyzing both the production, productivity and profitability performance.

Desai (2001) in his article, "Sugar Industry in India" has made a comparative statement of sugar production and price of sugar in India and the whole world. He also suggested the utilization of co-products of sugar.

Sam Luther (2009) has undertaken a study entitled "Liquidity Risk and Profitability Analysis: A case study of Madras Sugars Ltd" and highlighted how the company had achieved adequate liquidity, risk minimization and profit maximization. The objectives of the study are to measure and evaluate
the liquidity position of MCL, to assess the correlation between liquidity and profitability and to assess the trade-off between profitability and risk for a period from 1994-95 to 2004-05.

Reddy and Naidu (2013) in their research paper studied the productivity trends of 12 Indian cement companies for the period from 2000 to 2009. The labour, capital productivity, capital intensity,labour, capital productivity indices and capital intensity indices have been calculated to determine the efficiency of an individual factor input.

Shinde, Dilip P. (2016) made a study on growth and productivity of co-operative sugar factory in Maharashtra and revealed that adequate facilities and other complimentary inputs are the key factors of utilization of production capacity. He explained that there is a need of coordinated and concerted effort for

appreciation and consolidation of the needs of consumers.
Chandrashila Gaikwad, Sheveta Jadhav (2017) have made an attempt to study the challenges faced by sugar mills and farmers in India and revealed that sugar mills and cane growers are plagued with number of production problems. It was suggested to apply new methods and technologies in production process.

PRODUCTION: Sugar production depends on sugar Cane crushed and Recovery Rate.We can associate these variables on the three select sugar mills to find out result**.**

HYPOTHESIS.1 : To find the existence of relationship between sugar production and cane crushed and recovery rate the pattern is fit in the multiple regression by taking the sugar production as dependent variable and cane crushed and recovery rate as independent variable**s.** The following hypothesis is framed and tested and its results are given below:

There is no significant relationship between sugar production and cane crushed and recovery rate

Table No.1 Descriptive Statistics-Production, Cane Crushed and Recovery Rate

	Cheyyar		S.Siva		Kallakurichi-II	
Ratios	Mean	C.V(%)	Mean	C.V(%)	Mean	C.V(%)
Sugar production	26913.97	43.63%	29839.11	53.58%	39306.53	23.82%
Cane Crushed	294620.40	32.28%	284756.87	51.68%	434042.73	22.98%
Recovery rate	8.82	07.80%	10.1347	07.84%	9.08	06.04%

Table No.2 Regression: Sugar production and others :ANOVA

No	sugar mill	R-Square %	StandardError	F value	P value	Null Hypothesis
1.	Cheyyar	80.3	5413.71	52.86	0.00	Rejected
2.	S.Siva	99.8	675.10	7840.03	0.00	Rejected
3.	Kallaku richi-II	99.6	655.37	1422.62	0.00	Rejected

Table No.3 Regression Equation

sugar mill	Sugar Production=	Excluded Variable
Cheyyar	-5670.067+0.111*Cane Crushed	Recovery rate
S.Siva	-1072.308+0.109*cane Crushed	Recovery Rate
Kallakurichi-II	-36842+0.087*Cane Crushed+4247.519*Recovery Rate	---

Source: Computed

Inference:
As the P value of ANOVA is "zero" ,the regression model is valid in all the cases .The model shows that thereis a positive relationship between sugar production and cane crushed. The step regression method hasremoved other insignificant variables affecting the sugar production. It shows that in case of cheyyar , if cane crushed increases by 1 unit, sugar production would increase by 0.111 units keeping other things constant. Thehigh impact factor is Cane crushed for Cheyyar and S.Siva. Whereas for Kallakurichi the highest impact factor is Recovery rate . The R-Squared statistic indicates that the model as fitted explains 80.3 percent,99.8 percent and 99.6 respectively of the variability in sugar production in Cheyyar,S.Siva and Kallakurichi-II.
The hypothesis is **rejected as the co-efficients of the predictor variables are not zero . The P values of the regression model is also "zero".** Hence, it shows that there is significant relationship between the sugar production and cane crushed for Cheyyar and **S.Siva mill**. Where as there is significant relationship between sugar production, Cane Crushed and recovery percentage in Kallakurichi**-II.** The lowest co-efficient of variation (C.V) in sugar production, cane crushed and recovery Rate in case of Kallakurichi-II indicates the low variation in data**.**

PRODUCTIVITY:
Productivity means the ability to produce output from the given input. Outputs value in terms of total income and cost of each element of cost such as material, conversion and overhead costs are taken as the inputs. The productivities are arrived based on the general formula. Total Income of Output/Cost of Each element of Input.

1. Total productivity =Total Income of production/(Material Cost Conversion Cost +overhead costs)
2. Material (Cane-Crushing) cost productivity=Total Income of Production/Material Cost of production.
3. Overhead cost productivity=Total Income of Production/Overhead Cost of production
4. Conversion cost productivity=Total Income of Production/Conversion Cost of production.

HYPOTHESIS-2 : It is very interesting to know the significant association between the productivities. Here, the total productivity is taken as dependent variable and other productivities as independent variables. The following hypothesis is framed and tested and its results are given below:

There is no significant association between total productivity and other productivities.
The following descriptive and regressive analysis shows three sugar mills mean, CV and regression equations are narrated.

Table No.4 Descriptive Statistics-Productivities

	Cheyyar		S.Siva		Kallakurichi-II	
Ratios	Mean	C.V(%)	Mean	C.V(%)	Mean	C.V(%)
Total productivity	1.0767	31.35%	1.3360	40.97%	1.4420	41.55%
Material Cost productivity	1.4920	33.37%	2.0787	52.24%	1.8620	48.91%
Conversion Cost productivity	23.5747	43.01%	32.8220	40.99%	25.8360	34.83%
Overhead Cost Productivity	5.0273	31.15%	4.8040	33.90%	9.6680	30.32%

Table No.5 Regression: Sugar production and others: ANOVA

No	sugar mill	R-Square %	StandardError	F value	P value	Null Hypothesis
1.	Cheyyar	99.9	0.01463	2478.304	0.00	Rejected
2.	S.Siva	99.0	0.06031	570.548	0.00	Rejected
3.	Kallaku richi-II	99.6	0.04025	1544.954	0.00	Rejected

Table No.6 Regression Equation

Sugar mill	**Total Cost Productivity =**	**Excluded Variable**
Cheyyar	-0.33+0.504*Material Cost productivity+ 0.004*Conversion Cost productivity+ 0.053*Overhead Cost productivity	-----
S.Siva	-0.012+0.407*Material Cost productivity+ 0.104*Overhead Cost productivity	Conversion Cost productivity
Kallaku richi-II	0.021+0.584*Material Cost productivity+ 0.034*Overhead Cost productivity	Conversion Cost productivity

Source: Computed

Inference:
As the P value of ANOVA is "zero" ,the regression model is valid in all the cases. The model shows that thereis a positive relationship between Total Cost Productivity and Material Cost Productivity, Conversion Cost Productivity and Overhead Cost Productivity. It shows that in case of cheyyar , if Material Cost Productivity increases by 1 unit, Total Cost productivity would increase by 0.504 units keeping other things constant. Similarly, if conversion cost productivity increases by 1-unit, Total Cost Productivity would increase by 0.004 units and in the same way, if Overhead cost productivity increases by 1 unit, Total Cost Productivity would increase by 0.053 units. Thehigh impact factor is Cane crushed for Cheyyar and S.Siva.In the same way Total Cost Productivity and Other Productivities are related. The highest impact factor's are Material Cost productivity of 0.584 of Cheyyar, Overhead Cost Productivity of 0.104 Overhead Cost Productivity of S.Siva .Conversion Cost Productivity has been excluded for S.Siva and kallakurichi . The R-Squared statistic indicates that the model as fitted explains 99.9 percent,99.0 percent and 99.6 respectively of the variability in Total Cost Productivity by the independent variables of Cheyyar,S.Siva and Kallakurichi-II.
The hypothesis is **rejected as the co-efficients of the predictor variables are not zero . The P values of the regression model is also "zero".** Hence, it shows that there is significant relationship between the Total Cost Productivity and Material Cost productivity, Conversion Cost Productivity and Overhead Cost Productivity in Cheyyar. Whereas in Both S.Siva and Kallkurichi Conversion Cost Productivity is excluded. In these cases there is significant relationship between Total Cost Productivity and Material Cost Productivity and Overhead Cost Productivity. There is lowest co-efficient of variation (C.V) in Total Cost Productivity and Material Cost Productivity in Cheyyar and Conversion Cost Productivity and Overhead Cost Productivity in Kallakurichi-II.

HYPOTHESIS-3 :
It is very interesting to know the significant differences in the productivities among the three sugar mills. To find the existence of difference between total productivities of three sugar mills. a non-parametric Kruskal-

Wallis test is employed. The following hypothesis is framed and tested and its results are given below:

There is no significant differences in total productivities of the select three sugar mills
The following table shows the total productivities of three sugar mills

Table-7 Total Productivities of select sugar mills

YEAR	CHEYYAR	S.SIVA	KALLAKURICHI-II
2020-21	**1.20**	**1.36**	**1.55**
2019-20	**0.90**	**2.12**	**1.53**
2018-19	**1.31**	**0.29**	**1.03**
2017-18	**0.85**	**2.26**	**2.81**
2016-17	**0.92**	**1.12**	**1.28**
2015-16	**0.71**	**1.00**	**1.01**
2014-15	**1.61**	**1.98**	**1.72**
2013-14	**0.92**	**1.57**	**1.29**
2012-13	**0.96**	**0.99**	**1.31**
2011-12	**0.86**	**1.14**	**1.15**
2010-11	**0.94**	**1.30**	**0.76**
2009-10	**1.72**	**1.74**	**2.56**
2008-09	**1.56**	**1.44**	**1.78**
2007-08	**0.58**	**0.53**	**0.62**
2006-07	**1.11**	**1.20**	**1.23**
Average	**1.08**	**1.34**	**1.44**
Std.Deviation	**0.34**	**0.55**	**0.60**
C.V	**31.3%**	**40.8%**	**41.6%**

Kruskal-Wallis H Test:
The Kruskal-Wallis H test is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable.

Table No.8 Kruskal-Wallis H Test

Ranks			
	Name of Co-operative Sugar Mill	N	Mean Rank
Total Productivity=Total Income/(Material ,Conversion &Overhead cost)	CHEYYAR	15	16.97
	S.SIVA	15	25.43
	KALLAKURICHI-II	15	26.60
	Total	45	
Material Cost Productivity	CHEYYAR	15	18.27
	S.SIVA	15	27.17
	KALLAKURICHI-II	15	23.57
	Total	45	

Table No.8 Kruskal-Wallis H Test ....

Conversion Cost Productivity	CHEYYAR	15	18.20
	S.SIVA	15	28.80
	KALLAKURICHI-II	15	22.00
	Total	45	
Overhead Cost Productivity	CHEYYAR	15	17.13
	S.SIVA	15	16.20
	KALLAKURICHI-II	15	35.67
	Total	45	

Table No.9 Test Statistics[a,b]				
	Total Productivity=Total Income/(Material ,Conversion &Overhead cost)	Material Cost Productivity	Conversion Cost Productivity	Overhead Cost Productivity
Chi-Square	4.808	3.486	5.016	20.965
Df	2	2	2	2

Asymp. Sig.	.090	.175	.081	.000
a. Kruskal Wallis Test				
b. Grouping Variable: Name of Co-operative Sugar Mill				

Interpretation:
The mean rank of the total productivity for each sugar mill can be used to compare the effect of the different productivities among the three select sugar mills. Kruskal-Wallis H test is employed to find the significant differences among the sugar mills. Since the P value of Overhead productivity is less than 0.05, there a statistically significant difference in Overhead productivity scores of the three select sugar mills. However, the P values of Total Productivity, material cost productivity and conversion cost productivity are greater than 0.05,hence it is concluded that there is no significant difference of these productivities among the three select sugar mills.

FINANCIAL PERFORMANCE

The financial performances are measured by using a few ratios given below.
Health Ratio= Revenue/Total Liabilities, Return On Assets= EBIT/TA, Working Capital Policy Index= Asset Efficiency Ratio=EBIT/T.A.

Table No.10: ROA of Select three sugar mills

Year	Cheyyar	S.Siva	Kallakurichi-II
2020-21	**0.62%**	**1.35%**	**0.83%**
2019-20	**1.18%**	**2.19%**	**8.69%**
2018-19	**2.86%**	**1.52%**	**1.36%**
2017-18	**8.33%**	**1.88%**	**11.33%**
2016-17	**1.97%**	**4.08%**	**11.38%**
2015-16	**-18.73%**	**-1.91%**	**-10.74%**
2014-15	**-6.39%**	**3.16%**	**2.62%**
2013-14	**-5.28%**	**3.98%**	**7.82%**
2012-13	**-5.52%**	**3.11%**	**10.15%**
2011-12	**-2.37%**	**6.46%**	**9.24%**
2010-11	**2.01%**	**9.02%**	**7.71%**
2009-10	**3.28%**	**7.35%**	**18.23%**
2008-09	**11.60%**	**10.57%**	**16.21%**
2007-08	**-5.98%**	**-4.69%**	**-4.15%**
2006-07	**-2.84%**	**5.18%**	**6.65%**
Average	**-1.02%**	**3.55%**	**6.49%**
Std.Deviation	**7.15%**	**3.94%**	**7.52%**
C.V	**-703.00%**	**110.88%**	**115.94%**

Source: Computed

HYPOTHESIS-4 :

It is very interesting to know the existence of significant relationship between Profitability and Interest Coverage, Asset Efficiency ,Asset Leverage and Asset Turn Over Ratios. Multiple regression analysis is employed to find the association between them. The following hypothesis is framed and tested and its results are given below:

There is no significant association between ROA and Interest Coverage, Asset Efficiency, Asset Leverage and Asset Turn Over Ratios.
The result of the analysis is given below:

Table No.11 Descriptive Statistics

	Cheyyar		S.Siva		Kallakurichi-II	
Ratios	Mean	C.V(%)	Mean	C.V(%)	Mean	C.V(%)
Return On Assets Ratio	-0.0100	-721%	0.0347	115%	0.0647	116%
Interest Coverage Ratio	-1.5377	-440%	2.6207	124%	5.5766	137%
Asset Efficiency Ratio	-0.0101	-706%	3.3067	16%	2.3953	21%
Asset Leverage Ratio	2.0907	13%	0.0356	111%	0.0648	116%
Assets Turn Over ratio	0.6540	40%	0.4847	48%	0.8187	32%

Table No.12 Regression: Profitability and other ratios :ANOVA

No	sugar mill	R-Square %	StandardError	F value	P value	Null Hypothesis
1.	Cheyyar	99.8	0.003157	7291.49	0.00	Rejected
2.	S.Siva	99.6	0.002759	2925.19	0.00	Rejected
3.	Kallaku Richi-II	99.8	0.003091	8169.15	0.00	Rejected

Table No.13 Regression Equation

sugar mill	ROA =
Cheyyar	0.00021+ 1.0076* Asset Efficiency Ratio
S.Siva	-0.00141+ 1.0135* Asset Efficiency Ratio
Kallaku Richi-II	0.00029 + 0.9933 * Asset Efficiency Ratio

Excluded variables in the Three mills are: Interest Coverage, Asset leverage & Asset Turn Over Ratios

Interpretation:

The average ratio of all ratios except Asset leverage and Asset Tur over are negative in Cheyyar.All Ratios except asset efficiency is higher in Kallakurichi-II .Asset efficiency is greatest in S.Siva .Co-efficient of variation (CV) is lower Cheyyar indicating lower fluctuations of ratios.

As the P value in the ANOVA is less than 0.05,the null hypothesis is rejected. That is there is significant association between ROA and Asset Efficiency invariably in all the three sugar mills.

The co-efficient of Asset Efficiency and also net result of the value of equation is greaterest,ROA is greatly influenced by Asset Efficiency.

Summary of Statistical Analysis:

A.Regression

No.	Independent Variables	Most Influencing Dependent Variable	Sugar Mills
1.	Production	Cane Crushed	Cheyyar& S.Siva
		Cane Crushed & Recovery rate	Kallakurichi-II
2.	Total productivity	Material Cost and Overhead Productivity	S.Siva& Kallakurichi-II
		Material Cost, Conversion and Overhead Productivity	Cheyyar
3.	ROA	Asset Efficiency Ratio	Cheyyar,S.Siva& Kallakurichi-II

B.Kruskal-Wallis H Test:

No.	Variables	Significant differences
1.	Total productivity	No Significant differences among the mills
2.	Material Cost Productivity	No Significant differences among the mills
3.	Conversion Cost Productivity	No Significant differences among the mills
4.	Overhead Cost Productivity	Significant differences among the mills

It is interested to find that production, productivity and financial performances are influenced by indicated variables and shows that there is significant association between them. Kruskal-Wallis H test shows that the Overhead Cost Productivity is significantly differ among mills

FINDINGS : The findings of the study are given below**:**

1. Multiple Regression shows that there is significant association between sugar production and cane crushed in Cheyyar &S.Siva but in kallakurichi II there is significant association between sugar production, cane crushed and recovery percentage.
2. Multiple regression shows that there is significant association between total cost productivity and Material Cost and Overhead Productivity in S.Siva& Kallakurichi-II but in Cheyyar there is significant association Material Cost, Conversion and Overhead Productivity.
3. Kruskal-Wallis H Test shows that there are significant differences only in the Overhead productivity among the three sugar mills.
4. Multiple regression shows that there is significant association between ROA and Asset Efficiency ratio in all the three sugar mills.

SUGGESTIONS:

The following suggestions may be considered:

1. As the output sugar production depends on sugar cane crushed and recovery rate, more use of hybrid high yielding sugarcane can be used to enhance the production.
2. As there is significant association between total cost productivity and Material Cost, Overhead Productivity and Conversion Cost productivity saving in each element of cost would reduce the total cost and which would result into higher total productivity.
3. The analysis shows that Return on Assets-the profitability can be improved only by improving the asset efficiency. Hence steps are to taken for improving asset efficiency by employing Total Cost Management (TCM) techniques.

CONCLUSION

From the study, it is found that the Dash Board of Production, productivity and profitability indicates that the Profitability can be improved in three Phases, one by increasing sugar production, second by improving Total Cost Productivity and third by Improving efficiency to get incredible ROA. Production can be enhanced by using hybrid high yielding sugar canes having reasonably good recovery rate. Total Cost productivity can be improved by continuous evaluation of cost reduction process without spoiling the quality. Better TCM techniques would give the possibilities of improving the costs so as to be brought down to the optimal levels. ROA -Improvement depends on the Asset Efficiency. Applying the result of the study, sugar mills may enhance the production and productivity and profitability performances as a route for sustainable growth and profitability.

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