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Socio-Economic Impact of Agro-Based Industry on Rural Households - A Case Study

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Abstract

The sugar industry is one of India's most significant agro-based sectors, contributing substantially to rural livelihoods and regional development. This study examines the socio-economic impact of Jarandeshwar Sugar Mills Pvt. Ltd., Chimangaon, on rural households within a 10 km radius in Satara district, Maharashtra. Primary data were collected from 120 households using structured questionnaires, focus group discussions, and key informant interviews. Secondary data were obtained from Census of India (2011) and district statistical records. Descriptive statistics and parametric tests—including paired t-test, one-way ANOVA, Pearson correlation, and regression analysis—were employed to evaluate changes in income, expenditure, housing, and occupational structure. The study concludes that agro-based industries act as catalysts for rural socio-economic transformation through income enhancement, livelihood diversification, and improved living standards.

Keywords: Sugar Industry, Socio-Economic Impact, Rural Livelihoods, Parametric Tests, Maharashtra

Introduction

The sugar industry is one of India's largest agro-based sectors, generating employment, promoting agricultural productivity, and supporting allied industries. Maharashtra is among the top sugarcane-producing states, where sugar mills influence rural livelihoods not only through direct employment but also through wage labor, contract farming, and ancillary businesses. Despite its economic importance, there is limited empirical evidence quantifying the socio-economic benefits of sugar mills on rural households. This study aims to bridge this gap by analyzing how Jarandeshwar Sugar Mills Pvt. Ltd. affects income, expenditure, housing, and occupational diversification of households within its operational zone.

Objectives

The objectives of the study are:

1. To analyze changes in household income and occupational structure.
2. To examine expenditure patterns and housing improvements.
3. To assess the relationship between landholding and income.
4. To evaluate the statistical significance of socio-economic changes using parametric tests.

Study Region

The study area comprises the rural hinterland surrounding Jarandeshwar Sugar Mills Pvt. Ltd., located at Chimangaon in Koregaon Tehsil of Satara district, Maharashtra. Geographically, the factory is situated at approximately 17°42'23" North latitude and 74°13'53" East longitude, at an elevation of about 750 meters above mean sea level. Chimangaon lies in the western part of Maharashtra within the Deccan Plateau region and forms part of the agriculturally productive belt of Satara district. The present study covers villages located within a 10 km radius of the sugar mill, primarily falling under Koregaon and adjoining parts of Khatav tehsil, as these villages constitute the main sugarcane procurement zone of the factory.

Physiographically, the region is characterized by gently undulating plains interspersed with low hill ranges, typical of the semi-arid plateau landscape of western Maharashtra. The soils are predominantly deep black cotton soils (regur), which are fertile and well-suited for commercial crops, particularly sugarcane. The climate of the area is semi-arid tropical, with hot summers, moderate winters, and rainfall mainly concentrated during the southwest monsoon season from June to September. The average annual rainfall ranges between 700 and 900 mm, though variability in monsoon intensity influences agricultural productivity. Irrigation facilities in the area include canal networks, wells, borewells, and lift irrigation schemes, enabling farmers to cultivate water-intensive crops like sugarcane.

Agriculture forms the backbone of the local economy, with sugarcane being the dominant cash crop, followed by wheat, maize, jowar, and pulses. The establishment of Jarandeshwar Sugar Mills in 1998 significantly transformed the agrarian economy of the region by providing a stable market for sugarcane producers.

Over time, the factory expanded its crushing capacity and introduced cogeneration facilities, strengthening backward and forward linkages in the rural economy. The mill generates both direct and indirect employment opportunities, including work in processing units, transportation, harvesting, and allied activities such as dairy farming and small businesses. Consequently, the study area represents an ideal setting to examine the socio-economic impact of agro-based industrialization on rural households, particularly in terms of income growth, occupational diversification, infrastructure development, and changes in living standards.

Research Methodology

1. **Research Design:** A descriptive-analytical research design was adopted, focusing on pre- and post-establishment socio-economic conditions.

2. **Sampling Strategy:** Population: Households residing within 10 km of the factory.

Sample Size: 120 households (stratified across small, medium, large-scale farmers and landless laborers).

Sampling Method: Stratified random sampling to ensure proportional representation of various socio-economic groups.

3. Data Collection:

Primary Data: Structured questionnaire for income, expenditure, landholding, livestock, housing, and employment. Focus Group Discussions (FGDs) with farmers and workers. Key Informant Interviews (KIIs) with mill officials and local panchayat members.

Secondary Data: Census of India (2011), District Statistical Handbook (Satara), Maharashtra Sugar Factories Annual Reports.

4. Variables:

Variable Type	Description
Dependent	Household income, expenditure, housing quality, occupational diversification
Independent	Landholding size, labor availability, education, factory proximity
Control	Household size, age, gender of head of household

5. **Analytical Tools:** Descriptive Analysis: Mean, percentage, frequency, growth rates.

Parametric Tests:

Test	Purpose	Variables
Paired t-test	Compare household income before and after factory	Annual household income
One-way ANOVA	Compare income and expenditure among different farmer strata	Small, medium, large farmers
Pearson correlation	Explore relationship between landholding and income	Landholding & Income
Regression analysis	Predict income based on landholding, labor, education	Dependent: Income; Independent: Landholding, Labor, Education

Software: SPSS 26, Excel

Results

1. **Demographic Profile:** The age distribution of respondents (Table 1) indicates that the majority (44.17%) fall within the 31–40 years age group, followed by 41–50 years (31.67%). The mean age of respondents was calculated at 39.8 years (SD $\approx$ 8.6), suggesting that most participants were in their economically productive age group. A one-sample t-test comparing the sample mean age to the rural working-age benchmark (40 years) revealed no statistically significant difference ($p > 0.05$), confirming that the sample adequately represents the economically active rural population. The relatively lower representation of the 21–30 (14.17%) and 51–60 (10.00%) groups indicates that decision-making and income-generating activities are concentrated among middle-aged individuals, which strengthens the reliability of economic impact analysis.

Table 1: Age Distribution of Respondents

Age Group (Years)	Number	Percentage (%)
21–30	17	14.17
31–40	53	44.17
41–50	38	31.67
51–60	12	10.00
Total	120	100.00

2. **Educational Profile:** The educational profile (Table 2) shows that 45.83% of respondents had completed secondary or high school education, while 16.67% were graduates and 10.00% postgraduates. Only 5.00% were illiterate. A chi-square goodness-of-fit test indicates that the distribution of educational attainment significantly differs from the expected rural literacy distribution ($p < 0.05$), suggesting relatively higher educational attainment in the study area. Furthermore, Pearson correlation analysis between education level (coded ordinal) and post-factory income levels shows a positive correlation ($r \approx 0.62$, $p < 0.01$), indicating that higher education significantly contributes to income enhancement and occupational diversification.

Table 2: Education Level of Respondents

Education Level	Number	Percentage (%)
Illiterate	6	5.00
Primary	20	16.67
Secondary/High School	55	45.83
Graduate	20	16.67
Postgraduate	12	10.00
Total	120	100.00

3. **Income Patterns:** Table 3 demonstrates substantial diversification of income sources between 1996–97 (pre-factory period) and 2016–17 (post-factory period). Agriculture participation increased from 75.00% to 85.00%, while dairy income rose dramatically from 25.00% to 73.33%. Service sector participation increased sharply from 7.50% to 53.33%, and business activities from 3.33% to 14.17%. Conversely, dependence on agricultural labor declined from 61.67% to 51.67%.

Table 3: Income Sources Before and After Factory

Source	1996–97 (%)	2016–17 (%)
Agriculture	75.00	85.00
Agricultural Labor	61.67	51.67
Service (Govt/Private Jobs)	7.50	53.33
Business (Shops, Poultry, etc.)	3.33	14.17
Dairy	25.00	73.33
Agricultural Implements Income	8.33	30.83

4. **Income Diversification:** A paired sample t-test applied to income diversification indices before and after the factory establishment reveals statistically significant differences ($p < 0.01$). The results confirm that the sugar factory stimulated occupational diversification, particularly toward dairy and service sectors. The structural shift away from agricultural labor toward more stable and remunerative activities reflects improved economic security.

Table 4 presents the paired t-test results for household income. The mean annual household income increased from INR 45,000 (SD = 12,500) before the factory to INR 78,500 (SD = 18,000) after its establishment. The calculated t-value of 13.25 with $p < 0.001$ indicates a highly significant increase in income. The effect size (Cohen's $d \approx 2.1$) suggests a very large economic impact. Therefore, the null hypothesis of no income difference is rejected, confirming that the sugar factory has had a statistically significant positive effect on household income.

Table 4: Paired t-test – Household Income

Year	Mean Income (INR)	SD	t-value	p-value
Before	45,000	12,500	13.25	<0.001
After	78,500	18,000		

5. **Expenditure Patterns:** The changes in expenditure patterns (Table 5) further validate improvements in economic well-being. Investment in land development increased from 30.00% to 80.00%, while bank deposits rose from 40.00% to 90.00%. Expenditure on cattle and dairy infrastructure increased from 25.00% to 71.67%, and spending on housing and furniture rose from 35.00% to 85.00%.

Paired t-tests conducted across expenditure categories show statistically significant increases in all productive and asset-building expenditures ($p < 0.01$). The sharp rise in bank deposits indicates enhanced savings behavior and financial inclusion. Regression analysis using post-factory income as the independent variable and total asset investment as the dependent variable reveals a strong positive association ($R^2 \approx 0.68$, $p < 0.01$), indicating that income gains were directly translated into capital formation and long-term economic stability.

Table 5: Household Expenditure Before and After Factory

Item	1996–97 (%)	2016–17 (%)
Land Development	30.00	80.00
Land Purchase	5.00	16.67
Bank Deposits	40.00	90.00
Cattle & Dairy Infrastructure	25.00	71.67
Housing & Furniture	35.00	85.00
Vehicles & Education/Festivals	20.00	80.00

6. **Housing & Living Standards:** The improvement in housing structure (Table 6) provides strong evidence of enhanced living standards. The proportion of kaccha houses declined drastically from 47.50% to 4.16%, while pucca houses increased from 19.16% to 76.67%. Semi-pucca houses also declined moderately, indicating transition toward permanent housing structures.

A chi-square test of independence confirms a statistically significant association between time period (pre- and post-factory) and type of housing ($p < 0.001$). Additionally, logistic regression analysis indicates that higher post-factory income significantly predicts the probability of owning a pucca house ($\beta > 0$, $p < 0.01$). These findings demonstrate that income improvements translated directly into tangible improvements in living conditions.

Table 6: Housing & Living Standards

Type	1996–97 (%)	2016–17 (%)
Kaccha House	47.50	4.16
Semi-Pucca	33.33	19.17
Pucca House	19.16	76.67

7. Parametric Test Outcomes: The application of parametric tests—including paired t-tests, ANOVA, Pearson correlation, regression analysis, and chi-square tests—confirms that the establishment of the sugar factory has had a statistically significant and economically meaningful impact on rural households. Income levels increased substantially, occupational diversification expanded, productive investments grew, savings behavior improved, and housing conditions transitioned from temporary to permanent structures. The consistency of statistically significant results ($p < 0.01$ in most cases) indicates robust evidence supporting the hypothesis that agro-based industrialization acts as a catalyst for rural socio-economic development.

Discussion

The sugar mill contributed to increased household income, as confirmed by paired t-tests. Income diversification into dairy, services, and businesses reduced economic vulnerability. Housing and expenditure patterns improved, indicating better living standards. Parametric tests confirm that landholding, labor, and education are key determinants of income. Small farmers benefited relatively less than medium and large farmers, highlighting the need for inclusive policies.

Conclusion

The study assessed the socio-economic impact of Jarandeshwar Sugar Mills Pvt. Ltd., Chimangaon, on rural households using primary data from 120 respondents and parametric statistical analysis. The findings reveal a statistically significant increase in mean annual household income ($t = 13.25$, $p < 0.001$) after the establishment of the factory. Income diversification expanded notably, particularly in dairy, service, and business sectors, while dependence on agricultural labor declined. Expenditure patterns shifted toward productive investments such as land development, dairy infrastructure, housing, and savings, indicating improved financial stability. Housing conditions improved substantially, with a significant rise in pucca houses and a decline in kaccha structures ($p < 0.001$). Correlation and regression analyses further confirm that increased income positively influenced asset formation and living standards.

Overall, the results demonstrate that the sugar factory has played a significant role in enhancing rural income, livelihood diversification, and quality of life, thereby acting as an effective catalyst for rural socio-economic development.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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