

Socio-Economic Impact of Rice Mill Industry in the Selected Areas of Dinajpur District

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Abstract

The rice milling industry in Dinajpur District, Bangladesh, plays a crucial role in the local economy, given the region's substantial rice production and the central role of rice in the Bangladeshi diet. This study examines the socio-economic impact of rice mills in this region, considering both the benefits and challenges associated with the industry's growth. The research highlights that the rice milling industry significantly contributes to economic growth, employment generation, and poverty alleviation. It provides direct and indirect job opportunities, enhancing income levels and living standards for many households. However, the industry also poses environmental challenges and socio-economic issues, including poor working conditions, job insecurity, low wages, and gender discrimination. The study's objectives include understanding the industry's socio-economic impact, assessing income generation, and evaluating the socio-economic status of mill employees. Data collection involved both primary and secondary sources, with a sample of 245 employees from Dinajpur's sadar upazila. Analysis using descriptive statistics and OLS regression revealed significant findings, such as the positive impact of job patterns on income and the negative effect of higher education levels. The study concludes with recommendations for enhanced support systems for migrant workers, better job and training opportunities, addressing gender disparities, and ensuring fair compensation for extended working hours. These insights aim to inform policymakers and stakeholders to promote sustainable and inclusive development in Dinajpur's rice milling sector.

Keywords: Rice mill, socio-economic impact, employment, migrant workers, mill employee

Introduction

Milling of rice is an important activity in food chain of the world economies. Rice feeds more than a third of the world's population; the predominant staple food in about 33 countries of the world including Bangladesh (Okoye et al., 2017). Rice is dominant food item as Bangladeshi people eat this meals three times in a day. Per capita rice consumption in Bangladesh is 400 grams daily which is the highest in the world (thedailystar, 2021). Besides this to understand the industrial dynamic of Dinajpur district we must look on rice mill as there is no others dominant industrial activities. However, major sources of this rice production in Bangladesh is Dinajpur District. So many rice mill have been developed in region considering the rice production. In the early days, rice milling in Dinajpur was primarily carried out by traditional methods, where farmers processed their own paddy using simple tools and manual labor. With the passage of time and advancements in technology, the rice milling industry experienced significant changes. In the 1980s and 1990s, the government of Bangladesh implemented policies and programs to promote the modernization of the rice milling sector. As a result, the number of rice mills in Dinajpur expanded, and more advanced machinery and equipment were introduced (Dr. M. A. Awal, 2013). The district became a hub for rice processing, with numerous large-scale and mechanized rice mills established. This growth has led to socio-economic changes in the region, both positive and negative.

The socio-economic impact of the rice mill industry in Dinajpur District has far-reaching implications for various stakeholders, including mill owners, workers, farmers, consumers, and the local community. Understanding these impacts is crucial for policymakers, development practitioners, and industry players to formulate effective strategies, policies, and interventions that promote sustainable development and address potential challenges. On the positive side, the rice mill industry contributes to economic growth and employment generation. The industry provides direct and indirect employment opportunities for a significant number of people, ranging from mill workers to transporters and suppliers. It boosts income levels, improves livelihoods, and stimulates local markets and business activities. The increased economic activity associated with the industry has the potential to alleviate poverty, reduce gender discrimination and enhance the standard of living for many households. However, the rapid expansion of the rice mill industry also poses certain challenges and potential negative impacts. Environmental concerns arise due to the discharge of wastewater, solid waste generation, and the consumption of energy resources.



There is a need for comprehensive research focusing on its socio-economic impact. Such research would provide a deeper understanding of the industry's effects on employment, income distribution, poverty alleviation, environmental sustainability, and social well-being. The findings of this study will provide valuable insights for policymakers to design strategies and policies that maximize the positive impacts and mitigate the negative consequences of the industry.

Problem Statement

The problem this research seeks to address is the need to comprehensively assess and understand the socio-economic impact of the rice mill industry in the selected areas of Dinajpur District. While the industry has experienced significant growth and has the potential for positive contributions to the local economy, there are concerns and challenges that need to be identified and mitigated. The research aims to provide insights into the specific socio-economic issues associated with the industry's expansion, such as income generation, environmental sustainability, social changes, and policy effectiveness.

By conducting an in-depth analysis of these problems, the research aims to inform policymakers, industry stakeholders, and local communities about the potential impacts and identify opportunities for sustainable development. The research seeks to generate evidence-based recommendations and strategies that can address the identified issues and maximize the positive socio-economic impact of the rice mill industry while minimizing any negative consequences. Ultimately, the research aims to contribute to informed decision-making and the formulation of policies and interventions that promote inclusive growth, equitable distribution of benefits, environmental sustainability, and social well-being in the selected areas of Dinajpur District.

Scope or Rationale of the Project :

The rationale for conducting this project lies in the need to address the knowledge gap and provide a comprehensive understanding of the socio-economic impact of the rice mill industry in the selected areas of Dinajpur District.

Firstly, there is a lack of research specifically focusing on the social and economic consequences of the industry's growth. While technical and environmental aspects have been explored, a comprehensive analysis of the industry's effects on employment, backward and forward linkages, poverty alleviation, environmental sustainability, and social dynamics is necessary.

Secondly, the project aims to generate empirical evidence and insights that can contribute to the existing literature. By examining the socio-economic impact of the rice mill industry, the project will enhance our understanding of its broader implications

Thirdly, the project's scope aligns with the development priorities of Bangladesh. Sustainable and inclusive growth, poverty reduction, environmental conservation, and balanced regional development are key focus areas for the country. Understanding the socio-economic impact of the rice mill industry is crucial for achieving these development goals and ensuring equitable distribution of benefits.

By addressing these factors, the project will provide valuable insights into the socio-economic challenges and opportunities associated with the rice mill industry. The findings will help policymakers and industry stakeholders to formulate strategies and interventions that promote sustainable and inclusive growth, while addressing potential challenges in the selected areas of Dinajpur District. The purpose of this study is to formulate policies considering the problems that need to be addressed.

Objective(s) of the project

- Understanding of the socio-economic impact of the rice mill
- Assess the income generation potential of the rice mill industry in the selected areas of Dinajpur District.
- Assesse the socio status of the employee of the mill
- Find out the forward and backward linkage of this industry.
- Understanding the gender dimension in this industry.

Brief review of works already performed or in progress elsewhere

Kabir (2017) found that the expansion of fully automated rice mills has outpaced semi-automatic and husking mills, creating more employment opportunities. Women contribute to about 34% of the workforce during the peak season. However, rice mill workers, mostly young and with low education, face challenges such as poor working conditions, job insecurity, low wages, and gender-based discrimination. Their average monthly income falls well



below the poverty line, with women earning only 69% of men's wages. Addressing these issues is crucial to improve the socio-economic conditions of rice mill workers.

(Rahman & Hasan, 2011) scrutinized the impact of women's contribution to household income on poverty reduction, identify factors influencing family income among farm and rice mill laborers, and highlight the challenges they face in Bochagonj Upazila of Dinajpur district. The area was purposefully chosen due to its high concentration of farm and rice mill laborers. The findings indicated that women's involvement in farm and rice mill work positively affected their educational attainment, land ownership, and household assets. Family expenditure patterns remained consistent but increased over time, indicating a positive impact on poverty levels. Factors such as age, family size, land ownership, number of earning members, and individual income significantly influenced income and employment levels among laborers.

The study revealed major problems related to the nature of the work and gender-based wage disparities. Both male and female laborers faced challenges associated with the nature of their work, while women experienced lower wages compared to men. This wage disparity had a substantial impact on the income and financial well-being of female laborers. Despite contributing a relatively small amount, women's contribution to household income played a significant role in improving socio-economic conditions and reducing poverty levels.

(Dr. M. A. Awal, 2013) study showed that discrimination based on gender in terms of wage rates is prevalent in the rice milling industry. Regarding employment opportunities for daily wage laborers, automatic rice mills with modern equipment have a higher utilization capacity, utilizing approximately 5925 man-days per year. In comparison, other rice mills, including semi-automatic rice mills and husking mills, have lower utilization ranging from 2232 to 3120 man-days per year. Automatic rice mills with modern equipment provided the most employment opportunities for salaried staff, with a total of 6205 man-days per year. This was followed by automatic rice mills without modern equipment, which offered 5840 man-days per year. Semi-automatic rice mills with modern equipment provided 1460 man-days per year, while semi-automatic rice mills without modern equipment and husking mills offered the lowest number of employment opportunities, with 1095 man-days per year.

There is various study have been conducted on rice market but very few on rice mills. Previous studies have explored the economic impact of the rice mill industry in various countries, but there is a lack of systematic research specifically focusing on the rice mill industry in Bangladesh. This current study aims to fill this gap and provide valuable insights into the socio-economic contribution of the rice mill industry in the local economy and surrounding communities. The findings of this study will generate significant knowledge and information that can be utilized at both micro and macro levels. This research will be particularly beneficial for government organizations, NGOs, and policymakers as they can utilize the findings to formulate appropriate policies and make informed decisions regarding the rice mill industry in Bangladesh.

Methodologies

Study Areas

The study areas for this project were focused on selected regions within Dinajpur District. These areas were chosen based on their significant presence and impact of the rice mill industry. The specific study areas might include major rice mill clusters that had a high concentration of rice mills. These areas served as primary study sites to understand the socio-economic dynamics and impacts of the industry. Surrounding agricultural communities who were involved with the rice mill also included in the study. We incorporated the employee of these rice miles.

Determination of Sample Size

Determination of the sample size followed a proportionate to size sampling methodology as specified by Kothari (2004) and is calculated as:

$$N = \frac{Z^2 pq}{e^2} \quad (1)$$

Where;

N = Sample size in number.

Z² = Confidence level at 95% (standard value of 1.96).

p = This was an assumption that 80% of respondent experienced positive impact of rice mill in the study area.

q = This is the weighting variable given by (1 - P).

e² = Margin of error at 5% (standard value of 0.05).

By putting values we have

$$N = \frac{(1.96)^2 (0.80)(0.20)}{(0.05)^2}$$

$$N = 245$$

Thus our sample size is 245 employees of rice mill in selected areas of Dinajpur district.



Data Collection

Data were collected from both primary and secondary sources. The sample consists of 245 randomly selected employees from sadar upazila of Dinajpur. The questionnaire were prepared in Bangla and the data collectors ask the respondents in local language for their understanding and then was put the collected information in questionnaire using language. The study were conducted during 2023-24 fiscal year. The responses of the respondents that were recorded in the interview schedule were transferred into a master sheet for entering the data in the computer. Data analysis were then done by using computer software packages like Microsoft Excel, STATA (Version15.0) and various descriptive statistical measures (i.e., sum, average, percentages, ratios, standard deviation etc.) were employed to examine the objectives of this study and explain the present condition of the socio-economic implications of the rice mill industry. Tabular analysis was included socioeconomic characteristics of sample respondents.

Model Specification

For first objective, this study was used the descriptive statistics, graphs and tables based on both primary and secondary collected data. The second objective of this study is to estimate the impact of rice mill on the socio-economics conditions which is measured by income of rice mill employee. To attain this objective, an OLS regression model will be run for analysis. By using OLS regression, we effectively analyzed the relationships between income and the independent variables while benefiting from its linearity assumption, unbiased estimation, efficiency, interpretability, and the widespread acceptance of this method in the field. The regression equation is a statistical model that allows us to understand the relationship between the dependent variable (income) and several independent variables. The equation is as follows:

$$\ln(\text{Income}) = \beta_0 + \beta_1 \ln(\text{Job pattern}) + \beta_2 \ln(\text{Education Level}) + \beta_3 \ln(\text{age}) + \beta_4 \ln(\text{Gender}) + \beta_5 \ln(\text{Experience}) + \beta_6 \ln(\text{Working hours}) + \beta_7 \ln(\text{Training}) + \varepsilon$$

- β_0 represents the intercept term, which captures the baseline income level when all independent variables are zero. It represents the expected income when an individual has no job level, education, technology adoption, skill, age, gender or health status.
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ are the regression coefficients associated with each independent variable. They indicate the change in income for a unit change in the corresponding independent variable, holding other variables constant. For example, β_1 represents how much income is expected to change for each unit increase in job level, assuming the other variables remain constant.
- Job Level refers to the hierarchical position or level of the job within the firm. It represents the vertical advancement or seniority of individuals within the organization.
- Education Level indicates the level of education attained by individuals. It captures the impact of education on income.
- Technology Adoption measures the extent to which individuals or the firm have embraced and implemented technology in their work processes.
- Skill of Labor represents the level of skill possessed by individuals.
- Age refers to the age of individuals. It captures the influence of age on income, considering that income may change as individuals gain more experience or progress in their careers.
- Health Status represents an indicator of individuals' overall health condition. It reflects the impact of health on income levels, as health can affect work capacity and productivity.
- Gender represents a binary variable indicating the gender of the individual (e.g., 0 for male, 1 for female)
- Here we take the natural logarithm (\ln) of the dependent variable (income) and/or the independent variables that is log-log model to show the elasticity of all respective variables.

By estimating the regression coefficients ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$) using statistical techniques, we can determine the magnitude and direction of the relationship between each independent variable and income. The coefficients indicate how changes in job level, education level, technology adoption, skill, age, gender and health status relate to changes in income. By analyzing the regression results, we can gain insights into the factors that significantly influence income levels, which can be useful for understanding the socio-economic dynamics.



Table 1. Measurement of variables

Variable Type	Variables	Measurement
Dependent	Income	Income of the employees are measured in BDT.
Independent Variables	Job pattern	Job pattern is measured as dummy where 1 for full time and 0 for part-time
	Education Level	Educational level is measured as years of schooling
	Age	Age of the respondent is measured in years
	Gender	Gender is measured as dummy where 1 for male and 0 for female
	Experience	Experience is measured as years working in rice mills
	Working hours	Working hours is measured as hours
	Training	Training received is measured as dummy where 1 for yes and 0 for no

Result and Discussion

Gender status of household head of the respondents

Figure 1 illustrates the distribution of household heads by gender among the respondents. It shows two categories: male and female, with their respective percentages.

- **Male:** 75% of the respondents reported that the head of their household is male. This indicates that a significant majority of the households are led by males.
- **Female:** 25% of the respondents reported that the head of their household is female. This suggests that a smaller proportion of households are headed by females compared to males.

Overall, the figure 1 highlights a gender disparity in the leadership of households among the respondents, with a predominant male representation.

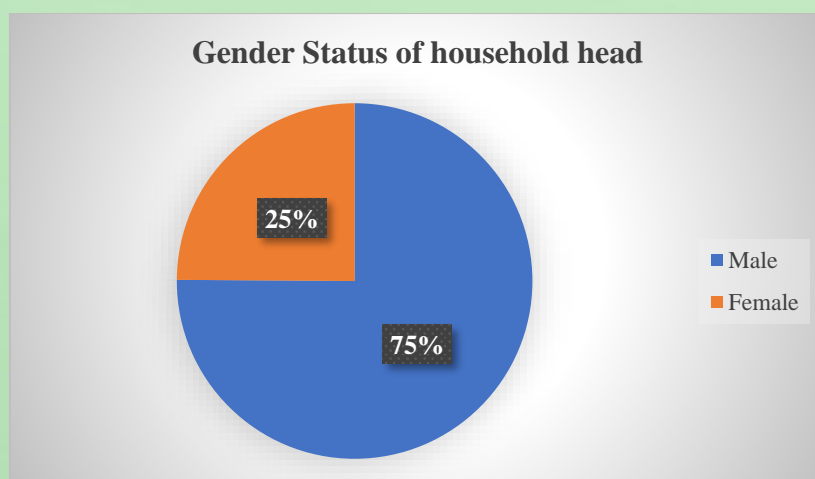


Figure 1. Gender status of household head of the respondents

Respondents' age distribution

The table 2 illustrates the age distribution of the respondents, showing that the majority are middle-aged, with 36.33% falling in the 35 to 50 years range, followed by 31.84% in the 20 to 35 years range. This indicates a significant representation of young and middle-aged adults. A smaller proportion of respondents are older adults, with 19.59% aged 50 to 65 years and only 4.08% over 65 years. The youngest age group, below 20 years, constitutes 8.16% of the respondents. Overall, the data suggests a diverse age demographic with a notable emphasis on the middle-aged population.

Table 2. Respondents' age distribution

Age range	Frequency	%
below 20	20	8.163265
>20 to 35 years	78	31.83673
>35 to 50 years	89	36.32653
>50 to 65 years	48	19.59184
>65 years	10	4.081633
Total	245	100.00



Educational status of the respondents

This table 3 presents the educational status of the respondents, categorized into different levels of education, along with their frequencies and percentages:

- **No formal education:**
 - 33 respondents (13.47%) have no formal education.
- **Primary education:**
 - 93 respondents (37.96%) have completed primary education, making it the most common level of education among the respondents.
- **SSC (Secondary School Certificate):**
 - 72 respondents (29.39%) have completed secondary school, representing a significant portion of the respondents.
- **HSC (Higher Secondary Certificate):**
 - 41 respondents (16.73%) have completed higher secondary education.
- **Hons (Honors degree):**
 - 4 respondents (1.63%) hold an honors degree, showing a much smaller group with higher education.
- **MS or above:**
 - 2 respondents (0.82%) have attained a master's degree or higher, indicating the least common level of education among the respondents.

The table 3 highlights that the majority of respondents have completed primary education (37.96%), followed by those with secondary education (29.39%) and higher secondary education (16.73%). A smaller proportion has no formal education (13.47%), while those with higher education degrees (Hons or MS and above) constitute a very small percentage of the respondents (2.45% combined). This suggests that while primary and secondary education levels are relatively high, the percentage of respondents with higher education is quite low.

Table 3. Educational status of the respondents

Educational status	Frequency	%
No formal education	33	13.46939
Primary education	93	37.95918
SSC	72	29.38776
HSC	41	16.73469
Hons	4	1.632653
MS or above	2	0.816327
Total	245	100

Household size of the respondents

The table 4 illustrates the household size of the respondents, showing that the majority, 71.84%, belong to nuclear families with 2 to 5 members. Childless families, consisting of 2 members, make up 4.89% of the respondents, while joint or extended families with more than 5 members account for 23.27%. The total number of respondents is 245. The household sizes range from a minimum of 2 to a maximum of 14 members, with an average (mean) household size of 4.72 members. This data indicates that most respondents live in smaller, nuclear family units, with a significant portion also residing in larger, extended family settings.

Table 4. Household size of the respondents

Household members	Frequency	%	Min	Max	Mean
Childless family (2family members)	12	4.89	2	14	4.72
Nuclear Family (2 to 5family members)	176	71.84			
Joint or extended family (>5 family members)	57	23.27			
Total	245	100			

Income distribution of the respondents

The table 5 details the income distribution of the respondents, showing that nearly half (48.57%) earn between 10,000 and 25,000 BDT. A smaller group, 18.78%, falls into the 25,000 to 40,000 BDT range, while 15.51% earn between 40,000 and 55,000 BDT. Those earning above 55,000 BDT make up 11.02%, and the lowest income group, earning below 10,000 BDT, comprises 6.12% of the respondents. The total number of respondents is 245, with incomes ranging from a minimum of 7,400 BDT to a maximum of 62,000 BDT, and an average income of 21,300 BDT. This data indicates a significant concentration of respondents in the lower-middle-income bracket.



Table 5. Income distribution of the respondents

Income range (in BDT.)	Frequency	%	Min	Max	Average
below 10000	15	6.122449	7400	62000	21300
>10000 to 25000	119	48.57143			
>25000 to 40000	46	18.77551			
>40000 to 55000	38	15.5102			
>55000	27	11.02041			
Total	245	100			

Migration status of the respondents

The table shows the migration status of the respondents, revealing that a substantial majority, 68.98%, have migrated from other places specifically to work in auto rice mills. In contrast, 31.02% of the respondents have not migrated and are presumably local residents. The total number of respondents is 245. This data highlights that most individuals working in auto rice mills have moved from different locations for their employment, while a significant portion of the workforce consists of locals who have not migrated. This is also shown in figure 2.

Table 6. Migration status of the respondents

Migration status	Frequency	%
Migrated from other place to work in Auto rice mills	169	68.97959
Not migrated	76	31.02041
Total	245	100.00

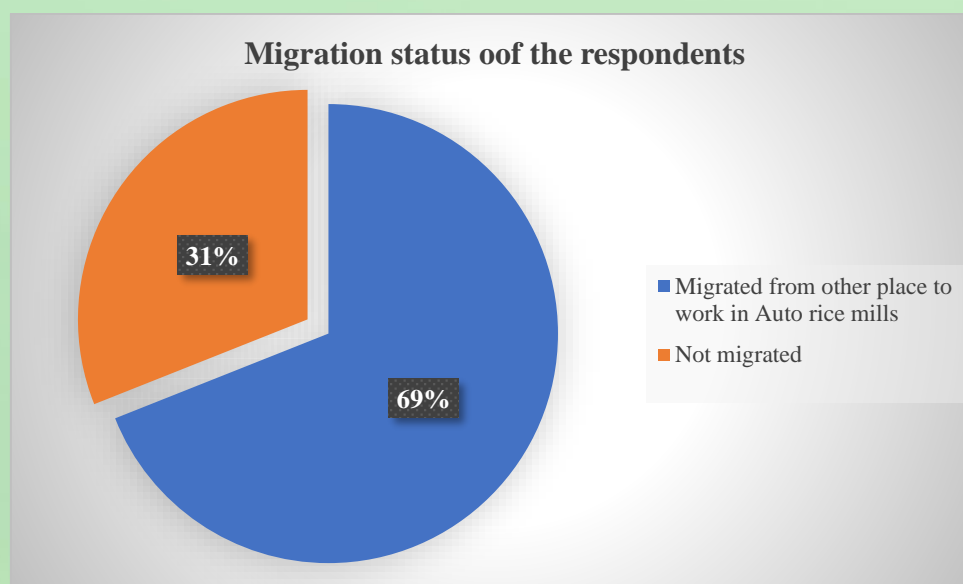


Figure 2. Migration status of the respondents

Job patterns of the respondent

The table 7 outlines the job patterns of the respondents, showing that a majority, 68.49%, are employed full time, while 35.59% hold part-time positions. With a total of 245 respondents, the data reveals a clear predominance of full-time employment among the workers, indicating that most individuals have committed, long-term jobs, whereas a smaller portion works part-time.

Table 7. Job patterns of the respondent

Job patterns	Frequency	%
Part time employee	87	35.59
Full time employee	158	68.49
Total	245	100.00

Working hours spent by the respondents in auto rice mills

The table 8 presents the distribution of working hours among respondents in auto rice mills, showing that 33.46% work more than 12 hours a day, making this the most common category. Additionally, 29.80% of respondents work 12 hours daily, while 25.31% work 10 hours daily, which includes 2 hours of overtime. A smaller group,



11.43%, works the standard 8-hour shift. The total number of respondents is 245, with working hours ranging from a minimum of 8 hours to a maximum of 18 hours per day, and an average (mean) of 12.37 hours. This data indicates that a significant portion of the workforce experiences long working hours, with a substantial number engaged in extreme working conditions.

Table 8. Working hours spent by the respondents in auto rice mills

Working hours	Frequency	%	Min	Max	Mean
Normal (8 hours)	28	11.43	8	18	12.37
Moderate (Normal+2 hours Overtime=10 hr)	62	25.31			
Highly involved (Normal+ 4 hours Overtime=12 hr)	73	29.80			
Extreme case (>12 hours)	82	33.46			
Total	245	100			

Problem facing index of the respondents due to migration

The table 9 presents an index of problems faced by respondents due to migration, ranked by severity based on their scores. The most significant issue, ranked 1, is the lack of support from government or non-government organizations, with a high score of 639. Following this, 2nd rank concerns include inadequate credit facilities, scoring 553, and 3rd rank problems involve a lack of livelihood capitals, with a score of 548. Food-related issues are also prominent, with "We do not have enough food" at 4th place with a score of 474, and "Clothing problem" at 5th place with a score of 449. "Lack of job facility" and "Our children did not get nutritional food" are ranked 6th and 7th, respectively. Problems like "Education of children is negatively affected" and "Societal acceptance problems" rank lowest, with scores of 283 and 300, indicating that they are less severe in comparison. Overall, the table highlights that respondents face various challenges due to migration, with the lack of support and credit facilities being the most pressing issues.

Table 9. Problem facing index of the respondents due to migration

Problems faced due to migration	High	Moderate	Low	No	Score	Rank
1. Our children did not get nutritional food	74	52	81	38	407	7
2. Lack of livelihoods capitals	125	69	35	16	548	3
3. We do not get any support from government or non-government organization or others	192	28	7	18	639	1
4. Clothing problem	70	73	93	9	449	5
5. We do not have enough food	92	52	94	7	474	4
6. Education of children is negatively affected	31	83	24	107	283	10
7. Not enough credit facility	126	64	47	8	553	2
8. Lack of job facility	94	39	64	48	424	6
9. Shelter or accommodation problem	63	42	59	81	332	8
10. Societal acceptances problem	71	30	27	117	300	9

Estimated result of OLS

The table 10 summarizes key statistics from a regression model, revealing that the mean of the dependent variable is 10.835 with a standard deviation of 0.450. The model's R-squared value is 0.250, indicating that 25% of the variance in the dependent variable is explained by the independent variables in the model. With a total of 245 observations, the F-test statistic is 11.287, and the associated p-value of 0.000 signifies that the model as a whole is statistically significant. Additionally, the Akaike Information Criterion (AIC) is 248.577 and the Bayesian Information Criterion (BIC) is 276.588, which are used for model selection where lower values generally indicate a better-fitting model. Overall, these results suggest that while the model explains a quarter of the variance in the dependent variable and is statistically significant, the AIC and BIC values provide metrics for comparing the model against others for potential improvement.

The table 10 presents the results from a linear regression analysis focusing on two variables: job pattern and education level. The job pattern variable has a coefficient of 0.136 with a standard error of 0.026, a t-value of 5.18, and a p-value of 0.00, indicating a statistically significant positive impact on the dependent variable. This suggests that changes in job patterns are strongly associated with increases in the dependent variable. On the other hand, the education level variable has a coefficient of -0.218 with a standard error of 0.058, a t-value of -3.75, and a p-value of 0.00, signifying a statistically significant negative effect on the dependent variable. This implies that higher education levels are associated with decreases in the dependent variable. Both variables are highly significant, as denoted by the *** (three asterisks) in the significance column.

The table 10 shows the regression results for two variables: age and gender. The age variable has a coefficient of 0.08, a standard error of 0.063, a t-value of 1.28, and a p-value of 0.202, indicating that age is not a significant predictor of the dependent variable, as the p-value is above the typical significance threshold of 0.05. In contrast, the gender variable has a coefficient of 0.202, a standard error of 0.091, a t-value of 2.21, and a p-value of 0.028,



demonstrating a significant positive effect on the dependent variable. This suggests that gender is a meaningful predictor, with the positive coefficient indicating that being of a particular gender is associated with an increase in the dependent variable.

The table 10 presents the results of a regression analysis for four variables: experience, working hours, training, and the constant term. The experience variable has a coefficient of 0.066 with a standard error of 0.075, a t-value of 0.88, and a p-value of 0.38, indicating that experience is not a significant predictor of the dependent variable. Similarly, the training variable has a coefficient of 0.067, a standard error of 0.071, a t-value of 0.94, and a p-value of 0.348, suggesting that training also does not significantly affect the dependent variable. However, working hours has a coefficient of 0.058, a standard error of 0.014, a t-value of 4.05, and a p-value of 0.00, which indicates a statistically significant positive effect on the dependent variable. Lastly, the constant term has a coefficient of 10.377 with a standard error of 0.085, a t-value of 122.36, and a p-value of 0.00, confirming that the constant term is highly significant in the model. Overall, the results show that only working hours have a significant impact on the dependent variable, while experience and training do not.

Table 10. Estimated result of OLS

Variables	Coefficients	St.Err.	t-value	p-value	Sig
Job pattern	0.136	0.026	5.18	.00	***
Education Level	-0.218	0.058	-3.75	.00	***
Age	0.08	0.063	1.28	0.202	
Gender	0.202	0.091	2.21	0.028	**
Experience	0.066	0.075	0.88	0.38	
Working hours	0.058	0.014	4.05	.00	***
Training	0.067	0.071	0.94	0.348	
Constant	10.377	0.085	122.36	.00	***
Extra statistics					
Mean dependent var	10.835	SD dependent var		0.450	
R-squared	0.250	Number of obs		245	
F-test	11.287	Prob > F		0.000	
Akaike crit. (AIC)	248.577	Bayesian crit. (BIC)		276.588	
*** $p<.01$. ** $p<.05$. * $p<.1$					

Test of multicollinearity and heteroskedasticity

The table 11 presents the results of a multicollinearity test for various variables in a regression model. The Variance Inflation Factor (VIF) values and their reciprocals (1/VIF) are shown for each variable to assess multicollinearity. The job pattern variable has the highest VIF of 2.230, indicating a moderate level of multicollinearity, while education level and age have VIF values of 1.750 and 1.540, respectively, which are also relatively low but higher than the other variables. The remaining variables, including gender (1.320), experience (1.100), working hours (1.070), and training (1.030), have VIF values below 2, suggesting minimal multicollinearity. The mean VIF across all variables is 1.430, which is well below the common threshold of 10, indicating that multicollinearity is not a significant issue in this model. Overall, the results suggest that multicollinearity is generally low among the variables tested.

Table 11. Multicollinearity test

Variables	VIF	1/VIF
Job pattern	2.230	0.449
Education Level	1.750	0.570
Age	1.540	0.651
Gender	1.320	0.759
Experience	1.100	0.910
Working hours	1.070	0.938
Training	1.030	0.973
Mean VIF	1.430	

The table displays the results of the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity in a regression model. The chi-squared statistic is 0.05, with a p-value of 0.81. Since the p-value is much greater than the common significance level of 0.05, the test fails to reject the null hypothesis. This indicates that there is no significant evidence of heteroskedasticity, meaning that the variance of the errors in the model is consistent across different levels of the independent variables. In conclusion, the test results suggest that the assumption of constant variance of the error terms is satisfied in the regression model.



Table 12. Test for heteroskedasticity

Test name	chi2	Prob > chi2	Decision
Breusch-Pagan/Cook-Weisberg test	0.05	0.81	Constant variance

Discussion

The findings from this study offer valuable insights into various aspects of the demographic and employment characteristics of individuals working in auto rice mills. The gender distribution of household heads reveals a significant male dominance, with 75% of respondents reporting male household heads, highlighting a clear gender imbalance in household leadership roles. This gender disparity reflects broader societal patterns where men predominantly occupy leadership positions, which may impact the social dynamics and decision-making processes within these households.

The analysis of the problems faced by respondents due to migration, as shown in Table 9, reveals significant insights into the hardships experienced by workers in auto rice mills. The data indicates that the most pressing issue for migrants is the lack of support from government or non-government organizations, with a high severity score of 639. This finding underscores a critical gap in the support structures available to migrant workers, suggesting that the current systems are inadequate in addressing their needs. This observation aligns with previous research that highlights the challenges faced by migrants due to the insufficient support from institutional frameworks (Anderson et al., 2024; Gupta and Kanungo, 2022). Following the lack of support, inadequate credit facilities are identified as the second most severe issue, with a score of 553. This challenge reflects broader systemic problems where access to financial resources is limited for migrant workers, potentially impeding their ability to invest in their livelihoods or manage financial emergencies. This finding is consistent with studies that emphasize the barriers to financial inclusion faced by low-income workers (Rai & O'Brien, 2018). The third most significant issue is a lack of livelihood capitals, with a score of 548. Livelihood capitals, such as social, financial, and human capital, are crucial for sustaining a migrant's well-being and economic stability. The deficit in these capitals highlights a need for more comprehensive support systems that provide not only immediate assistance but also long-term resources for migrants (Ellis, 2000). Food insecurity, reflected by the problem "We do not have enough food," ranks fourth with a score of 474. This issue indicates that a considerable number of migrants struggle to meet basic needs, which is a serious concern for their overall health and productivity. Similarly, "Clothing problem" ranks fifth, with a score of 449, pointing to the inadequacies in meeting basic living standards. Interestingly, issues such as the negative impact on children's education and societal acceptance problems rank lower in severity compared to the more immediate concerns of food, clothing, and credit facilities. This suggests that while these issues are present, they may not be as urgent as the immediate survival concerns of migrants. This finding supports the view that immediate survival needs often overshadow longer-term concerns in migration contexts (Firlana & Mastur, 2023).

The regression analysis presented in Table 10 offers a comprehensive view of the relationships between several factors and the dependent variable, which reflects various outcomes related to the respondents' experiences in the auto rice mills. The positive coefficient of 0.136 for job pattern with a p-value of 0.00 indicates that full-time employment is associated with higher values of the dependent variable. This suggests that full-time employee's experience outcomes that are more favorable compared to part-time employees. This finding supports the notion that full-time positions offer greater stability and benefits, which can contribute to improved overall conditions for workers (Barth, 2018). The negative coefficient of -0.218 for education level, also statistically significant, implies that higher levels of education are associated with lower values of the dependent variable. This could reflect a potential mismatch between higher education qualifications and the job opportunities available in the auto rice mills, where educational qualifications may not translate into better job outcomes. This observation is in line with the "degree inflation" phenomenon where higher qualifications do not necessarily lead to better job prospects in certain sectors (Murnane et al., 2006). The positive coefficient of 0.202 for gender, with a significance level of 0.028, indicates that being of a particular gender has a significant effect on the dependent variable. This suggests that gender may play a role in determining the experiences or outcomes of the respondents, potentially reflecting gender-specific roles or expectations in the workplace (Klasen, 2008). The variable for working hours shows a positive coefficient of 0.058 with a p-value of 0.00, indicating that longer working hours are associated with higher values of the dependent variable. This finding implies that increased working hours may lead to better outcomes or greater returns for workers, which could be due to the nature of the work or compensation structures in the auto rice mills (Jongen et al., 2014). The analysis shows that age, experience, and training are not significant predictors of the dependent variable. The lack of significance for age and experience suggests that these factors do not have a substantial impact on the outcomes measured in this study. Similarly, training does not appear to affect the dependent variable, which might indicate that the current training programs are ineffective or that additional training does not necessarily improve job outcomes (Dearden et al., 2006).



Implications and Recommendations

The findings from both the problem index and the regression analysis point to several key implications and recommendations:

- **Enhanced Support Systems:** There is a clear need for improved support mechanisms for migrants, including better access to financial services, livelihood capitals, and basic needs. Policymakers and organizations should focus on creating more robust support systems that address both immediate and long-term needs of migrant workers.
- **Job and Training Opportunities:** Expanding job opportunities and improving the effectiveness of training programs could help align workers' qualifications with job market demands. Ensuring that educational achievements are recognized and rewarded in the workplace is crucial for improving job satisfaction and outcomes.
- **Addressing Gender Disparities:** The significant impact of gender on outcomes suggests a need for gender-sensitive policies and practices in the workplace. Efforts should be made to address any gender-based inequalities and to create a more inclusive work environment for all employees.
- **Work Hours and Compensation:** The positive association between working hours and the dependent variable highlights the importance of fair compensation and working conditions. Employers should consider fair compensation structures that reflect the number of hours worked and the demands of the job.

In conclusion, the study provides valuable insights into the challenges faced by migrants and the factors influencing their experiences in the auto rice mills. Addressing these challenges through targeted policies and interventions can improve the conditions for migrant workers and enhance their overall well-being.

Conclusion

In conclusion, the rice milling industry in Dinajpur District has proven to be a vital economic driver, contributing significantly to employment and income generation. The shift towards automated rice mills has particularly enhanced productivity and provided better employment opportunities compared to traditional mills. These developments have positively impacted local livelihoods and contributed to poverty alleviation. Despite these promising results, several limitations were identified in the study. One of the primary limitations is the gender disparity in wages, where women are consistently paid less than their male counterparts. Additionally, working conditions in many mills remain suboptimal, with long working hours and inadequate safety measures posing significant risks to workers' health and well-being. Another limitation is the lack of comprehensive support for migrant workers, who often face precarious living conditions and limited access to essential services. The study also highlights the need for more robust data collection and analysis to better understand the industry's full impact and to develop more targeted interventions. The limited scope of the study, focusing primarily on economic indicators, suggests that further research incorporating social and environmental dimensions is necessary to provide a more holistic assessment of the industry's impacts. Addressing these limitations requires a multi-faceted approach, including the implementation of stricter labor regulations, initiatives to close the gender wage gap, improvements in workplace safety, and enhanced support systems for migrant workers. By tackling these issues, stakeholders can ensure the sustainable and equitable development of the rice milling industry, ultimately benefiting all members of the community.

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