Original Research Article

Impact of Rice Mill Pollution on Surrounding Environment: A Case Study in Sadar Upazila, Dinajpur, Bangladesh

Abstract: A study was conducted to find out the impact of rice mill pollution on the surrounding environment, agricultural production and human health status at Dinajpur Sadar Upazila through a semi-structured questionnaire during the period from October 2018 to October 2019. Nine rice mills were randomly selected and data were collected from a number of 104 respondents. Data were collected from the respondents at four distant places away from a rice mill viz. 0 meter (in and around mill area), 100, 500, and 1000 meter away. Appropriate scales were developed to measure both the independent and dependent variables by using Microsoft excel and SPSS (Statistical Package for Social Sciences) program. Results showed maximum respondents attitude (>50%) towards the impact of rice mill pollution on envielnment, agricultute and their health status were not positive (score was 8-15 out of 32) i.e. they were suffering from the rice mill pollutions. Study on four different distances showed that the closest surroundings were highly affected category (impact score >40 out of 60) by the rice mill pollution. The pollution effect on agricultural productivity and human health was in the highest category up to 500 meter away from the mill site and it was found in decreasing trend (impact score <20) at the distance of 1000 away from the rice mill. The overall findings of the study suggested that rice mill should be established more than half a kilometer away from the human settlement and arable land to minimize the rice mill pollution hazards.

Key words: *Rice mill pollution, environmental affect, health hazards, agricultural hazard*

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1. INTRODUCTION

Pollution is the introduction of contaminants into the natural environment that cause adverse change. It can take the shape of chemical substances or energy like noise, heat, or light. This condition of Bangladesh isn't in the slightest degree equilibrium. Severe air, water, and soil pollution are threatening human health,ecosystems, agricultural production, and the economic process of Bangladesh. Environmental degradation of Bangladesh is caused because of poverty, over-population, and lack of awareness. It's manifested by deforestation, destruction of wetlands, wearing, and natural calamities. Bangladesh is an agricultural country having 164.68 million populations [1]. Rice is that the primary important cereal crop grown in Bangladesh and occupies about 80% of the general cultivated area giving a whole production of about 26.2 million metric tonnes of rough rice and about 17.3 million metric tonnes of milled rice [2]. Besides, rice sector contributes one-half of the agricultural GDP and one-sixth of the worth in Bangladesh [3]. Production of rough rice has increased significantly due to use of HYV and increased cropping intensity, but the status of rice processing technology did not change such plenty. After harvesting paddy from the crops field, some process is maintained to form it suitable for consumption. There are numerous techniques to hull rice [4]. Few decades ago,dheki (local husking pedal) was accustomed process rice for family level consumption. The rice processing is becoming modernday by daybecause of ongoing industrailization. Automatic and semi-automatic rice mills are being founded at a growing rate, raising competition for thousands of small and medium husking mills. Over the last decade, several hundred automatic and semi-automatic rice mills were established in various rice producing zones. Naogaon, Chapainawabganj, Dinajpur, Kushtia and Jessore are some districts that havehugeinvestment to line up big automatic rice mills. In Bangladesh, there are two types of commercial mills. These are modern or automated rice mill, and husking or traditional rice mill. In 2005, there are only

200 semi-automatic and automatic rice mills [5,6]. The amount has tripled to quite 600 and total number of rice mills about 17,000 according to Bangladesh Rice Mills Association are operating. The nature of pollution is changing [7]. In modern or automatic rice mill all activities are done through mechanical process. Dust release from by-products, high internal or external noise levels, and odor generated from the soaking reservoirs within the parboiling process or soaking water which isn't properly treated, runoff surface water which may contain high levels of organic material, effluent produced during cleaning of apparatus etc are polluting our surroundings continuously [8]. Most of the respondents are sleep in risky environment. As a result several unhealthiness and diseases may occur. Besides, condition could even be occurred becauseofcarrying heavy loads over head, back and shoulder, firing boiler, rice drying, driving huller machine, mechanical and manual separation of husks from head rice [9]. According to [8], rice mills is a source of pollution both on site and in the surrounding locality, as it discharges acidic gases and black smoke with bad smell [10] that causes health problem [9]. Also, [11] reported that the by-products include both the solid and liquid waste such as the rice husk, bran, and effluents from fuel and used water pollute the environment. [12] observed that dust from rice mill affect the photosynthesis of crops, and reduces the food production [13] around the rice mill areas. So automatic rice mill encompasses a high impact on the environment and health status. No previous study has been conducted on the impact of rice mills pollution on their surrounding environment in Bangladesh. This research was conducted to investigate the impact of rice mill pollution on the environment as well as agricultural production and health status. This study will help to improve knowledge of the land use planners and policy makers that which types of farming systems and mitigation should be best for the concern areas, and also helpful for future planning to mitigate and provide alternative farming systems for the nearby area of Sadar upazila of Dinajpur district. The specific objectives of the study were to identify the presentstatus of the people sorrounding the rice mill area of Dinajpur Sadar upazila, and to ascertain the impact of rice mill pollution towards environmental, agricultural and health status at different distances from the rice millsite. Finally, the findings of this study will also help to meet the sustainable development of the country.

Comment [u3]: The objectives of the article should be presented in a separate paragraph at the end of the introduction

2.Materials And Methods

2.1 The Study Area

Dinajpur district consists of 13 upazila named Dinajpur sadar, Birganj, Setabgonj, Birol, Kaharol, Parbotipur, Birampur, Khanshama, Fulbari, Chirirbanadar, Nawabganj, Ghoraghat and Hakimpur. Out of them only Dinajpur sadar was purposively selected as the locale of the study which lies between 25°28' and 25°48' north latitudes and 88°34' and 88°46' east longitudes.

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2.2 Procedure methodology

An updated list of rice mill was collected from the Rice Mill Malik Somite. There were about 365 rice mills in Dinajpur sadar upazila, and about nine rice mills were selected randomly. Those rice mill respondents and nearby household members constituted the population of the study. Multi-stage random sampling procedure was followed in this study area. The data were collected physically from selected area 00on their environment, agricultural production and human health statuswithin four different distance viz. 0 m, 100 m, 500 m and 1000 m from the rice mill. Total numbers of the respondents 104 were selected as the sample by using random sampling procedure. After collection, the data were coded into a coding sheet, and then compiled, tabulated and analyzed the data in accordance with the objectives of the study by using Microsoft excel and SPSS (Statistical Package for Social Sciences) program. After that, all qualitative data were converted into quantitative form by means of suitable scoring techniques for the purpose of analysis.

In this study age, education, family size, farm size, gender, organizational participation, annual incomeknowledge and attitudes ewre selected as an independent variable, and impact of rice mill on

environment,agriculture and human health were selected as dependent variable.The age of a respondent was measured in terms of actual years from his/her birth to the time of interview on the basis of his/her response. A score of one (1) was assigned for each year of age. For example, if any respondent's age was 28 years then he/she was given a score of 28. Education of a respondent was measured in terms of classes he/she passed in formal education system. If a respondent passed the final examination of class two in the school, a score of two was taken for calculating his/her education score. In case of education outside the school the level of education was converted into class and scored according to the class scoring system. A score of 0.5 was given to the respondents who could sign only and the respondents who could not read and write were given zero (0) as an education score. Family size of a respondent was determined in term of actual number of members in his/her family including himself/herself, his wife/her husband, his/her sons, daughters, brothers, sisters, parents and any other person(s) who depend on the respondent's income. A score of one (1) was assigned for each member of the family. For example, if a respondent mentioned that he/she had 3 members in his/her family then his/her family size was 3. Annual income of a respondent was measured in taka on the basis of his total yearly earnings from farming, livestock, fisheries and other sources (business, service, etc.). For measuring the knowledge on rice mill of a worker, a knowledge scale was developed. For this, each worker was asked 10 questions covering the different aspects of rice mill. Score of each question was 2, and the total score was 20. For correct responses to all the 10 questions, a worker could secure a total score of 20. Thus the total score could be 0 to 20. The total score indicated the knowledge of the worker on rice mill where zero (0) indicate no knowledge and 20 indicate very high knowledge on rice mill of a worker. Attitude of a worker was used to refer his/her feelings and actions towards rice mill. There were eight (8) statements (4 positive and 4 negative) related to rice mill. A statement was considered positive if it possessed an idea favorable towards rice mill and a statement was considered negative if it was unfavorable towards the rice mill. The respondents were asked to express their opinion in the form of strongly agree, agree, undecided, disagree and strongly disagree. A score of 4 was given to strongly agree, 3 to agree, 2 to undecided, 1 to disagree and 0 to strongly disagree whenever the statement was positive. A reverse scoring method was followed in case of negative statement such as 4 to strongly disagree, 3 to disagree, 2 to undecided, 1 to agree, and 0 to strongly agree. The sum total of the scores obtained by a respondent was his/her score for this variable. The scores of respondents could range from 0-32 while 0 indicate very unfavorable attitude, and 32 indicate highly favorable attitude towards rice mill.

The scores of respondents of the impact of rice mill pollution on nearbyenvironmentranged from 0-48 while 0 indicate very low impact, and 48 indicate highly impact of rice mill pollutions on nearby environment. It was measured by using questionnaire where a score of 4 was given to strongly agree, 3 to agree, 2 to undecided, 1 to disagree and 0 to strongly disagree whenever the statement was positive. The sum total of the scores obtained by a respondent was his/her score for this variable. Impact of rice mill pollution onnearbyagriculture was measured by using questionnaire where a score of 4 was given to strongly agree, 3 to agree, 2 to undecided, 1 to disagree and 0 to strongly disagree whenever the statement was positive. The sum total of the scores obtained by a respondent was his/her score for this variable. The respondent's scores range from 0 to 48. Score 0 indicate very low impact while the 48 indicate highly impact of rice mill pollutions on nearby agriculture. Impact of rice mill on nearby human health was measured by using 12 questions. The sum total of the scores obtained by a respondent was his/her score for this variable. This variable was measured by using questionnaire where a score of 4 was given to strongly agree, 3 to agree, 2 to undecided, 1 to disagree and 0 to strongly disagree whenever the statement was positive. The scores of respondents could range from 0-48 while 0 indicate very low impact, and 48 indicate highly impact of rice mill pollutions on nearby human health. An interview schedule was used as the data gathering instrument. The interview schedule was carefully prepared considering the objectives of the study. The interview schedule contained both open and closed form. Considering the selected characteristics of rice mill, easy and direct questions were included in the schedule to obtain necessary information. On the basis of pre-test, necessary corrections, alterations and

modifications were made before finalizing the interview schedule. The interview schedule was then printed in its final form and was multiplied for collecting data from the respondents. Accordingly, each question of the questionnaire was discussed in detail regarding its reason, measurement, concept, coverage and the reference period. Both English and Bangla version questionnaire were prepare but face to face interviews were conducted with household heads in Bangla language. To ensure high quality of the data, close supervision of enumerators was undertaken during the process of data collection.

2.3 Statistical analysis

The coded data were put into the computer for statistical analysis. The SPSS (SPSS Inc., Chicago, IL) computer program was used for analyzing the data. Various descriptive statistical measures such as frequency, number, %, age, mean and standard deviation were used for categorization and describing the variables. In addition thegraphs and tables were also used to interpret the finding.

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3. Results and Discussion

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1. Justify and interpret your research results with references
2. Compare your results with other articles

3.1 Annual Income

From Table 1, the result revealed that majority (30.77%) of the respondent belonged to high income as compared to 26.92% had medium income, 23.08% had very high income, 11.54% had low income, and only 7.69% had very low income. Generally higher income encourages one's integrity to achieve better performance and to show his/her individual better status in the society.

Table 1: Distribution of respondents according to their annual income

Categories	Respondents		Range ('000' taka)		Mean	Standard deviation
	No.	(%)	Min.	Max.		
Very low income (<15)	8	7.69				
Low income (15-25)	12	11.54				
Medium income (26-50)	28	26.92				
High income (51-75)	32	30.77	12	120	56.23	27.81
Very high income (>75)	24	23.08				
Total	104	100				

3.2 Organization participation

The score of the respondents varied from 1 to 20 against possible range 0 to 36 with an average of 13.87 and standard deviation of 4.50 regarding organizational participation. On the basis of observed scores, the respondents were classified into 3 categories such as low participation (5-11), medium participation (12-18) and high participation (above 18). Distribution of the respondents according to their organizational participation is presented in Table 2.

Table 2: Distribution of respondents according to their organizational participation

Categories	Respondents		Range		Mean	Standard deviation
	No.	(%)	Min.	Max.		
Low participation (5-11)	36	34.62				
Medium participation (12-18)	48	46.15	5	24	13.87	4.50
High participation (>18)	20	19.23				
Total	104	100				

3.3 Knowledge on rice mill

Knowledge on rice mill score of a respondent could range from 1 to 20 with the observed range from 4 to 19. The mean and standard deviation of knowledge was 12.92 and 3.47 respectively. On the basis of observed knowledge scores, the respondents were classified into three categories such as poor knowledge (4-9), moderate knowledge (10-15) and adequate knowledge (above 15). The distribution of the respondents according to their knowledge has been given in Table 3.

Table 3: Distribution of respondents according to their knowledge on rice mill

Categories	Respondents		Mean	Standard deviation
	No.	(%)		
Poor knowldge (4-9)	17	16.35	12.92	3.47
Moderate knowledge (10-15)	61	58.65		
Adequate knowledge (>15)	26	25.00		
Total	104	100		

Table 3 indicates that the moderate knowledge category constituted the highest proportion (58.65%) followed by adequate knowledge category (25.00%), and poor knowledge category (16.35%).

3.4 Attitude towards rice mill

Observed score of attitude towards rice mill of the respondents ranged from 8 to 30 against the possible range from 0 to 32. The mean and standard deviation of attitude towards rice mill was 16.35 and 5.94 respectively. On the basis of attitude towards rice mill scores, the respondents were classified into three categories such as low favorable attitude (8-15), medium favorable attitude (16-23) and high favorable attitude (above 23). The distribution of the respondents according to their attitude towards rice mill shows in Table 4.

Table 4: Distribution of respondents according to their attitude towards rice mill

Categories	Respondents		Mean	Standard deviation
	No.	(%)		
Low favorable attitude (8-15)	52	50.00	16.35	5.94
Medium favorable attitude (16-23)	36	34.62		
High favorable attitude (>23)	16	15.38		
Total	104	100		

Data presented in Table4 shows that half (50.00%) of the respondents had low favorable attitude towards rice mills where 34.62% had medium favorable attitude towards rice mills and only 15.38% had high favorable attitude towards rice mills.

3.5 Impact of rice mill based on distance

The impact of rice mill towards environmental, agriculture and health status at different distances viz. 0 m, 100 m, 500 m and 1000 m was measured on the basis of opinion score of the respondents about the effect and changes in three selected dimensions named environmental changes, agricultural changes and changes in health status of the respondents due to rice mill in that locality.

Respondent's perception on rice mill pollution: Observed opinion score of the respondents at 0 m, 100 m, 500 m and 1000 m towards the impact of rice mill ranged from 8-47, 9-47, 9-47 and 20-47 respectively against the possible range from 0 to 48. The total score indicated the score on impact of rice mill towards environment. Based on the observed scores the respondents were classified into three categories such as low impact (>20), medium impact (20-40) and high impact (above 40). Distribution of the respondents

according to impact of rice mill towards environment has been graphically presented in Figure 1.

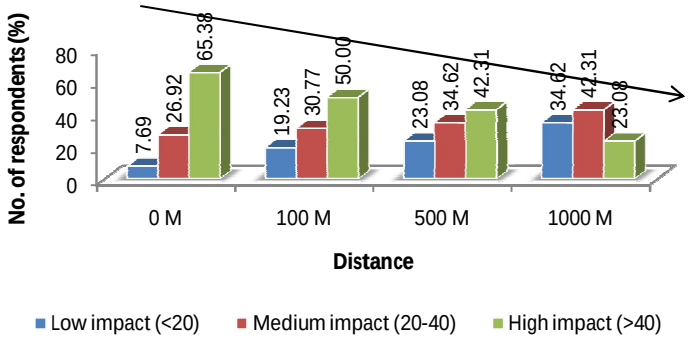

Fig. 1: Distribution of the respondents according to impact of rice mill towards environment at 0 m, 100 m, 500 m and 1000 m from rice mill

Rice mill pollution impact on agriculture: Observed opinion score of the respondents at 0 m, 100 m, 500 m and 1000 m towards the impact of rice mill ranged from 8-47, 9-47, 9-47 and 20-47 respectively against the possible range from 0 to 48. The total score indicated the score on impact of rice mill towards agriculture. Based on the observed scores the respondents were classified into three categories such as low impact (>20), medium impact (20-40) and high impact (above 40). Distribution of the respondents according to impact of rice mill towards agriculture has been graphically presented in Figure 2.

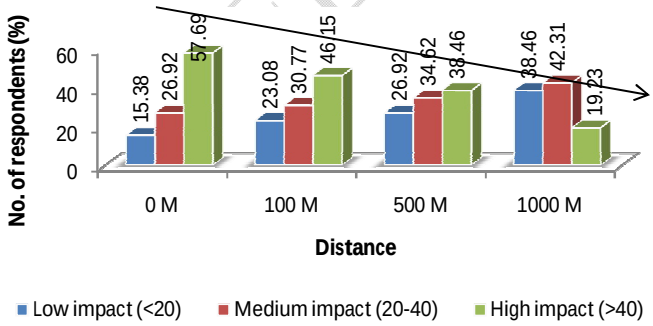

Fig. 2: Distribution of the respondents according to impact of rice mill towards agriculture at 0 m, 100 m, 500 m and 1000 m from rice mill

Rice mill pollution impact on health: Towards the impact of rice mill the observed opinion score of the respondents at 0 m, 100 m, 500 m and 1000 m ranged from 8-47, 9-47, 9-47 and 20-47 respectively against the possible range from 0 to 48. On impact of rice mill towards health status of the respondents the total score indicated the score. the respondents were classified into three categories such as low impact (>20), medium impact (20-40) and high impact (above 40) based on the observed scores. Dispersal of the respondents as stated by impact of rice mill towards health has been graphically shown in Figure 3.

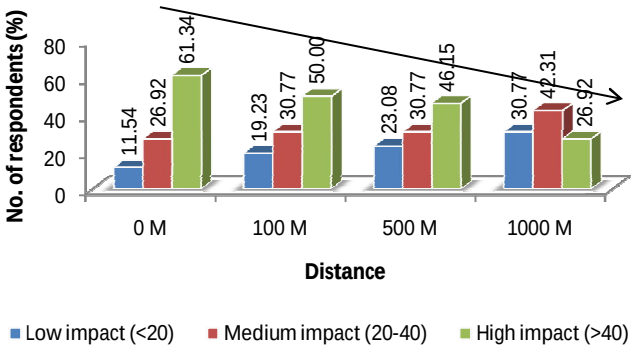

Fig. 3: Distribution of the respondents according to impact of rice mill towards health at 0 m, 100 m, 500 m and 1000 m from rice mill

The present study reveals that majority (30.77%) of the respondent belonged to high income, higher income encourages one's integrity to achieve better performance and to show his/her individual better status in the society as shown in Table 1, but in Table 2, it observed that the highest proportion (46.15%) of the respondents of the study area had medium organization participation, 34.62% of the respondents had low participation, and only 19.23% of the respondents had low participation. And the respondents had some knowledge on rice mill but that was not enough as data shown in Table 3. So, more organizational participation is need to increase knowledge and information about rice mill which help them to protect environmental pollution, and also protect them from health hazards.

The present study confirms that peoples are not satisfied in different activities of rice mill. As a result, half of them showed low favorable attitude towards rice mill (Table 4). In the study shows that (Figure 1) the highest respondents (65.38%) at 0 m from rice mill faced high impact of rice mill towards environment compared to 26.92% medium impact and only 7.69% faced low impact of rice mill towards environment. In case of 100 m distance from rice mill, half of the respondents (50.00%) faced high impact of rice mills towards environment compared to 30.77% medium impact and 19.23% faced low impact of rice mill towards environment. On the other hand, the highest respondents (42.31%) at 500 m from rice mill faced high impact of rice mill towards environment compared to 34.62% medium impact and 23.08% faced low impact of rice mill towards environment. But in case of 1000 m from rice mill, the highest respondents (65.38%) faced medium impact of rice mill towards environment compared to 34.62% low impact and only 23.08% faced high impact of rice mill towards environment. From our study shows that the pollution impact level is decreasing with the increasing of the distance from rice mill. Therefore, the highest pollution impact was found at 0 m whereas the lowest impact was found at 1000 m far from rice mill.

The present study shows that in Figure 2 the highest respondents (57.69%) at 0 m from rice mill faced high impact of rice mill towards agriculture compared to 26.92% medium impact and only 15.38% faced low impact of rice mill towards agriculture. In case of 100 m distance from rice mill, most of the respondents (46.15%) faced high impact of rice mill towards agriculture compared to 30.77% medium impact and 23.08% faced low impact of rice mill towards agriculture. On the other hand, the highest respondents (38.46%) at 500 m from rice mill faced high impact of rice mill towards agriculture compared to 34.62% medium impact and 26.92% faced low impact of rice mill towards agriculture. But in case of 1000 m from rice mill, the highest respondents (42.31%) faced medium impact of rice mill towards agriculture compared to 38.46% low impact and only 19.23% faced high impact of rice mill towards

agriculture. From the data it was clarify that the rice mill pollution impact level was decreasing with the increasing of the distance from rice mill. Therefore, the highest impact of rice mill on agriculture was found at 0 m whereas the lowest impact was found at 1000 m far from the rice mill. In this study the maximum respondents (61.34%) at 0 m from rice mill met great impact of rice mill towards health associated to 26.92% medium impact and only 11.54% faced low impact of rice mill towards health (Figure 3). In case of 100 m remoteness from rice mill, half of the respondents (50.00%) faced maximum impact of rice mill towards health compared to 30.77% medium impact and 19.23% faced low impact of rice mill towards health. On the contrary, at 500 m from rice mill, the uppermost respondents (46.15%) meet immense impact compared to 30.77% medium impact and 23.08 % faced low impact of rice mill towards health. But the highest respondents (42.31%) faced medium impact of rice mill towards health compared to 30.77% low impact and only 26.92% faced high impact of rice mill towards health in case of 1000m from rice mill.
Thus, overall results observed in this study we identified three major problems about the negative impacts of rice mill on the surrounding area. The first and most important problem is the environmental problem because it pollutes air by emitting dust particle, black smoke and bad odor in this study were also consistent with results by [14]. We identified the reduction of agricultural production as second problem. A negative impact of rice mill on nearby agricultural production was recorded because rice mills produce more CO_2, SO_2, dust particle, hot water etc. These hamper the agricultural production. Lastly, we identified health issues as a negative impact of rice mill. As rice mill pollutes sound as well as the air and water of the surrounding locality that tell upon human health. We recommend three probably solution of the identified problems. These are establishment of rice mill from the human locality (at least 0.5 km) along with using modern technology (modern chimney) for minimum emission and dispersion of ash and dust particle. They also told that proper management of discharged water of the rice mill should give prime priority. Proper transport management system of the goods of rice mill (ash, dust and husk etc. should keep in cover) also should give priority to reduce the pollution.

4. Conclusions

Based on the above findings, it can be concluded that the introduction and invasion of rice mills in an area can bring better economic benefits to the villagers. But this also brings many environmental, agricultural and health problems in the area. More specifically, it has had some negative impacts on the environment, agriculture and health of residents in the area near the Dinajpur Sadar Upazila rice mill. The pollution affect on agricultural productivity and human health was in highest category upto 500 meter away from the mill site and it was found in decreasing trend with the increase of distance. Therefore, the present study suggests that rice mill should be established at least more than half kilometer away from the human settlement and arable land to minimize the mill pollution hazards.

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