The Research Analytics
Volume 3, Special Issue 3, May 2026
ISSN (Online): 3107-6165

The Research Analytics
(A Peer Reviewed and Open Access Journal)

29

Assessment of Socio-Demographic Profile and Occupational health Risk of the Brick Kiln Workers in Dinajpur District, Bangladesh

Zahidul Islam[1], Jogesh Roy[2], Mahitosh Das[3]* & Sneha Swarup[4]

[1]Bangladesh Studies and Geography, Manarat Dhaka International College, Dhaka, Bangladesh
[2] ACTS International Graduate School, South Korea
[3]PG Department of Geography, Magadh University, Bodh Gaya, Bihar, India
[4]Department of Geography, S.S. College, Jehanabad, Bihar, India
*E-mail: mahitoshdas006@gmail.com
Page No. 367-382
DOI: https://doi.org/ 10.5281/zenodo.20408720

Abstract: *Brick kilns industries are one of the fastest-growing yet informally recognized sectors in Bangladesh, significantly contributing to both economic development and environmental degradation. However, these industries pose severe occupational health risks to workers, who often come from marginalized socio-economic backgrounds. This study aims to assess the socio-demographic status of brick kiln workers and analyze the occupational hazards they face. A field survey was conducted during November and December 2022, covering nine brick kilns in Bochaganj upazila (sub district) under the district of Dinajpur. Using a simple random sampling method, 100 workers were selected for the study. Descriptive statistical analysis was employed to evaluate the collected data. The findings reveal that 85% of the workforce consists of males with low level of formal education, while 84% of workers earn less than 7000 BDT per month. The study also identifies significant health concerns among the workers, with 30 % suffering from whooping cough, followed by both 18 % experiencing headaches and injuries. 12 % of them reported suffering from high blood pressure. To reduce the occupational health risks, the study underscores the necessity of stringent policy interventions, improved workplace monitoring and enhanced labour welfare initiatives at the government level.*

Keywords: Brick field, Brick field workers, Socio-Demographic status, Health Hazards, Dinajpur, Bangladesh

1. Introduction

In Bangladesh, fired brick fields are among the most essential building suppliers (Luby *et al.,* 2015). Bangladesh has ranked as the world's fourth-largest manufacturer of bricks (Rahman 2022). Approximately 8122 brick kilns can be found all over the country. Bangladesh manufactures between 23-32.4 billion bricks annually (Siddik *et al.,* 2021). Bangladesh's

expanding population will require the building of 4 million new homes annually (Barua *et al.,* 2010). About 8122 brickfields in Bangladesh are legal, but there are many more that are not. The unlawful brickfields lack the necessary equipment to operate and a valid license to maintain the field's integrity (Rahman, 2021).

Socio-Demographic status involves variables such as gender, age, income, education, employment, marital status, ethnicity etc. (Melgar *et al.,* 2010). In Bangladesh, every single economic, social, and other component is steadily rising over the years. Bangladesh's current GDP is 7.25%, and its per-capita income is around 2824 USD (BBS, 2022). Infrastructure development is one of the main problems across the nation as a result of the increasing macroeconomic stability. Bangladesh's construction sector has been growing at a pace of roughly 5.28% (Asadullah & Chakravorty, 2019). The construction industry has grown at a rate of roughly 5.28% during the past few years (Liu et al., 2023). Every infrastructure development endeavor starts with a brick. One percent of the nation's GDP is contributed by the brick industry, which also employs about 1 million people (Ahmed, 2019). Over 20 billion bricks may be produced annually in the existing brick kilns (Nath *et al.,* 2018). The Department of the Environment (DoE) and the Bangladesh Brick Making Owners Association (BBMOA) claim that new brick kilns were erected in 1930. In terms of lowering agricultural land, deforestation, air pollution, and GHG emissions, coupled with other social problems like labor rights and gender violence at work, this sector is currently seen as one of the alarming sectors (Hossain *et al.,* 2019). Total annual amount of CO_2 emission for six divisions: Dhaka, Chittagong, Rajshahi, Khulana, Sylhet and Barisal are 8.862 Mt/year, 10.048 Mt/year, 12.783 Mt/year, 15.250 Mt/year, in the year of 2002, 2005, 2007 and 2010, respectively. Humans are quite concerned about the percentage of CO_2 emissions that have increased geographically during the past ten years (Imran *et al.,* 2015).The greatest source of GHC emissions in the nation over the past few decades has reportedly been the brick industry (Saha & Hosain, 2016). Brick kilns are now responsible for 58% of all $PM_{2.5}$ pollution generated in the city of Dhaka. During the dry season, the proportions significantly higher (Khaliquzzaman *et al.,* 2020). The socio-demographic condition of brick kiln workers revealed that the majority of workers are male respondents with low education levels, with 91.79% getting monthly pay less than 15000 BDT and experiencing serious health and environmental challenges (Sajan *et al.,* 2017). A study found that 70% of respondents to a questionnaire survey 64% were male, and 36% were female, while 38% respondents were illiterate and 10% were graduates (Tusher *et al.,* 2019).

An enormous number of brick kilns are using firewood illegally as fuel. A study finds that, about 30% of Bangladesh's brick kilns are defective (Eil *et al.,* 2020). The current production of red bricks (clay burned) uses top soil from farms. Typically, the top soil the upper 6 to 24 inches of the agricultural field is needed for the traditional brick-making process (Fatema & Hossain, 2022). Research findings indicated that more than 100 core tones of agricultural topsoil are required for bricklaying every year. Everyday about 690 acre of agricultural land is transforming into non-agricultural land all over the country (Hossain et al., 2022). Brick field provide a livelihood for thousands of unskilled workers across the country. The seasonality of work attracts workers and landless farmers (Hossain *et al,* 2019). The demographic and health aspects of brick kiln workers are not clearly known from various published research papers and

book. As a result, ongoing research has been conducted to find out these issues. Thus this research attempts to show the scenario of the socio demographic status and health hazards of brick field workers.

The workers work long hours and do manual hard work in brick field. During work, they have to carry various heavy loads. Thus, they most often suffer from muscle raises (Guttikunda *et al.,* 2012). These disorders are caused by strenuous exercise, rigid working postures, frequent bending and twisting, lifting, pushing and pulling, repetitive tasks, vibrations and psychosocial stress (Das, 2014). Apart from these problems, workers suffer from various ailments such as skin allergies, eye irritation, tuberculosis and joint disease. They suffer from asthma, chronic obstructive pulmonary disease, silicosis, and more from exposure to dust particles (Hunashal, 2013). The majority of brick kiln workers in the proximity of these facilities were found to be affected by numerous illnesses, such asthma, weariness, headaches, eye irritation, and other conditions, indicating that the pollutants from brick kilns may be a contributing factor in these conditions (Saha *et al.,* 2020).

It was found that 14.3% of workers did not exhibit pale, chilly skin symptoms; but migrant workers employed temporarily exhibited the condition in 85.7% of cases, and fatigue symptoms were found in all cases when 82.2% of workers were assessed by brick kiln experts (Gogoi, & Hazarika, 2016). It was shown that a maximum 96.8% of responders had tinges on their hand's palms or their eye's conjunctiva, which indicated nutrient deficiencies, vitamin D deficits, iron shortcomings, headaches, common cold, diseases, insufficient sleep, and anemia (Gogoi, & Hazarika, 2016). There are usually no clean drinking water or sanitation facilities in all around brick field area (Saha *et al.,* 2020). Brick kilns lack the availability of normal medical amenities, clean drinking water, and sanitary facilities (Sajan *et al.,* 2017). The health of those who work in brick kilns is poor, with 96.7% indicating some sort of complaint, with musculoskeletal, respiratory, and skin issues being the most prevalent (Kazi & Bote, 2019). A research in South India discovered that 9.4% of brick kiln migrant workers experienced chest symptoms, with illiteracy, alcohol misuse, and excessive smoking being important risk factors (Thomas *et al.,* 2014). The brick kilns business in Pakistan releases toxic gasses that threaten human health and the environment, and it is advised that innovative technology be used to mitigate negative impacts and eliminate harmful emissions (Khan *et al.,* 2019).

Another study indicates that because of their dangerous working circumstances, over 11% of brick kiln workers have health issues; yet, only 7% of these workers are receiving care, and the remaining 4% do not have access to medical supplies or care (Kumari, 2018). According to the survey, asthmatic disease is one of the main factors affecting worker health, while other factors have a negative impact on local resident's health in brick kiln locations (Saha *et al.,* 2020). Brick kilns are used to prepare, process, and bake bricks. It offers employment in a variety of sub-occupations to practically everyone. The majority of brick manufacturing field workers are uneducated and from lower socio-economic strata (Kainth, 2009). Brick field workers do not receive appropriate payment or access to healthcare (Darain *et al.,* 2015). Brick field workers have poor dietary habits, and since they work in a challenging environment, they are highly susceptible to various health problems (Rizwan, 2021). The goal of this study is to examine the

socio-demographic status and health hazards of this unorganized sector. This research is to evaluate how brick fields affect the health of brick field workers, specifically their socio-demographic status and the factors that influence their health.

2. Methodology

This study employs a mixed-method approach, incorporating both primary and secondary data to comprehensively assess the socio-demographic status and occupational health hazards of brick kiln workers in Dinajpur District, Bangladesh. Primary data were collected through a structured questionnaire survey conducted during November and December 2022. Through the questionnaire survey, the socio-demographic status of the respondents, and their physical problems due to working in brick kilns were brought out. The final questionnaire is based on a compromise between the need for the data and the respondent's capacity to provide it. Certain statistical and operational factors, including the nature of the data sought the method of collection and the need for respondents' units to process and tabulate the data, were taken into account when designing the questionnaire.

2.1 Selection of study area and respondents

Brick making industry is currently a fast-growing sector in Bangladesh. It provides employment opportunities to people at a given time of the year. There were about 8122 brick fields in the country. Of these, there are only 45 hybrid Hoffmann and 86 tunnels Kilns. The rest were zigzag method (BBS, 2022). In the brick field a large amount of wood and coal is used as fuel. There are17 brick kilns in Bochaganj upazila (Sub-district) under Dinajpur district. Of them 9 Brick fields were selected in which nearly 10,000 public relations people who do their promotional work, both men and women make up the research population. Figure1 represents the Map of study area. Questionnaires of 100 workers of 9 brick kilns from Bochaganj upazila have been surveyed based on random selection from among these brick kilns.

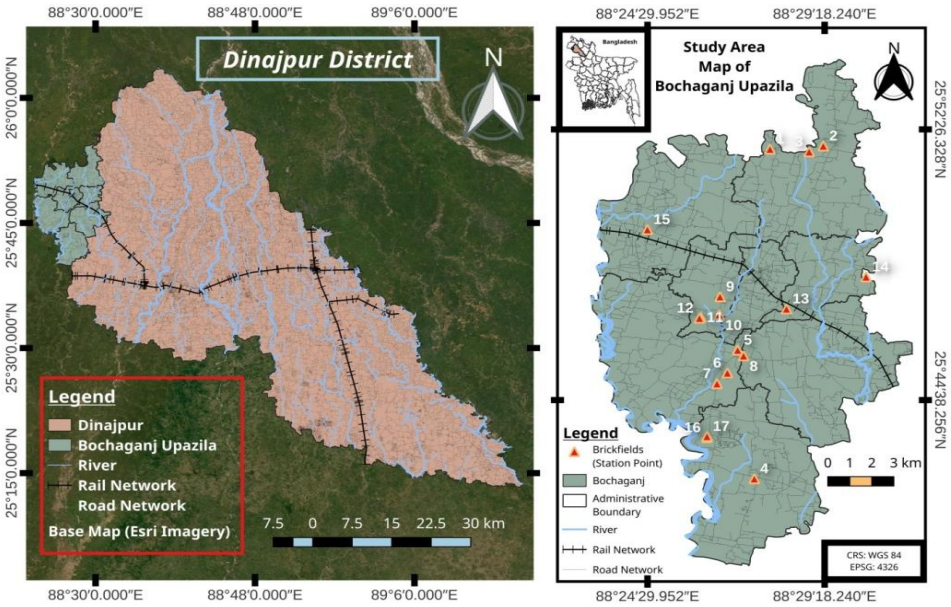


Fig. 1: Location Map of the study Area

2.2 Sampling technique and sample size

Data for the study were purposefully gathered from respondents who were working and available during the survey. There will be a random selection of 100 workers from the 9 distinct brick fields in the study region. The sample for this research was calculated using the 95% confidence level of Taro Yamane's formula (Yamane, 1973). The following is a demonstration of Taro Yamane's calculating formula.

$$n = \frac{N}{1 + Ne^2}$$

Where, N= Total population, e= Error and n= Sample size

Using the above formula, the calculated sample size of the research is 100. The following table presents the distribution of sample along with coordinates of the location of the brick field.

Table 1: Location of the Sample Site

Brick Field No	Latitude	Longitude	Respondent
1	25.864585	88.463713	12
3	25.863312	88.481439	11
5	25.768026	88.435231	12
7	25.751880,	88.439746	11
9	25.793657,	88.441109	11
12	25.783339,	88.431809	10
14	25.803202,	88.507170	11
16	25.725935,	88.435148	12
17	25.726546,	88.435231	10
Total			100

Source: Primary Data

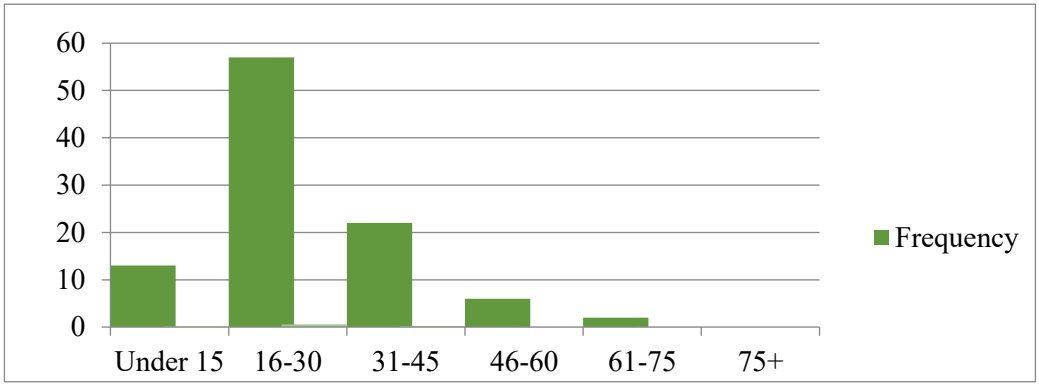
3. Results and discussion

3.1 Socio-demographic Status of the Bick Kilns workers

Age factor

Most of the responders in Bochaganj upazila were older than 16 years of age. 80% of the responders were in the 16 to 45 age range. 8% of responders were in the 46–75 age range. A large number of young individuals are obliged to work in this dangerous profession due to severe unemployment and poor levels of education. The age ranges of (61-75) and (75+) are represented by 2% and 0%, respectively (Figure 2).

A study by Gogoi and Hazarika (2015) showed that 56.3 % of the workers in brick kilns are between 31 and 60 years of age. Besides, 19 to 30 years old workers are 34.2 %. A study finding show that the highest number of respondents (41.79%) belonged to the age of group 31-35 years, followed by the age group of 26-30 (31.59%), 36-40 (19.15%), 20-25 (5.72%) and only 1.74% of male respondents were more than 40 years (Sajan *et al.,* 2017)

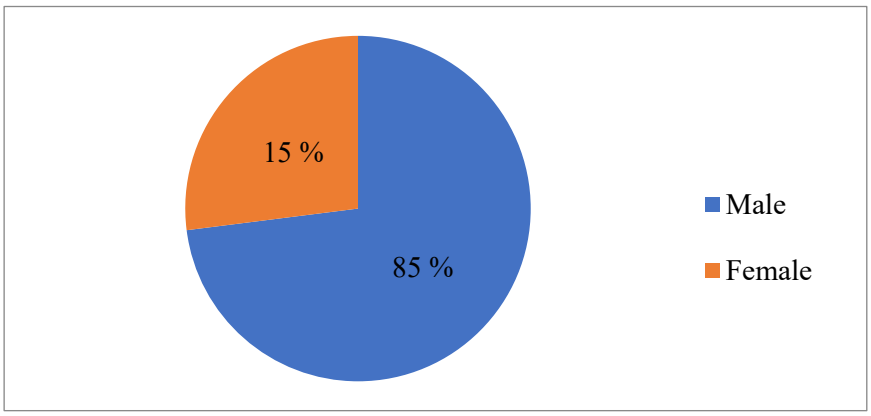


Source: Primary Data

Fig. 2: Age Factor

Sex factor

According to the figure 3, men make up the majority of responders (85%), while women make up 15%. Working in the brick industry requires physical strength and the right kind of energy to endure the hard conditions. Because women are inherently weaker than men, this job targets a relatively small number of women. A study by Gogoi and Hazarika (2015) also found that 87.9 % were male and 12.1 % were female. Another study on brick field workers health of 402 interviewees contained 269 (66.92%) males and 133 (33.08%) females, ranging in age from 20 to >40 years (Sajan *et al.,* 2017).



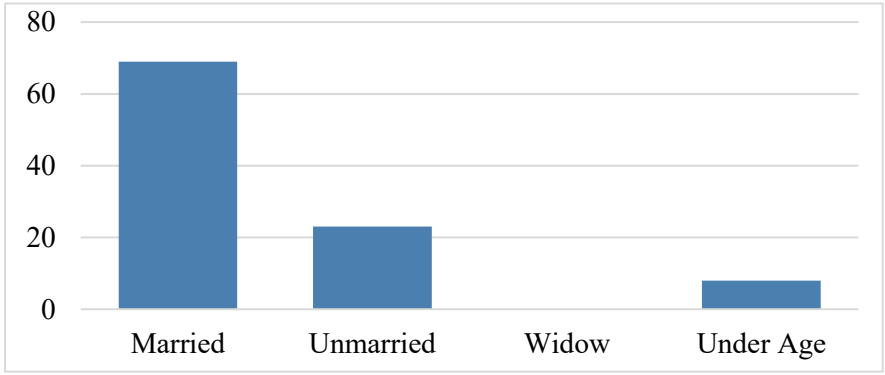
Source: Primary Data

Fig. 3: Sex Factor

Marital status

With a few exceptions, the majority of responders in the study population are married. Due to a lack of education and appropriate social awareness, the majority of respondents (65%) don't have any proper knowledge regarding marriage. Additionally, they typically originated from rural areas where early marriage is a widespread practice. From the data on marriage, about 8 percent of the respondents got married before the appropriate age which is called under age marriage (Figure 4).

ISSN (Online): 3107-6165

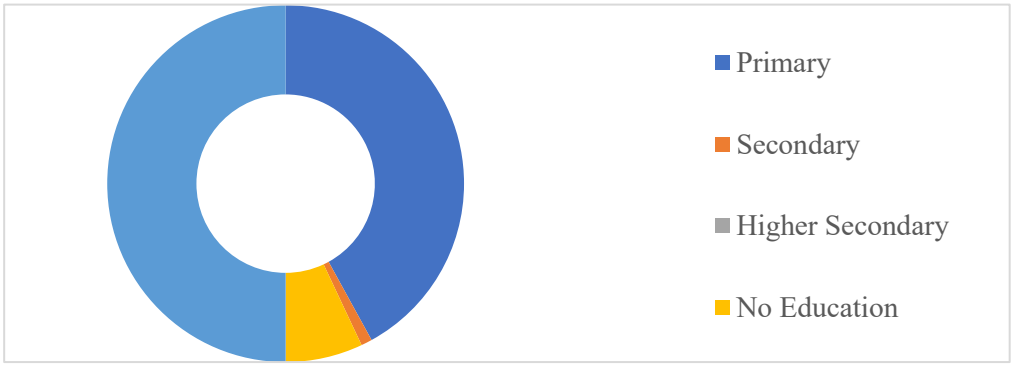


Source: Primary Data

Fig. 4: Marital Status of the Respondents

Educational Status

According to field survey, 84% of the respondents have basic level education, with the exception of 14% of respondents who are illiterate (Figure 5). Another study on the brick field workers health found that 9.7% of the sampled workers were uneducated and pursued primary (72.64%) and secondary (17.66%) levels of study (Sajan *et al.,* 2017)



Source: Primary Data

Fig. 5: Education Qualification of the Respondents

Main Occupational Status

When the respondent had no option to work in the brick field, majority of them worked as farmers. Workers work in brick kilns for 3 to 4 months a year. During the remaining months of the year, they are busy with various economic activities. 57 % of them are engaged in agriculture. Apart from this, thirty percent people work as day labor. Rest of them earns their living as housewives, fishermen or business (Table 2).

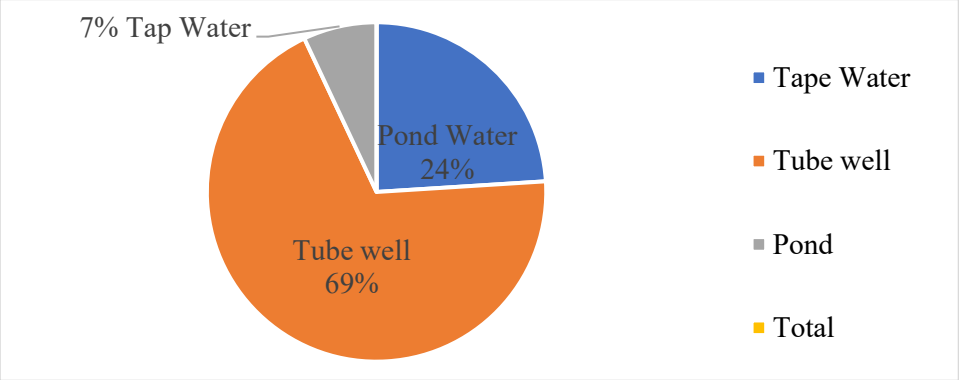
Table 2: Occupation Types

Occupation	Frequency	Percentage
Agriculture	57	57%
Business	3	3%
Day labor	30	30%
Housewife	5	5%
Fisherman	5	5%
Total	100	100%

Source: Primary Data

Availability of Drinking Water

The majority (69%) of drinking water comes from tube wells. The workers source of drinking water is a tube well, which is almost always present in brick fields. And the workers use neighboring ponds and tap water for bathing and washing, which equals 24% and 7%, respectively (Figure 6). In a study on the effect of brick industry on water, total solids, dissolved oxygen, Calcium, hardness, and total hardness were estimated. These were found in significant quantities in the water around the brick fields (Khan, & Vyas, 2008). Another study found that majority of workers (98.01 %) do not have access to clean water and (90.80 %) do not have proper sanitation facilities (Sajan, *et al.,* 2017).



Source: Primary Data

Fig. 6: Drinking Water Availability

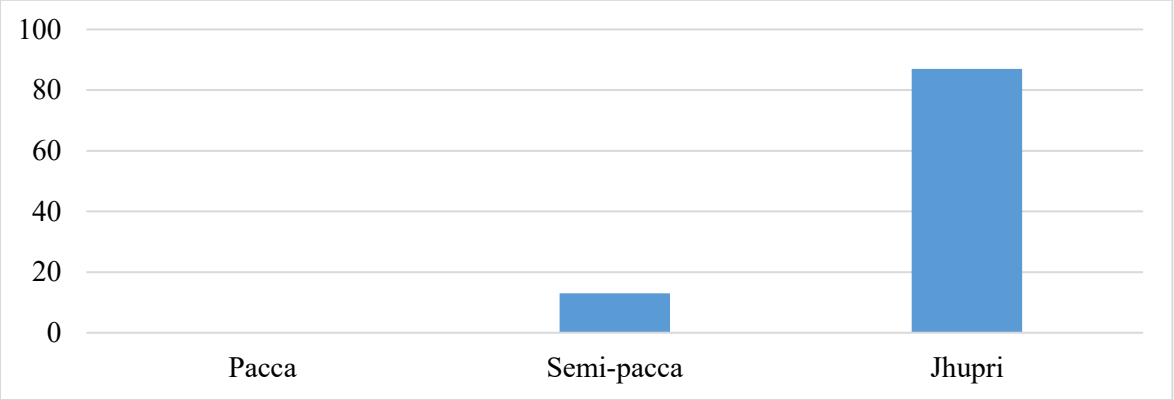
A study by the International Agency for Research on Cancer found sulfur dioxide in water sources around brick kilns. Ingestion of these SO_2 amplified pulmonary resistance, and changes

ISSN (Online): 3107-6165

in metabolism, resulting in chronic exposure to inflammation and increased secretion of mucosal tissues which causes cancer (WHO, 1979; Toyokuni *et al.,* 2017). In a study on the effect of brick industry on water, total solids, dissolved oxygen, Calcium, hardness, and total hardness were estimated. These were found in significant quantities in the water around the brick fields (Khan & Vyas, 2008). Another study found that majority of workers (98.01 %) do not have access to clean water and (90.80 %) do not have proper sanitation facilities (Sajan *et al.,* 2017).

Availability of Sanitary Systems

Modern sanitary systems are not present in brick field's area. The majority (88%) of brick workers lack access to contemporary sanitary facilities. They consequently experience a variety of illnesses that are directly related to sanitary systems. Nearly 88% of the respondents complained about having to use the Jhupri type toilet every day. A single toilet is used by numerous individuals (Figure 7). According to a survey, the majority of workers reside in subpar home with an unhealthy (Jhupri) environment (Sajan *et al.,* 2017).



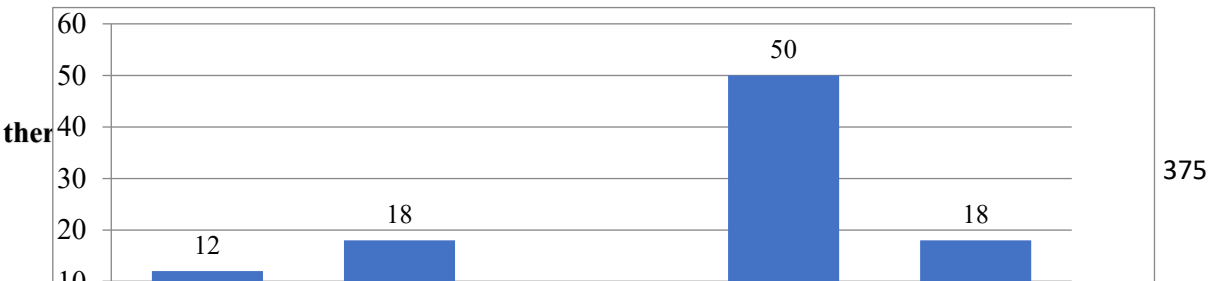
Source: Primary Data

Fig. 7: Sanitary Systems of the Respondents

4. Causes and Incidence of Disease among Brick Field Workers

4.1 Causes of Diseases

According to the results of field survey, roughly 50% of the study area is afflicted with ailments brought on by dust and sand. They are used to work in and dust environment. In addition, 18% of the respondents reported health problems due to incaution and sound. Moreover, some blamed work pressure and poor sanitation (Figure 8). Based on research conducted in developing nations, brick kilns burn tires, fuel gas, and coal. These sources of air pollution include CO_X, SO_X, NO_X, and suspended particulate matter, all of which have negative health effects on people (Ismail *et al.,* 2012).

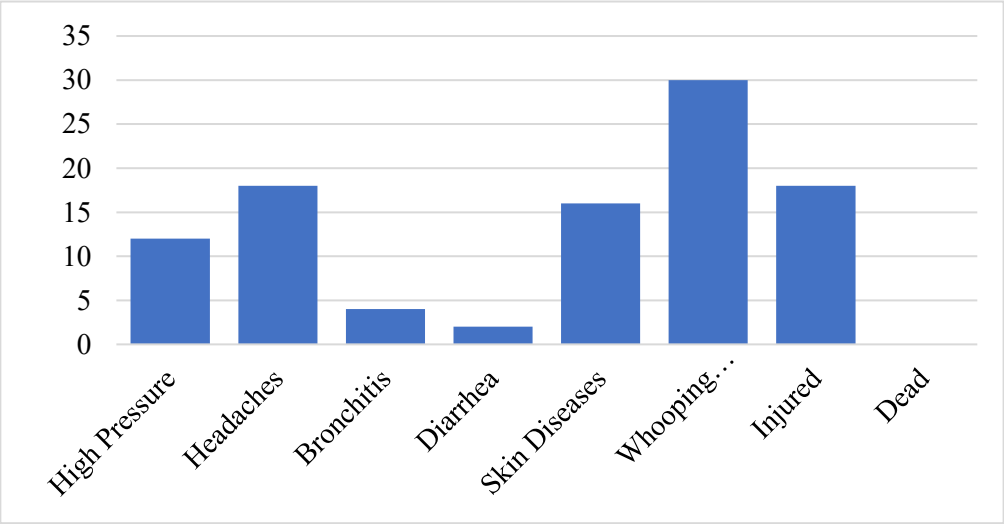


Source: Primary Data

Fig. 8: Causes of Diseases

4.2 Impact of Brick Field on worker's Health

Field Survey findings indicate that, workers are most affected by whooping cough (30 %). Headaches and injuries at work accounted for 18 percent of cases. Besides, 16 percent of skin diseases, 12 percent of high blood pressure, 4 percent of bronchitis and 2 percent of diarrhea cases are recorded (Figure 9).



Source: Primary Data

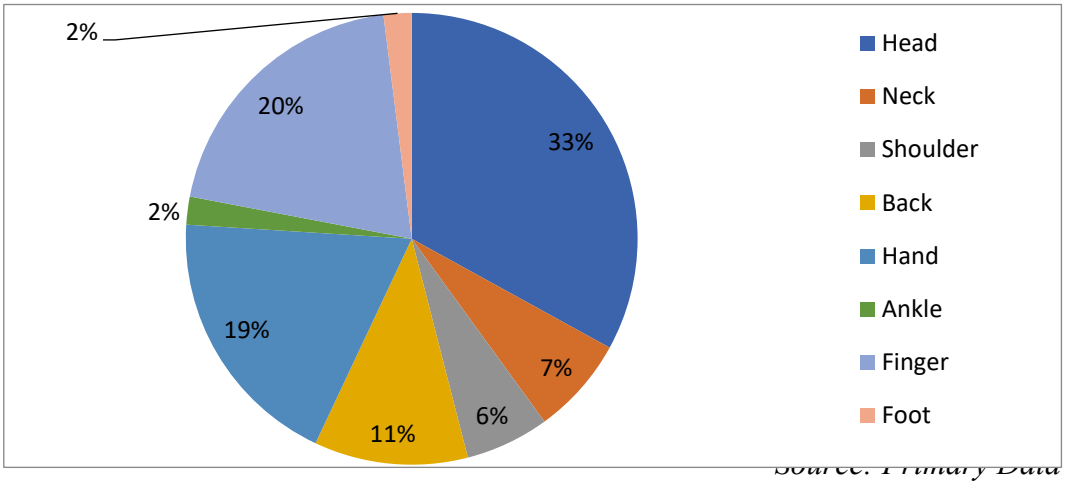
Fig. 9: Consequence of Disease in Brick Fields

A study on brick field in Indian perspective reveals that 21% of respondents had stage 1 hypertension, 7.3% had hypotension, and 6.2 % had stage 2 hypertension, whereas 33.7 % of respondents had prehypertension, 31.8 % had desirable or normal blood pressure (Gogoi1 & Hazarika, 2015). In this study 27.2% of respondents reported not having a fever, cold, or cough, while 72.8% of respondents reported having these illnesses. Their results found that, 50.4% of the respondents reported having a persistent cough that was accompanied by chest pain and sputum that had bronchitis symptoms. 49.6% of respondents said they had not noticed any bronchitis symptoms. Before starting work in the brickfield, 75.2% of the respondents had

diarrhea. However, 24.8% of the respondents claimed that they did so either before or after reporting for duty didn't experience diarrhea. 86 % of the respondents reported having skin conditions, while the remaining 14 percent had no complaints. The majority of respiratory illnesses and symptoms are caused by occupational risk factors, and lung disease accounted for 29.6% of workers with chronic obstructive pulmonary disease. Nasal congestion affected 68.7% of the respondents. In addition, 32.1% of respondents reported experiencing physical harm as a result of mishaps during work in brick kilns. After starting work in brick kilns, seasonal illnesses struck 77.6% of the workforce. Another study found that, Ninety five percent (95%) of respondents from the affected area reported having a respiratory illness or the common cold within the previous 12 months. 36% of respondents in the control region and 72% of respondents in the brick kiln area believed that the diseases were caused by brick kilns, respectively (Joshi, & Dudani, 2008). Another study shows that skin diseases and eye problems of the workers are 10% and this number is increasing day by day (Jerin, et al., 2017). Skin diseases, asthma, headaches problem are common disease among the workers and the residents lived nearby of brick field. Joshi & Dudani's health survey in Nepal clearly demonstrated that residents who live close to brick kilns are more likely to have illnesses brought on by kiln pollution than those who live farther away (Joshi & Dudani, 2008).

4.3 Injuries among the brickfield Workers

A large proportion (16%) of the respondents suffered head injuries while working in brick fields. Fingers and hands were injured rate same like as 10%. They also suffered neck, backbone, shoulder, ankle, back, and foot spinal, hip, and foot injuries during work which percentages are refer to the figure separately (Figure 10).



Source: Primary Data

Fig. 10: Types of Injuries

About 20% of brick field workers experience back and muscular pain, and as the hands and feet are the primary body parts that enable workers to retain their range of motion during activities, these organs are harmed as a result (Rizwan, 2021). A study showed that in case of injury of the brick field workers, hands (59%), legs 53 percent, knees 19 percent were injured.

Apart from these organs like neck, shoulder, knee, wrist, finger, ear, hip, elbow, back and ankle also suffered during working at brick field (Sajan, *et al.,* 2017).

4.4 Initiatives for the Improvement of Brick Filed Worker's Health Condition:

According to the field survey data, if the workers get any illness or injury, in most cases they have to get treatment at their own expense or at their own initiative (85%). In this case, among others, the owners of brick field's help in some cases (10%) with some money and some NGOs (5%) take the initiative to provide treatment. The owner is not concerned with the physical improvement of the brick field laborers. Some NGOs assist the workers with their medical needs. Survey findings confirm 10% of the workers receive care from the owners. 85% of the employees are responsible for covering their own medical expenses. Owners of brick factories do not care about worker's living standards. A study found that nearly 90% of brick field workers do not have health insurance. As a result, if they suffer any accident during work, they have to pay the medical expenses on their own. This affects the family's income. Brick field owners do not take any plans or initiatives to take care of their workers. There were very few workers who benefited from the government at various times (Saha, *et al.,* 2020). This research shows that brick field workers do not have health insurance. So, those who are injured are treated at their own expense. As a result, their families are also suffering financial losses.

5. Conclusion

The rate of brick production is increasing day by day due to rapid population growth all over the world. This increase in the rate of brick production is detrimental to the human health, environment, society and economy of the country due to its harmful effects. The demands of bricks for building new infrastructure will tend to increase in future. The study found that among the respondents, males were more (85%) than females working in the bricklaying. In terms of age, most (90%) workers are between 16 to 45 years old. Number of married men 65%) is higher than all others. Moreover, 84% of their education is up to primary level and a large proportion of them are involved in agriculture during the rest of the year. Regarding the availability of drinking water, 69% of them drink water from tube wells and their sanitation system is very unhealthy. Incidence of whooping cough occurs 30% among brick field workers, headache and injury in 18 %. Besides, 16 percent of skin diseases, 12% of high blood pressure, 4 % of bronchitis and 2 % of diarrhea cases are recorded. Dust-sand and sound pollution have been found to be the cause of these diseases. Brick field workers (33%) suffered also head injuries followed by 20% hands and 19% fingers respectively.

The findings also indicate that in most cases (85%) if injured, they get treatment at their own expense. Government agencies such as the Department of Environment (DOE) should also set standards and limits for harmful smoke emission rates from brick kilns. These efforts by the Government of Bangladesh and brick kiln owners will help control the harmful effects which in turn will help reduce the damage to the environment and human health. Initiatives for reducing health impact and injuries to body must be taken in the brick field industries. Relevant policies are urgently required in this regard.

References

Ahmed, S. (2019). *Energy efficient brick kilns for sustainable environment*. http://dspace.bracu.ac.bd/xmlui/handle/10361/12344

Asadullah, M. N., & Chakravorty, N. N. T. (2019, May 4). Growth, governance and corruption in Bangladesh: a re-assessment. *Third World Quarterly*, *40*(5), 947–965. https://doi.org/10.1080/01436597.2019.1599854

Bangladesh Bureau of Statistics (BBS). (2022). *Bangladesh Selected Statistics 2022*. www.bbs.gob.bd. Retrieved January 14, 2023, from http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b343a8b4_956b_45ca_872f_4cf9b2f1a6e0/2022-09-01-08-35-0535fd609d0c3666dd0c9e5cffb48d9b.pdf

Barua, S., Haider, A., Mridha, A. M., & Khan, R. H. (2010). Housing real estate sector in Bangladesh present status and policies implications. *ASA University Review*.

Darain, K. M. U., Jumaat, M. Z., Islam, A. S., Obaydullah, M., Iqbal, A., Adham, M. I., & Rahman, M. M. (2015, April 9). Energy efficient brick kilns for sustainable environment. *Desalination and Water Treatment*, 1–10. https://doi.org/10.1080/19443994.2015.1012335

Das, B. (2014, January 1). Assessment of occupational health problems and physiological stress among the brick field workers of West Bengal, India. *International Journal of Occupational Medicine and Environmental Health*, *27*(3). https://doi.org/10.2478/s13382-014-0262-z

Eil, A., Li, J., Baral, P., & Saikawa, E. (2020, April 1). *Dirty Stacks, High Stakes*. World Bank, Washington, DC eBooks. https://doi.org/10.1596/33727

Fatema, K., & Hossain, I. (2022, February 7). Utilization of riverbed silt and subsoil of Gopalganj for masonry bricks incorporating internal fuel and comparison of their construction properties with commercial bricks. *Innovative Infrastructure Solutions*, *7*(2). https://doi.org/10.1007/s41062-022-00745-8

Gogoi, B., & Hazarika, J. (2016). An assessment of health status of seasonal migrant brick kiln workers of Jorhat district of Assam. *International Journal of Science and Research (IJSR)*, *5*(12).

Guttikunda, S. K., Begum, B. A., & Wadud, Z. (2012, October 5). Particulate pollution from brick kiln clusters in the Greater Dhaka region, Bangladesh. *Air Quality, Atmosphere & Health*, *6*(2), 357–365. https://doi.org/10.1007/s11869-012-0187-2

Hossain, M. A., Zahid, A. M., Arifunnahar, M., & Siddique, M. N. A. (2019). Effect of brick kiln on arable land degradation, environmental pollution and consequences on livelihood of Bangladesh. *Journal of Science Technology and Environment Informatics*, *6*(2), 474–488. https://doi.org/10.18801/jstei.060219.50

Hossain, M. S., Islam, M. N., Rahman, M. M., Mostofa, M. G., & Khan, M. A. R. (2022, June). Sorghum: A prospective crop for climatic vulnerability, food and nutritional security. *Journal of Agriculture and Food Research*, *8*, 100300. https://doi.org/10.1016/j.jafr.2022.100300

Imran, M., Baten, M., Nahar, B., & Morshed, N. (2015, March 20). Carbon dioxide emission from brickfields around Bangladesh. *International Journal of Agricultural Research, Innovation and Technology*, *4*(2), 70–75. https://doi.org/10.3329/ijarit.v4i2.22653

Ismail, M., Muhammad. , Khan, F. U., Munsif, F., Ahmed , T., & Ali, S. (2012). Effect of Brick Kilns Emissions on Heavy Metal (Cd and Cr) Content of Contiguous Soil and Plants. *Sarhad Journal of Agriculture*, *28*, 165–170.

Jerin, M., Mondol, S., Sarker, B., Rimi, R., & Aktar, S. (2017, April 14). Impacts of Brick Fields on Environment and Social Economy at Bagatipara, Natore, Bangladesh. *Journal of Environmental Science and Natural Resources*, *9*(2), 31–34. https://doi.org/10.3329/jesnr.v9i2.32148

Joshi, S. K., & D, I. (2008). Environmental health effects of brick kilns in Kathmandu valley. *Kathmandu University Medical Journal*, *6*(1), 3–11.

Kainth, . (2009). Push Pull Factors of Migration: A case of Brick Kiln industry of Punjab State. *Asian-Specific Journal of Social Sciences*.

Kazi, R. N., & Bote, M. M. (2019, November 27). A cross sectional study to determine the health profile of brick kiln workers. *International Journal of Community Medicine and Public Health*, *6*(12), 5135. https://doi.org/10.18203/2394-6040.ijcmph20195458

Khaliquzzaman, M., Sesha Harinath, A., Ahmed Ferdousi, S., & Mohammed Munjurul Hannan Khan, S. (2020). Thirty Years' Quest for Emission Reduction and Energy Efficiency Improvement of Brick Kilns in Bangladesh. *International Journal of Environmental Monitoring and Analysis*, *8*(1), 11. https://doi.org/10.11648/j.ijema.20200801.12

Khan, M. W., Ali, Y., De Felice, F., Salman, A., & Petrillo, A. (2019, August). Impact of brick kilns industry on environment and human health in Pakistan. *Science of the Total Environment*, *678*, 383–389. https://doi.org/10.1016/j.scitotenv.2019.04.369

Khan, R., & Vyas, H. (2008). A study of impact of brick industries on environment and human health in Ujjain city (India). *Journal of Environmental Research and Development*, *2*(3), 421–425.

Kumari, S. (2018). Occupational health of brick workers of India. *International Journal of Health Sciences & Research*, *8*(9), 183–189.

Liu, T., Dai, J., Zhao, Y., Tian, S., Nie, Z., & Ye, C. (2023, July). Using remote sensing technology to monitor salt lake changes caused by climate change and melting glaciers: insights from Zabuye Salt Lake in Xizang. *Journal of Oceanology and Limnology*, *41*(4), 1258–1276. https://doi.org/10.1007/s00343-022-2138-6

Luby, S. P., Biswas, D., Gurley, E. S., & Hossain, I. (2015, October). Why highly polluting methods are used to manufacture bricks in Bangladesh. *Energy for Sustainable Development*, *28*, 68–74. https://doi.org/10.1016/j.esd.2015.07.003

Melgar, N., Rossi, M., & Smith, T. W. (2010, March 1). The Perception of Corruption. *International Journal of Public Opinion Research*, *22*(1), 120–131. https://doi.org/10.1093/ijpor/edp058

Nath, A. J., Lal, R., & Das, A. K. (2018, April). Fired Bricks: CO2 Emission and Food Insecurity. *Global Challenges*, *2*(4). https://doi.org/10.1002/gch2.201700115

Rahman, A. M. (2021). CO2 Emission from Brickfields in Bangladesh: Can Ethical Responsibility by Doing Reduce Level of Emission. *Athens Journal of Social Sciences*, *8*, 1–17.

Rahman, A. M. (2022, January 12). CO2 Emission from Brickfields in Bangladesh: Can Ethical Responsibility by Doing Reduce Level of Emission? *ATHENS JOURNAL OF SOCIAL SCIENCES*, *9*(3), 255–272. https://doi.org/10.30958/ajss.9-3-3

Rizwan, A. A. (2021). *Food habit and health problems among brick field workers in Coxâ€™s Bazar district, Bangladesh*. https://EconPapers.repec.org/RePEc:aif:journl:v:5:y:2021:i:9:p:112-117

Saha, C. K., & Hosain, J. (2016, June 8). Impact of brick kilning industry in peri-urban Bangladesh. *International Journal of Environmental Studies*, *73*(4), 491–501. https://doi.org/10.1080/00207233.2016.1179014

Saha, M. K., Ahmed, S. J., Sheikh, M. A. H., & Mostafa, M. G. (2020, September 21). Occupational and environmental health hazards in Brick Kilns. *Journal of Air Pollution and Health*. https://doi.org/10.18502/japh.v5i2.4242

Saha, M. K., Ahmed, S. J., Sheikh, M. A. H., & Mostafa, M. G. (2020, September 21). Occupational and environmental health hazards in Brick Kilns. *Journal of Air Pollution and Health*. https://doi.org/10.18502/japh.v5i2.4242

Sajan, D., Md., S. Q. H., Rumana, A., Sumaiya, H., Sumana, K., Md., Z. H. G., & Mohammad, S. (2017, July 31). Socioeconomic conditions and health hazards of brick field workers: A case study of Mymensingh brick industrial area of Bangladesh. *Journal of Public Health and Epidemiology*, *9*(7), 198–205. https://doi.org/10.5897/jphe2017.0927

Siddik, M., Bakar, A., Hannan, M., & Mou, M. A. (2021). Environmental Pollution by Brick Kiln in Bangladesh: An Analysis of the Existing Legal Framework. .

Thomas, B. E., Charles, N., Watson, B., Chandrasekaran, V., Senthil Kumar, R., Dhanalakshmi, A., Wares, F., & Swaminathan, S. (2014, December 23). Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour: a study from South India. *Journal of Public Health*, fdu104. https://doi.org/10.1093/pubmed/fdu104

ISSN (Online): 3107-6165

Toyokuni, S., Ito, F., Yamashita, K., Okazaki, Y., & Akatsuka, S. (2017, July). Iron and thiol redox signaling in cancer: An exquisite balance to escape ferroptosis. *Free Radical Biology and Medicine*, *108*, 610–626. https://doi.org/10.1016/j.freeradbiomed.2017.04.024

Tusher, T. R., Ashraf, Z., & Akter, S. (2019, July 17). Health effects of brick kiln operations: A study on largest brick kiln cluster in Bangladesh. *South East Asia Journal of Public Health*, *8*(1), 32–36. https://doi.org/10.3329/seajph.v8i1.42270

World Health Organization (WHO),. (1979, January 1). *Sulfur Oxides and Suspended Particulate Matter*. WHO Publications Centre.

Yamane, T. (1973). *Statistics: An Introductory Analysis*. Harper Collins Publishers.