

IMPACTS OF BRICKFIELDS ON ENVIRONMENT AND ASSESSMENT OF ENVIRONMENTAL LAWS: A CASE STUDY OF PABNA SADAR UPAZILA IN BANGLADESH

Ayesha Siddika^{*1}, Ritu Saha², Farhana Tanvin³, Kh. Zubaida Gulshan⁴ and Md. Sohel Rana⁵

¹Lecturer, Pabna University of Science and Technology, Bangladesh, e-mail: ayesha.shammy@gmail.com

²Student, Pabna University of Science and Technology, Bangladesh, e-mail: ritusaha.pust.bd@gmail.com

³Student, Pabna University of Science and Technology, Bangladesh, e-mail: e72055494@gmail.com

⁴Student, Pabna University of Science and Technology, Bangladesh, e-mail: tabassumtayeba5@gmail.com

⁵Student, Pabna University of Science and Technology, Bangladesh, e-mail: eclipsesohel@gmail.com

***Corresponding Author**

ABSTRACT

Building Structures and major construction works are booming in both the urban and rural areas in Bangladesh. Brick is an essential construction material for building structures. To meet the excessive demand of bricks, there are many brickfields are growing sporadically here and there at the fringe zones and rural areas. The purpose of this study is to investigate environmental impacts of brickfields and assess the environmental legal guidelines in Bangladesh. Pabna Sadar Upazila has been selected as the study area because of its rapidly changing population density, socioeconomic phenomena and industrial and environmental concerns. At present, 45 brickfields are located in the study area. This study is based on randomly selected respondents' perception on change of any resource or condition of environment and assessment of Brick manufacturing and Brickfield Establishment Act 2013 and Environment Conservation Rule 1997. Primary data is collected in three ways such as reconnaissance Survey, questionnaire survey, interviews, FGD and photography. All these data were collected to the selected community members living near the brickfields. The sources of secondary data were high-resolution satellite images in Google Earth, BBS, official documents and so on. Impacts on soil fertility, agricultural production, vegetation, fish culture, health status were assessed on the answer of respondents. Different types of software tools like Microsoft Excel program, SPSS have been helped to analyze data digitally and utilized to produce this paper. From the study, it was found that most of the brickfields of the study area were located near agricultural lands and residential areas those were responsible for loss of agricultural production, fish cultivation, local community's health problems and violation of environmental laws specifically Brick Burning Acts in great extent. Improving technology, development of policy and proper regulations of this act may be the best recommendation for the betterment of urban and rural environment.

Keywords: *Brickfields, Agriculture, Aquaculture, Environmental pollution, Environmental laws.*

1. INTRODUCTION

The population of Bangladesh is 158.9 million with a growth rate of 1.37 and a total number of establishments are 78, 18,565. The population density of Bangladesh is 1,106 per km (BBS, 2015). This vast amount of population and growing economic sectors lead the construction sectors in the country. The demand for building materials is very high at the moment of Bangladesh because of a large number of government projects as well as individual usage (The Daily Star, 2019). Rapid urbanization, industrialization and construction of buildings in Bangladesh use bricks from several past decades. This has reinforced brick manufacturing industry a fastest growing sector (Saha & Hossain, 2016). UNDP reported that Bangladesh manufactures 1,200 crore of bricks each year for the rapid urbanization rate (7-8%) in medium and large cities (UNDP, 2011). There are approximately 6637 traditional and modern brickfields are currently operating brickfields in Bangladesh. According to the report of the Bangladesh Centre for Advance Studies (BCAS), only 735 of these brickfields follow the new regulations. According to the BCAS, 1,745 of the brickfields in Bangladesh begin operations before obtaining a license (Ahmed, 2019). Nearly 90 percent of the brick-makers have not updated their production process in keeping with new environmental regulations on the fuel (Faisal, 2016). Nearly 23 billion bricks are produced annually in traditional brickfields of Bangladesh by mining an estimated 3350 million cubic feet of soft clay, and burning 5.67 million tons of coal and 3 million tons of firewood (DoE, 2017). In absence of natural sources of stones and climate consideration, bricks are mostly used in the country. In traditional brickfields, bricks are produced from clay and then fired in the kiln. But brick kilns location in agricultural lands, low quality wooden for burning of bricks, improper fixed chimneys and the violation of laws to conserve environment is leading this sector into a major cause of agricultural productivity decline, pollution of environments and hazards towards human health (Guttikunda & Khaliqzaman, 2014).

Pabna is the oldest district in Bangladesh under the Rajshahi division. Many old architectural symbols like Pabna Mental Hospital, Hardinge Bridge, Jor-bangla temple and so on that are made by brick. There are 96 brickfields in Pabna district. Among of them, 76 brickfields are illegal. Without the license, workers of these industries used fuel as wood and tire for the production of brick. Most of the brickfields are located near agricultural fields and adjacent of roads (Desh Rupantor, 2019).

A few articles were found on impacts of brickfields and no specific papers that have been found on the assessment of environmental laws in Pabna Sadar Upazila. It is assumed that the following gaps of the research should be filled to reach the goal of this research. That's why Pabna Sadar Upazila is selected as the study area. The resulting conclusion will be helpful for policymakers and responsible authority toward defining adaptive measures and taken steps against on illegal actions of brickfield owners. This study is analysed based on the changes of environmental aspects what the respondents observed before and after establishment of brickfields around them and location of brickfields and burning process of bricks are assessed on the basis of field observation, gazette of Brick Manufacturing and Brick Kiln Establishment Act 2013, Brick Manufacturing and Brick Kiln Establishment Act 2019 and Environmental Conservation Rule 1997. The objectives of this research are:

1. To find out negative or positive effects of brickfields on soil fertility, agriculture, aquaculture, vegetation and health status of residents if the study area based on field observation and answer of the respondents.
2. To evaluate the environmental laws and their post-construction environmental effect.

2. LITERATURE REVIEW

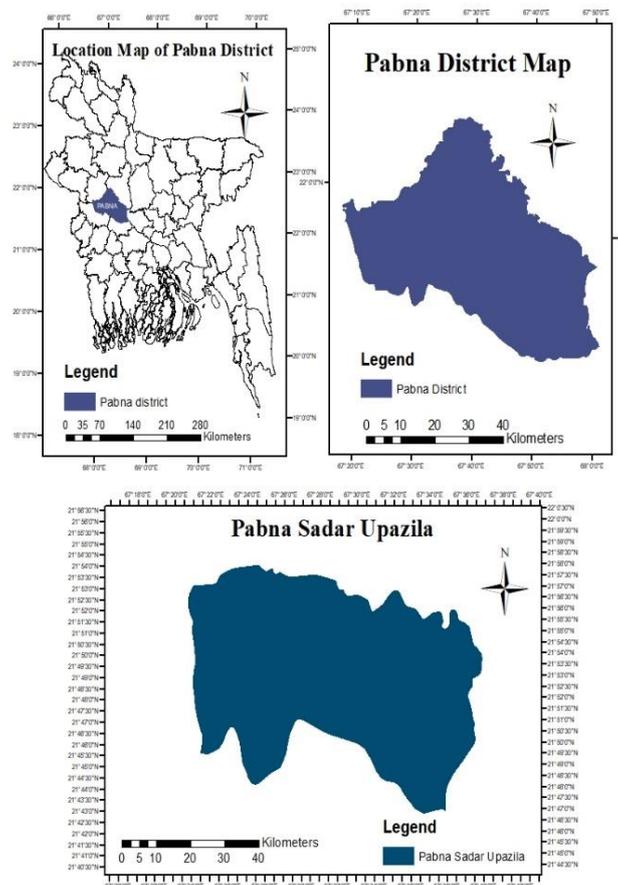
“Brick” means sand or cement or any building materials manufactured by the soil in brick kiln and “Brickfields” are those places where latest technology, reducing fuel air pollution rules according to laws of Environment Conservation Rule, 1997 (DoE, 2017). Based on the production process, brickfields can be classified in several ways. Fixed chimney kiln (FCK) has an oval shape in which the chimney is located at the centre and the bricks are fired in the space around the chimney, between the central part of the kiln and the outer wall. It is a continuous moving-fire kiln in which the fire burns

continuously and moves in a closed circuit through the bricks stacked in the trench. Usually, solid fuels such as coal, wood, saw dust, and agriculture residues are used in FCBTKs (BRICKGURU, 2017). The improved zigzag kiln is a modified traditional zigzag “Hawa bhatta” kiln taken in Bangladesh to demonstrate this technology. It is an elliptically shaped kiln with well insulated permanent side walls and roofs and arched firing chambers to allow easy air flow. After sun drying, bricks are loaded manually into the firing chambers. Air required for the combustion process is forced from it reaches the line to be fired, it is previous firing zone thus reducing firing time hour (English Booklet, n.d.). A Hybrid Hoffman Kiln is a rectangular shaped annular circuit with an arched roof covered with a shade to protect it from rains. It has a firebrick lining on the inside surface. The thick walls of the kiln and good insulation minimize heat loss to the surrounding (DoE, 2017). The tunnel kiln is considered to be the most advanced brick making technology. In a Tunnel Kiln, green bricks produced by mixing powdered fuel with clay are loaded on cars and then pushed in the kiln, a horizontal tunnel (DoE, 2017).

3. MATERIALS AND METHODS

3.1 Study Area Profile

Pabna Sadar Upazila, a small administrative unit, situated in Pabna district under Rajshahi division which is positioned between 23°53' and 24°05' north latitudes. It is covered with an area of 439.30 square kilometre and the total population is 590914 (Community Report: Pabna, 2013). This Upazila consists of 1 municipality, 15 wards, 46 mahallas, 10 unions, and 291 villages. Main sources of income of the study area are agriculture 38.77 percent among all occupation types. Natural resources sand, coal have been found in this Upazila (Daily Sun, 2018). Figure 1 shows the location of the Pabna Sadar Upazila in the context of Pabna district and Bangladesh.



Map 1: Location of the Study Area [Source: Author, 2019]

3.2 Sampling and Data Collection

Primary data were collected by Field Observation, Questionnaire Survey, Focus Group Discussions and interviews of the people. For the questionnaire survey, a total of 348 people were selected randomly in the study area. However, all respondents were later divided into two groups. The owners and workers of brickfields are in category-1 who were engaged in the brick manufacturing process and the workers were the most vulnerable to health hazards because of direct involvement with brickfield activities. None of them is in below 18 in age. The people who were living within 1 kilometre of the brickfields are in category-2. Each category consisted of 174 respondents in the study area. They were involved in farming, aquaculture, household and different types of activities. Local knowledgeable persons including assistant director and other officials of the Department of Environment, Forests and Climate Change in Pabna district, community representatives, and teachers were interviewed individually to know their perception about this study. Two FGD were conducted with the workers of brickfields to identify the brick kiln technology, chimney height, fuel and brick manufacturing process. Impacts of brickfields were assessed in terms of changes in soil fertility, agricultural production, vegetation, fish production, health status and air quality based on how respondents found these after the construction of brickfields. Secondary data were collected from newspapers, journals, reports and web browsing.

3.3 Data Processing and Analysis

Data were analysed and produced graphs by SPSS (Statistical Package for Social Science) software and Microsoft Excel and GIS (Geographic Information System) is used for map preparation for showing the existing location of brickfields and 1km area from it for environmental law assessment.

4. DATA ANALYSIS AND RESULTS

4.1 Impacts on Soil Fertility

According to the survey report, 68% of the respondents' answered that the felt adverse effects on soil fertility due to the brickfields. On the other hand, 13% of the respondents complained about moderate effect, 6% answered minor effect and 13% felt no effect on soil fertility because of brickfields that show in figure 1. The brick kiln workers remove topsoil for brick production. It has a direct impact on soil fertility and land degradation. The negative impact of topsoil removal is the reduction of agricultural output and increases the cost of replacing the nutrients lost (Bisht and Neupane, 2015). Burning of the soil decreases the soil pH and make it acidic. It has serious impacts on soil physical, biological and chemical properties resulting in sharp declination in soil fertility and productivity (Pariyar, 2013).

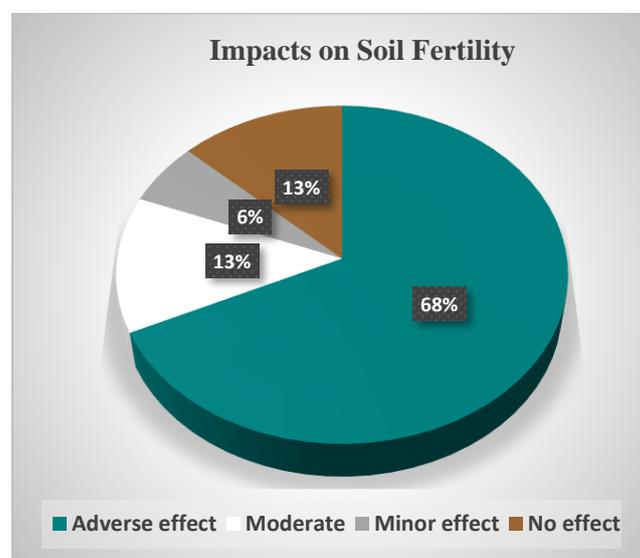


Figure 1: Impact on soil fertility [Source: Field Survey, 2019]

4.2 Impacts on Agricultural Production

Most of the brickfields were situated near the agricultural lands. 23% of the respondents opined that they felt adverse effects of brickfields on agricultural production. Half (50%) of the respondents complained about moderate effect, 27% of the respondents answered minor effect and none of the respondents answered no effect on agricultural production (figure 2). Some people who were lived around the brickfields said that production of crops had been declined after construction of brickfields. Agricultural lands had become unsuitable for producing any crops due to over-exploitation of its topsoil (Jerin et. al, 2016). For this reason, farmers are now applying high doses of chemical fertilizers, which have harmful consequences to the environment. Majority of the respondents said that black smoke of brick kilns is responsible for the reduction of crop production.

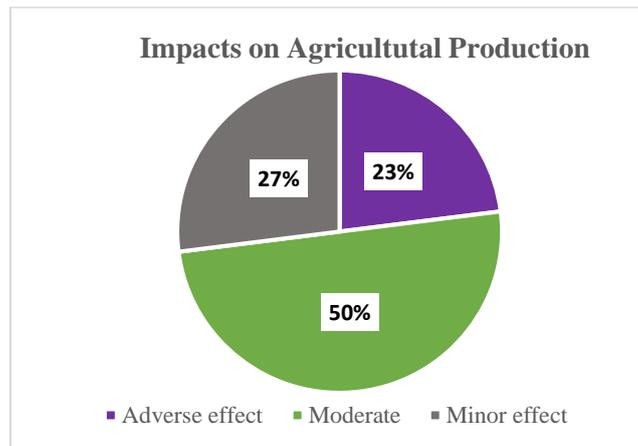


Figure 2: Impact on Agricultural production [Source: Field Survey, 2019]

4.3 Impacts on Vegetation

Result shows that 48% of the respondents opined that they felt adverse effects on vegetation, especially on fruits and vegetable plants within 1 km of brickfield. Among of the respondents who were the residents around brickfields, 16% respondents opined that brickfield had a moderate effect, 23% commented on minor effect and 13% felt no effect on vegetation (figure 3). Many of the residents said that the plant buds died due to the emission of black smoke of brick kiln i. e. mango tree, litchi tree flowering trees and so on and sometimes plants do not grow properly. They also noted that fruits production is reduced after the establishment of brickfields in the study area. In some residential areas surrounding brickfields, it is directly observed that leaves were covered with black smokes.

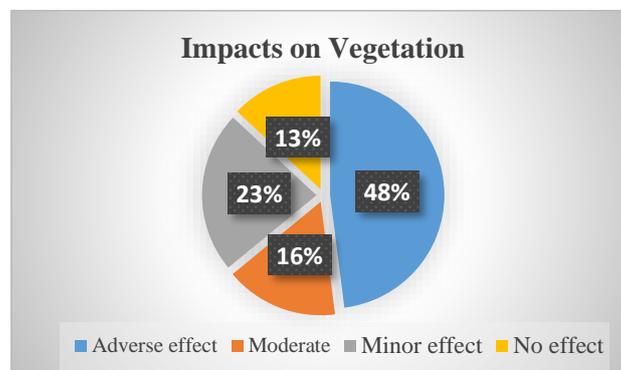


Figure 3: Impact on vegetation [Source: Field Survey, 2019]

4.4 Impacts on Aquaculture

Majority of the respondents in category-2 said (36%) that, “brickfields had no effect on fish production and aquatic plant production” and 17% of the respondents said about the adverse effect, 21% commented on moderate effect and 26% respondents said that they felt minor effects on aquaculture after establishment of brickfields (figure 4). In Hemayetpur, Dapunia and Dogachi union of Pabna Sadar

Upazila, most of the brickfields are located near water bodies. According to the respondents' fish cultivation were hampered in nearby water bodies due to water pollution.

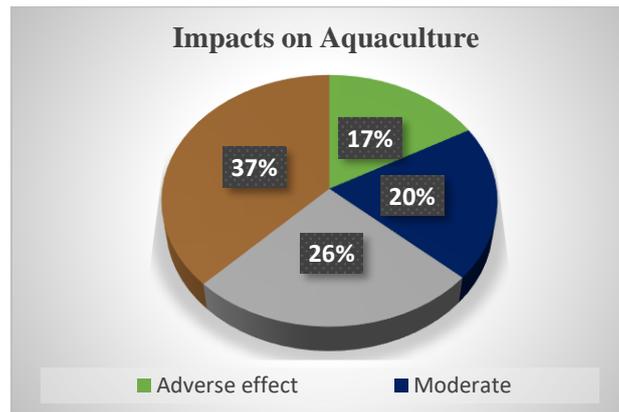


Figure 4: Impacts on aquaculture [Source: Field Survey, 2019]

4.5 Air Pollution

A study was found that the concentrations of particulate matter (PM) in the air around the brick kilns zones are three times higher than the offseason of brick kilns (Raut, 2003). Brickfields are important contributors to the emission of greenhouse gases in Bangladesh as they burn huge amounts of coal and wood fuel. The main reason for poor emission from brick kilns is the poor quality of coal and uses of biomass mainly firewood. FCKs are not energy efficient and consequently, pollutants are being emitted by a greater rate. The main pollutants which are emitted from the brickfields are particulate matter (PM), some hazardous gases like CO₂, CO, NO_x, NO and SO₂. The PM concentration appears to be low but it is expected to have long term massive impact on global environments as well as on human health. The particulate matter consists of dust, smoke, fumes, and fly ash (Daraina et. al, 2013). At present, 45 brickfields where a fixed kiln chimney, 44 Hawa-Bhatta and a hybrid Hoffman brickfield located in the study area (Department of Environment, Forests and Climate Change of Pabna District, 2019). According to the respondents of category-1, the chimney height of some brickfields is less than 120 feet. It is another cause of air pollution.

4.6 Health Status of Respondents

In Bangladesh, most of the brickfields are situated near the residential area and many people work in the brickfields daily in the brick production period. A health survey clearly showed that people who are living near brick kilns are more likely to suffer from illnesses caused by air pollution, comparing those who are living in areas without the kilns. School children nearby brick kilns were had the worse condition of health and they were suffered for higher prevalence of upper respiratory tract infections like pharyngitis and tonsillitis (Joshi and Dudani, 2008). It was also found that brick field workers suffered from discomfort in different parts of the body, especially in the lower back, knees and upper extremities (Das, 2014). Another study of brickfield impacts on human health showed that residents who were working in the brickfields suffering from eye irritation, respiratory problems and skin diseases (Jerin et. al, 2016).

This study is divided into two parts i. e. category-1 and category-2. Table 1 shows the types of disease that were found in both category respondents due to the brickfields.

Table 1: Health status of respondents

Types of disease	Category-1	Category-2
Respiratory problems	13	6
Skin disease	8	12
Respiratory problems and skin disease	17	24
Eye irritation	6	7
Respiratory problems and Eye irritation	10	5

Types of disease	Category-1	Category-2
Respiratory problems, skin disease and eye irritation	21	23
Others	1	4
No problem	24	19
Total	100	100

[Source: Field Survey, 2019]

4.7 Assessment of Environmental Act related with brickfields

- According to the section-4 of Brick Manufacturing and Brick Kiln Establishment Act-2013, “brick manufacturing is prohibited without taking a license from the Deputy Commissioner of the district” (DoE, 2017). But the assistant director of the Department of Environment, Forests and Climate Change in Pabna district complained that most of the brickfields have not any license from deputy commissioner or other legal documents from the Department of Environment.
- In section 5(1) of this act, any person can’t cut earth from ponds, canals, marshes, creeks, lakes, rivers, wetlands, sandbars or other areas without permission from appropriate authorities. 5(2)- Requires permission from the appropriate authority for the collection of soil for brick manufacturing from haor-baors, ponds, canals, beels, river beds, chars and fallow land. From the field investigation, most of the brickfields are located adjacent to the agricultural field. According to the residents of Hemayetpur union, owners of brick industry dug canals and ponds to use soil in brick production. This activity is an example of violation of this act.
- According to the rules, there are three types of brick kilns are allowed for the burning of bricks i. e. improved zigzag kiln, Hybrid Hoffman kiln and Tunnel Kiln. According to the survey data, a fixed kiln chimney was found in the study area which is not allowed. The chimney height of some brick kilns is within 110-115 feet. M/S MCA Brickfield’s chimney height is 115 feet. But the chimney height of zigzag kiln should be 120 feet in height according to the act (DoE, 2017).
- According to the Brick Manufacturing and Brick Kiln Establishment Act-2013 “Fuel wood cannot be used in brick kilns for burning bricks” (DoE, 2017). But workers of brickfield said that they use wood, tire for burning of bricks.
- According to the section 8(a), establishment of brick kilns within the boundary of residential, commercial or preserved area, municipality or Upazila headquarters, forest, orchard, wetland, sanctuary, agricultural land, ecologically critical area and degraded air shed is prohibited and according to section 8(b), establishment of brick kilns in the following distance or places is totally banned namely: (a) within 1 kilometers distance from the boundary of prohibited areas, (b) within 2 kilometers distance from boundary of public forest, (c) within half kilometers distance from the foot of the hill or hillock, (d) within 1 kilometers distance from any special structure, railways, educational institutions, hospitals and clinics, research institutions or any other similar place or institution, and (f) with half kilometers distance from Upazila, union or rural roads made by Local Government Engineering Department (LGED) (DoE, 2017).
But figure 5 shows the location of brickfields where most of the brickfields are located near the residential area and agricultural lands. The population of the ward no. 9 of Dogachi Union of Pabna Sadar Upazila is 3000. In this ward 3 brickfields are located near educational institutions, agricultural land within 1 km. As a result, people especially children and old man are suffering from many respiratory diseases (Pabna Samachar, 2019). It was directly observed that in Hemayetpur and Dapunia union, brickfields are located with near half kilometer from the Local Government Engineering Department (LGED) road.

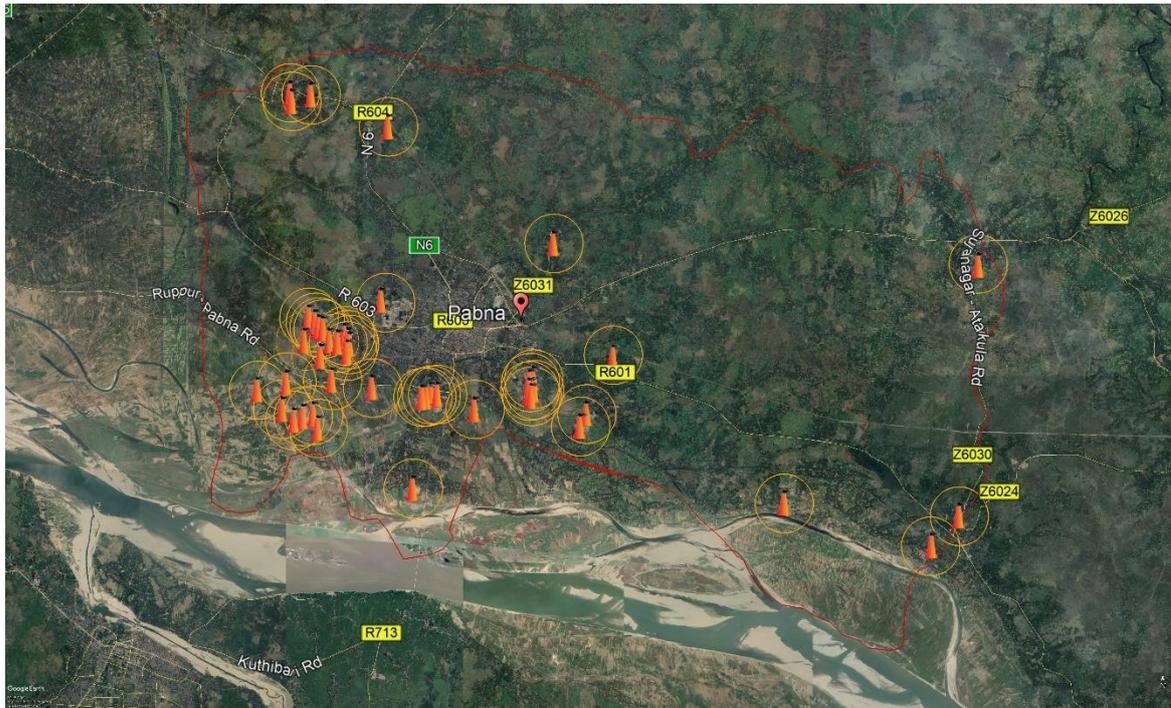


Figure 5: Location of brickfields in Pabna Sadar Upazila [Source: Author, 2019]

- In Section 7(a), waste disposal and gaseous emissions emission will be in a limit according to environment conservation rules of 1997. The Department of Environment (DoE) published a gazette by named “Environment Conservation Rule, 1997” where includes the standard unit of emission that can produce different brick kiln that is in table-2 (DoE, 1997).

Table 2: Standard measurement of parameters of different types of brick kiln

Nature	Parameter	Unit	Ideal measurement
Zigzag or FCK	Total particles	Mg\Nm ³	400
Vertical soft brick kiln\Tunnel kiln	Total particles	Mg\Nm ³	250
Hybrid Hoffman Klin\Tunnel kiln (fuel: coal)	Total particles	Mg\Nm ³	250
Hybrid Hoffman Klin\Tunnel kiln (fuel: gas)	Total particles	Mg\Nm ³	100

[Source: Environmental Conservation Rule, 1997]

The brick manufacturing season is November to April. In every season, approximate 7 million bricks in average are produced in every brickfield. 1 million bricks are burnt in each round and 180 ton coal is needed for each round. 1 short ton (2,000 pounds) of coal can be generated about 5,720 pounds (2.86 short tons) of carbon dioxide. From the study, it can be easily identified that these brickfields generate a huge amount of CO₂ that is the main culprit of global warming. From field investigation, questionnaire survey and interviews of the assistant director of the Department of Environment, Forests and Climate Change in Pabna district, these brickfields are produced an excess amount of gaseous particulates that is too much from an ideal measurement. But, they don't pay any compensation for it.

5. CONCLUSIONS

From the study it was found that most of the brickfields of the study area were located near agricultural lands, ponds and residential areas those were responsible for decrease of soil fertility, loss of agricultural production, fish cultivation and local community's health problems in great extent. Most of the brickfields didn't follow the acts and they have no licence from the deputy commissioner which is

totally illegal. Besides, brick fields were considered as the principle reason of land degradation, health problem and air pollution in rural areas of Pabna Sadar Upazila.

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