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Environmental Impact of Brick Manufacturing Process in Rajshahi Region, Bangladesh

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Abstract: Brick is the most common construction material that we use for the construction of buildings and structures all over Bangladesh. To supply the brick locally, many brickfields have emerged all over the country. The production of brick has seasonal, environmental, social and biological impact. The adverse pollution effect of the brick production process is increasing every year as the brick production and number of brick kilns are increasing day by day. A life cycle assessment or LCA analysis has been carried out to evaluate the overall impact of brick manufacturing process on environment and human health in Rajshahi region. The LCA software OpenLCA 1.11.0 was used to carry out the study with a scope from "cradle to gate" of LCA methodology. We focused on the potential environmental burden, including resource depletion, air pollution, water pollution, soil pollution and adverse effects on human health and crop production. The brick manufacturing phases of 20 brick fields are assessed through interviews, questionnaire surveys and in-situ observations. We also focused on the management system of the brickfields to assess the mismanagement and safety issues. We also compared the environmental effect and mismanagement on the brick manufacturing process to find the correlation between them. Based on the major findings from our study, some recommendations are proposed to mitigate the problems. The main recommendations include the use of eco bricks, recycled bricks, modified kiln systems, alternative firing technologies, training programs and a safe working environment.

Keywords: Brickfield, LCA Analysis, Environmental Impact, Mismanagement, Eco Bricks

1. Introduction

The ancient most popular building material 'brick' has been used for more than 7 thousand years for making buildings [1] and the fired-clay bricks are known to be used from 4500 BC [2]. The traditional bricks are made with clay as it has a unique mineralogical composition that makes the brick very durable [3] with superb thermal, mechanical and physical properties [4]. Bricks can handle all types of loads and weather [5] while being used in different types of work [6], refractory [7] or any conventional building.

Brick usage is increasing in Bangladesh and other developing countries as their main projects include infrastructure development. Bangladesh has 158.9 million habitants with population density of 1,106 per square kilometer and a growth rate of 1.37 [8]. So, many of them are migrating to large cities leading to more building construction [9]. That's why, the brick sector has begun to increase at a projected 2 - 3 percent annually [10]. Around 11,100 brickfields are operating throughout the country, almost 27 billion bricks are annually produced [11] and the brick demand is increasing quickly [12]. A previous report estimated the brick kilns to increase around 50% by 2020 from 4500 kilns that time [13]. This sector has some economic significance and it manufactures around 1,200 crores of bricks annually that also is a part of a large number of employment [14]. Around 1 million people are employed in the brick production process in Bangladesh [15].

Building sector is a major consumer and contributor of energy and CO_2 respectively [16, 1]. Not only the production process, but the refurbishment and maintenance processes also affect our environment [17]. Those effects include less vegetation, land infertility, thin ozone layer and other problems of global warming [18]. The agricultural production got impacted as fertile topsoil are removed for making bricks [19, 20]. So, the overall agricultural productivity is highly impacted by brick production [21] and affecting our food security [22].

Because of these kilns, improper production process, low quality materials and law violation, Bangladesh is facing huge environmental impact and health hazards [23]. In some studies, those impacts on the surrounding environment have been assessed [24-26]. As traditional fixed chimney kilns (FCKs) are worse for the environment, The Ministry of Environment and Forests banned this type of brick kilns [27]. However, this ban implementation is facing many challenges and barriers, so the process is still not over [28, 29]. Research shows that every year 0.73% [30] to 1% [31] arable lands are decreasing and since these lands contain fertile alluvial soil, these soils and agricultural productivity is declining [32-35]. Brick firing is also a source of air pollution as this process consumes almost 24 million tons of coal per year [36]. Usually, the fuel burning emits harmful gases like carbon dioxide (CO_2), ammonia (NH_3), carbon monoxide (CO), and sometimes chlorine and fluorine [37, 38].

According to several studies, it's found that, manual coal breaking and feeding, exposure to high concentration of dust and to the ash in the bottom of the kiln leads to respiratory illness like chronic phlegm, cough and chest tightness [39-41]. Not only the workers, but also the inhabitants near the kilns are more prone to suffer from health problems compared to the inhabitants far from kiln areas [42]. Rajshahi region is also facing all the problems regarding brick production.

To deal with all the problems of brick manufacturing, different recycled materials and wastes are evaluated for reducing total environmental impact with help of their energy properties in production process [43-45]. Since the construction industry faces most challenges for sustainability [1], alternative materials are being developed to fight environmental impacts [46] and to make production or consumption more sustainable [47]. According to research in life-cycle analysis of traditional and alternative bricks, they found that the alternative bricks are more eco-friendly than the traditional ones [48].

The aim of this study is to evaluate the environmental effect of brick production on the environment and human health in Rajshahi city and Chapai Nawabganj city so that in future the Rajshahi region faces less environmental pollution.

2. Methodology

At the very beginning, we needed to study about every detail related to our research. Then we used questionnaire surveys and in-situ observation to collect data of different stages of the brick making process, such as raw material collection, clay preparation, molding, drying and burning of bricks, management system of the brickfields, conditions of the workers, surrounding environmental conditions of the brick kilns. From the gathered data, we did a lifecycle analysis by the OpenLCA software and a comparison of environmental impact of brick manufacturing process among the different brick kilns was made. Figure 1 shows the steps of the methodology of our study.

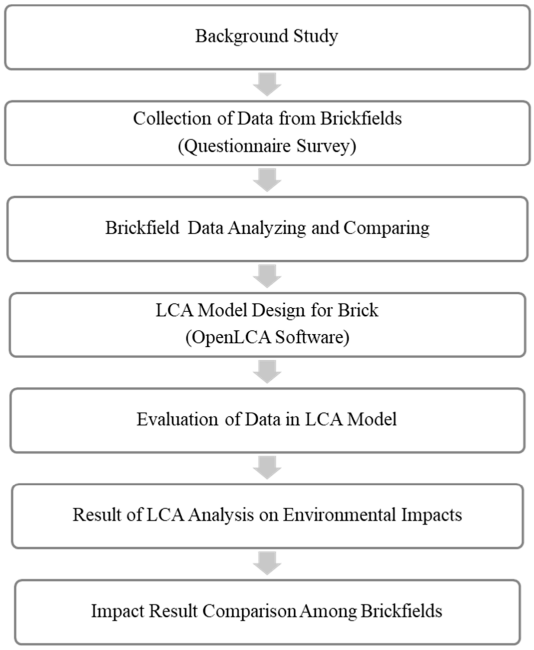

Figure 1. *Methodology Steps.*

2.1. Study Area

We selected 20 brick kiln sites for our study from the Rajshahi region. Among these, 4 of these are from Rajshahi district and 16 of these are from Chapai Nawabganj district.

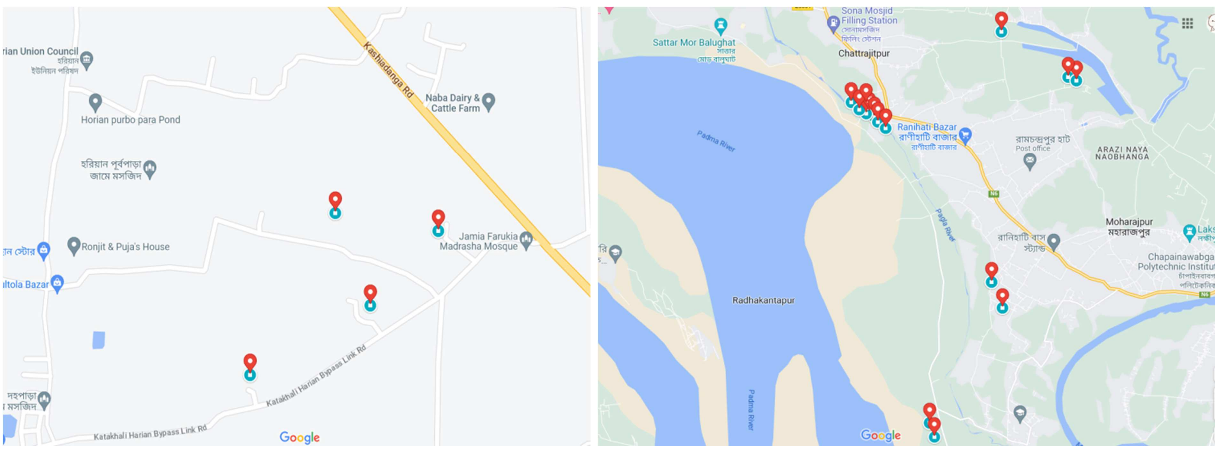

Figure 2. *Brick field sites in Rajshahi and Chapai Nawabganj district.*

2.2. Open LCA Software

To do lifecycle assessment, an LCA software is needed where we can analyze our data accurately. OpenLCA is one of the most popular software applications for doing LCA analysis. For the analysis, we used OpenLCA software version 1.11 and used the lcia_2_0_2 database. The advantages of using this software is that we can do lifecycle analysis from anywhere in the world and get an approximate estimation of environmental impact. It's also an open-source software, so we can get enough data that we can be missing and anyone can benefit from it.

2.3. Survey Data

Survey was done using questionnaire and in-situ observations in time between February and March of 2023. Most of the values are approximate values since the management system of all the brickfields aren't modernized and they don't keep track of the data properly. Also, many of the kiln managers didn't want to share the exact value of data for their privacy. Table 1 summarizes the survey data.

Table 1. *Survey data from all the brick klin sites.*

	Sample Brick Kiln (BK) Site in Rajshahi and Chapai Nawabganj				
	BK 1	**BK 2**	**BK 3**	**BK 4**	**BK 5**
Site Area (Bigha)	30	32	30	20	20
Kiln Type	FCK	FCK	FCK	FCK	FCK
Brick Production (lakh/yr)	65-70	60	50-60	80	10
Working Season	Nov-May	Nov-April	Dec-May	Nov-May	Nov-April
Average Cost (BDT)	4,00,00,000	3,50,00,000	3,00,00,000	4,50,00,000	1,40,00,000
Fuel Types	Coal	Coal	Coal	Coal	Coal
Brick Drying Process	Sun-dry	Sun-dry	Sun-dry	Sun-dry	Sun-dry
Total Workers	200	150	100	100	70
Mask/Safety Equipment	No	No	No	No	No
Working Hours Per Day	6-8 hours	6-8 hours	6-8 hours	6-8 hours	6-8 hours
Raw Material Source					
Soil	Rajshahi	Rajshahi	Rajshahi	Rajshahi	Chapai
Sand	Padma	Padma	Padma	Padma	Padma
Coal	Jashore	Jashore	Jashore	Jashore	Jashore
Water	Site	Site	Site	Site	Site
Raw Material Collection Process					
Soil, Sand, Coal	Truck	Truck	Truck	Truck	Truck
Water	Pump	Pump	Pump	Pump	Pump
Total Consumption in One Year					
Soil (cft)	7,00,000	6,00,000	6,00,000	8,00,000	1,00,000
Sand (cft)	1,50,000	1,30,000	1,50,000	1,70,000	40,000
Coal (ton)	1,000	1,200	1,000	1,500	500
Water (L)	7,00,000	6,00,000	7,00,000	8,00,000	1,00,000

	Sample Brick Kiln (BK) Site in Rajshahi and Chapai Nawabganj				
	BK 6	**BK 7**	**BK 8**	**BK 9**	**BK 10**
Site Area (Bigha)	40	47	45	30	30
Kiln Type	FCK	FCK	FCK	FCK	FCK
Brick Production (lakh/yr)	35	30	60-70	30-40	70
Working Season	Nov-April	Nov-April	Nov-April	Nov-April	Nov-April
Average Cost (BDT)	2,00,00,000	2,00,00,000	4,00,00,000	2,50,00,000	2,00,00,000
Fuel Types	Coal	Coal	Coal	Coal	Coal
Brick Drying Process	Sun-dry	Sun-dry	Sun-dry	Sun-dry	Sun-dry
Total Workers	200	200	180	150	200
Mask/Safety Equipment	No	No	No	No	No
Working Hours Per Day	7-8 hours	6-8 hours	7-8 hours	6-8 hours	6-8 hours
Raw Material Source					
Soil	Chapai	Chapai	Chapai	Chapai	Chapai
Sand	Padma	Padma	Padma	Padma	Padma
Coal	Jashore	Jashore	Jashore	Jashore	Jashore
Water	Site	Site	Site	Site	Site
Raw Material Collection Process					
Soil, Sand, Coal	Truck	Truck	Truck	Truck	Truck
Water	Pump	Pump	Pump	Pump	Pump
Total Consumption in One Year					
Soil (cft)	1,60,000	3,00,000	7,00,000	3,00,000	4,00,000
Sand (cft)	60,000	60,000	1,20,000	70,000	1,50,000
Coal (ton)	700	1,200	1000	1000	1,200
Water (L)	6,00,000	2,00,000	5,00,000	3,00,000	6,00,000

	Sample Brick Kiln (BK) Site in Rajshahi and Chapai Nawabganj				
	BK 11	**BK 12**	**BK 13**	**BK 14**	**BK 15**
Site Area (Bigha)	18	15	27	25	25
Kiln Type	FCK	FCK	FCK	FCK	FCK
Brick Production (lakh/yr)	10	10	10	10	60-70
Working Season	Dec-April	Nov-April	Oct-May	Oct-May	Nov-May
Average Cost (BDT)	70,00,000	60,00,000	4,00,00,000	4,00,00,000	3,00,00,000
Fuel Types	Coal	Coal	Coal	Coal	Coal
Brick Drying Process	Sun-dry	Sun-dry	Sun-dry	Sun-dry	Sun-dry
Total Workers	150	100	150	150	190
Mask/Safety Equipment	No	No	No	No	No
Working Hours Per Day	6-8 hours	7-8 hours	7-8 hours	7-8 hours	7-8 hours
Raw Material Source					
Soil	Chapai	Chapai	Chapai	Chapai	Chapai
Sand	Padma	Padma	Padma	Padma	Padma
Coal	Chapai	Chapai	Pabna, Chapai	Pabna, Chapai	Jashore, Chapai
Water	Site	Site	Site	Site	Site
Raw Material Collection Process					
Soil, Sand, Coal	Truck	Truck	Truck	Truck	Truck
Water	Pump	Pump	Pump	Pump	Pump
Total Consumption in One Year					
Soil (cft)	1,50,000	6,50,000	7,00,000	7,00,000	7,00,000
Sand (cft)	50,000	1,50,000	1,40,200	1,30,000	1,40,000
Coal (ton)	650	1,000	1,100	1,200	1,000
Water (L)	3,00,000	7,00,000	5,00,000	5,00,000	6,00,000

	Sample Brick Kiln (BK) Site in Rajshahi and Chapai Nawabganj				
	BK 16	**BK 17**	**BK 18**	**BK 19**	**BK 20**
Site Area (Bigha)	27	30	30	32	25
Kiln Type	FCK	FCK	FCK	FCK	FCK
Brick Production (lakh/yr)	65	60	50	60	50-60
Working Season	Nov-May	Nov-May	Nov-May	Nov-April	Nov-April
Average Cost (BDT)	2,50,00,000	3,00,00,000	2,00,00,000	2,00,00,000	70,00,000
Fuel Types	Coal	Coal	Coal	Coal	Coal
Brick Drying Process	Sun-dry	Sun-dry	Sun-dry	Sun-dry	Sun-dry
Total Workers	200	200	180	200	170
Mask/Safety Equipment	No	No	No	No	No
Working Hours Per Day	7-8 hours	7-8 hours	7-8 hours	6-8 hours	6-8 hours
Raw Material Source					
Soil	Chapai	Chapai	Chapai	Chapai	Chapai
Sand	Padma	Padma	Padma	Padma	Padma
Coal	Jashore, Chapai	Chapai, Naogaon	Chapai, Naogaon	Chapai, Natore	Jashore, Chapai
Water	Site	Site	Site	Site	Site
Raw Material Collection Process					
Soil, Sand, Coal	Truck	Truck	Truck	Truck	Truck
Water	Pump	Pump	Pump	Pump	Pump
Total Consumption in One Year					
Soil (cft)	6,50,000	6,00,000	5,00,000	6,00,000	6,00,000
Sand (cft)	1,20,000	1,00,000	95,000	1,10,000	1,00,000
Coal (ton)	1,200	1,000	1,000	1,000	1,100
Water (L)	4,00,000	4,00,000	3,00,000	4,00,000	4,00,000

3. Results and Discussion

Firstly, we analyzed the observed data and survey data to evaluate the conditions of the sites and the mismanagements happening on different phases of brick production. Then the environmental impact of brickfields through the LCA analysis was done by OpenLCA software of 1.11.0 version.

3.1. Mismanagements in Brick Manufacturing Process

Brick manufacturing process consists of raw materials collection phase, molding phase, drying, burning phase and stacking & dispatch phase. In every brick kilns we visited, found some same types of mismanagements in the whole manufacturing process of brick production, which are responsible for the bad impacts on our environment. Raw materials are collected far away from the brick fields, so more amounts of vehicles are used for transportation which emits more amounts of toxic gasses. Modern technologies and expert workers are not used for brick production process. There is no proper supervision system for protecting the unfired bricks in bad weather. Ancient technologies and restricted fuels are used for burning of bricks. Most of the brick kilns are not properly equipped and are not conscious about the health of the workers.

3.2. LCA Analysis (Results from OpenLCA Software)

The result of LCA analysis of 20 brick fields are compared with OpenLCA software to find out their approximate effect on the environment. We used several types of LCIA methods for different impact categories.

3.2.1. Raw Material Consumption

For understanding how the raw material consumption is affecting the LCA or lifecycle analysis of different brick fields, we should first know how much raw materials is consumed and how much brick is produced per brick kiln sites every year. The raw materials mainly used are soil, sand and water. We also used coal for the burning phase of the brick production. The consumption of soil and sand is presented in CFT or cubic feet, the coal consumption is in ton, water consumption in liter, and amount of brick production is in lakh.

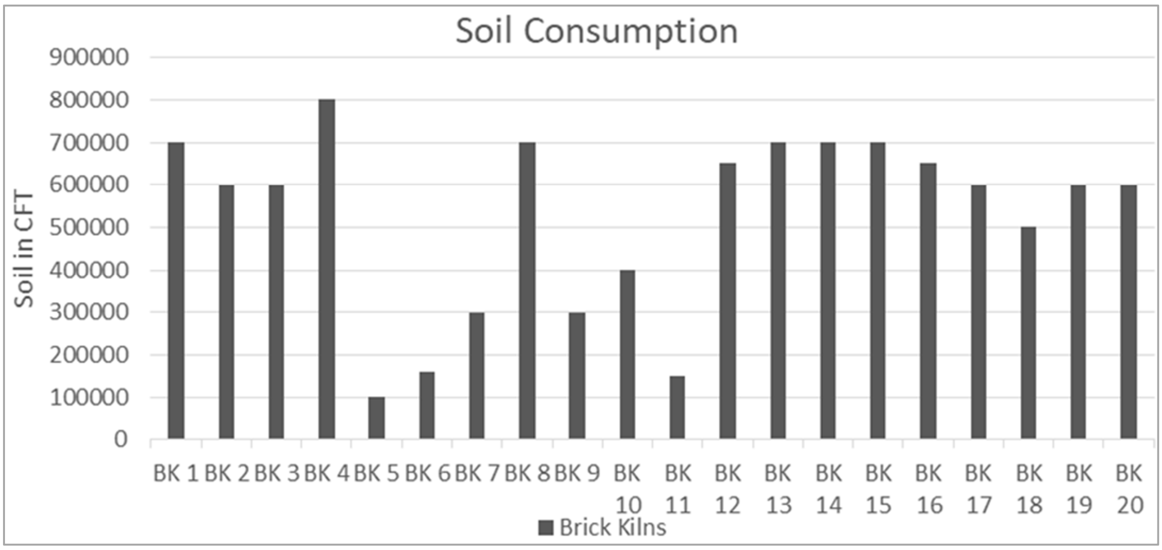

Figure 3. *Yearly soil consumption in brick kiln sites.*

From Figure 3 it is shown that, the highest amount of soil is consumed by the brick kiln number 4, while the lowest amount of soil is consumed by brick kiln 5.

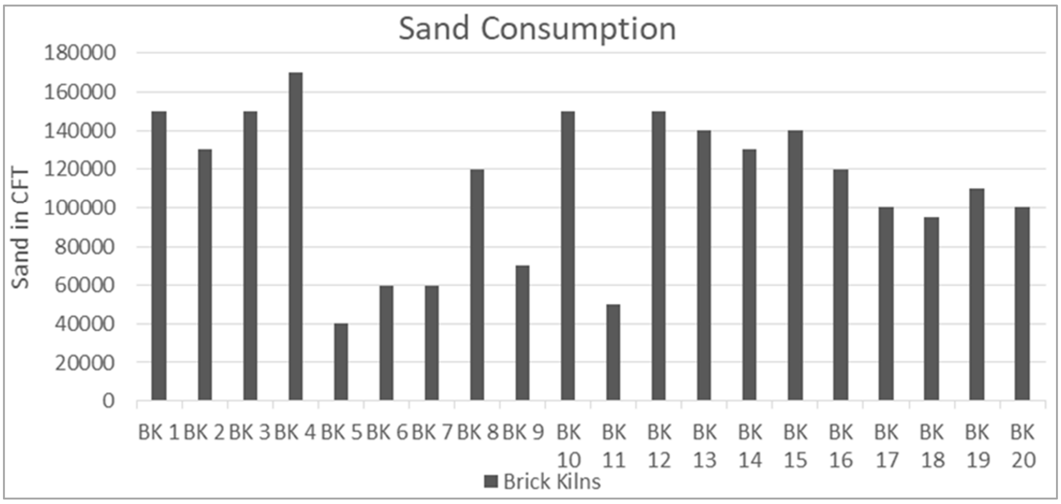

Figure 4. *Yearly sand consumption in brick kiln sites.*

In case of sand consumption, Figure 4 shows that the highest amount of sand is consumed by the brick kiln number 4 while the lowest amount of sand is consumed by brick kiln 5.

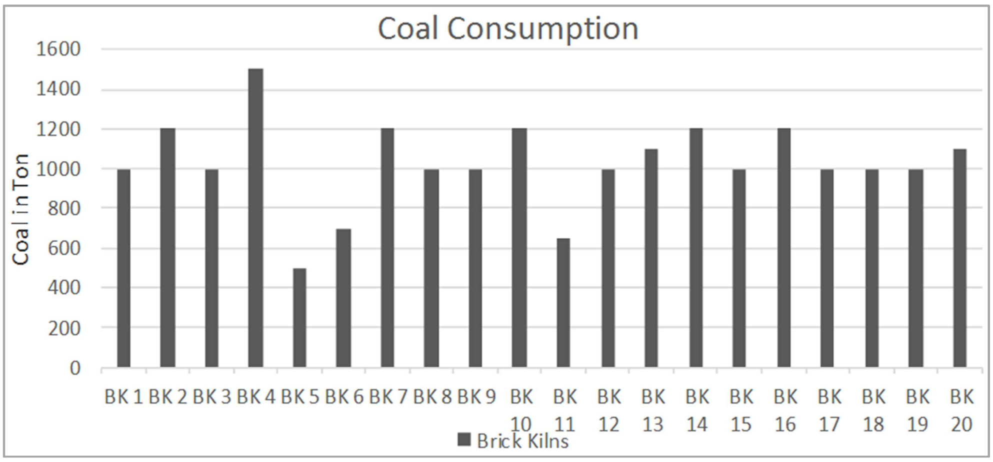

Figure 5. *Yearly coal consumption in brick kiln sites.*

In case of coal consumption, Figure 5 shows that the highest amount of coal is consumed by the brick kiln number 4 while the lowest amount of coal is consumed by brick kiln 5.

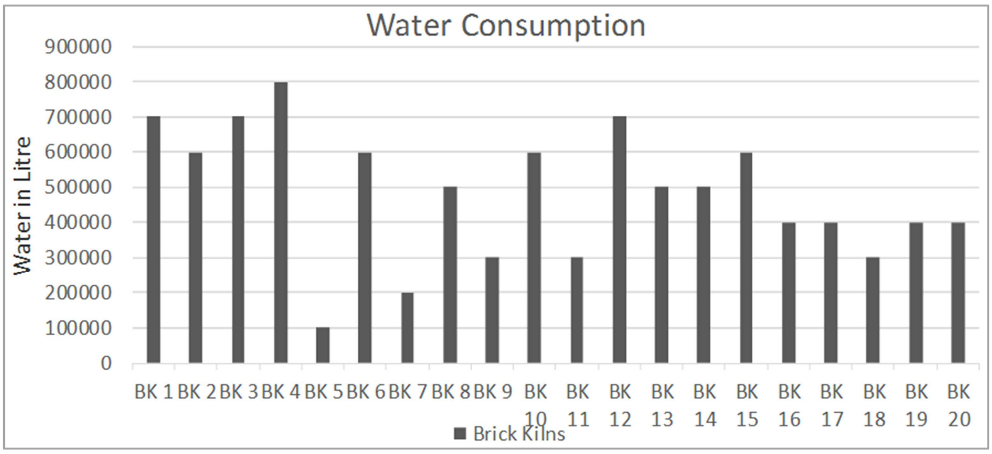

Figure 6. *Yearly water consumption in brick kiln sites.*

Figure 6 shows the highest amount of water is consumed by the brick kiln number 4, while the lowest amount of water is consumed by brick kiln 5.

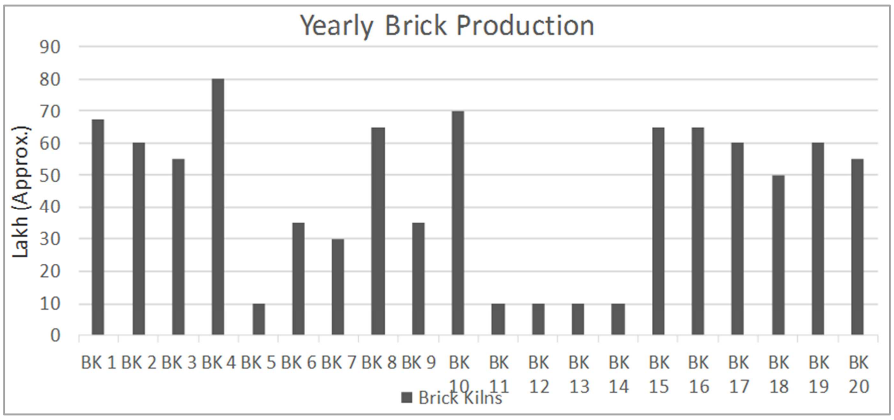

Figure 7. *Yearly brick production in brick kiln sites.*

From figure 7 it is shown that, the highest amount of brick is produced by brick kiln 4 while the lowest amount of brick is produced by the brick kiln number 5, 11, 12, 13, and 14 with approximately 10 lakh brick production per year.

Raw material consumption is varying due to the mismanagement of the kiln workers. There are no proper safety against rain or other weather effect, and many of the raw materials gets washed away or bricks break down easily and that's why we need to use more raw materials than other brickfields to produce same amount of bricks. And using too much raw materials, like the topsoil removal is harming the environment by reducing crop production, habitat alteration and so on.

From the above figures 3-7 we can see that the consumption rate of raw materials (soil, sand, coal & water) is varying a lot in different brick kilns. The reasons of varying raw materials consumption are wastage of raw materials due to mismanagement in brick manufacturing process and different brick kilns produce different amount of bricks per year. When more amount of raw materials are used for brick production it causes bad environmental impact like scarcity of natural resources, air pollution by producing more amount of harmful gasses, climate change etc.

3.2.2. Ozone Depletion

Ozone depletion refers to the gradual thinning or reduction of the ozone layer in Earth's stratosphere, particularly in the region known as the ozone layer. The ozone layer plays a crucial role in protecting life on Earth by absorbing and blocking a significant portion of the sun's harmful ultraviolet (UV) radiation from reaching the Earth's surface. Ozone depletion is primarily caused by human-made chemicals known as ozone-depleting substances (ODS). Ozone depletion leads to increased levels of harmful UV radiation reaching the Earth's surface. This can have serious consequences for human health, such as an increased risk of skin cancer, cataracts, and other UV-related health problems. It can also harm ecosystems, including damage to phytoplankton and marine life in aquatic environments and disruption of terrestrial ecosystems [49]. The 'g CFC-11 eq' unit represents that the ozone depletion is gram equivalent to the CFC-11 gas.

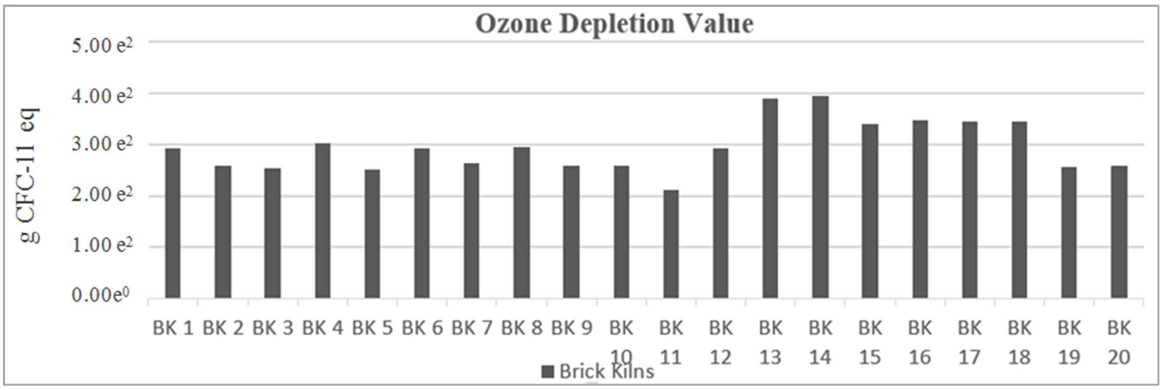

Figure 8. *Ozone depletion of brick kiln sites.*

Figure 8 shows the highest amount of ozone depletion is caused by BK 14, while the lowest amount of ozone depletion is caused by BK 11. The highest depletion is caused because the more fuel is burning while firing the bricks and transporting raw materials from far places using trucks.

3.2.3. Habitat Alteration

Habitat alteration refers to changes made to the natural environment that affect the physical or biological characteristics of a particular habitat or ecosystem. These alterations can be driven by human activities, natural processes, or a combination of both. Habitat alteration can have significant impacts on the plants, animals, and ecosystems that rely on those habitats. It can have serious ecological consequences, including the loss of biodiversity, disruptions to ecosystem services, and changes in the overall functioning of ecosystems [50]. The 'T & E count' unit represents that the habitat alteration is measured by the travel and expense count of the transported habitants.

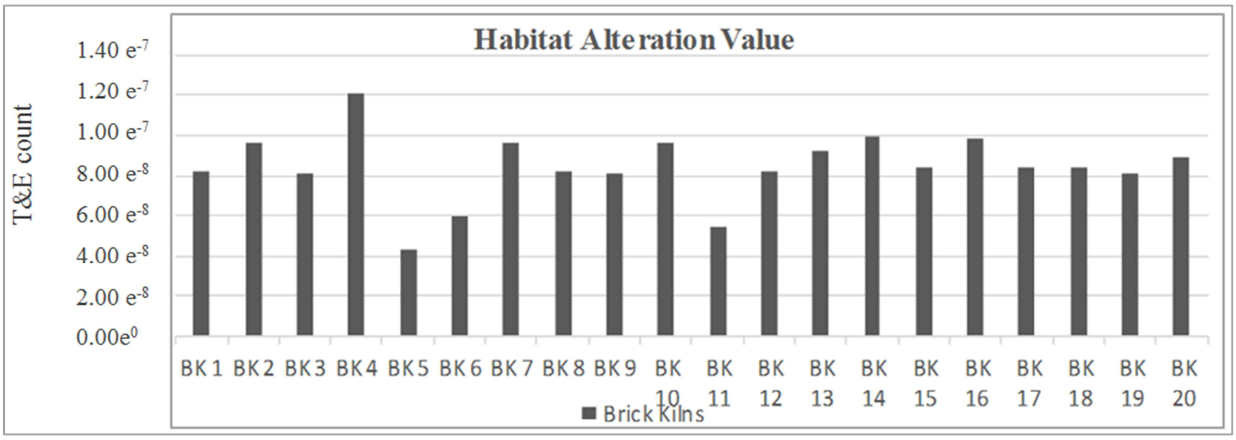

Figure 9. *Habitat alteration of brick kiln sites.*

From Figure 9 it is observed that the highest amount of habitat alteration is caused by BK 4, while the lowest amount of habitat alteration is caused by BK 5. Because BK 4 consume the most and BK 5 consume the least amount top soil for per brick production.

3.2.4. Natural Resource Depletion

Natural resource depletion refers to the exhaustion or reduction of Earth's finite natural resources at a rate faster than they can be naturally regenerated or replenished. This depletion occurs due to over-exploitation, pollution, deforestation, and climate change. The consequences of natural resource depletion have negative impacts on environment. Also, It will cause inadequacies of natural resources for further use. The unit 'MJ surplus' means that the additional amount of energy needed to extract one unit of fossil fuel in the future.

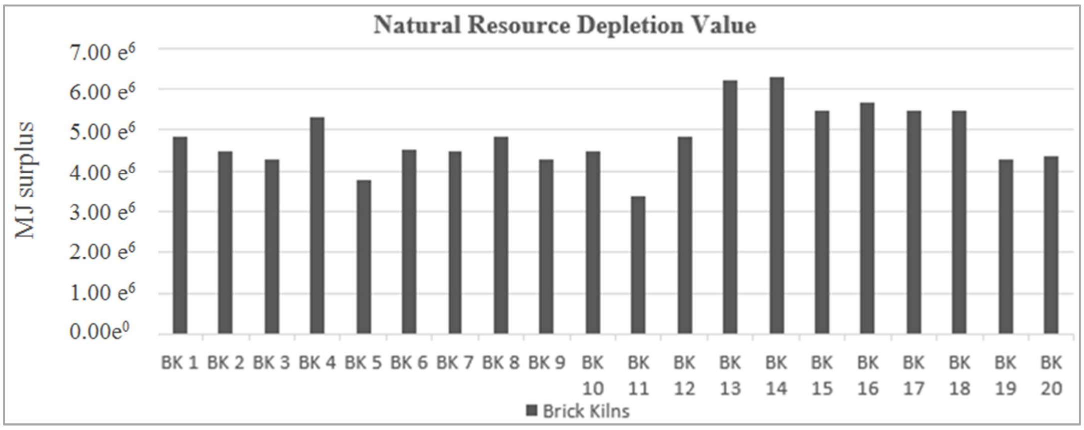

Figure 10. *Natural resource depletion of brick kiln sites.*

Figure 10 shows the highest amount of natural resource depletion is caused by BK 13 and BK 14 while the lowest amount natural resource depletion is caused by BK 5 and BK 11.

3.2.5. Land Use

Land use for brick kilns typically involves the allocation of land for the construction and operation of facilities used in the production of bricks. The quantity of used land for production of brick depends upon the management systems of brick kiln.

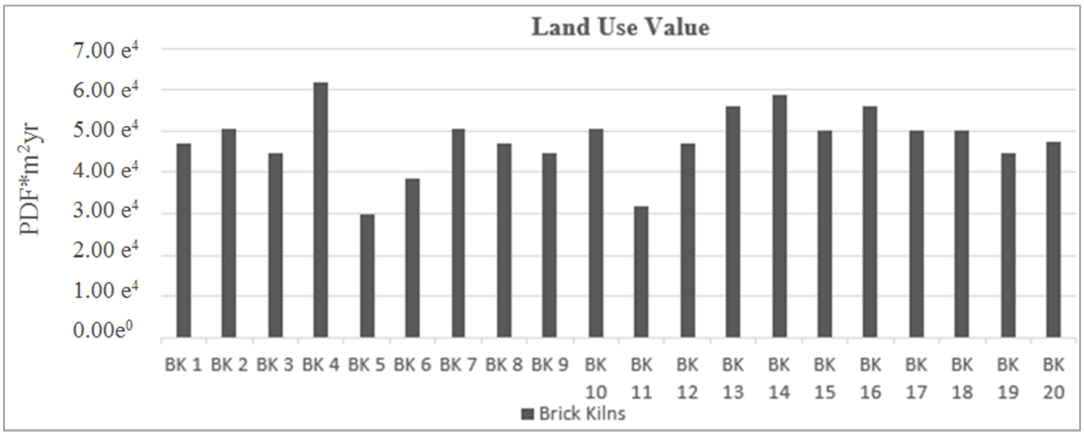

Figure 11. *Comparison of land use among brick kiln site.*

Figure 11 illustrates that the, highest amount of land use is caused by BK 4, while the lowest amount of land use is by BK 5. The unit of '$PDF*m^2yr$' represents the potentially disappeared fraction of plant species per meter square area in a year. So, the higher values of land use mean they are endangering more plants.

3.2.6. Fossil Resource Scarcity

Fossil resource scarcity refers to the lower availability of fossil fuels, such as coal, oil, and gas, due to their increasing demand for energy worldwide. Fossil fuels are non-renewable resources, meaning they cannot be replaced on a human timescale. The consumption rate of fossil resources depends upon the production rate and management systems of a kiln. In this analysis result, the unit USD2013 represents the value of US dollar in year 2013. So, the higher the value of the fossil resource scarcity, the less fuel is available, that's why their dollar value is higher.

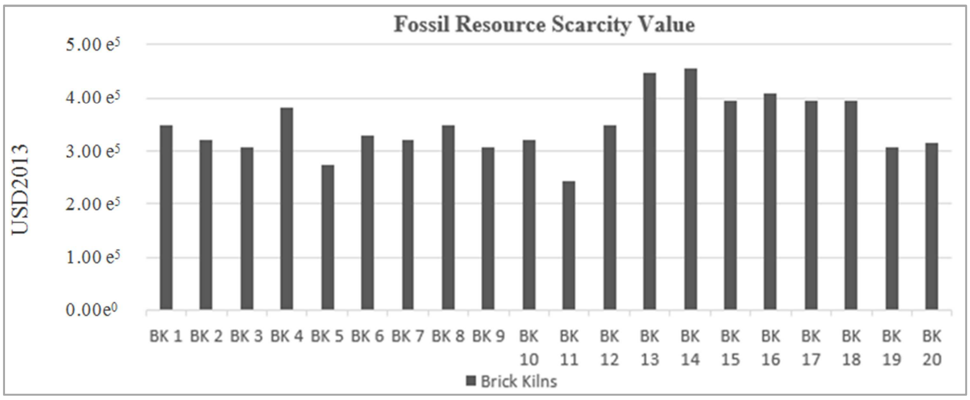

Figure 12. *Comparison of fossil resource scarcity among brick kiln sites.*

Figure 12 shows the highest amount of fossil resource scarcity is caused by BK 13 and BK 14, while the lowest amount of fossil resource scarcity is by BK 11. The higher amount of fuel scarcity is caused by high coal consumption and truck fuels needed for raw material transportation.

3.2.7. Freshwater Ecotoxicity

Freshwater ecotoxicity refers to the potential harm or toxic effects that substances or pollutants can have on freshwater ecosystems, including rivers, lakes, streams, and wetlands. Freshwater ecotoxicity can be reduced by applying proper water management system. Here, the unit of freshwater ecotoxicity 'species.yr' represents that, every year how many species that lives in the freshwater are disappearing due to water pollution of brick production.

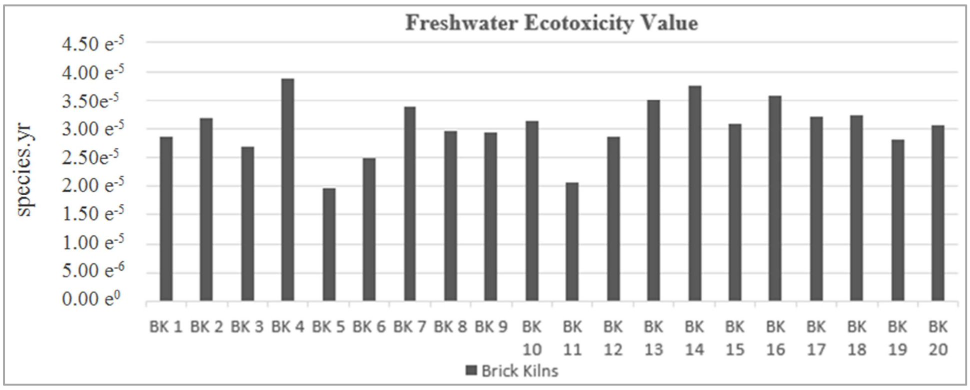

Figure 13. *Comparison of freshwater ecotoxicity among brick kiln sites.*

Figure 13 depicts the highest amount of freshwater ecotoxicity is caused by BK 4, while the lowest amount of ecotoxicity is by BK 5.

3.2.8. Particulates

Particulates, also known as atmospheric particulate matter or aerosols, are tiny solid or liquid particles that are suspended in the air. These particles vary in size, composition, and origin and play a significant role in the Earth's atmosphere and environment. These particles are a significant concern in environmental and public health due to their small size, which allows them to be easily inhaled deep into the respiratory system.

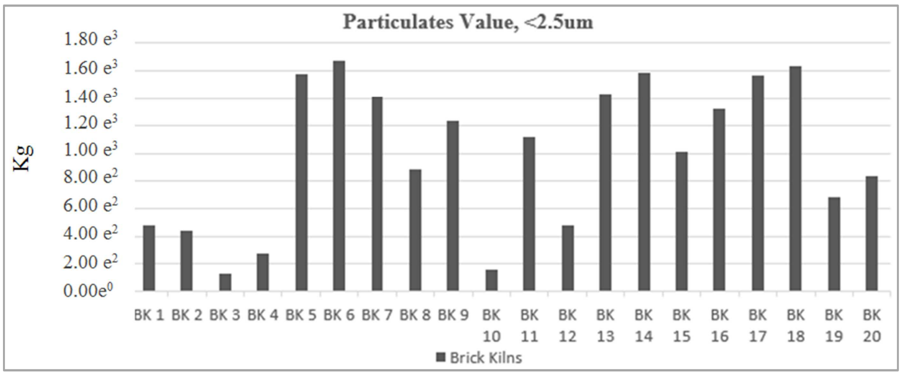

Figure 14. *Comparison of particulates among brick kiln sites.*

From Figure 14, we can see that the highest number of particulates is caused by BK 6 and BK 18. The lowest number of particulates is by BK 3 and BK 10. The amount of particle release in Kilogram. Higher particulates are caused due to more fossil fuel burning in brick firing and while material transportation.

3.2.9. Global Warming

Global warming refers to the long-term increase in Earth's average surface temperature due to the buildup of greenhouse gases in the atmosphere. This phenomenon is a significant aspect of climate change and has far-reaching impacts on the planet's ecosystems, weather patterns, and human societies. Brick kilns can contribute to global warming and climate change primarily through the release of greenhouse gases and particulate matter into the atmosphere. Reducing the environmental impact of brick kilns is essential not only for addressing global warming but also for improving local air quality and the health of communities living near these facilities. The unit of global warming 'UBP' represents environmental impact points in ecological scarcity method.

Figure 15 shows the highest amount of global warming is caused by BK 13 and BK 14, while the lowest amount of global warming is by BK 11. The higher amounts are caused due to the more coal consumption, usage of fossil burning vehicles and producing toxic gas.

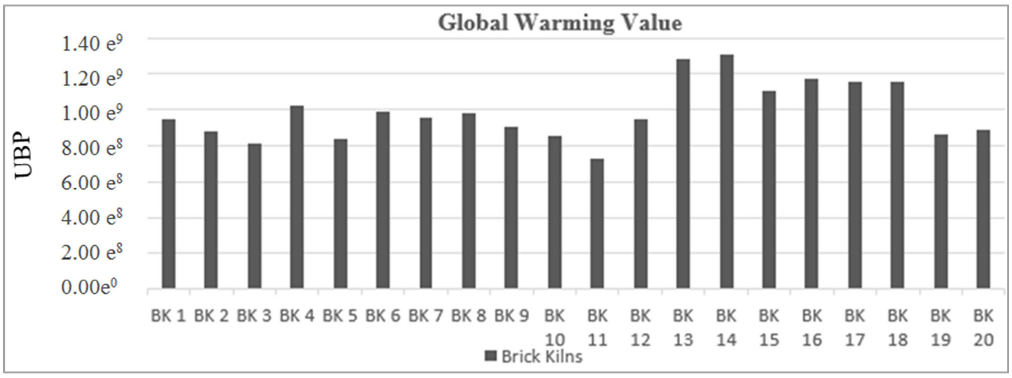

Figure 15. *Comparison of global warming among brick kiln sites.*

3.3. Health Condition of Workers and Inhabitants Near Brick Field

In our study, a survey of 100 brick kilns workers and inhabitants near the sites was carried out to determine how brick production affects the health of the workers and inhabitants.

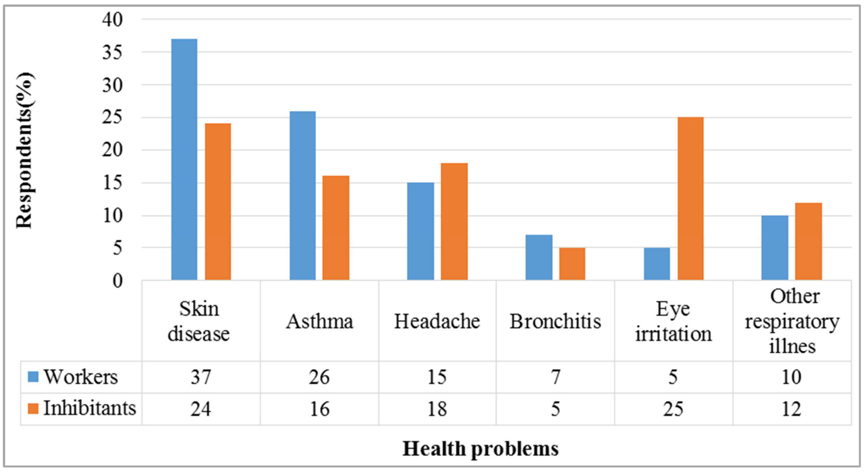

Figure 16. *Health problems of workers and inhabitants.*

From figure 16, we can say, most of the inhabitants and workers face skin problems because the nearby air and water is being polluted by brick production substances. Also, a high number of people near the brick kiln sites face headache and lunch problems, specifically asthma. This happens because they inhale toxic gas directly and don't wear face masks.

4. Conclusions

From present study, it could be concluded that the brick kiln site number 14 has the highest and the brick kiln site number 11 has the lowest amount of environmental impact on average. Since both brick kilns produce almost the same amount of brick per year, still their environmental impact varies a lot. The reason why BK 11 has lower impact is that, for per brick production, it burns less fuel and less raw materials. BK 14 requires more raw materials and more fuel for every brick production as much of them got wasted or damaged due to mismanagement (such as lack of proper brick production equipment, lack of proper knowledge of the workers, lack of proper supervision and violation of law for brick production). Besides that, brick kilns with higher raw material consumption to produce per brick have higher environmental impact than the kilns with lower raw material consumption. We also concluded that the brick kilns that operates more working hours per day and works for more month in a year has higher impact on the environment. We also found that, each of the brick kiln sites weren't enough equipped with safety equipment, workers aren't trained or have no knowledge about hazards. So that the workers are suffering from different health problems like eye irritation, headache, skin disease, bronchitis, asthma, other lung diseases etc. The inhabitants around the brick kilns face scarcity of water in dry season, infertility in agricultural lands, scarcity of fresh food and livable land. Environmental pollution, destruction of natural resources and living place of different species etc. causes bad impact on our environment which causes climate change, natural calamities etc. Eco-friendly bricks can be manufactured using local recyclable materials and collecting raw materials from nearby sources to reduce transportation distance. Making hollow bricks will be more environment-friendly as they will need less raw materials, but good for making buildings. Using renewable fuel to burn the bricks or using advanced technologies can also reduce toxic gas emission, and thus makes brick manufacturing process eco-friendly and reduce the adverse environmental impact. More accurate data can be obtained from survey for more accurate analysis results. Separate LCA analysis on every phase of brick manufacturing can be done to breakdown recommendations and solutions in detail.

Conflicts of Interest

The authors declare no conflicts of interest.

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