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THE EFFECTS OF BRICK KILN ACTIVITY ON THE DETERIORATION OF AGRICULTURAL SOIL QUALITY: A STUDY AT BARISHAL SADAR UPAZILA, BANGLADESH

[1]Md. Liton Rabbani,[2]Golam Sazzad,[3] Rakib Miah,[4] Tauhidul Islam

[1]Assistant Professor,[2,3,4] Student, B.Sc.in Civil Engineering
[1]Department of Civil Engineering,
[1]Barishal Engineering College, Barishal, Bangladesh.

Abstract: Brick kilns have a major negative influence on the environment, which in turn has an adverse effect on agricultural productivity. In comparison to soils located farther away, the productivity of the land surrounding brick kilns is much lower. The purpose of this research is to ascertain the influence that the operation of brick kilns has on the deterioration of the soil quality in a variety of places within the Barishal Sadar Upazila. A total of 20 samples were selected at random from ten distinct locations within the research site. According to the findings of the research, industrial activities related to brick kilns negatively influenced the soil's physical and chemical properties, hence lowering the soil's quality. The findings demonstrated that the pH values of soils in both the surface and the subsurface were dramatically lowered after being subjected to a burning process. The organic matter content of the samples observed from 0.259 to 0.923 percent in the burnt soil and from 0.287 to 1.077 percent in the unburned soil for surface soil. For subsurface soil, the organic matter content was observed to range from 0.190 to 0.635% and 0.184 to 0.630% in the burnt and unburned soil respectively. The total nitrogen concentration of the surface soil varied from 0.022 to 0.100 percent in burnt soil and from 0.027 to 0.12 percent in unburnt soil, respectively. In the case of subsurface soil, the nitrogen concentration varied from 0.036 to 0.061% in burnt soil and from 0.039 to 0.066% in unburnt soil. The accessible phosphorus level of the surface soil samples ranged from 9.89 to 19.16 ppm in the soil that had been burnt, whereas it was in the range of 17.46 to 21.95 ppm in the soil that had not been burnt. The range for unburned subsurface soil was from 11.20 to 19.21 ppm, while the range for burnt subsurface soil was from 8.64 to 13.16 ppm. For surface soil, the EC of burnt soil varied from 9.7 to 25.3 ds/m, while for subsurface soil, the EC ranged from 5.2 to 12.2 ds/m. For the unburnt soil next to brickfield, the electrical conductivity values ranged from 13.3 to 27.7 for the surface soil and from 8.3 to 24.3 for the subsurface soil. All of the soil's chemical attributes were lower in the burnt soil from the brick kiln as compared to the soil from the unburned agricultural area. Increasing depth also degraded chemical properties. According to the findings of the research, brick burning in close proximity to agricultural fields has a negative impact on soil fertility. The combustion of vast amounts of carbon, nitrogen, and sulfur not only degrades the soils used for agricultural production but also contributes to shifts in the world climate.

***Index Terms*–Soil Quality, Deterioration, burnt, unburnt, Agricultural Soil.**

I. INTRODUCTION

The brick-making industry has grown quickly. This may be because developing countries have become more urbanized and industrialized, which has raised the demand for building services. Brick industry investment is high, but employment is seasonal. Bricks are the most common and widely used building material in urban areas, and they are the most important for constructing homes. Brick makers need silt clay soils with good drainage, although brick kilns are often built on productive agricultural land. In addition to contributing to air pollution, the manufacture of bricks reduces crop productivity by removing topsoil from agricultural areas and emitting heavy metals and other pollutants that reduce crop yields.

Topsoil, which is the outermost layer of the earth's crust, is formed by the combination of nutrient-rich humus, minerals, and decomposed organic waste. The aforementioned resource has significant importance on a global scale because to its comprehensive composition of chemical, physical, and biological constituents that are essential for facilitating optimal plant development. Topsoil degradation and environmental pollution are now seen as the most pressing global concerns due to their adverse impacts on agriculture and the whole ecosystem. These difficulties arise from a combination of natural processes and human activities.

One of the main causes of topsoil deterioration is brick burning. In addition to continuously dissipating heat over the environment, the brick kiln activity has over the years covered the nearby plants in layers of brick dust. Additionally, the vegetation and human health are greatly impacted by the release of gaseous pollutants and ash. Also, the biodiversity and biogeochemical cycling are negatively impacted by brick kilns.

In the context of Bangladesh, the production of bricks involves the extraction of soil from agricultural areas; brick kilns are responsible for a large-scale land destruction each year. In several brick field pockets, it rose to 5000 hectares between 1998 and 1999 [1]. Around 6,000 brick factories create 18 billion bricks annually. Many of them lack valid licenses, and local government agencies lack the resources needed to monitor the fields [2]. As a result of urbanization and the demand for brick production, the land use pattern surrounding growing towns has shifted from agriculturally productive to agriculturally unproductive regions. Therefore, the acquisition and application of indigenous soil knowledge, environmental awareness, prudence, and economic utilization of soils are essential for the long-term preservation of soil resources. The study's goal was to learn more about the agricultural land's nutritional quality, particularly in the brickfield region.

II. Literature Review

Bisht et al. [3] said the soil quality exhibited an upward trend as the distance from the kiln increased. This improvement in soil quality was shown to be closely correlated with the concentration of heavy metals and nutrients present in the soil. The investigation was conducted to assess the physicochemical properties of soil, soil fertility, and the presence of heavy metal pollutants in the soil. Throughout the duration of the research conducted in Nepal, the soil's water absorption exhibited a range of 2.4 to 3.3 mg/L. The pH levels varied between 5.885 and 7.64. Additionally, the organic carbon content and organic matter shown variations spanning from 0.277% to 0.93% and 0.477% to 1.603%, respectively. The nutrient content, namely the concentration of sulfate and nitrate, in the soil exhibited a range of 0.829 to 3.764 mol/L and 0.984 to 29.99 mol/L, respectively. Nevertheless, the soil at a distance of 50 m exhibited inadequate physical characteristics and nutrient content, although these factors shown a progressive increase at distances of 100 m and 150 m.

According to Gupta & Imtiaz [4,5], the process of brick burning has the potential to modify the physicochemical characteristics and ecological conditions of adjacent soil. This is mostly due to the detrimental effects it has on essential nutritional components found in the topsoil, including macronutrients such as carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur, as well as micronutrients such as boron, copper, iron, manganese, molybdenum, and zinc. Additionally, brick burning may negatively impact the soil biota present in the affected area.

Biswas et al. [6] said the removal of soil has been associated with a significant decrease in crop output ranging from 40% to 80%, as well as a fall in revenue ranging from 40% to 70%. The depletion of soil resources has a detrimental effect on agricultural productivity, resulting in significant consequences for both immediate and long-term crop yields, so affecting the overall food security of the nation.

Rajonee et al. [7] analyzed the Soil characteristics along the Kirtonkhola River in Barisal to see how much they had changed as a result of brick kiln activity. Soil moisture content ranged from 18.77% to 56.49 % throughout the study period; bulk density and particle density ranged from 0.23 - 0.53 g/cm3 and 1.11 - 3.15 g/cm3; soil porosity ranged from 60.36% to 88.14%; pH ranged from 6.98 - 8.85; and organic carbon content ranged from 0.22% to 1.4%.Soil pH reduced as one moves away from a kiln, but moisture and organic carbon levels rise, and particle density is about right for plant development, yet low bulk density and high porosity point to a poorly structured soil, both of which are detrimental to plant health.

Kathuria et al. [8] said that since brick producers need silt clay loam to silt clay soils with adequate drainage characteristics, brick kilns are often located on fertile agricultural land. Good agricultural land has been transformed into agriculturally unproductive regions surrounding numerous expanding cities of the developing world as a consequence of urbanization and the need for brick production.

Khan et al. [9] conducted a study in the Dinajpur, Rangpur, Rajshahi, Khulna, and Patuakhali districts to assess the impact of brick kilns on soil degradation and environmental pollution. The study focused on comparing the soil profiles of burnt (soil around brick kilns) and unburned (agricultural land) soils. The pH values of the unburned soils were observed to rise with soil depth in Rangpur, Khulna, and Patuakhali, but decrease in Dinajpur. Soil acidity dropped by 0.4 pH units on average (7% increase over average content = IOAC) after burning, while EC values rose dramatically from 0.26 to 1.77 mS/cm (592% IOAC), with the impact being most obvious with the depth function. On average, fires in agricultural areas result in a loss of 63 percent of the soil's organic matter, 56 to 86 percent of the soil's accessible N, P, K, and S, and 23 to 88 percent of the soil's total N, P, K, and S. The massive loss caused by the burning of a 1-meter-deep soil profile, equivalent to about three-quarters of the soil's fertility decline, is not only lowering agricultural yields but also damaging the surrounding ecosystem and atmosphere. In addition to contributing to global climate change, the massive combustion of carbon, nitrogen, and sulfur degrades agricultural soils.

Jerin et al. [10] finds by a questionnaire survey that Crop loss, reduced soil fertility, and consequent decreases in crop yield. The dust and ash that arose from brickfields adversely damaged the trees in the area and degraded the quality of the water in surrounding bodies of water. There were discernable negative effects on aquaculture. Impacts of brickfields on the environment and local economy in Natore district's Bagatipara Upazila were studied.

Pokhrel et al. [11] said that Brick kilns have both immediate and delayed effects on the natural world. Short-term effects include a slowing of the vegetative process, a drop in crop output, a decrease in plant fruit, etc.; long-term effects include ozone depletion, global warming, photochemical pollution, a drop in soil fertility, a reduction in ground water level, etc.

The annual soil removal rate caused by brick kiln operations is 1500 metric tones per ropani (0.05 hectares). The process of soil combustion leads to a reduction in soil pH, resulting in increased acidity. This procedure also causes the soil's sand content to rise while the clay content falls. The phenomenon under consideration has significant effects on the physical, biological, and chemical attributes of soil, leading to a pronounced decrease in soil fertility and production. Additionally, it eliminates organic substances and renders the soil unsuitable for agricultural purposes. Local farmers have already seen a decrease in visibility due to the pollutants emitted by brick kilns. In order to preserve their well-being, individuals expressed a desire to either cease brick kiln operations or use technological advancements inside the kilns to mitigate environmental pollution. Eighty percent of the participants expressed a high inclination to promptly embrace new technologies as a means to mitigate pollution. According to some participants, it was observed that individuals had more hardships in the previous model of brick kilns compared to the present-day brick kiln regions. Additionally, they informed us that in conjunction with their health issues, they were experiencing a decline in food production and a scarcity of groundwater. Furthermore, all plant life in the vicinity of brick kilns was seen to be in a depleted state. It is evident from public opinion that those living in close proximity to brick kilns experience heightened levels of suffering and are acutely impacted by the deleterious consequences of air pollution.

III. MATERIALS & METHODS

3.1 Experimental Area

3.1.1 Selection of site

The investigation included determining the level of pollution in cultivated land, therefore the decision to use a particular brick kiln was based on its production capacity and proximity to agricultural grounds.

3.1.2 Location

This research was conducted in the Barishal Sadar Upazila between November and April from 2022 to 2023. The research region was situated within the latitudinal range of 22°37' to 22°43' north and the longitudinal range of 90°16' to 90°32' east. The region in question is geographically demarcated by the Babuganj, Muladi, and Mehendiganj Upazilas to the north, the Bakerganj and Nalchity Upazilas to the south, the Mehendiganj and Bhola Sadar Upazilas to the east, and the Jhalokati Sadar and Nalchity Upazilas to the west. [12].

The purpose of the research was to quantify the rate of soil degradation in five distinct brick kilns.

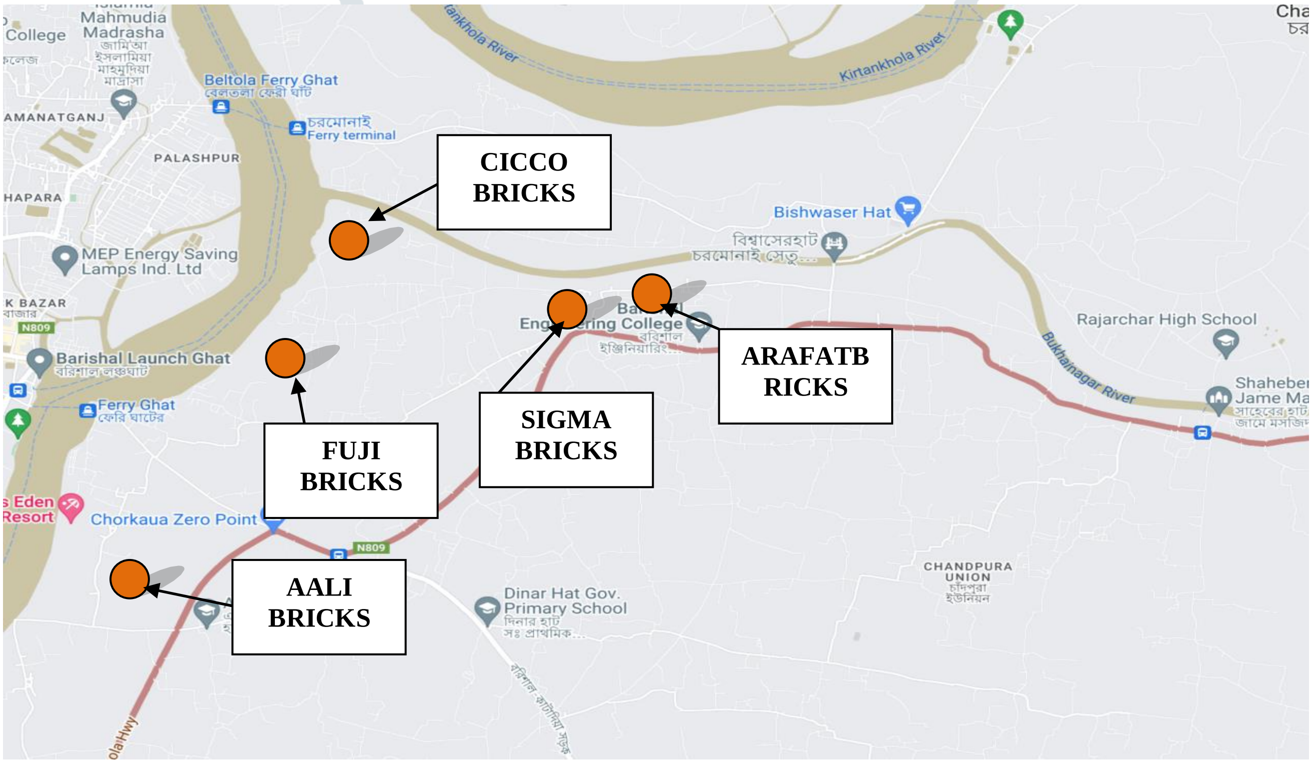

Figure 3.1: Barishal Sadar Upazila research location and sample collection point schematic map.

Table1: Brick Field Names and Locations

Short Name	Full Name	Location
AB	Arafat Bricks	Durgapur Bazar,Barishal Sadar
FB	Fuji Bricks	Janotar Hut,Barishal
CB	Cicco Bricks	Chanondi Union,Barishal Sadar
AAB	Aali Bricks	Char Kowa, Barishal Sadar
SB	Sigma Bricks	Durgapur Bazar,Barishal Sadar

3.2 Abiotic *features*

3.2.1 Soil Characteristics

The research site is characterized by a medium-high elevation and falls within Agro Ecological Zone (AEZ) 13, specifically the Ganges tidal floodplain. The soil in this area is classified as non-calcareous alluvium, which is a common soil type found in the region. The Kirtankhola and Bukhainagar rivers' tidal floodplains are located in this area. It contains intricate patterns of cut-off channels, inter-ridge depressions, and low, typically smooth ridges. Grey-layered sands and silts are distributed across the region in uneven patterns. They are consistently mildly acidic, and the source alluvium is mineral-rich. Non-calcareous alluvium is the most common of the four primary soil types in the region. Overall, the soil is rather fertile. Unstable char land may be found all across the area as well.

3.3 Biotic characteristics

3.3.1 Vegetation Characteristics

Since the beginning of time, Barishal has been an agricultural territory that produces rice, jute, wheat, oil-seeds, potatoes, pulses and other fruits and vegetables to drive the economy of the Barishal district. The Kirtankhola and Bukhainagar rivers are used by farmers to irrigate high yielding rice types and other crops during the winter months, when the tidal floodplain often stops. This helps to maintain a sustainable economy. By storing agricultural products over the summer, a number of cold-storage centers benefit the local economy.

3.4 Sampling Period

From November 2022 to April 2023, The specified plot was used to gather soil samples for analysis.

3.5 Sampling design

Pits for natural soils, about 30 centimeters deep, were dug out at a distance of 35 to 45 meters from the brick kilns from where the material was often gathered. When examining nutrient dynamics and the decline of soil fertility from an agronomic viewpoint, the top 100 centimeters of soil have a significant influence. As a result, soil samples from 0 to 30 cm deep were taken from each profile and evaluated. Prior to laboratory examination, the soil samples from each area were immediately placed into polyethylene bags and kept in the field's moist conditions.

3.6 Collection of Sample

A total of ten made up profiles of burned soil were examined. These profiles were created by staking soil samples in the open air at each brick kiln's perimeter or boundary. They had been heated at temperatures between 400 and 1000 °C and were made up of brickfield remains. The ten unburned soil profiles that were analyzed were close to the boundary of the aforementioned brick kilns and mainly consisted of agricultural land soils. The experiments were conducted from 2022 through 2023's dry seasons. Twenty samples were taken at random from ten locations around the research region. Ten specimens were collected from a region near a brick kiln, which the record refers to as "burnt soil." Ten more samples were taken from the brick kiln's far the location, where local farmers reported that there had been no change in production of crops (this area was referred to as the "unburned soil" in all of our discussions). Using an auger, we collected specimens from two depths at each location: 0-15 centimeters and 15-30 centimeters. For the purpose to prepare and analyze the samples, they were carried to the lab in sealed polythene bags.

(a)

(b)

Figure3.2: Burnt soil sample collection

(a)

(b)

Figure 3.3: Unburnt soil sample collection

3.7 Preparation of Sample

After the composite samples had been air dried, they were sieved using a 2 mm sieve, and then 500 g of each sample was kept for further chemical analysis. There were three separate trials conducted for each sample.

3.8 Soil Sample Analysis

Soil samples were analyzed for their physical and chemical properties using the industry-standard techniques.

IV. Results and Discussion

This section presents a description of the findings pertaining to the state of different physical and chemical components of soil collected from various places within the Barishal Sadar Upazila. The soil's pH, organic matter (OM), accessible nitrogen, phosphorus, potassium, electrical conductivity (EC), and other relevant parameters were assessed. The following steps are shown results and discussion:

4.1 Soil pH

The pH levels exhibited a range of 5.25 to 6.51 in the burnt soils and 5.60 to 6.91 in the unburned soils for the surface soil samples (0–15 cm). The range of pH 5.2-7.7 has all important nutrients, thus all crops grow well there [13]. According to the results, the unburned soil has a pH that is ideal for growing crops. The pH of the soil is lowered by the brick kiln's operation [9],The surface soil pH of burnt soil was found to be significantly lower than that of unburned soil in the research. The pH ranged from 5.12 to 6.37 in the burnt soil found 15-30 centimeters below the surface near the brick kiln, and from 5.31 to 6.50 in the unburned soil found in the agricultural field.

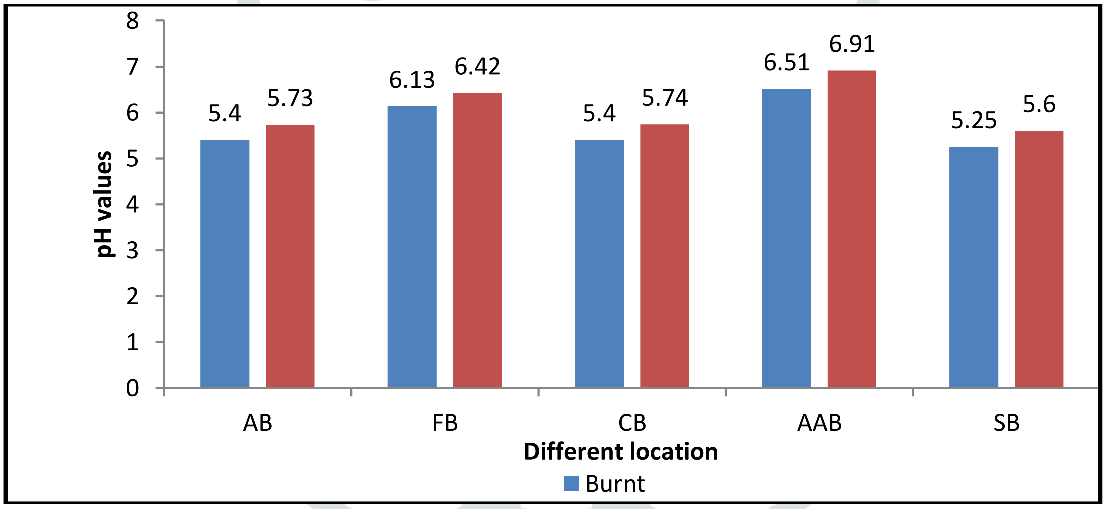

Figure 4.1: The pH values of the surface soil (0-15 cm) in several brick kilns within the study location.

In the profiles of the unburned and burnt soils, the pH values reduced with increasing depth. For burnt areas, AAB recorded the highest pH values and also AAB brick field had the highest values for unburned areas. In burnt and unburned soil, the average pH values for surface soil were 5.47 and 6.08, respectively. Burnt and unburned soil had subsurface soil pH values of 5.58 and 5.75, respectively. For burnt and unburned soil, the standard deviation (SD) of the surface soil was 0.55 and 0.56, respectively. In burnt and unburned soil, the SD values for the subsurface soil were 0.55 and 0.50, respectively. The study site's pH is indicated as acidic

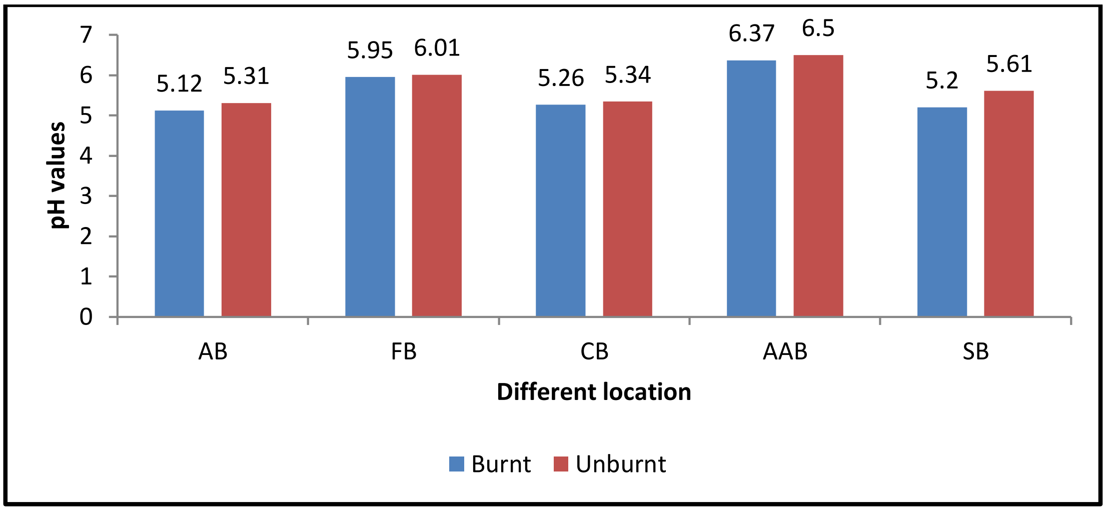

Figure 4.2: The pH values of the subsurface soil (15-30 cm) in several brick kilns within the study location.

Brick fields use the large fields surrounding them for gathering the soil needed to make the bricks. Since there were no agricultural fields close to the brick kiln, agricultural unburned soil was thus collected from a distance. The study found that the pH of the surface soil was lower in the burnt region. Fertilizers like Gypsum, TSP, MOP, and urea are widely used by farmers, which gathered in the surface and increase the pH compared to the subsurface soil in the area.

4.2 Organic matter (OM)

The organic matter values from burnt and unburned soil in surface and subsurface soil shown in figure 4.3 and 4.4. For both burned and unburned soil, the highest OM value was found in the surface soil (0–15 cm) and the subsurface soil (15–30 cm). Similar result was also found by Fakir & Mondal [14, 15]. The OM content of the samples was measured to be between 0.259 and 0.923% in the burnt soil and between 0.287 and 1.077% in the unburned soil for the top 15 centimeters of soil, and between 0.190 and 0.635% and 0.184 to 0.630% for the subsurface soil. In SB brick field, the OM value for both burnt and unburned soil was highest, whereas in FB, it was lowest for both surface soil and subsurface soil. The SB brick kiln area had the higher organic carbon value for surface soil in the unburned region next to the brick kiln (1.077) while the lowest organic carbon value (0.287%) was found in the FB brick kiln. This SB brick field's total maximum value for the surface soil was also discovered there. For the subsurface soil, the AAB brick kiln area had the greatest percentage (0.635%) while the FB brick kiln had the lowest percentage (0.205%). For burnt and unburned soil, the standard deviation (SD) of the surface soil was 0.25% and 0.30%, respectively. The SD values for the subsurface soil both in burnt and unburned soil were 0.18%. According to the SRDI [13] report, the OM of the agricultural soil in Barishal Sadar Upazila ranged from 0.87% to 4.17% . Organic matter (OM) in the soil acts as a nutrient storage facility for plants, increases the soil's ability to retain water, and resists the soil's underlying structure against degradation [16]. The research indicated that when more and more surface and subsurface soil was burnt in the brick field, the OM content of the surrounding agricultural land decreased. Khan et al. [9] found the same thing. Both at the surface soil and subsurface soil had higher levels of organic matter in the unburned soil near the brick kiln. The head and the deposition of brick waste may have contributed to the reduction in OM content in the brick kiln soil. Additionally, the soil, crop, and management techniques varied from farmer to farmer in different experimental site. The variation in OM concentration may be due to varied management practices and soil textures in various locations.

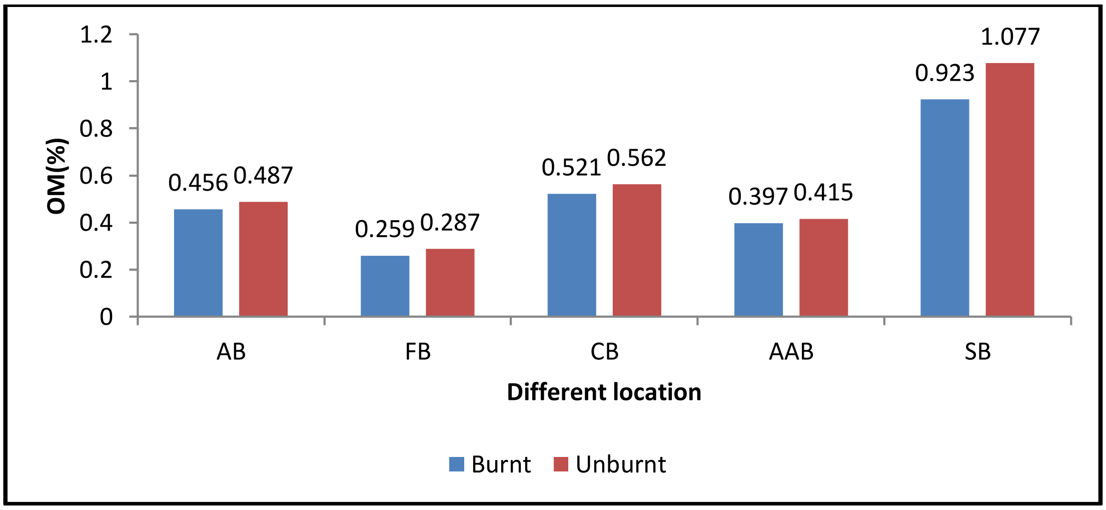

Figure 4.3: The OM values of the surface soil (0-15 cm) in several brick kilns within the study location.

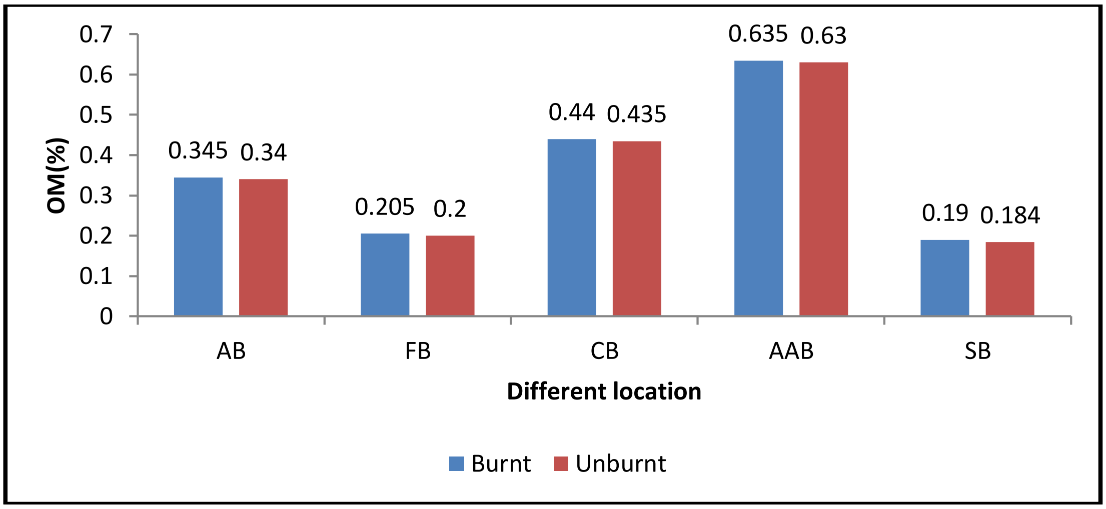

Figure 4.4: The OM values of the subsurface soil (15-30 cm) in several brick kilns within the study location.

4.3 Nitrogen contents (N)

The total N concentration in the surface soil (0–15 cm) in the burnt and unburned soils, respectively, ranged from 0.022 to 0.100% and 0.027 to 0.122%. The nitrogen concentration of soil that had been burned and unburned ranged from 0.036% to 0.061% and 0.039% to 0.066%, respectively, in the subsurface soil (15–30 cm) (Figure 4.5 and figure 4.6). The highest nitrogen level (0.122%) was found in unburned surface soil at the AAB location, whereas the lowest nitrogen content (0.036%) was found in burnt subsurface soil at the FB location. For surface soil, the average total N concentration was determined to be 0.059% in burnt soil and 0.067% in unburned soil. The average value for subsurface soil is 0.049% for burnt soil and 0.054% for unburned soil. For burnt and unburned soil, the standard deviation (SD) of the surface soil was 0.035% and 0.041%, respectively. The SD values for the subsurface soil both in burnt and unburned soil were 0.01%.The typical level of total N in soil is 0.32%, per BARC[17]. According to the SRDI [13] report, the N levels of the agricultural soil in Barishal Sadar Upazila ranged from 0.044 to 0.209%. In lower depths, the nitrogen content decreased. The range of total nitrogen in the study area was much below the necessary range of nitrogen, with nitrogen content being higher in surface soil than subsurface soil for both burnt and unburned soil. The cause of that was low organic matter concentration and soil burning from heat. The loss of organic carbon, which contains nitrogen, and nitrogen-fixing microorganisms in the soil is what causes the lower value of N [18]. The majority of the soil in Bangladesh was found to have nitrogen levels below the critical limit as reported by Portch et al. [19].

As a result, it was discovered that the nitrogen concentration of subsurface soil had reduced. The same conclusion was reached by Alam et al. [20] ,who discovered that the nitrogen content of all the soil was inadequate.

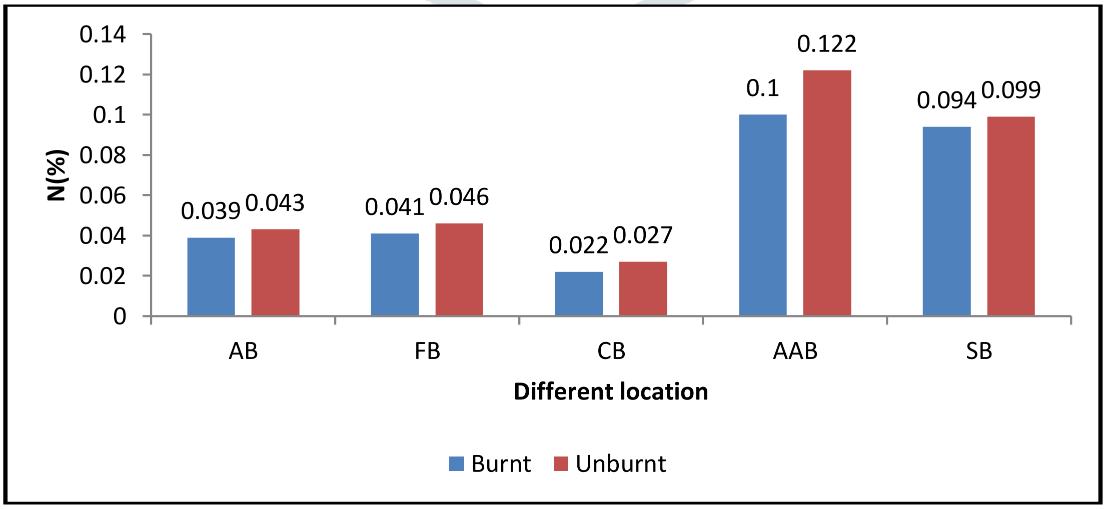

Figure 4.5:The N values of the surface soil (0-15 cm) in several brick kilns within the study location.

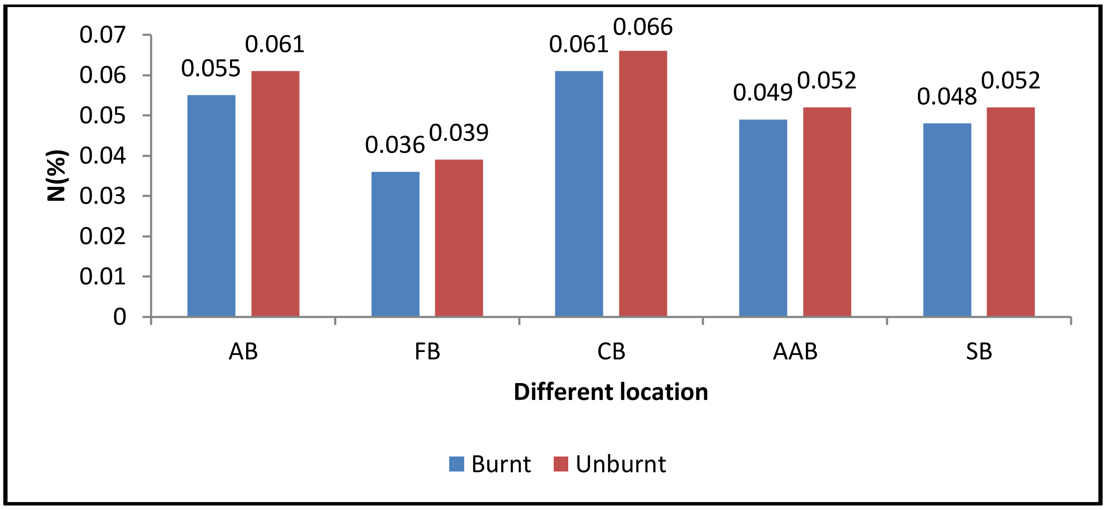

Figure 4.6: The N values of the surface soil (15-30 cm) in several brick kilns within the study location

4.4 Phosphorus availability (P)

The samples' surface soil (0–15 cm) P availability ranged from 9.89 to 19.16 ppm in burnt soil and from 17.46 to 21.95 ppm in unburned soil. In subsurface soil (15–30 cm), the ranges for burnt soil and unburned soil were respectively 8.64–13.16 and 11.2–19.21 ppm (Figures 4.7 and 4.8). In burnt and unburned soil, respectively, the highest phosphorus values were reported to be 21.95 ppm and 19.21 ppm for surface and subsurface soil. The AB brick field had the lowest soil phosphorus contents, which were 9.89 ppm and 8.64 ppm, respectively. Brick burning had a negative effect on the surface and subsurface soil P contents, as evidenced by the lower amount of P (8.64) that was observed in burnt soil compared to unburned soil. It will be discussed how much P is required for crop cultivation, which is 21 ppm [17].According to SRDI [13], the agricultural soil in Barishal Sadar Upazila has P levels that ranged from 0.92 to 1.67 ppm. As a result, the study found that the P content in the study area was significantly higher than what SRDI found.

According to the study, surface soil has a larger phosphorus content than subsurface soil. At the location AAB, surface soil had phosphorus values that were higher (21.95ppm) than those of subsurface soil. In subsurface soil, the lowest phosphorus content (8.64 ppm) was found.

At burnt and unburned soil, respectively, the average surface phosphorus level was 14.66 ppm and 19.64 ppm. 10.77 ppm of burnt soil and 16.05 ppm of unburned soil are present in the subsurface soil. For burnt and unburned soil, the standard deviation (SD) of the surface soil was 3.7 and 1.76, respectively. The SD values for the subsurface soil were 1.99 and 3.1 for burnt and unburned soil, respectively.

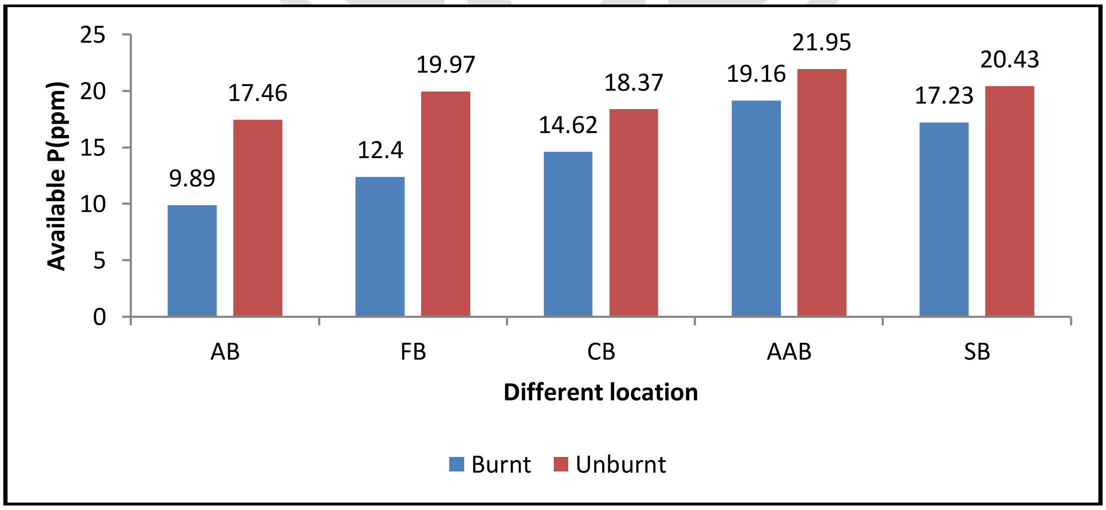

Figure 4.7: The P values of the surface soil (0-15 cm) in several brick kilns within the study location

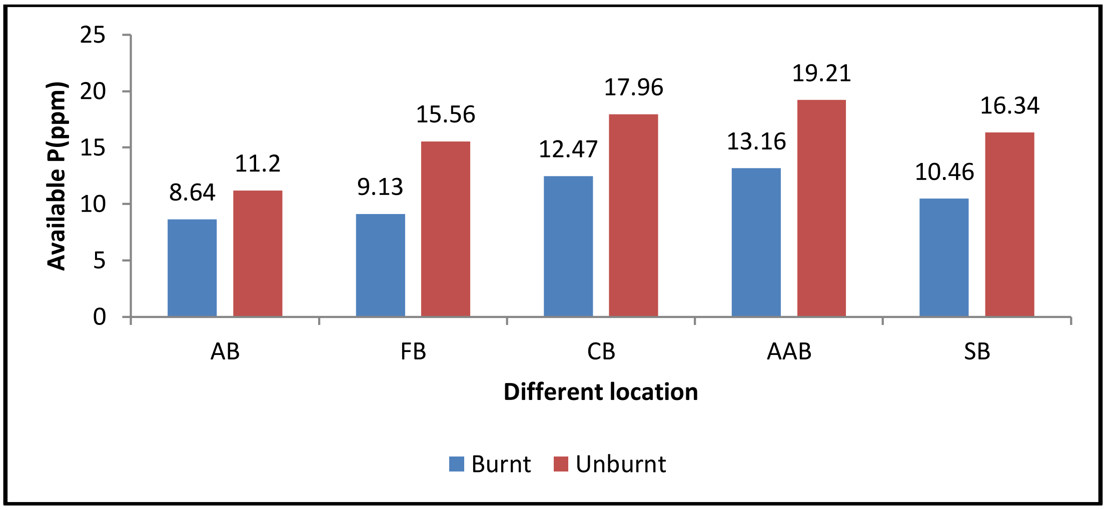

Figure 4.8: The P values of the surface soil (15-30 cm) in several brick kilns within the study location

4.5 Electrical conductivity (EC)

Figure 4.9 and 4.10 show the electrical conductivity (EC) measurements of soil at both surface and subsurface levels. The electrical conductivity (EC) values of the burnt soil varied between 9.7 and 25.3 ds/m for the surface soil layer (0–15 cm), and between 5.2 and 12.2 ds/m for the subsurface soil layer (15–30 cm). The surface soil measurements obtained for the unburned soil around brick field exhibited a range of 13.3 to 27.7 ds/m, while the subsurface soil measurements displayed a range of 8.3 to 24.3 ds/m. The AB brick field had the greatest electrical conductivity (EC) values of 27.7 ds/m in the unburned surface soil. The surface soil at the AB brick field had the highest electrical conductivity (EC) value of 25.3 ds/m, while the subsurface soil at the FB brick field displayed the lowest EC value of 5.2 ds/m. The average electrical conductivity (EC) values of the surface soil were 18.36 ds/m and 20.39 ds/m for the burnt and unburned soil, respectively. The average electrical conductivity (EC) values for subsurface soil were determined to be 8.52 dsm-1 for burnt soil and 12.82 ds/m for unburned soil, respectively. The standard deviation (SD) of the surface soil for both burnt and unburned conditions was found to be 5.86 ds/m and 5.48 ds/m, respectively. The SD values for the subsurface soil were 2.6 and 6.73 ds/m for burnt and unburned soil, respectively.

According to the SRDI. *(*2009*)* [13] report, the EC of the agricultural soil in Barishal Sadar Upazila ranged from 15 to 30 ds/m. The EC values of the unburned agricultural land were caused by management practices as irrigation, fertilizer, etc. In agricultural fields that had not been burnt, these procedures aided in soil buildup of cations (+). No such practises were carried out in soil from burnt brick fields, which also had low cation (+) carrying materials such dust, sand, brick, etc. combined with soil. Low EC values in brick field's burnt soils were caused by those.

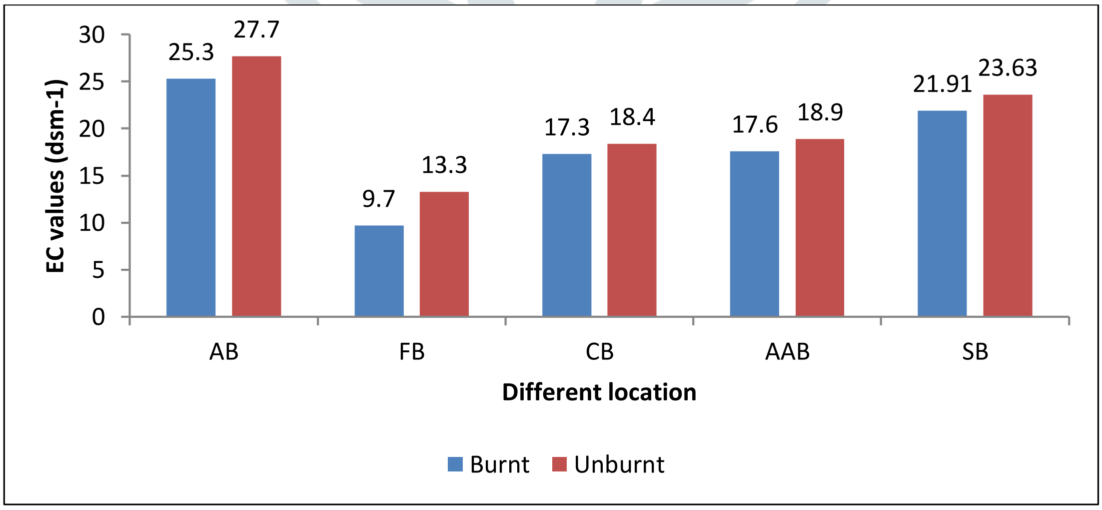

Figure 4.9: The EC values of the surface soil (0-15 cm) in several brick kilns within the study location.

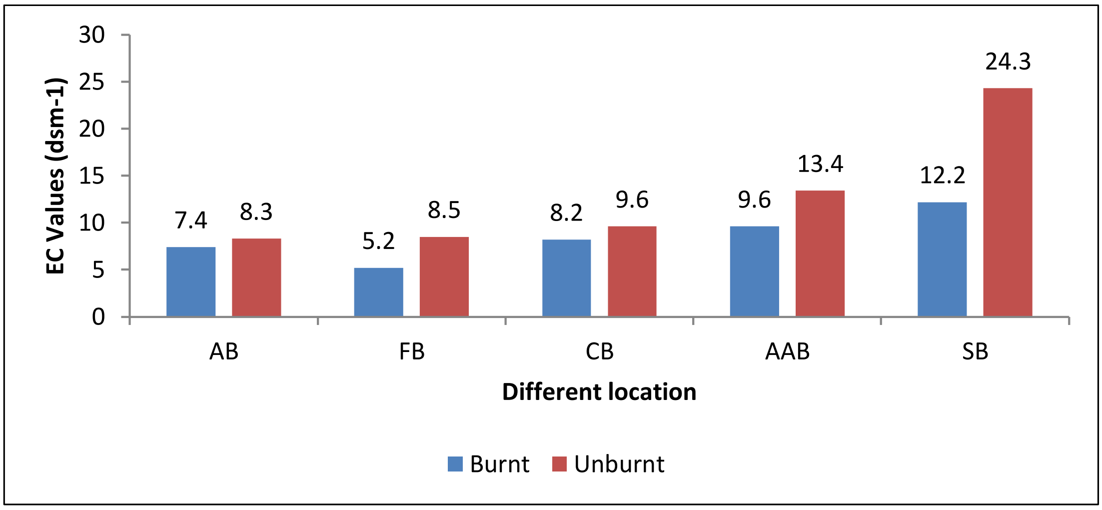

Figure 4.10: The EC values of the surface soil (15-30cm) in several brick kilns within the study location

V. CONCLUSION

Brick kilns are not only destroying large areas of lands, but also the organic material and nutrients in the soil. When compared to the unburned soil in the research region, the burnt soil's values for OM (0.51%) and nutrients were found to be extremely low, but the soil's pH and EC were comparatively greater. The study showed clearly that brick kiln operation reduces OM and critical nutrients through deteriorating soil quality. According to the study's results, brick kiln soil's chemical characteristics were poorer than those of unburned agricultural soil.

VI. RECOMMENDATION

This research raises awareness of the degree of pollution to the environment and land degradation caused on by brick kiln operations. The main objectives of this study are to be to reduce soil erosion, air and water pollution, preserve soil nutrients, and encourage sustainable land management practices. The research recommends the following to reduce soil nutrient loss and deterioration of soil quality:

i. Brick fields should be constructed far from productive agricultural land.
ii. In order to minimize the harmful impacts of brick burning operations, restore organic material and nutrient status.
iii. The government and related agencies have to establish laws and regulations for the management of the brick fields.
iv. Encourage the use of energy-saving and environmentally friendly brick-making methods, such as contemporary, high-efficiency kilns that emit fewer emissions and require less fuel.
v. Reduce soil erosion, improve soil fertility, and offset carbon emissions, promote reforestation and afforestation activities in and around brick kiln regions.
vi. Invest in research and innovation to develop and promote sustainable brick production methods that have minimal environmental and soil quality impacts.

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