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Abstract- Brick industry is one of the largest informal industrial sectors in Bangladesh contributes to 1% of GDP. Brick industry is expanding due to the expansion of the real estate sector while compromising several environmental and social consequences. To modernize the industry and to manage the environmental pollution, the government amended the Brick Burning Act 1989 and issued a number of orders following by enacting the Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013. The current study aims to understand the implications of regulatory changes in Brick Sector at Faridpur District based on primary and secondary data and identified around 66% brick kilns transformed into modern technology like zigzag and total 23100 tons of GHG emission has been reduced per year. At local level, technological availability, finance, government law and policy enforcement for pollution control, role of local DoE and administration, education and leadership of the local Brick Manufacturing Owners, etc. have influenced the adoption of modern kiln technology. Besides, the government has changed the brick kiln technology very fast. An incremental emission standard should be deployed to improve the energy efficiency of the brick sector.

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Implication of National Strategies to Reduce Environmental Pollution from Brick Industries at Local Level

Mowshumi Sharmin [α], Rafiul Islam [σ] & Dr. Mahfuzul Haque [ρ]

Abstract[1] - Brick industry is one of the largest informal industrial sectors in Bangladesh contributes to 1% of GDP. Brick industry is expanding due to the expansion of the real estate sector while compromising several environmental and social consequences. To modernize the industry and to manage the environmental pollution, the government amended the Brick Burning Act 1989 and issued a number of orders following by enacting the Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013. The current study aims to understand the implications of regulatory changes in Brick Sector at Faridpur District based on primary and secondary data and identified around 66% brick kilns transformed into modern technology like zigzag and total 23100 tons of GHG emission has been reduced per year. At local level, technological availability, finance, government law and policy enforcement for pollution control, role of local DoE and administration, education and leadership of the local Brick Manufacturing Owners, etc. have influenced the adoption of modern kiln technology. Besides, the government has changed the brick kiln technology very fast. An incremental emission standard should be deployed to improve the energy efficiency of the brick sector.

Keywords: brick kilns, environmental pollution, urbanization, legislative process, GHG emission, national strategy.

I. Introduction

Brick industries are identified as one of the major environmental pollutants in Bangladesh. Every year five thousand brick industries burn almost 3.8 million tons of coal and another 1.9 million tons of wood indiscriminately to meet the demand of 400 to 1200 tons of fuel to produce 17.2 billion bricks emitting 9.8 million ton of CO2 and 170 billion $\mu g/m^3$ of particulate pollution (World Bank, 2011). The emission from brick industries is causing serious health threats to adults that harm their eyesight, lungs, and throat as well as stunt the psychological and physical development of the children (Guttikunda & Khaliquzzaman, 2013). Brick making subsidizes a lot to the construction sector and contribute 1% of the country's Gross Domestic Product (GDP) or $245 million (2010) but it is not formally recognized as industry (Word Bank, 2011).

In Bangladesh, brick fields are the main supplier of building material. The country's overwhelming dependence on bricks is due to its lack of stones in any sizable quantity or other alternative building materials at a comparable cost (World Bank, 2011). To attain the target of sustainable growth in the country and to achieve the efficacy in the building material sector, there is an urgent need of improving the brick industries in the country.

In the country, there are generally six types of brick kilns: (i) Bull's Trench Kilns (BTKs), (ii) Fixed Chimney Kilns (FCKs), (iii) Improved Zigzag Kilns, (iv) Vertical Shaft Brick Kiln (VSBKs), (v) Hoffman Kilns, and (vi) Tunnel Kilns. Among these technologies, 92% of the total 5000 brickfields are highly polluting FCKs. More energy efficient and less environment polluting improved zigzag kilns, vertical shaft brick kilns (VSBKs), hybrid Hoffman kiln (HHKs), and tunnel kilns are rare (World Bank, 2011).

An expansion in the real estate sector of Bangladesh encouraging brick industries to grow abundantly stimulates the process of urbanization and economic growth sacrificing several environmental and social consequences. For developing countries like Bangladesh, air pollution is acting as one of the main problems of environment pollution and brick industries are identified as major contaminants in the vicinity of the cities of the country in the name of progress. Discharge of huge quantity of toxic elements from brick industries causing serious health threats polluting the environment.

In order to protect the environment, the government of Bangladesh is trying to compress down the brick industries through regulations and encouraging the use of cleaner technologies. There is a lack of government policy to support a long-term brick sector development strategy. As a result, the legal and regulatory framework does not adequately address the relevant energy efficiency guidelines and other

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underlying development constraints. However, the existing legislation is based on the Brick Burning Act (1989) and various amendments and circulars after that. Though in place, these legal frameworks have not been effective to encourage brickfield owners to switch to the most efficient technologies and reduce pollution. The most concrete step taken by the government is the 2010 government notification that banned the operation of FCKs by September 2013 (ADB, 2012). Due to the still-developing economy, businesses often choose cheap, though inefficient, operational techniques to reduce costs. Most brickfields are informal, small to medium-sized businesses that operate with outmoded technologies, are severely polluting, and have poor labor standards. Hence, the country's inability to develop an energy efficient, clean and modern brick sector is a sign of market failure, and is a result of general lacks of (i) awareness of available modern technologies, (ii) technological and operational capacity, and (iii) targeted finance.

After 2013, old kiln technologies are banned and the government is enforcing the proposed three new brick field technologies without having any comprehensive brick sectoral road map or plan. Therefore, brick sectoral upgradation only through legislative change is quite challenging, and the level of upgradation is an objective of this study. The current study looked into the implication of legislative changes as well as the factors which could support the upgradation of the brick sector at local level in Faridpur district.

This paper is organized as follows. Section two summarizes existing empirical evidence and section three presents the objectives. The remainder of the paper includes research methodology in section three, findings and discussion in section four and conclusion and some policy recommendations of the study are drawn in section five.

II. Existing Empirical Evidence

The study reviewed a number of literatures mainly on the brick sectors. The study has reviewed papers and publics form World Bank, ADB, and the SAARC. The review is done to capture the current scenario of the Brick sector in Bangladesh. World Bank (2011) published a comprehensive report on the brick sectoral situation with a set of the policy measure to be taken to make the sector energy efficient. ADB (2012) has analysed the current situation along with the legislative development process to prepare a feasibility study on the sector for developing investment project. SAARC (2014) Energy Centre in Pakistan prepared a detail sectoral study compiling all the available information including World Bank, ADB, and other institutional research documents.

BUET (2007) study on Small Study on Air Quality Impacts of the North Dhaka Brickfield Cluster by Modelling of Emissions and Suggestions for Mitigation Measures including Financing Models intends to find technically and financially viable alternatives polluting brick kilns around Dhaka city taking secondary data. GEF-UNDP (2006) report postulates that brick making is one of the largest sources of greenhouse gas emission in Bangladesh and observes that the country does not have financing and strong regulatory incentives to become energy efficient.

Croitoru, L., & Sarraf, M. (2012) shows that cleaner technologies are more attractive than traditional technologies both from the private and social perspective, and recommended for a cleaner brick sector in Bangladesh. Development Alternatives & Practical Action. (2009) analysis of the brick sector shows the feasibility of cleaner alternative technologies in Bangladesh.

Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013, (Government of Bangladesh, 2013) is provided for the control of activities relating to brick manufacturing and brick kiln formation and to re-enact with some modifications by annulling the prevailing act. It is necessary to establish control over brick kiln establishment for the conservation of environment and biodiversity.

In summary, from the aforementioned existing empirical literature, it is evident that there is a substantial amount of empirical literature showing the brick field scenario particularly on Bangladesh but very few studies concentrate on the implication of national strategies. This study endeavors to give an inclusive scenario of the implication of national strategies. This study has reviewed all these documents to develop the objectives and methodology to carry out the current study. Although the study tried to analyze both the primary and secondary information to document the current brick sectoral scenario in terms of size, employment, production, technology used, efficiency of fuel burning and environmental pollution etc. and side-by-side the legal instrumental development to promote the sector as an efficient one in the country but it has some limitations also. The study has been done by focusing on the few key literatures. If there were a process of information collection form the key stakeholder at the national level, then the study findings could be further improved.

III. Objectives

The aim of this study is to find out the current scenario of brick industries in Bangladesh and to analyze the impact of national brick sectoral strategies at Faridpur district (local level). However, the specific objectives of this study are the following:

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i. To study the current scenario of national brick industries and the relevant legal instruments promulgated for improving the brick sector in Bangladesh;
ii. To find out the local level situation and the implication of national legal instruments in the brick industries of Faridpur Districts.

IV. Methodologies

The study has been carried out with a structured methodological process. The scope of the study requires having both the review of the current situation in terms of size of the brick industries, employment, materials produced, legal instrumental development, etc. and the local level information collection, analysis and reporting to draw the linkages between the national and local level scenario.

The study was carried out at Faridpur District located in the central part of Bangladesh. Faridpur is a part of the Dhaka Division and has a population of over 1.7 million and is situated on the banks of the Padma River. The study has been carried out using both primary and secondary data. Secondary data has been used to draw the analysis on sectoral scenario, legislative changes while Key Informant Interviews (KIIs) have been carried out with the relevant stakeholders like, brick kiln owner, representatives of local Brick Manufacturing Owners Association (BMOA), Department of Environment (DoE), local administration etc. to find out the implications of the legislative changes and factor influenced the transformative changes in the brick sector of Faridpur. The data analysis was done to draw a chronological change in the brick sector of the country and how it has affected at the local level to adopt modern kiln technologies and the factors which have facilitated the adoption process.

V. Study Findings

The study findings have been arranged from the national scenario on the brick industries of the country from the legislative process development and the local situation at Faridpur and the role of the national legislative related with the brick industries. The following part is showing the findings of this study:

a) Brick Sector related Legislative Development in Bangladesh

From the review on the legal instrumental development process, it is evident that prior to 1989, brick making was an unregulated industry in Bangladesh. In 1989, The Brick Burning (Regulation) Act of 1989 was enacted, and it banned the use of firewood in brick burning with a provision of limited fuel wood burning in the remote areas and also introduced the licensing process for the brick field and soil use guideline for making brick. Later on, a number of amendments of this act have been done by the government and enacted Brick Burning Rules 2002 and issued few notifications on the technology to be used, areas where the brick field to be constructed, and finally the revision of the brick burning act took place in 2011. The following table demonstrates the chronological legal instrumental development process for facilitating and regulating the brick industries in Bangladesh:

Table 4.1: Summary of the legislations of brick burning in Bangladesh

Year	Regulation	Responsible Agency	Details	Remarks
1989	The Brick Burning (Regulation) Act of 1989	Department of Environment (DOE), Ministry of Environment and Forests (MOEF)	Bangladesh's first brick-making law banned the use of firewood for brick manufacturing and introduced licensing for brick kilns.	Use of firewood has largely been discontinued, but in remote areas, it continues on a limited scale.
2001	Revision of the Brick Burning (Regulation) Act of 1989	DOE, MOEF	The 1989 act was amended to regulate the location of brick kilns. The new provision required that brick kilns not be set up within 3 kilometers of the upazilla (district center),municipal areas, residential areas, gardens, and government reserve forests.	Using the given criteria, it is nearly impossible in reality to find land for brick kilns in Bangladesh. The Bangladesh Brick Manufacturing Owners Association often cites this as a major deficiency in the law. Despite this amendment, the location requirements have not been enforced.
2002	Brick burning Rules	DOE, MOEF	The government introduced a rule that made the use of 120 feet (36.6 meters) chimneys for brick kilns compulsory.	This requirement was successfully enforced, especially in the vicinity of urban areas, and most bull's trench kilns were upgraded to fixed chimney kiln technology. However, some bull's trench kilns continue to operate, albeit illegally.

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2007	Government Of Bangladesh notification	DOE, MOEF	The government issued a notification that environmental clearance certificates would not be renewed if an owner did not shift to alternative fuel and improved technologies by 2010.	This regulation has not been implemented since little on-the-ground activity occurred to facilitate the switch.
2010	Government of Bangladesh notification	DOE, MOEF	A new notification was issued banning fixed chimney kiln operation from 2013.	Activities are being undertaken under the government's Clean Air and Sustainable Environment Project with World Bank support
2013	Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013	DOE, MOEF	The revision of the act has the objective to regulate the brick industry establishment, licensing, efficient fuel use, soil use, the location of brick field, etc.	Brick field technologies were not mentioned.

Source: ADB,2015

There is a lack of a government policy to support a long-term brick sector development strategy. As a result, the legal and regulatory framework does not adequately address the relevant energy efficiency guidelines and other underlying development constraints.

b) Local Context of Brick Industries in Faridpur

The local level consultation with the brick field stakeholders mainly the owners and the manager has revealed a comparatively good scenario of the transformation of the brick industry in Faridpur. The following table shows the at glace brick sector scenario of the Faridpur District.

Table 4.2: At a glance brick field scenario in Faridpur District

Type of Brick Field	No. of Brick Field
Unlicensed FCK	26
Licensed FCK	8
Zigzag	77
Hoffman (coal based)	2
Total	113

Source: Local BBMOA and DoE.

The above table reveals in Faridpur there are around 113 brick kilns. However, out of 113, 87 kilns are licensed, and the rest 26 are unlicensed FCKs. Among the licensed Kilns around 77 Zigzag kilns are found to be mostly upgraded from the FCKs. Among the Zigzag Kilns, around 50% are improved version zigzag which uses water to settling the particulate matters from the emission while other kilns do not use the water for cleaning the smog. In the district, there are two coal-based Hoffman kilns established recently and still there are 8 licensed FCKs exist although the FCKs are banned. Overall the transformation of the FCK into the improved kiln technology is very promising in Faridpur. Around 68% FCKs has been transformed into the Zigzags after banning the FCK by 2013. And most of the FCK have been upgraded into zigzag before 2013.

Table 4.2.1: Understanding about the technologies by the entrepreneurs

Technologies	Key Issues			
	Capacity	Environmental pollution	Investment	Profit
FCK	Capacity of the brick production is same in both the kilns.	Higher environmental pollution	While the FCK has been upgraded in the Zigzag then around 6.0 million BDT additional investment required	Profit margin is same as the fuel requirement is same
Zigzag		Comparatively less environmental pollution due to suction and settling effect.		

Source: Field Survey 2017

Following the World Bank recommendations, if the upgraded zigzag kilns use the internal fuel then it will further reduce the 20 GHG emissions. The conversion from FCK into the Zigzag required around BDT 6.0 million additional investments. While the fuel consumption and production capacities are same with both the technologies, hence the environmental pollution or the GHG emission is less in the Zigzag kilns. It is estimated that the 77 nos. of zigzag kilns are yearly producing around 231 million of brick in the district and reducing average 100 tons of GHG to produce per million brick (BBMOA and World Bank, 2011). Therefore, total 23100 tons of GHG emission has been reduced per year by transforming 77 nos. of FCK into the zigzag kilns.

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Table 4.2.2: Factors Influenced the Brick Making Technology Up Gradation

Factors	Overall responses of the brick field owners/managers
Technological availability	The technological transformation was not very difficult. There were few initiatives on the transformation of FCK into Zigzag by the self-interest of the entrepreneurs which actually helped the other entrepreneurs to follow the up-gradation process.
Finance	No financial supports were available from the government. The entrepreneurs manage the finance by themselves while the CC loan was available at a higher rate of interest.
Government law /policy enforcement for pollution control	Those who have upgraded their brick kiln in zigzag, they did it because of the legal compliance. Because, these entrepreneurs understood, without compliance with the legal process, it is difficult to do the brick business. Therefore, they were interested to comply with the legal process and upgraded their kilns.
Role of local DoE	The entrepreneurs opined that the local DoE officials were very much positive and always were sensitizing the brick entrepreneurs about the benefit of upgrading into the new technologies also about the negative environmental consequences of using un-improved technologies. Even the DOE officials were supporting and motivating towards entrepreneurs in any locations of the district. The officials never demanded any extra amount during the license renewal process and sometimes, the officials were pro-actively informing about the renewal process and timeline.
Role of local administration	Local district and Upazila administration were very active to start the up-gradation of the industry. The local administration was running frequent mobile court operation to stop the un-improved brick kiln operations in the district and they sometimes put pressure on the entrepreneurs to upgrade the kiln technologies.
Education and leadership of the local Brick Manufacturing Owners Association	The local BMOA leaders are comparatively higher educated in Faridpur district and they took the vigilant action by the local administration as one of the disrespectful acts. Additionally, the brick field owners are comparatively the well-off people in the local society. Hence, it became an issue of ego, why to be disrespected by the local administration. The leader has up-graded their kiln first and they also tried to sensitize the other members to upgrade their kiln technology. This process has given a quick result for the kiln up-gradation.
Business potential	The owners of the brick fields understand the current level of growth in the brick sector and they know there is lot more demand of brick in the country since there is actuate shortage of the building material in the country.

Source: Field Survey 2017.

VI. Conclusion and Policy Recommendations

Two-thirds of the brick industries have been up-graded till date by converting mostly the FCKs into the Zigzag Kilns. The Brick Field owners lead by local BMOA is in favor of extending time period for conversion of existing FCK to Zigzag beyond 2013. However, the owners require financial assistance from the Bank and other financial institutions with a single digit interest.

The local level brick sectoral scenario has been studied only form Faridpur District; therefore, the situation of Faridpur may not be representative for the whole country. Like the transformation process and the facilitation of the adoption of improved brick kiln technologies may not be in same pace in other districts. Further study could focus more districts of Bangladesh for better representation of the country.

The following recommendations can take place to improve the sector as well as to attain the energy efficiency and less GHG emission in the country:

- Current financing which is one of the key constraints for low sized kilns managed by family business does not offer any additional benefits to the brick entrepreneurs, therefore, some of the entrepreneurs go bank for the CC loan. If government can arrange a finical facility with a single digit interest rate to these entrepreneurs with a condition of technology up-gradation, then it could help the transformation of the sector at a faster rate;
- Local DoE can set-up a monitoring cell at local level jointly with the local BBMOA leaders to monitor the level of pollution, and other social issues like stop child labor, sharing local knowledge among entrepreneurs, stakeholders, specially fireman, owners, and managers, brick makers for capacity building;
- An incremental emission standard should be deployed to improve the energy efficiency of the brick sector like, combining the internal fuel in the zigzag kiln which could further improve the performance of it;
- Need to set-up R&D cell regionally to research on various issue related with the brick industries and the DoE and the BBMOA can link with the universities. The R&D initiatives can undertake the institutionalized training programme on internal fuel, firing, kiln making, process mechanization etc. issues for the target stakeholders; and
- Coals are sometimes not available and low-standard coal is being imported from the neighboring countries which need to be dealt properly.

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