



## NATIONAL STRATEGY FOR SUSTAINABLE BRICK PRODUCTION IN BANGLADESH



DEPARTMENT OF ENVIRONMENT  
MINISTRY OF ENVIRONMENT AND FORESTS  
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MAY 2017

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# CHAPTER 1

## INTRUDUCTION

### 1.1 BACKGROUND

Since the dawn of civilization, bricks have been playing an important role for construction of houses and other infrastructure and are a major catalyst for economic progress. In Bangladesh bricks are the most important building material in urban areas. However, with income rising, it has become a significant building material in rural areas as well. Rapid urbanization and associated rural to urban migration has created an increasing demand for residential, commercial, industrial, public buildings and other infrastructures. With the rising demand for construction materials to carter to the infrastructure growth, the brick manufacturing industry in Bangladesh has risen dramatically. Therefore, brickfields have thrived and mushroomed all over the country with heavy concentration at the outskirts of cities and towns. The brick making industry in Bangladesh is transitioning slowly towards mechanization, they are largely using inefficient, dirty technology, informal seasonal employment methods and haphazard growth. The unplanned development of the brick industry is completely unsustainable. Therefore, there is an urgent for national strategies and policy actions for cleaner and sustainable brick production in Bangladesh.

### 1.2 OBJECTIVES

The overall objective of this initiative is to prepare a 'National Strategy Paper' and recommend policy actions for sustainable brick manufacturing industry in Bangladesh. This includes all elements of strategic plan, but only with the level of detains allowed by available information and preliminary assessment. This initiative will seek to identify major social and economic concerns posed by brick industry, assess various policy measures being implemented in the country that are relevant to brick sectors, capacity and policy gaps would need to be addressed to ensure effective strategic planning and options for addressing major challenges and problems posed by the brick sector. Most importantly this work will identify which priority actions could be mainstreamed into existing government policies; which will require new national initiatives; and which can simply adopt international best practices.

### 1.3 OUTLINE OF METHODOLOGIES

The methodology followed for developing a National Strategy for Sustainable Brick Manufacturing in Bangladesh is summarized below:

- 1) Formulating the architecture of the National Strategy Paper through consultation with stakeholders including relevant officials of the Department of Environment, Department of Public Works and Bangladesh Brick Manufacturing Owners Association;
- 2) Review current status of brick industry of Bangladesh;
- 3) Identify emissions from and social and environmental impacts of brick kilns, based on available information;
- 4) Identify existing policies, projects and programs addressing brick issues, evaluate opportunities and barriers (e.g., policy, institutional, technological, market, finance, knowledge and information) to cleaner brick production;
- 5) Identify a set of strategies and policy actions needed for successful transition to cleaner and sustainable brick making industry in Bangladesh;
- 6) Interact with key stakeholders through one to one interview to get feedback on strategies and actions needed to be mainstreamed into existing government policies and actions that would require new policies and strategies;
- 7) Prepare the National Strategy Paper and present it to stakeholders at the workshop for getting feedback;
- 8) Update the draft National Strategy Paper based on stakeholders feedbacks and distribute it among key stakeholders for peer review;
- 9) Finalize National Strategy Paper by incorporating feedback from peer review.

## CHAPTER 2

### OVERVIEW OF BRICK SECTOR

#### 2.1 INTRODUCTION

Fired clay bricks are one of the most important construction materials in Bangladesh. Bangladesh stands as the fourth largest brick producer in the world. The country has more than 7,000 brick kilns, producing about 23 billion bricks annually. The industry accounts for approximately 1% of the country's GDP and generating employment for more than a million people. Bangladesh has a population of 159.9 million and at current growth rate, Bangladesh will require constructing approximate 4 million new houses annually to meet the demand for the growing population and that, in turn, will lead the growth for the brick sector. The Table 2.1 below provides a snapshot of brick sector in Bangladesh.

Table 2.1: Bangladesh's Brick Sector at a Glance

Parameter	Value
Estimated total number of coal-fired kilns	7,000
Annual brick production	23 billion
Value of output	USD 2.53 billion
Contribution to GDP	~1%
Coal consumption	5.68 million tons
Emission of CO <sub>2</sub>	15.67 million tons
Clay consumption	3350 million cubic feet
Total employment (including supply of clay and coal)	>1 million
Estimated future growth rate over the next ten years	2-3%

#### 2.2 CHARACTERISTICS OF BRICK INDUSTRY

The brick industry in Bangladesh can be categorized as SME size operations characterized by two types of firms with high profit structures and owing three or four production modules and marginal ones, the greater majority by, typified by low incomes and small production units.

Even though there are a number of brick making units using improved technologies, operating round the year, most brick plants use dirty technologies with low energy efficiency and high emissions, relying on single raw material i.e., clay and product (solid brick). The continuing use of low-tech fixed chimney kiln to fire manually produced, sun-

dry bricks and clustering patterns have combined to cause significant deterioration in air quality around these clusters and the adjacent urban areas. Not only have SPM emissions increase alarmingly from the uncontrolled burning of coal in these inefficient kilns, emissions of dust and other particulates have also risen significantly from the increase use of transport vehicles and the unplanned use of land around the clusters. The later has led to a significant land degradation of the surrounding areas and the former to critical deterioration of the air quality around nearby towns and cities.

Brick production in Bangladesh is seasonal, confined to five to six dry months of the year. Due to seasonal nature of operation and employment, brick making has not classified as an industry in the Industry Policy of Bangladesh. In brick sector, labor productivity is low, capitalization non-existent, mostly operation on equity capital and informal management. Most of the brick manufactures face extreme difficulty with working capital and that push them to count on informal banking channels such as family, friend and money lenders to finance their activities. In addition to high interest rates, these channels are cumbersome, time consuming and mostly, inadequate.

### **2.3 BRICK MAKING TECHNOLOGIES**

There are five different technologies being used in brick kilns in Bangladesh such as Fixed-Chimney Kiln (FCK), Zigzag, Hybrid Hoffman (HHK), Vertical Shaft Brick Kiln (VSBK) and Tunnel Kiln. Among these kiln technologies, the FCK is the least efficient and most polluting and the Tunnel, the most efficient and less polluting. Other technologies such as Improved Zigzag and HHK are substantially cleaner, consuming less energy and emitting much lower amounts of pollutants technology, but are still being piloted in Bangladesh and are, therefore, at an early adoption stage.

The Table 2.2 below shows different types of technologies being used in Bangladesh in 2009 and 2017 with the market share for each technology. As can be seen of the total 15.75 billion bricks produced in 2009, the FCK accounted for about 92%, the remaining technologies were responsible for 8% of the bricks. In 18 years the mix of technologies in the brick industry has changed dramatically. From 2008 to 2017, the number of FCKs has declined from staggering 4500 to 2373. On contrary, the number of Zigzag Kilns rose to 4274 in 2017 from a mere 150 in 2009. This rapid change has taken place due to the banning of FCKs through a government notification effected in September 2010, many

owners have converted FCKs to Zigzag kilns. Despite this banning, FCK still continues to be operated in brick production.

Table 2.2: Brick production using different types of technologies

Kiln Type	2009				2017 (June)			
	Number	Percentage of total	Annual Production (billions)	Percentage of total production	Number	Percentage of total	Annual Production (billions)	Percentage of total production
FCK	4,500	92.21	13.5	89.46	2373	35.19	7.1	31.16
Zigzag	150	3.07	0.5	2.98	4247	62.97	12.7	55.76
HHK	30	0.61	0.5	3.58	61	0.90	1.1	4.81
Tunnel	0		0.0	0.00	58	0.86	1.7	7.62
Others	200	4.1	0.6	3.98	5	0.07	0.2	0.66
Total	4880		15.1		6744		22.8	100.00

The Hybrid Hoffman Kilns could get hold of the market of share of brick sector in Bangladesh as can be seen in Table 2.2. According the information provided by the Department of Environment, there were 105 HHKs in the country in 2015- many of them were run by natural gas. However, with the dwindling gas supply and supports from financial institutes and donor agencies, their number continues to decrease each year and stood at only 61 in 2017. On the other hand investment in modern and automatic Tunnel Kilns increased in recent years. Currently 58 Tunnel Kilns are in operation in different parts of the country which are due to the extension of low-cost loans by banks and financial institutions.

### 2.3.1 Fixed Chimney Kiln (FCK)



FCK is essentially a modified Bull's Trench Kilns with a 120 ft long fixed chimney. It has elliptical shape shaped dugout area. The bottom and the sidewalls of the kiln are lined with bricks keeping the top open. Sun dried bricks are sacked in the kiln in an orderly fashion leaving enough room for fuel stoking and air circulation. After arranging the bricks in the kiln, the top of the kiln is covered with fired bricks and pebbles. The bricks are fired from the top and the fire moves forward towards the chimney. The air hole and the chimney are located at the two ends in such a way that

combustion air is preheated by taking heat from the fired bricks and the green bricks to be fired are preheated by the flue gas on its way out of the chimney. The bricks are fired all around the kiln, which means that the chimney and the air hole must be progressively moved forward, until all bricks in the trench are fired. The tall chimney creates a stronger draft thereby improving the combustion process and releases the flue gas at a height 120 ft above the ground thus providing faster and better dispersion. The kiln has underground piping to diver the flue gas from anywhere in the kiln to the fixed chimney. The FCK has better insulation than BTK in the sidewall, which reduces heat loss to the surroundings. The cost of construction of the chimney is nearly 50% of the total cost of a FCK.

### 2.3.2 Zigzag Kiln or Hawa Bhatta

The Zigzag Kiln is rectangular in shape, measuring 250 ft by 80 ft. The kiln has a 55 ft high fixed chimney located on one side of the kiln. At the bottom of the chimney there is a



blower, which draws the flue gas from the kiln and discharges it to the atmosphere. The kiln is divided into 44 to 52 chambers, which are separated from each other in such a way that the hot gases move in zigzag path through the kiln. While some utilize a natural draft, others use a fan to draw the fire and heat through the zig-zag stacking pattern. This firing process requires a set of highly trained and skilled workers to

operate and maintain the kiln. The Zigzag Kiln is reported to be 10-15% more fuel efficient than the FCK.

### 2.3.3 Improved Zigzag Kiln

The improved Zigzag Kiln is a modified version of the traditional Zigzag Kiln or ‘Hawa



Bhatta’. It is elliptically shaped with well insulated permanent side walls and roofs and arched firing chambers that allow easy air flow. The kiln is versatile in size ranging from 22 to 42 chambers.

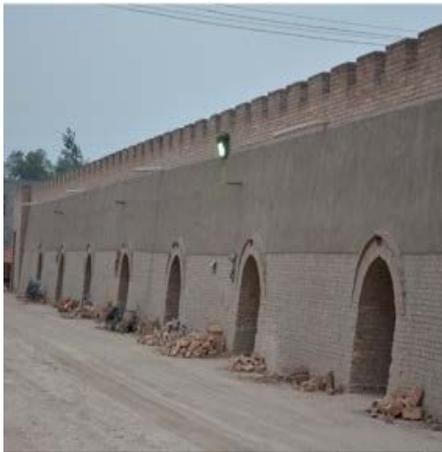
Clay and coal is mixed together to form into bricks. After sun drying, the green bricks are loaded into

chambers which are fired through stoke holes in the roof until the temperature rises to about 800°C. Air required for the combustion process is forced from behind by a

centrifugal draft fan since the zigzag path giving long distance and high obstacles for the flue gas to pass. As air reaches the line to be fired, it is already preheated from the previous firing zone thus reducing firing time to about 1m/hour. A water scrubbing system is installed inside the chimney that filters before releasing into atmosphere through the chimney.

### 2.3.4 Hybrid Hoffman Kiln (HHK)

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. The chimney is 76 feet high with a blower at the bottom which forces the air required for combustion from behind. The green bricks are stacked in the kiln almost similar fashion as that in the FCK. Bricks are fired from the top by introducing the fuel (natural gas) into the

combustion zone. The burners are transferred forward from section to section as the fire progresses. Fired brick are unloaded at the back while green bricks are loaded in from of the firing zone. The flue gas is conveyed towards the chimney through a network of channels just below the kiln.

### 2.3.5 Tunnel Kiln

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. The firing of products occurs at the central part of the tunnel. Fuel is fed into the firing zone of the kiln through feed holes provided in the kiln roof. Cold air enters the kiln for the car exit and cools the fired bricks while getting heated as it proceeds towards the firing zone. After combustion, the hot flue gases travel towards the car entrance end losing a part of the

heat to the green bricks entering the kiln. Hot air/gases are extracted from the tunnel kiln at several points along the length of the kiln and are supplied to the drying tunnel/chamber.

## **2.4 POLLUTION**

Coal is the primary fuel for brick making process in Bangladesh. Coal-fired brick kilns often use low grade, high sulfur coals imported from India. The burning process in these kilns is not very efficient and depends on the expertise of the firemen in charge. Exhausts from these kilns contain fly ash, particulate matter and high concentrations of CO and SO<sub>x</sub>. The sever pollution level is readily discernible from the thick back plume emanating from the chimneys and the dismal state of vegetation in the vicinity of the kilns.

In the Greater Dhaka region, the total emissions from the clusters of brick kilns for 2013 had been estimated at 53,333 tons of PM<sub>10</sub>, 17,557 tons of PM<sub>2.5</sub>, 59,221 tons of SO<sub>x</sub> (DOE, 2013). As has been shown in above result, the brick industries in Dhaka region contribute approximately 91% and 84% of total annual PM<sub>10</sub> and PM<sub>2.5</sub>, respectively The brick-kiln's contribution to the CO emission might be significant during the dry season but this part will be zero during rainy season.

### **2.4.1 Health Impacts**

This fine PM is considering more harmful to human health, because it has the capacity to travel deeper into the respiratory system and cause premature mortality and respiratory ailments (Guttikunda, 2009). From these PM, mainly both elder people and children are suffered more than any ages because on these stages of life our disease prevention mechanisms become weaker (OAQPS Fact Sheet, 1997). American Lung Association (ALA) found in their research that, for the PM in air premature deaths rate increased three times higher than the previous studies. Child mortality rate were also increase for air pollution (ALA, 2006). A health survey clearly showed that people who are living near brick kilns are more likely to suffer from illnesses caused by kilns 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).

Exposure to sulfur dioxide in the ambient air has been linked with reduced lung function, increased prevalence of respiratory symptoms and diseases, irritation of the eyes, nose and throat and early mortality. Children, the elderly and those previously suffering from respiratory ailments, such as asthmatics, are mostly at risk.

Studies show that work related dust exposure is a risk factor for acute and chronic respiratory irritation, inflammation and cardiovascular diseases (Koskela et al., 2005). It is also reported that elevated amounts of CO, which is formed in brick kilns due to poor kiln design that consequences in incomplete combustion of coal, could also cause undesirable health effects on central nervous system and eventually resulted in symptoms of headache, nausea, exertion and shortness of breath (Seinfeld and Pandis, 1998; Zuskin et al., 1998; Maynard and Waller, 1999). Plentiful epidemiological studies have exposed a correlation between prominent levels of airborne particulates and amplified rate of morbidity and mortality (Pope, 2000; Shah, 2009). Likewise, epidemiological studies done with respect to the worsening ambient air quality at different places around the world have revealed the evidence of an increase in the rate of bronchitis, asthma, decreased lung function, pharyngitis, cough, eye irritation, fibrosis, emphysema, allergic rhinitis and low birth weight (Pope and Dockery, 1992; Schwartz, 1996; Bobak, 2000; Donaldson, 2001; Pope et al., 2002; Callen et al., 2009). The airborne particulates and associated trace metals have been related to both acute and chronic adverse health effects which mostly consist of respiratory diseases, lung cancer, heart diseases and damage to other organs (Prieditis and Adamson, 2002; Magas et al., 2007; Wild et al., 2009)

Various gaseous and particulate pollutants emanating from brick kilns show negative impact on the adjacent vegetation. Suspended Particulate Matter (SPM) has an effect on plants in an ample range of ways, depending upon the composition of the particles and is recognized to have direct or indirect effects on agricultural plants. Dust particles are of localized significance near brick kilns, roads, quarries, cement works and other industrial areas (Zeiger and Taiz, 2006). Aside from screening out sunlight in the atmosphere, the undeviating impact of the dust on leaves reduces radiation to chloroplasts and stomatal conductance and can affect control of water loss by physically preventing stomata closure (Zeiger and Taiz, 2006). The direct impact of particles containing contaminants for instance heavy metals can also cause phytotoxicity (Erickson, 1979). Accumulation of particulates on the surface of the plants can in due course alter plant vulnerability to pathogens and pests (Emberson et al., 2001) and the exposure to dust pollution stress provoked significant reductions in photosynthesis in most plants. Thus, may alter plant growth and production, without physical damage to the plant (Kumar and Thambavani, 2012). It is also the fact plants provide a vast leaf area for impingement, assimilation and accumulation of air pollutants diminish the pollutant level in the air environment (Warren,

1973; Shannigrahi et al., 2004), thus can be used as bioindicator of air pollution (Tripathi and Gautam, 2007; Lalitha et al., 2013)

## 2.4.2 Emission from Different Kiln Technologies

The thick black smoke that everyone associates with BTKs and FCKs is emitted during coal charging. After the completion of coal feeding, the flue gas color changes from grayish black to milky white and remains white until the next coal charging.

In Zigzag Kiln, the flue gas moves in a zigzag path and most of the coarse particles are retained in the kiln preventing them from being discharged into the atmosphere. It employs a scrubber- the flue gas is drawn into an underground water reservoir and scrubbed before being released into the atmosphere. However, its performance is strongly dependent on regular changing of the scrubbing water. It is reported that brick makers often do not bother to do that, and as a result, the pollution is only marginally abated.

Table 2.1: Comparing Different Brick Kilns

Kiln Type	Coal Consumption (ton/100000 bricks)	Particulate Matter mg/cm <sup>3</sup>	CO <sub>2</sub> Emission ton/100000 bricks	Annual Production (million)
<b>FCK</b>	20-22	>1000	47-52	3.5-4
<b>Zigzag</b>	16-18	600-900	38-43	3.6
<b>Improved Zigzag</b>	14	65	33	5.4
<b>HHK</b>	12-14	20.3	28-33	24
<b>Tunnel</b>	18-22	16	50	24-48

## 2.5 Compliance and Enforcement

The Bangladesh Environment Conservation Act, 1995 (ECA 1995) and Environment Conservation Rules, 1997 (ECR 1997) outline the environmental regulatory regime to establish environmental administration in Bangladesh and give Department of Environment (DOE) mandate for their enforcement. DOE officials are often engaged in different activities to enforce the provisions of laws and rules as provided in the ECA, 1995 and ECR, 1997

Department of Environment (DOE) routinely conducts compliance monitoring of industries and development projects to ensure that they have been established or undertaken after having Environmental Clearance Certificates (ECC) from the Department of Environment as mandated by the Bangladesh Environment Conservation Act, 1995. DOE also enforces environmental quality standards and management of those

industrial units and project as stipulated in the Environment Conservation Rules, 1997 and conditions set out in the ECC.

As per section 7 of the Bangladesh Environment Conservation Act, 1995, compensation is realized from polluting, non-conforming enterprise for the environmental damage caused by them. Under this regulatory provision, from June 2016 to June 2017 the Department of Environment carried out enforcement drive against 38 brick fields in which a total of Taka 120 million as compensation was assessed and out of which approximately Taka 8.5 million was realized.

In addition enforcement activities were carried out against illegal brick kilns under the Mobile Court Act, 2009 under which penalty is imposed instantly by taking cognizance of the offences. During last year mobile court fined a total of 27 brick fields Taka 8.3 million for operating the kilns without having ECC and Brick Manufacturing Licenses. In the same time, a total of 29 brick kilns established without environmental clearance certificates were knocked down by the Department of Environment.

## **2.6 Land Requirement**

Land requirement for FCK or a Zigzag Kiln is about 2.5 acres whereas that for Hoffman or Tunnel Kiln is about 10 acres predominately because the latter's greater production capacity. It must however be made clear that the major portion of the land requirement is for forming and drying. Bricks are formed annually and sun dried in a large open area four to five times the area occupied by the kiln.

Land requirement is an important issue for a land scarce country of 169 million. Most brickfields are constructed in land that would otherwise be used for rice cultivation, but because the returns for land owners is much greater if lease out for brick making, the temptation for a poverty stricken agricultural community is too great to resist. This is causing serious concern because the increasing demand for bricks is causing the mushrooming of brickfields all over the country. An additional problem in brick making is that the clay for bricks is taken from mostly agricultural land causing loss of productivity of agricultural land. The temptation to sell off a few inches of topsoil is too great to resist.

## **2.7 Coal Consumption**

The annual coal consumption for brick making is in excess of 1 million tons. As can be seen in Table 3.1, FCK is the least efficient requiring at least 15 to 20% more coal. Fuel

cost contributes significantly to the cost of production of bricks and varies between 38% and 50% of the total brick production in FCKs and Zigzag. FCKs and traditional Zigzag Kilns are very low and fall in the range of 15-20%. Fuel efficiency can be greatly improved by improved kiln design and proper training of the firemen.

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## CHAPTER 3

### REVIEW OF EXISTING POLICIES AND LEGISLATIONS

#### 3.1 Brick Kiln Policy, 2008

The Brick Kiln Policy 2008 has been formulated with the focus of controlling indiscriminate establishment of brick kilns, using the tool of environment clearance certificate issued by the Department of Environment under the Bangladesh Environment Conservation Act, 1995. The Brick Kiln Policy is based on 3 objectives and 7 issues.

##### 3.1.1 Objectives

The objectives of this policy is fourfold, namely

1. Ensure that brick kilns are established in suitable locations complying regulations;
2. Ensure rational and efficient use of natural resources e.g., soil, water.
3. Control environmental pollution and improvement of environment, where applicable.

##### 3.1.2 Issues

The Brick Kiln Policy 2008 provides the framework for management of brick sector, focusing on 7 different issues elaborated below:

###### a) Locational Aspects

In order to avoid increased pressured on agricultural land and localized pollution, 6 conditions are to be met while selecting site for brick field such as i) priorities will be given to establish brick kiln in the bank of river, canals and wetlands and in char land, ii) brick kiln cannot be built in residential, commercial, municipal, forest and other officially declared restricted areas, iii) brick kiln shall be set up keeping a distance from key installations, highways, hills, education and research institutes and hospitals and clinics stipulated in the rules, iv) no brick kilns can be setup in 3 hill districts namely, Rangamati, Khagrachari and Bandarban, and pre-dominantly agricultural areas where land is not kept fallow for crop production in anytime of a year, v) baseline air quality of proposed site for a brick field shall not exceeds national standards.

b) Operational Aspects

Operational aspects give an outline about types of fuels and soil that can be used in brick kilns. With the aim of resource conservation and pollution control, 6 conditions are set out for brick kilns including i) firewood cannot be used as fuel in kilns, ii) coal being used as fuel shall contain reasonably low levels of sulphur, ash, mercury and other trace elements, iii) maximum land area for a brick field shall be not more than 1 acre, iv) soil from fertile land being used for cropping twice and thrice in a year and hills or hillocks cannot be used for brick making.

c) Relocational Aspects

The policy requires relocation of brick kiln whose current site is not appropriate in the light of the Brick Policy 2008. By fulfilling the obligations set out in (a) and (b), existing brick kilns can be relocated.

d) Environmental Pollution Control Aspects

A brief and general outline is given in the policy for controlling pollution from brick kilns. In order to mitigate pollution, best available technology shall be installed in the brick kilns so that emission from kilns does not exceed national standards.

e) Environmental Clearance and Monitoring Aspects

Policy requires brick kilns obtaining site clearance followed by environmental clearance under the Environmental Conservation Rules, 1997. In addition, a license from the Deputy Commissioner has to be obtained after site clearance. The policy suggests setup a monitoring cell in the Department of Environment to monitor environmental impacts of kilns on environment.

f) Research and Development

The policy put emphasis on under taking research on advanced brick making technology, alternate brick making materials and emission control.

g) Policy Formulation Aspects

The policy requires formulating a technical committee in the Department of Environment responsible for recommending the government about various policies and technical issues related to brick kilns.

### **3.2 National Land Use Policy 2001**

Realizing the pressure on the land of Bangladesh due to high density of population and viewing agriculture as one of the major economic activities, the National Land Use Policy, 2001 was formulated. The objectives of this policy focus on effective ways of using the lands which include land zoning system to regulate unplanned expansion of residential areas, establishment of industrial or commercial activities; balanced use of land harmonious with the environmental system, prevention of soil pollution etc.

The necessity of land zoning is emphasized in this policy as a way of regulating the unplanned use of the land resources. This policy also aims to declare a national zoning law under which the local governments would develop their own zoning map. The use of agricultural land, especially the irrigable ones, for other purposes is strictly discouraged in this policy. Moreover, due to rural-urban migration, the demand of land for housing is increasing and hence the pressure on agricultural land. The policy suggests undertaking specific coordinated policies regarding housing. It also states the importance about protecting the water bodies and increasing the fish production.

Section 13.2 of the policy recognizes that increasing use of bricks in construction sector and establishing brick kilns indiscriminate have caused land use change, resulting in deterioration of environment. In order to surmount these problems, the policy suggests encouraging the use hollow blocks made of stone chips, sand and cement in construction work as alternative to clay bricks.

### **3.3 Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013**

The first act to regulate brick burning was formulated during 1989 which was named as Brick Burning (Control) Act, 1989. That act was emendated (revised) twice and the revised versions were published as Brick Kiln (Control) (Amendment) Act, 1992 and Brick Kiln (Control) (Amendment) Act, 2001. However, in November 2013, a new law in this regard was formulated which is referred to as Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013. This act came into force on 1<sup>st</sup> of July 2014.

This act strictly bans the establishment of brick kilns in residential, business and preserved areas, agricultural land, government or private forests, orchard, sanctuary or wetland, degraded air shed and in ecologically critical area. It also restricts the collection of soil from agricultural land, mountains, and hillocks for manufacturing bricks. However, no one would be able to collect soil from haor-baors, ponds, canals, beels, river beds, chars and

fallow land for brick manufacturing purpose without the permission from appropriate authority. In order to reduce the use of soil, this act requires all the brick kilns with modern technology to prepare at least 50% hollow brick. This act prohibits burning fuel wood or any kind of wood for brick burning. Moreover, it proscribes the use of coal which exceeds the standards of sulphur, mercury, ash contents or other similar substances. Violation of this law would cause a person a maximum of 5 years of jail and/or BDT 500,000. All the punishable crimes under this law would be incognizable and bailable. The principle provisions of the act include the following:

Table 3.1: Principle provisions of the Brick Manufacturing and Brick Kiln Establishment Act, 2013

Section	Provision under section
Section 4	Prohibits brick manufacturing without taking license from the Deputy Commissioner of the district.
Section 5 (1)	Bans collection of soil from agricultural land, hill or hillock for brick making.
Section 5 (2)	Requires permission from appropriate authority for collection of soil for brick manufacturing from haor-baors, ponds, canals, beels, river beds, chars and fallow land.
Section 5 (3)	Minimum 50% hollow bricks shall be made in the brick kilns with modern technology.
Section 6	Bans fuel wood in brick kilns for burning bricks
Section 7	Proscribes the use of coal, exceeding the standards of sulphur, mercury, ash contents or other similar substances in the brick kilns.
Section 8(1)	Bans the 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.
Section 8(2)	Bans the establishment of brick kilns in the following distance or places, namely: (a) within 1 kilometer distance from the boundary of prohibited areas (mentioned above), (b) within 2 kilometers distance from boundary of public forest, (c) within half kilometer distance from the foot of the hill or hillock, (d) within 1 kilometer distance from any special structure, railways, educational institutions, hospitals and clinics, research institutions or any other similar place or institution, and (f) with half kilometer distance from upazila (sub-district), union or rural roads made by Local Government Engineering Department (LGED).
Section 12(1)	Requires forming a Search Committee in each district consisting of an Additional Deputy Commissioner, Upazila Executive Officer, Upazila Health Officer, Upazila Agriculture Officer, Divisional Forest Officer and a district officer of the Department of Environment.

Section 12(2)	Outlines functions of the Search Committee which include making recommendation regarding issuance or renewal of license.
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### 3.4 Bangladesh Environment Conservation Act, 1995

The Bangladesh Environment Conservation Act, 1995 (ECA '95) is the principle legislation for protection of environment in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. The law aims to conserve and improve the environmental quality and control and mitigate environmental pollution.

The enabling powers of the ECA'95 are wide ranging and allow for the formation of a Department of Environment (DOE) and the appointment of a Director General (DG) to oversee the department. Wide-ranging powers are also given to the DG to take various actions or measures to enforce the ECA'95.

One of the main strategies of the act is the declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/ initiated in the ecologically critical areas. Restricting vehicles which emit smoke or gas that are injurious to public health or harmful for environment, is another provision of this act. Manufacture, sale etc of the articles which are harmful for environment or injurious to public health is restricted through this act. For repairing the damages of the ecosystem caused by a person or a group of people, the Director General of DoE should determine the compensation for remedy of the injuries to the ecosystem. In case of discharge of excessive environment pollutant, the DG should take necessary remedial measures to control or mitigate environmental pollution and the recover the cost of those remedial measures from the responsible person/people/group for the pollution. This act provides the authorization power of providing environmental clearance to the DG. Promulgating standards for quality of air, water, noise and soil for different areas and for limiting discharge and emitting waste, is also a concern of this act. Formulation and declaration of environmental guidelines is also another sphere of concern in this act. Principle provisions of the Act include the following:

Table 3.2-1 Principle Provisions of the ECA, 1995

Section	Provision Under Section
Section 4	Powers of the DG to enforce various provisions of the Act including setting rules and regulations for environmental conservation and protection.
Section 4A	Powers given to the DG to seek the assistance of other enforcement authority (or authorities) in its enforcement. Done indirectly by way of disconnecting power, gas, or water supply to the user.
Section	Provision Under Section
Section 7	Allows the DG to seek compensation in cases of damage to the ecosystem or injury to person(s), whether directly or indirectly caused by a person or persons. He may also require that corrective or remedial action be taken to mitigate or ameliorate the situation.
Section 8	Allows any person affected or likely to be affected as a result of pollution or degradation of the environment to apply to the DG for remedy of the damage or apprehended damage.
Section 9	DG can require person responsible and the person in charge of the place of occurrence of an accidental pollution take measures to control or mitigate the environmental pollution.
Section 12	Requires that an Environmental Clearance Certificate from the DG be obtained before an industrial unit or project can be established or undertaken.
Section 13	Formulate and publish environmental guidelines relating to the control and mitigation of environmental pollution, conservation and improvement of the environment.
Section 14	Allows appeal against grievance to the Appellate Authority (Note: The Appellate Authority was constituted by Ministry of Environment and Forests by a notification dated 03/11/1997)
Section 15	Allows the imposition of penalties for various offences.
Section 20	Power to make rules for various purposes including the setting of EIA procedures.

### 3.5 Environment Conservation Rules, 1997

The Environmental Conservation Rules (ECR), 1997 is the main subsidiary legislation of the Bangladesh Environment Conservation Act, 1995 which outlines various procedures or measures that need to be taken for compliance with the related provisions of the ECA'95. The ECR provides specific rules and procedures for various categories of projects in relation to their approval prior to construction and operation. Considering sites and the impact on the environment, the industrial units and projects have been classified into four categories namely, Green (projects with positive environmental impacts or negligible negative impacts), Orange A (projects with minor and mostly temporary environmental impacts), Orange B (projects with moderately significant environmental impacts for which mitigation measures are easily identified) and Red (projects, which may cause 'significant adverse' environmental impacts).

ECR 1997 also includes Environmental standards which were prescribed for varying water sources, ambient air, noise, odour, industrial effluent and emission discharges, vehicular emission, etc. with the main aim of limiting the volume and concentrations of pollution discharged into the environment. While these standards are intended to assist project planners in determining measures to be taken to comply with these requirements, it is the ultimate responsibility of the Project Proponent to ensure that the environmental impacts arising from their projects are minimal or within acceptable levels that will protect the environment.

ECR 1997 requires three tiers of Environmental Assessment:

- Screening; required for all projects;
- Initial Environmental Examination (IEE): required of Orange B and Red category projects; and
- Environmental Impact Assessment (EIA): required of Red category projects.

In the context of the ECR 1997, screening would be in reference to determining the category in which the project or activity falls under (Schedule 1 of the Regulations). Upon determination as to which category the project or activity falls into, the process of environmental assessment and approval will follow that which is prescribed in the Regulations.

Brick kilns are classified as Orange B projects under the ECR 1997, hence mandatory for IEE to be prepared and submitted to the DOE. An IEE is typically a preliminary Environmental Impact Assessment study that is normally carried out at the early stage of project planning and is used to identify and estimate the potential environmental impacts from the project activities. IEE is normally done within a short time duration based on preliminary information that is readily available through environmental reconnaissance. In the context of the ECR 1997, an IEE is required to be submitted for obtaining location clearance from the DOE.

Section 12 of the Bangladesh Environment Conservation Act, 1995 clearly states that no industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an Environmental Clearance Certificate (ECC) from the Director General of the DOE. Application for ECC for brick project is undertaken in 2 stages which include following:

- a. Approval of the IEE will grant the Project Proponent a location clearance for undertaking land and infrastructural development, establishing machineries and pollution control devices.
- b. Upon completion of above activities, the Project Proponent shall be allowed to apply for environmental clearance. After receipt of environmental clearance the operation of the project will be allowed to commence.

However, in case of brick manufacturing project, environmental clearance from the Department of Environment will not allow project proponents to kick off brick burning in kilns. Upon receipt of the environmental clearance certificate, project proponent will proceed to apply for license to the Deputy Commissioner of the district under the Brick Manufacturing and Brick Kiln Establishment Act, 2013 and only after obtaining that license will operation of the brick kiln be allowed to commence.

The principle provisions of ECR include the following:

Table 3.3-Principle Provisions of the ECR, 1997

Rule	Provision Under Rule
Rule 3	Outlines factors (such as human habitat, archaeological site, ancient monument, national park, mangrove, etc) that the Government will take into account to declare an area as Ecologically Critical Area (ECA) and specify the activities or processes that cannot be continued or initiated in an ECA.
Rule 5	Outlines procedures for any person affected or likely to be affected as a result of pollution or degradation of the environment to apply to the DG for remedy of the damage or apprehended damage.
Rule 7	Outlines procedures for obtaining an Environmental Clearance Certificate (ECC).
Rule 7(1)	Classification of industrial units and projects for purpose of issuance of into four categories:- (a) Green; (b) Orange – A; (c) Orange – B; and (d) Red.
Rule 7(2)	Schedule 1 – provides list of industries and projects under the four categories. Brick kiln is listed under the Orange B Category.
Rule 7(4)	For Orange-A, Orange-B, and Red categories, require a Location Clearance Certificate (LCC) and thereafter an ECC to be obtained.
Rule 7(5)	Prescribed form for application of LCC or ECC.
Rule 7(6)	Outlines documents for various categories of industrial units and projects. Those within Orange-B and Red categories require submission of an Initial Environmental Evaluation (IEE), while an Environmental Impact Assessment (EIA) report is required for the latter category.
Rule 7(9)	Specifies type of activities that may be undertaken with approval of LCC.
Rule 8	Indicates period of validity of ECC for Green projects (3 yr), and for others (5 yr). Renewal is to be made at least 30 days before expiry of certificate.
Rule 9	Sets procedures for appeal against any notice, order or directive to the Appellate Authority.

Rule 12 &13	Prescribed emission and environmental standards to be complied with are outlined in various schedules.
Rule 14	Schedule 13 - prescribes fees for issuance or renewal of ECC.
Rule 16	Outline of procedures for payment of fees.
Rule 17	Require any accident that poses serious threat to the environment to be informed to the DG.

### **3.6 Bangladesh Labour Act, 2006 (amended in 2013)**

The Bangladesh Labour Act, 2006 deals with the employment of labour, relations between workers and employers, determination of minimum wages, payment of wages and compensation for injuries to workers, formation of trade unions, raising and settlement of industrial disputes, health, safety, welfare and working conditions of workers, and apprenticeship and matters ancillary thereto. The main issues covered in the Act include:

- Conditions of service and employment
- Employment of adolescents
- Provisions relating to health, hygiene
- Employee welfare
- Working hours and leave
- Wages and payment
- Wages boards
- Workers compensation for injury by accident
- Trade union and industrial relations
- Disputes, labour court, labour appellate
- Tribunal, legal proceedings, etc
- Workers participation in companies' profits
- Regulation of employment and safety of dock workers
- Provident funds
- Apprenticeship
- Penalties and procedure etc

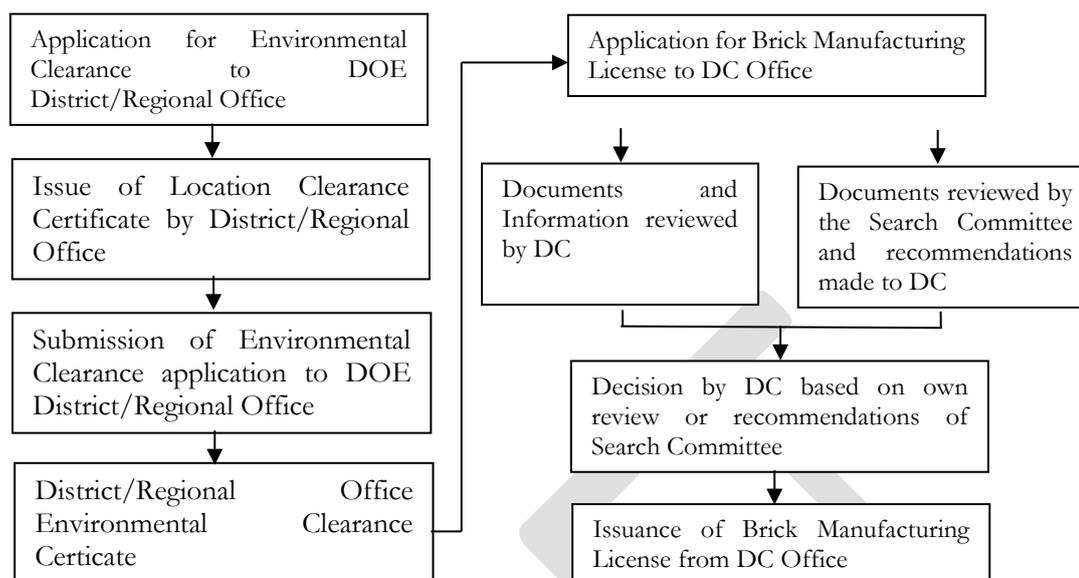
Moreover, as per the Bangladesh Labour Act 2006, organizations which do not fall within the scope of the Act, cannot have any employee rules, regulations and benefits less favorable than those provided under the Act.

With several small amendments, the Bangladesh Labour Act, 2006 has constantly been adapted to the ever-changing employment and common practices in the country. The Labour (Amendment) Act 2013 makes a large number of amendments to the Labour Act 2006 and, particularly, introduces several provisions aimed at improving workplace safety. Among others, the amended legislation now requires the creation of safety committees in factories with 50 workers or more, the establishment of workplace Health Centres in workplaces with over 5000 employees and safety welfare officers in workplaces with more than 500. Under the amendments compensation for work-related deaths is provided after two years in employment, compared to the current three years period. Workplaces of over 500 employers are required to arrange for and cover the cost of treatment of occupational diseases. The labour inspectorate is given new responsibilities to inspect safety and health conditions of workplaces and conduct on-the-spot inspections. Other important amendments deal with dangerous work for children; emergency exits; access to gangways and stairs for workers; mandatory use of personal safety equipment; notification of competent authority in case of incident; and provisions on social dialogue, trade unions and dispute resolution; and employers and companies responsibilities.

### **3.7 Application for Brick Manufacturing License**

Section 4 of the Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013 clearly states that no person shall manufacture bricks in the brick kiln without obtaining license from the Deputy Commissioner (DC) of the district in which the brick kiln is located. Prior to application for brick manufacturing license to the DC office, the project proponent has to obtain an Environmental Clearance Certificate (ECC) from the Department of Environment in the manner prescribed by the Environment Conservation Rules, 1997. ECC will grant the project proponent to setup a brick manufacturing unit. However, only after receipt of brick manufacturing license will brick manufacturing work be allowed to commence. The validity of license is 3 years.

Figure 5.2: Flow Chart for Application for Brick Manufacturing License



### 3.8 Emission Standard for Brick Kiln

Discharges and emission due to construction and operation of brick kilns must comply with appropriate standards and limits that have been set out in the Environmental Conservation Rules 1997 (ECR 1997). Emission standard for particulate matter is the only standard specific to brick kiln stipulate in ECR 1997. Emission standard for particulate matter stipulated in schedule 11 of ECR 1997 is 1000 mg/Nm<sup>3</sup>.

In case of absence of other specific standards for brick projects, the standards and limits prescribed for industries is deemed applicable for the discharges and emissions arising from the brick activities.

## **CHAPTER 4**

### **STRATEGIES AND WAY FORWARD FOR SUSTAINABLE BRICK PRODUCTION**

#### **4.1 INTRODUCTION**

In decade since 2007, Bangladesh averaged an economy growth of approximately 6.2 percent. The healthy economic with high rate of migration to the urban areas as well as a rapidly rising population in Bangladesh have created an increasing demand for residential, commercial, industrial, public buildings and other infrastructures. With the rising demand for construction materials to cater to the infrastructure growth, the brick manufacturing industry in Bangladesh has mushroomed all over the country with high concentration at the outskirts of the urban areas.

The brick industry in Bangladesh is characterized by inefficient, dirty technologies with high emissions; reliance on manual labour and low mechanization rate; dominance of small-scale brick kilns with limited financial, technical and managerial capacity; informal, seasonal employment; and a single raw material (clay) and product (solid clay brick).

In order to address the environmental problems associated with brick sector, the Government of Bangladesh has issued successive executive orders and promulgated rules and acts since 1989. Early attempts of the government included heightening the chimney of the BTK to less the impact of flue gas emissions on surrounding environment. However, this measure was not sufficient to abate the environmental impacts of brick industries. Through the promulgation of the act of 2013, the government of Bangladesh had decided to modernize the brick kiln and eliminate them from urban areas by June 2016. However, achievement of these objectives has been fraught with a number of difficulties. The rapid elimination of traditional brick kilns would have involved considerable social costs. On top of that, investment capacity of brick manufacturing owners was sufficient for setting up modern brick kilns such as Tunnel Kilns to expand quickly enough to replace thousands of traditional kilns.

#### **4.2 BASIS OF STRATEGY**

The proposed strategy for sustainable brick production in Bangladesh over the next ten years aims at transitioning the brick sector towards sustainable enterprise- socially,

environmentally and economically. Therefore, brick sector strategy has following four premises:

1. Improving public health is the driving reason for taking resolute actions;
2. Environmental improvement can deliver lasting benefits to brick sector and health and other benefits to people of the country;
3. Economic improvement of the entrepreneurs is crucial towards development of cleaner brick production industry in Bangladesh;
4. Investing time and efforts in institutional improvement will maximize the achievement of policy objectives.

### **4.3 STRATEGIC OUTCOME 1: SOCIAL IMPROVEMENT**

The brick industry is traditionally very labour-intensive and employs more than 1 million of unskilled and semi-skilled workers. The majority of the jobs associated with brick production can be done by anybody who is willing to carry clay, bricks and coal. However, some specialized tasks such kiln making and firing require skilled workers. Replacing kilns integrated into existing production system such as Zigzag Kilns with capital-intensive Tunnel Kiln technologies would cause to loss thousands of unskilled jobs. However, in most of the existing brick kilns laborers face harsh working environment in the way of exposing to direct sunlight and dusty environment for prolonged hours, long contact with mud and we clay, awkward posture resulting muscular disorders and dehydration due to lack of proper drinking water and excessive heat. Therefore, finding a middle ground with intermediate solutions is an important contribution to inclusive social development. Introduction of selective mechanization in the brick industry will help keep the jobs, make work easier and produce better bricks. Improved Zigzag has many positive effects on environment, economy and social life of the workers.

#### **4.3.1 Strategy 1: Selective Mechanization of Brick Making**

The country has long been experienced with BTK, FCK and Zigzag kilns but the experience has been restricted to using outdated methods of designing and building kilns and using time-old molding and firing process. They need today is for a different way of making bricks with versatile design, size and color. This can only be achieved through mechanization in brick manufacturing. However, the mechanization process should be progressive and selective given our limited know-how and skilled workforce in brick sector. In this circumstance, importance should be given on improving the occupational health

and safety of workers. And therefore, all tasks associated with heavy work needs to be mechanized, especially the molding of clay and transportation, loading and unloading of bricks, clay and coal.

#### **4.3.2 Strategy 2: Changes in Firing Process**

Better feeding, firing, and operating practices can improve the overall efficiency of the kiln and decrease emission of particulate matters. Emissions of high levels of particulate matters and black carbon occur in Zigzag and FCK during fuel feeding. Continues feeding of properly sized coal, using a coal stoker can considerably reduce stake emissions. Scrubbing system in the Zigzag kiln can drastically reduce particulate emission into surrounding environment.

#### **4.3.3 Strategy 3: Replacing Traditional Kilns with Small and Medium-sized Industries**

One of the strategies identified for cleaner brick production is through adoption of small and medium sized modern kilns. Because brick making technologies that require high upfront capital investments compared to FCK or Zigzag, often making the investment out of reach to local entrepreneurs.

- a) **Small-sized Kilns:** Improved Zigzag Kilns and Vertical Shaft Brick Kilns are smaller scale technologies, requiring smaller investments but never the less significant in terms of their impacts on energy use and emission reductions.
- b) **Medium to Large-sized Kilns:** The HHK and Tunnel Kilns are robust industrial scale technologies widely used in China. These kilns have fixed roofs that enable bricks to be fired throughout the year. However, during the rainy seasons, the production decreases significantly because of frequent rain, high humidity and greatly reduced sunlight.

### **4.4 STRATEGIC OUTCOME 2: ENVIRONMENTAL IMPROVEMENT**

The brick industry consumes large amounts of coal and thus produces emissions that are harmful to the local and the global environment. The uncontrolled burning of coal in inefficient kilns and the high amounts of sulphur in coal has led to significant deterioration of air quality around nearby towns and cities. Toxic flue gases emitted during the operation of the kilns damage the surrounding crops.

An even more annoying environmental impact of the traditional brick industry is the use of topsoil for green brick making. The brick industry is traditionally a seasonal industry using only the upper part of agricultural soils for brick making, and the growing number of bricks produced resulted in a conflict of interests between agriculture and industry.

This section identifies three different strategies to improve environmental condition: kiln switching, changes in firing practices, and utilizing resource-efficient bricks. One type of REB incorporates fuel into the clay mix (coal powder, boiler ash, fly ash, biomass, etc) to accelerate the firing process and reduce emissions (Premchander et al., 2011).

#### **4.4.1 Strategy 1: Reduction in flue gas emission**

Energy-efficient brick kiln technologies have lower Specific Energy Consumption (SEC), measured in kilojoules required per kilogram of fired brick, and therefore burn less fuel and release fewer GHGs per unit of output. Additionally, energy-efficient technologies give operators more control over the fuel combustion process, which results in a more complete combustion of carbonaceous fuel and decreased emissions of black carbon and other SPM. These technologies can provide financial returns through savings in fuel cost per unit of output.

Improving kiln efficiency depends on the choice of technology, continuous or batch operation, fuel availability, quality and preparation, firing processes and waste heat recovery systems. These are several kiln types that can reduce emissions.

- **Improved Zigzag Kiln:** After imposing a ban on FCKs, more than 60 of them have been converted to coal-based Zigzag Kilns which is an accepted technology the Department of Environment. This technology has not yet been standardized and, as a result, there is a varied performance level and emissions profile associated with the Zig-zag Kilns. A cleaner alternative appears to be Improved Zigzag technology as has been demonstrated in piloting carried out under the CASE project of the Department of Environment. Improved Zigzag Kiln's similar production capacity as FCK/Zigzag means that it is better suited for small-scale brick making operations. The high thermal efficiency of the new kiln is about 80% makes it extremely fuel efficient.
- **Vertical Shaft Brick Kiln (VSBK):** VSBKs are the smaller scale technologies, requiring smaller investments nevertheless significant in terms of their impact on energy use and emission reductions. The VSBK is a permanent structure and

produce bricks throughout the year. It has a life of 8 to 10 years with minimum maintenance. One VSBK with six shafts can have the same capacity as that of FCK but needs only 13% of the space of a FCK. The first attempt to operate a VSBK in Bangladesh was not successful due to the lack of adequate technical and financial support. In the case of VSBK, it requires a considerable amount of management efforts and above all an enduring will to optimize the production by actively overcoming context-related obstacles.

- **Hybrid Hoffman and Tunnel Kilns:** HHK and Tunnel Kilns are robust industrial scale technology having production capacity of approximately 3 to 4 times of FCK or Zigzag, but in terms of initial investment, they are clearly the most expensive requiring an initial investment of at least Taka 50 million. These kilns can operate throughout the year. Building a HHK or Tunnel Kiln requires special expertise and thus involves engaging engineering consultants mostly from foreign countries. Because of their greater production, the requirements for land to establish kilns and soils for brick making are 3-4 times higher than that of FCK or Zigzag technology. Uninterrupted supply of required amount of clay during the wet seasons to run these factories in optimum production levels is a major problem in Bangladesh. They also require a higher level of technical expertise to maximise the efficiency and output of the kiln. Therefore, switching to HHK or Tunnel Kiln on a large scale is highly unlikely unless they are customized to Bangladesh's situation.

#### **4.4.2 Strategy 2: Maintain Correct Coal Quality**

The use of the correct coal quality, with ideal chemical properties, for a kiln technology is essential. The main coal properties that are important while selecting coal as external fuel include ash content, calorific value, moisture contents, sulphur, volatile matter, particle size and ash fusion temperature.

A reasonable content of coal is between 0.5% and 1%. Coal having Sulphur >2 % should not be used because higher content of sulphur causes Sulphur Dioxide (SO<sub>2</sub>) pollution which has a direct negative effect on the health of workers and damages vegetation, life-stock and human population in the surrounding environment.

#### **4.4.2 Strategy 3: Resource Efficient Brick (REB) Production**

Through the use of resource-efficient bricks (REBs), reductions in resources being used for brick making and burning can be achieved. One type of REB includes perforated or hollow bricks and bricks made of compressed fly ash that do not require firing. Other type of REB substitutes river clay and sand and reduce the size of brick to make them resource efficient.

Perforated and hollow bricks are of lower weight and volume and have a larger surface area. These bricks can be fired with 20% less energy while maintaining the compressive strength of solid bricks. Perforated and hollow bricks can only be made with a semi-mechanized extrusion press; this requires a consistent source of electricity.

While traditional kilns can produce only solid bricks, modern kilns can produce hollow bricks that consume much less energy for firing, use 40% less clay, and have much better insulation standards. Better insulation can lead to considerable energy saving over the lifespan of a brick if the energy spent on heating and cooling can be reduced.

However, the upfront capital costs can put technology upgrades out of reach of small-business entrepreneurs.

### **4.5 STRATEGIC OUTCOME 3: ECONOMIC IMPROVEMENT**

Despite the emissions reduction potential of firing process changes and adoption of REBs, it is difficult to quantify the benefits. There are substantial environmental and social benefits from investing in emissions-reducing technologies, despite the upfront capital costs. However, environmental benefits alone are not sufficient incentive for brick kiln entrepreneurs to adopt clean technologies or processes. The business and financial benefit will be the key motivation of brick makers for kiln switching.

#### **4.5.1 Strategy 1: Industrialization of the Brick Sector**

The business-as-usual approach and change-resistance are the predominant attitudes of the kiln owners in the country. In this supply constrained industry, aforesaid attitudes are fostered and maintained is a result of the short production season, the small scale size of the production units and the non-availability of substitute products.

From the initial investment point of view, it should be clear that the profitability of the conventional brick kilns such as BTK would be the highest. If there is a long dry winter

starting in early November and continue well into April, a BTK investor is assured of a 100% return on his investment. Compared to BTK, the FCK and Zigzag will naturally have lower return because of the significantly higher initial investment. The HHK being an energy efficient kilns and a proper industry has a return of only 20-25%. Given these profitability differentials, transitioning the brick industry of a seasonal and intermittent production to industrial brick production with continuous brick-firing kilns and all-year round production can only usher a cleaner brick industry in Bangladesh.

#### **4.5.2 Strategy 2: Low-investment Improved Zigzag Kiln**

The capital intensive nature of the changes for a complete transformation of the brick sector is a complicated barrier because of their impacts in different ways on large and small enterprises. IZK technology combines a high efficient kiln technology, the annular kiln principle and the continuous loading and unloading process with a unique technique of forming green bricks; granulated coal is injected for internal combustion. This approach results in lower energy usage, higher quality bricks and reduced pollution. Since its initial investment is comparable with the cost of the traditional one and quick payback, IZK is suitable for small investors. In this system hollow and perforated bricks can be produced.

#### **4.5.3 Strategy 3: Low-cost Tunnel Kiln**

The tunnel kiln is considered to be the most advanced brick-making technology. It is a continuous kiln in which bricks move through a stationary fire zone. As long as there is a ready and reliable source of electricity, tunnel kilns can produce a large amount of bricks at very low operational costs. Tunnel Kiln requires 3 to 4 times more capital investment than traditional kilns, therefore suitable for medium to large firms.

The low-cost versions of Tunnel Kilns developed in Vietnam currently are in operation. Due to relatively low investment, adoption of this low-cost Tunnel Kiln can be an interesting option for Bangladesh.

#### **4.5.4 Strategy 4: Development of Model Enterprise**

Even a relatively low-cost tunnel kiln is not accessible for the many family-owned and traditional brick producers. They are more interested in medium-range investments, and the vertical shaft brick kiln is thus a more accessible solution. A VSBK is less capital-intensive than a tunnel kiln, but still can become a formal enterprise.

A VSBK was constructed in a short period, but without systematic know-how. The initially perception about the VSBK is that it is not a viable, socially and ecologically acceptable alternative to traditional kilns. The main concerns regarding the VSBK technology was its poor track record with respect to occupational health and product quality, as well as its 'traditional' nature – that is, it is meant for small-scale and seasonal production.

However, the VSBK has been operating successfully in China. Despite initial failure, the VSBK has also been a success in Vietnam as an all-year-round industrial activity with an impeccable social and environmental performance record. Utilizing the Vietnam experience, a model VSBK enterprise can be developed and scaled up.

#### **4.5.5 Strategy 5: Sustainable Use of Clay and Green Bricks of Better Quality**

Brick kilns use the topsoil of agricultural lands. A systematic mapping of clay resources allows for the sustainable use of clay. This will lead to better quality of bricks and less competition with agriculture.

### **4.6 STRATEGIC OUTCOME 4: INSTITUTIONAL IMPROVEMENT**

In order to transition to cleaner brick production in Bangladesh, it is critically important to identify and test technical and organizational options for brick-making that are environmentally sound, economically viable and, at the same time, accessible to small-scale producers. Therefore, sustainable brick production should aim at improvements along the entire production chain and does not simply promote one solution to fit all needs.

#### **4.6.1 Strategy 1: Demand Driven Development Support**

The identification and testing of options concerned the entire cycle of brick production, include clay extraction, green brick production, the firing processes, as well as production organization and business management. Additionally, options need to be identified that provide authorities with more effective methods, equipment, and capacities for “state management” functions such as: emissions measurement, environmental monitoring, clay resource management, planning, and promotion of development in the brick-making industry. In all of these areas, a demand-driven approach should be applied involving authorities and private brick-makers in a dialogue process of assessing existing problems, identifying options, and developing appropriate technical and organizational solutions.

#### **4.6.2 Strategy 2: Participatory State Management**

Appropriate technical solutions are crucial, but not sufficient to achieve policy objectives. In addition, the transition to sustainable brick-making requires significant changes in the management of brick-making by the government organizations. The challenges in this area are considerable. The policy application has hindered by the lack of reliable information on actual number, condition and process of brick-making, clay resources, energy efficiency, emissions, environmental impact, enterprise economics, etc. The authorities lack practical instruments for enforcing regulations and guiding development processes.

A platform for exchange and cooperation needs to be established encompassing all stakeholders – large and small-scale brick-makers, as well as national and district authorities. With strong official support, a pro-active and participatory approach will thus emerge towards state-management of the brick-making sub-sector.

It has become apparent that an extensive shift out of traditional brick-making cannot be left to the individual decisions of small-scale producers alone. It needs to be promoted within the framework of local, community-managed development.

#### **4.6.3 Strategy 3: Enabling Sustainable Development**

An enabling environment for sustainable brick-making involves the institutional anchoring, scaling-up, and dissemination of solutions, techniques and programmes that have to be developed and piloted by the cooperation. The cooperation approach encompasses strengthening the policy framework, namely:

- building the platform for public-private cooperation
- setting up a “sustainable brick-making support unit”
- supporting establishment of an active brick-makers association
- facilitating the regularization of small-scale enterprises
- disseminating the sustainable brick-making approach

#### **4.7 STRATEGIC OUTCOME 5: CAPACITY BUILDING**

The current brick policy of Bangladesh to modernize brick industry has been stalled by inadequate information on brick-making, lack of working contacts, insufficient policy instruments, as well as the absence of technical alternatives. In order surmount this situation, a systematic, goal-oriented programme has to be initiated involving the stakeholders in coordinated, mutually reinforcing activities of information gathering, problem-analysis, technical development, training, capacity building and policy application.

#### **4.7.1 Strategy 1: Basis for Decision Making**

The objective of establishing a “basis for decision-making” can be achieved by promoting the transfer of available information and solutions into actions. Contributions in this regard include: training courses; distribution of plans, guidelines and tools; technical assistance and field service for brick-makers; as well as policy instruments and capacity strengthening of the concerned government organizations.

Printed guidelines and tools should be prepared for brick makers addressing topics such as: enterprise economics; financial planning tools; credit application template; Improved Zigzag manual; and guidelines for mitigating the environmental impact of brick-making. Documentation has to be produced on a “model Brick Kiln enterprise”, including: plant layout; construction plans; financial planning format; environment clearance and licensing procedures. Finally, technical assistance in the field should be provided to brick-makers to assist them in solving practical problems associated with technical innovations.

The main impact of these measures on enterprise development is two-fold. First, through financial analysis and tools, entrepreneurs will become far more aware of the economic attractiveness of both tunnel kilns and Improved Zigzag. Second, the availability of tested designs, know-how, and competent technical assistance will give investors much higher confidence in their ability to establish a successful enterprise with high environmental standards.

#### **4.7.2 Strategy 2: Training Activities**

- Brick-makers and technical staff training course has to be arranged covering selected aspects of: labour protection and safety; equipment and technology; brick-making techniques; management skills.
- Production supervisors training course need to be arranged on modules dealt with: production techniques; quality control; trouble-shooting; energy efficiency; management functions, etc.
- Directors Forum: Workshop and seminar should be arranged for directors and owners of brick enterprises. The subjects to be covered include: investment decisions and enterprise expansion; technology and product design; planning and management of the enterprise; clay exploitation; environmental impact; production economics and cost efficiency; sales management; and human resource management.

## CHAPTER 5

### BRICK SECTOR TRANSFORMATION: POLICY RECOMMENDATIONS

#### 5.1 INTRODUCTION

Fired clay bricks are one of the most important construction materials in Bangladesh. Bangladesh stands as the fourth largest brick producer in the world. The country has more than 7,000 brick kilns, producing about 27 billion bricks annually.

With the rising demand for construction materials to cater to the infrastructure growth, brickfields have thrived and mushroomed all over the country with heavy concentration at the outskirts of cities and towns. The brick making industry in Bangladesh largely use inefficient, dirty technology, informal seasonal employment methods and haphazard growth. The unplanned development of the brick industry is completely unsustainable. Therefore, there is an urgent for national strategies and policy actions for cleaner and sustainable brick production in Bangladesh.

#### 5.2 RCOMMENDED POLICY INTERVENTIONS

The policy interventions recommended for sustainable brick production in Bangladesh focusing on transitioning the brick sector towards sustainable enterprise- socially, environmentally and economically.

##### 5.2.1 Update Brick Policy

The Brick Kiln Policy 2008 aimed at controlling indiscriminate establishment of brick kilns, using the tool of environment clearance certificate issued by the Department of Environment under the Bangladesh Environment Conservation Act, 1995. This policy was adopted to guide the environmental clearance procedure of the brick kiln project. However, while delineating the general procedure for environmental clearance and monitoring, this policy guideline addresses other issues relevant to brick making such as locational issues, environmental pollution control, and research and development aspects. More than 11 years have passed since this policy was adopted. During this time, the Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013 has been promulgated by the government without updating the Brick Policy. Now the government has taken

initiative to amend the Act. Prior to amend the act, the Brick Policy for next 10 years should be formulated considering the social, environmental and economic issues of brick industry.

### **5.2.2 Amend The Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013**

The Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013 was promulgated in 2013 and became effective in July 2014. The main object of this act is to control pollution from brick kilns in the way of brick production in technologically advanced brick kilns. However, the regulatory agencies face many difficulties in implanting this act. Indeed, the Act has seriously slowed down the adoption of efficient brick making technology in Bangladesh due to restriction of setting up brick kilns in some areas and some buffer areas. In accommodating the strategies for sustainable brick production this Act should be amended.

### **5.2.3 Formulate Subsidiary Rules under the Act of 2013**

In order to facilitate the implementation and enforcement of the Act, a subsidiary rule under the Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013 should be formulated.

### **5.2.4 Prepare Technical Guidelines on Entire Cycle of Brick Production**

Technical guidelines should be prepared for the accepted brick making technologies, encompassing the entire cycle of brick production, including clay extraction, green brick production, the firing processes, as well as production organization and business management.

### **5.2.5 Capacity Building**

The transition to sustainable brick-making requires significant changes in the way regulatory agency manages brick-making industry. The regulatory authorities should be provided with more effective methods, equipment, and capacities for “state management” functions such as: emissions measurement, environmental monitoring, clay resource management, planning, and promotion of development in the brick-making industry.

### **5.2.6 Establish Brick Information Services**

The transformation towards sustainable brick sector requires the policymakers a “basis for decision-making” can be achieved by promoting the transfer of available information and solutions into actions. For successful policy application a brick information services should be established with reliable information on actual conditions and processes of brick-making, clay resources, energy efficiency, emissions, environmental impact, enterprise economics, etc.

### **5.2.7 Education and Training**

In order to ensure sustainable development of brick industry, the transfer of available information and solutions into actions should be promoted. Contributions in this regard include: training courses; distribution of plans, guidelines and tools; technical assistance and field service for brick-makers; as well as policy instruments and capacity strengthening for regulatory authorities.

### **5.2.8 Pilot and Scale-up of Practical Model of Sustainable Brick Production**

The model brick production SMEs on a range of efficient technologies should be developed with government support. The models’ information should be documented and discriminated.

### **5.2.9 Research and Development**

Research and development facilities should be developed in relevant research organizations such as Housing and Building Research Organizations. The focus should be given on green brick making technologies including efficient firing technologies, renewable brick making materials etc.

### **5.2.10 Industrialization of Brick Sector**

There are profitability differentials among brick making technologies – dirty technology enjoys upper hand over efficient technology. In this circumstance, transitioning the brick industry of a seasonal and intermittent production to industrial brick production with continuous brick-firing kilns and all-year round production can only usher a cleaner brick industry in Bangladesh.

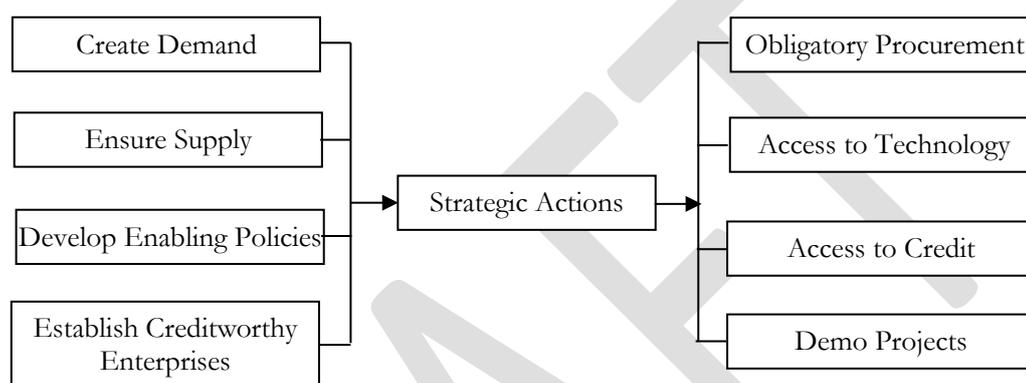
### **5.2.11 Standardization of Kiln Technology**

Brick Kiln technologies should be standardized by the competent authority.

### 5.2.12 Promote Development of Resource Efficient Brick (REB) Industry

Through the use of resource-efficient bricks (REBs), reductions in resources being used for brick making and burning can be achieved. The promotion of REBs such as hollow and perforated bricks requires management of supply and demand sides, development of enabling policies and put them into practice and setting up of creditworthy brick manufacturing units. Figure 5.1 shows a general approach for promotion of resource efficient brick products.

Figure 5.1: A general approach for promotion of resource efficient bricks



All of four strategies identified for promotion of resource efficient bricks in the country have been discussed in detail in this chapter and previous chapters.

### 5.2.13 Selective Mechanization of Brick Industry

The country has long been experienced with brick making but the experience has been restricted to using outdated methods of designing and building kilns and using time-old molding and firing process. Today there is a need for a different way of making bricks with versatile design, size and color. This can only be achieved through mechanization in brick manufacturing.

### 5.2.14 Create Enabling Environment for Sustainable Brick Making

An enabling environment for sustainable brick-making is critically important. It involves the institutional anchoring, scaling-up, and dissemination of solutions, techniques and programmes that should be developed and piloted by the cooperation approach. The cooperation approach encompasses strengthening the policy framework, namely:

- building the platform for public-private cooperation
- setting up a “sustainable brick-making support unit”
- supporting establishment of a brick-makers association

- facilitating the regularization of small-scale enterprises
- disseminating the sustainable brick-making approach.

### **5.2.15 Ease Access to Commercial Financing**

The approach that will facilitate improve access to finance includes:

- Building links between brick SMEs and lending institutions;
- Mitigating risks related to lending of credit to brick SMEs by setting up a risk-sharing mechanism in the form of partial guarantee;
- Assisting banks with technical assistance to evaluate new technology brick projects and to subsequently monitor and supervise the loads made; and
- Establishing a low interest, long tenor revolving fund using government/international donor fund

### **5.2.16 Protect Health and Safety of Workers**

The brick industry in Bangladesh has been traditionally a dirty enterprise, unfolding under difficult working conditions. However, it is the legal responsibility of the owner or the employer to ensure the health and safety of the workers at work place. A safe and health working environment has fewer risks of accident, injuries or damage to lives and property and less incidents of disability of workforce.

In order to protect the workforce from accident hazards and ensure hazard free environment in brick industry, the following recommendations are suggested to implement at plant level:

- First aid box should be available on site. There should be provision of Personal Protective Equipment (PEP) including gloves, shoes, helmet, mask and protective clothing for workers.
- Provide Health and Accident Insurance coverage for brick kiln workers. Arrangements be made to monitor the burning process inside the kiln from safe distance in order to avoid burning accidents.
- Provision of rest room on site and drinking water at the kiln to be arranged.
- A basic occupational training program should be provided to ensure that workers are oriented to the specific hazards of individual work assignments.

- Arrangements to be in place so that no employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection.
- Ensure prevention and control measures for fire and explosion hazards.
- Employers should take appropriate measures to maintain air quality in the work area.
- The employer should establish procedures and systems for reporting and recording occupational accidents and diseases and dangerous occurrences and incidents.