



Original Article

Effluent Gases Emission from Brickfields in Bangladesh: Policy Guidance Underpinning Bioethical Grounds Mitigating Emission Levels

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Abstract: Recent-years' rapid urbanization and then rural to urban migration have created increasing demands of bricks usages in Bangladesh. However, brick industry has been largely using inefficient, dirty technology and burns woods-coal. It injects huge volume of effluent gases namely CO₂, SO₂, NO_x, CH₄, CO etc., in atmosphere. Governments, particularly developing countries have lost the ability to effectively regulate environmental issues, while at the same time corporations have gained unprecedented influence over many facets of society. On this aspect, Bangladesh is no exception. For policy guidance underpinning ethical grounds on the issue, this study analyzes the basic issues of CO₂ emission from brickfields in terms of marginal damage (MD) analysis. Findings show that the marginal social costs are higher than marginal private (producer of bricks) costs where brickfields are benefiting with the expense of Bangladeshi society as a whole. As time passes by, rises of brick-prices have been causing upward trends of welfare losses where producers' surpluses are dominating in the total surplus. This economic situation has been causing higher deadweight loss year after year. Addressing the issues, national strategies and policy actions underpinning bioethical grounds are needed. Reforestation efforts can be achieved in multi-faucets: brick-fields' charity, government policies on planting trees and policies on motivational efforts inspiring citizens of Bangladesh. Bioethics responsibility trainings in multi-faucets are needed where government's roles in designing program(s) can be instrumental. Motivational policy can be: i) inspiring celebration individual's "Birthday, having 1st child in family and Event of marriage" by planting trees, ii) forcing to utilize green tech in brick kilns and iii) policies conducting academic research where financial supports are in need.

Keyword(s): brickfields, effluent gases emission, causes social costs & deadweight loss, bioethical grounds, reforestation, motivational efforts of govt. policies

Introduction: From the beginning of civilization, bricks as a product have been playing important roles for the construction of houses and other infrastructure and are a

a major catalyst for economic progress. An estimated over 1500 billion baked-clay bricks are produced globally every year where Asian countries alone produce 1300 billion bricks¹.

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Usages of bricks are common practice in many parts of South Asian Countries, which require a large scale of brick production in many countries in this part of the world. Asia alone per year produces 86.7 percent of world's bricks production in the world ¹.

Bangladesh, a South Asian country, is one the second highest brick producer after India. Considering the case of small scale industries, the brick industry is a developing industry because of increase in demand of bricks locally. Here bricks are the most important building material in urban areas that mostly use trees as fuels as fuels comparatively lower cost. With rising income, it has become a significant building material in rural areas as well. Rapid urbanization has created an increasing demand for residential, commercial, industrial, public buildings and other infrastructures. In Bangladesh, it has been contributing over one percent to the country's GDP² and generating employment for about two million people, despite the fact that vast majority of these kilns use outdated technologies. Because of outdated technologies and lack of ethical responsibilities from all parties involved, it causes emission problems, which are harmful for the nature as well as for human health.

However, conventional brick making in South Asian Countries including Bangladesh is a highly polluting, energy intensive and producing a large scale of CO₂. More specifically, burning wood and coal in brick kilns produces mainly high level of CO₂ and other effluent gases namely SO₂, NO_x, CO and CH₄. Thus brickfields inject them into atmosphere and deplete atmospheric O₂. In year 2011, Bangladesh emitted CO₂ from brickfields over 9.8million tons³. Here the percentage in last 10 years of CO₂ emission from brick kilns was 72.784, which is very alarming⁴.

Addressing the severity of emission level from brick kilns in Bangladesh, the primary objective of this study is to communicate on policy guidance underpinning ethical grounds mitigating emission from brick kilns. It aims to begin with analyzing basic issues in terms of marginal damage (MD) and neoclassical partial equilibrium demand and supply theory ^{5, 6}. Further, it plans to analyze the reasons of disparity between social and private cost by conventional marginal damage analysis ^{7, 8}. *Lastly*, this study will use a risk-reward nexus analysis on concluding *status quo* is neither economical nor ethical.

Problem Statement: Continued globalization on emission issues has witnessed that governments, particularly developing countries, lose the ability to effectively regulate many social and environmental issues, while at the same time, corporations have gained unprecedented influence over many facets of society⁹. On this aspect, Bangladesh is no exception.

It is undeniable fact that brick industry plays a significant role in economic growth of a nation. However, it becomes a problem when brick industry undermines or fails to marginalize the consequences, in this case, the emission of CO₂ from its production process. The root causes of this problem can be in four folds i) Emphasizing business mentality over ethical responsibility by parties involved ii) Lack of technology facilitations iii) Government's failure in application of strict laws iv) Corporations or businesses are motivationally failing to meet social & ethical responsibility standards, violating government laws. This phenomenon is more or less common in countries where the brick kilns are still in today's operation.

Emission issues: Usages of bricks are common practice in many parts of South

Asian Countries, which require a large scale of brick production in this part of the world. Fig. 1 shows China and India dominate the brick production level in Asian countries where China alone produces 76.92 percent and India stands second with 15.38 percent of brick production. Bangladesh produces around 17 billion bricks, which 1.30 percent of Asian total brick production¹.

China and Vietnam are the only two countries that have transitioned into mostly using modern and efficient technologies for brick making, India, Bangladesh other neighbouring Asian countries are still behind and dominating CO₂ emission from brickfields¹. In brick industry, wood and coal based fuels for brick production; India has estimated 13000 brickfields and Bangladesh has officially 7000¹⁰. There are total 20 natural gas based brick kilns in Bangladesh (WB, 2011). However, news media report, there are estimated 11000 brickfields in Bangladesh located all over the country where some are not even registered with the government^{10, 11}. Since data statistics relate to increasing rate of CO₂ emission level are available from six divisions namely Dhaka, Chittagong, Rajshahi, Khulna, Sylhet and Barisal where Dhaka stands first and Barisal stands the last in Bangladesh⁴.

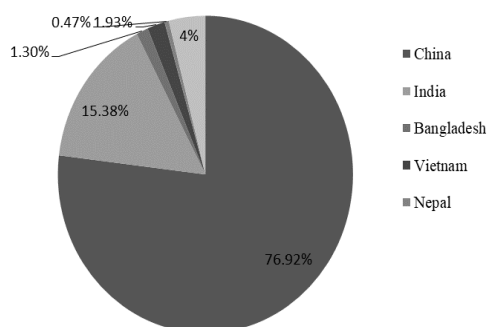


Fig1: Brick production in Asian countries;
Sources: US EPA, 2012

In Bangladesh, brick industry has been

playing significant role for construction houses and other infrastructure and is a major catalyst for economic progress in Bangladesh. However, its production process injects a significant portion of CO₂ from brickfields, which is considered as a major contributor of greenhouse gas (GHG). Scientists found that CO₂ emission plays a critical role in the acceleration of global warming trends¹². In Bangladesh, the major source of CO₂ emission is wood and coal burning¹³. This study is limited to looking into emissions level only from brickfield in Bangladesh.

The conventional brick making is held responsible for a host of accompanying perils. There is no disputing that amidst the many hazards affecting the environment, traditional brick making is one that not only adversely affects the ecosystem but more damagingly leaves a harmful impact on livelihood means of the masses, including among others cultivation. This is particularly so when it comes to conventional brick making practiced in Bangladesh for ages

Fired clay bricks are one of the most important construction materials in Bangladesh. Bangladesh stands as the fourth largest brick producer in the world. This industry accounts for approximately 1% of the country's GDP.

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. Table 2 above provides a snapshot of brick sector in Bangladesh. The brick-industry is largely using inefficient, dirty technology, informal seasonal employment methods and haphazard growth that has created some huge environmental problems. It has

Table 1: Bangladesh brick sector at a glance	Table 2: Brick sector in BD
	Total no. of coal fired kilns (Ested)
	7000
	Annual brick production
	23 billions
	Value of output
	\$2.53 billion
	Coal consumption
Wood & Coal fired kilns Source: The Daiy Star, 01/04/2020	5.7 million ton
	Emission of CO ₂
	16 milion tons
	Clay consumption
	3350 mil cft
	Total employment
	1 millions
	Source: DoE, Bangladesh, May 2017

been impacting on human health, agricultural yields and global warming. Addressing this issue, the authorities concerned put the blame for being unable to efficiently prevent the kilns from emitting black smoke and violating other environmental rules on local influential and dishonest brick field owners. As government claims, despite the existence of laws, many unauthorized brickfields across the country are operating in conventional methods¹⁰. These brick kilns are mostly using wood and some cases using coal to burn bricks¹¹. Its emission level has been damaging arable land by cutting earth and polluting the air. The DoE headquarters, however, has no specific data on the number of brickfields currently operating in the country and the extent of pollution -- the amount of emitted smoke and impact of its contents on human, and crops, vegetation and land. However, a World Bank study released last year found that in the North Dhaka cluster, brick kilns are the city's main source of fine particulate pollution, accounting for nearly 40 percent of total

emissions during the 5-month operating period. The regulator says the harmful brick kilns operating around Dhaka city and other places across the country had been set up after securing approvals through muscle power. Though the DoE officials conduct drives against the illegal brickfields flanked by law enforcers, they fear reprisal from those affected owners at other times.

In a recent global survey, Bangladesh ranked 131st among 132 countries in controlling air pollution with regard to its effect on human health. India holds the very last position¹¹.

Failure in ethical responsibility: Like many other issues, this environmental problem raises the ethical question of our human responsibility to protect the nature from destruction by human behaviours. Emission from brick kilns consists of mainly fine particles of coal, dust particles, organic matters and small amount of gases such as CH₄, SO₂, NO_x, H₂S, CO etc. The quantum of the dust evolved from non-chimney sources in brick kiln area is very high.

Progress on solving these problems depends on deciding who should pay for the protection of global environmental resources and this is an issue of distributive justice. The authorities concerned put the blame for being unable to efficiently prevent the kilns from emitting black smoke and violating other environmental rules on local influential and dishonest brick field owners. Despite the existence of laws, around 11,100 brickfields across the country are still operating in conventional methods, using wood to burn bricks, damaging arable land by cutting earth and polluting the air, while many other brickfields have been operating just without approval of the authorities, as reported by the DoE¹⁰.

Bioethical Grounds Responsibility:

Society can be seen as a system, a “collection of elements of dynamically and organized interactions around a goal” in which the elements are individuals and the interactions are the sharing and exchanging materials and immaterial things¹⁴. The overall aim is the survival of society. Various phenomenon such as a new natural science or medical phenomenon may emerge. Society must then determine whether the phenomenon concerned has a positive or negative effects on its survival and decide how to react. Bioethics intervenes at this point but in a very different way from law and morality. This systematic approach can show us how and why bioethics is different from law and morality.

Law and morality perspectives

A society organizes interactions between individual and different groups with at least a view for its survival through legal and moral standards in particular^{15, 16}. A particular standard is collection of rules allowing a system to organize itself optimally according to its goal. On the other hand, a legal standard inscribed in law and a moral standard is not. On legal

issues, punishment can be imposed based on Court decision whereas on morality issues, society can impose sanctions on individual misbehaves. Together these two allow a society to organize itself and to consider the effect of phenomenon relating to natural sciences or medicine on its survival.

In summary, if law and morality consider a phenomenon to be legal and moral, society will consider the phenomenon to have a positive effect on its survival and will act to amplify that effect. Conversely, if they consider being illegal and immoral, then society will consider the phenomenon to have a negative effect on its survival and will act to decrease that effect. On this aspect, effluent gases emission from brickfield can be re-examined when it come society's choices for their actions to address it.

Bioethics perspectives

An ethical issue is an entity or situation in which certain individuals or groups of individuals oppose the legal and moral standard in practice and react differently to emerging phenomenon. Bioethics intervenes at this point. It studies the phenomenon to identify the ethical issues and propose solutions by evaluating the benefits, costs and risks to determine whether this phenomenon really does have a positive or negative effect on the survival of society. It is about bioethics, not about general ethics.

The proposals, based on evaluation, here aim to act on effluent gases issues and on this society, to amplify positive effects and reduce negative effects. It aims to have a positive and negative feedback effect on gases emission level from the brickfield and society itself through the maintenance and changes to the legal and moral standards. On this aspect, bioethics can also use a systematic approach for this purpose¹⁷. Thus, our systematic analysis approach is entirely appropriate combin

with welfare economics approaches emphasizing the bioethics ground rather legal and moral obligations on addressing the effluent gases emission from brickfield in Bangladesh.

Compliance and enforcement: The Bangladesh Environment Conservation Act, 1995¹⁸ and Environment Conservation Rules, 1997¹⁹ outline the environmental regulatory regime to establish environmental administration in Bangladesh and give the DOE mandate for their enforcement¹⁰. The 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.

The 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 DoE as mandated by ECA 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 DoE 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. At the same time, a total of 29 brick kilns established without environmental clearance certificates were knocked down by the Department of Environment. However, many newspaper media report that a significant number of brick kilns are not registered^{11, 20}.

Methodology: The basic methodologies used in this study are Marginal Damage Analysis and the Standard Partial Equilibrium Models underpinning both bioethics and legal & moral aspect. This paper assumes

- i. Effluent gas such as CO₂ emission is external. It pollutes environment. In other words, environment quality is priced like a regular public good.
- ii. There are n competitive markets for the emission free environment
- iii. For simplicity both export and import of this good (bricks) are small or nonexistent.
- iv. Rivalry exists in case of consumer preferences for better environment
- v. Exclusivity exists
- vi. Changes in production level of emission caused by changing the input (wood or coal) and productivity and the change in demand for improved environmental quality (less pollution) by increasing income, population and life style or preferences over time are ignored. There are empirical evidences that increase in population, income and life style preferences increased the supply and demand for better quality of environment.

All these assumptions ensure that the aggregate demand for improved environment can be viewed as a negatively sloped schedule of the demand for improved environment at various prices holding income and tastes being constant.

These assumptions also ensure that the aggregate supply curve could be drawn as a positive sloped function, holding other prices, cost and technology unchanged. Given the assumptions, the 'n' demand functions of Bangladeshis for improved environment, are the function of n prices which are completely determined. In other words, Bangladesh can be considered as a single market for quality of the environment.

The concept of consumer surplus is used to capture consumer welfare changes resulting from a price change in bricks. The Marshallian demand curve is used to approximate change although the Hicksian demand curve would be theoretically better. However, the difference between Marshallian measurement and Hicksian measurement is not important if the following three conditions are satisfied^{21, 22}.

1. Identical consumer when it comes clean air facilitation being a part of the society
2. There is only one price change in one market and
3. Since bricks are products of manufacturing, the income effect is small. If these conditions are met, then the observed demand behaviour can be used to construct a measure of welfare change.

The assumption of n identical consumers is an approximation of Bangladeshis where the "traditional match up behaviour" makes consumption patterns more or less homogeneous^{21, 22}.

Therefore, for a single price change, the percentage of error resulting from using consumer surplus (CS) in the order of $CY / 2M$ which is likely to be small (CY = consumer income, M = consumer's constant income.). So, in the static partial equilibrium model, the size of the inefficiency of the efforts modernizing brick kilns for the improved environment

purchase and supply system can be measured by the deadweight loss.

Effluent Gases Such as CO₂ Emission from Brickfield under the Framework:

Considering the problem of effluent gases such as CO₂ emission in Bangladesh from brickfields into our framework, we can represent the problem in Fig 2. Let us assume that brickfield "A" produces Q_1 number of bricks. This production generates wood, coal and other input costs which are costs for both producer and society. In addition, there is a set of costs attributable to the pollution generated by this brickfield which is borne by Bangladeshis and not by brickfield 'A'. This situation creates a divergence between private and social costs that are also shown in Fig 2.

Here social cost includes additional costs consisting of the damages generated by effluent gases emitted by the brickfield A while producing bricks. In Fig 2, Q_1 number of bricks is total production corresponding to marginal private cost (MPC) equal to marginal private benefit (MPB). This Q_1 is greater than socially optimal level of output Q^* corresponding to marginal social cost (MSC) equal to marginal social benefit (MSB).

The excess cost $(EC) = (Q_1 - Q^*) * (P_2 - P_1)$ represents the cost to Bangladeshis for having this higher level of output than optimal level. Considering all brickfields in Bangladesh, the total excess cost is $EC_{BD} = n * (Q_1 - Q^*) * (P_2 - P_1)$. This is considered as the total damages i.e. pollution generates from n number of brickfields by degrading the environment in Bangladesh. In Fig 3, the area e represents total damages in Bangladesh by the brickfields. The total resource costs are examined in Fig 4. Here resource cost associated with Q_1 is area OBQ_1 . Area OP_1BQ_1 represents the benefit gained by Bangladesh society from having the resources utilized in 'n' brickfields in

Bangladesh. Area OQ_1B represents opportunity cost. Here, net value = area OBE , $PS = P_1OB$ and $CS = EP_1B$. Considering Fig 2, Q^* pieces of bricks production guarantees Bangladeshis a pollution free environment but they will have to spend as a whole $n * (P_2 - P_1)$. The welfare loss for this higher cost is shown in Fig 5.

In this case, the changes in price cause changes in CS. Price changes from P_1 to P_2 causes CS drops equal to the area $(A+B+C+D)$. On the other hand, PS increases by area A which directly goes to brickfields' owners. Area B represents variable input cost. Area $(C + D)$ is "deadweight" usages loss because consumers allocate this expenditure away from now more expensive Q_1 number of bricks usages. It can also be represented as Bangladeshi's real income loss for having a pollution free environment. It is noted that the relative size of $(C + D)$ depends on the magnitude of the induced price change and the price elasticity of supply and demand.

Feasible Options for Effluent Gases Such as CO₂ Emission Reduction from

Brickfield: The primary goal of this section is to looking for feasible options abating effluent gases such as CO₂ emission from brickfields in Bangladesh underpinning Kyoto Protocol requirement.

Reforestation: Reforestation is an act of restoring indigenous or exotic forests to lands originally covered by forest. Many studies found that reforestation is one of the important options in reducing the level of CO₂ in the atmosphere because it significantly mitigates CO₂ emissions²³. Plants can be used to control or sequester CO₂ in the atmosphere.

Hence, increasing the number of trees or plants and thus increasing the rate of photosynthesis may increase biological fixation of CO_2 and other effluent gases emit from brickfields. Applying this reforestation idea into welfare analysis which is shown in Fig 6, let us assume brick-kilns or government makes tree planting decision setting $\text{MPC} = \text{MPB}$.

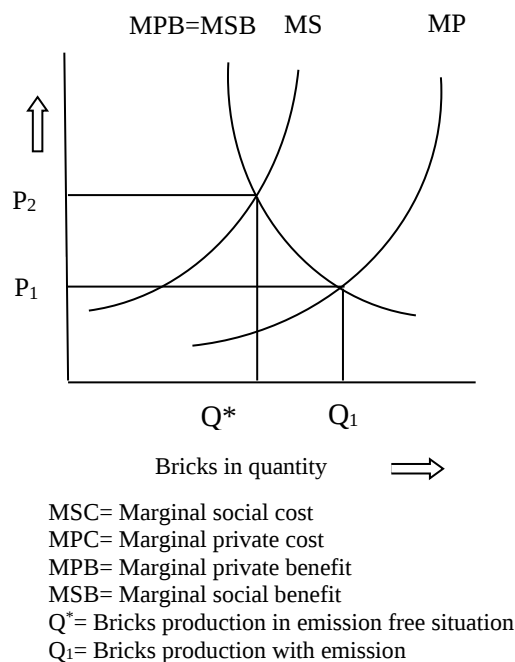
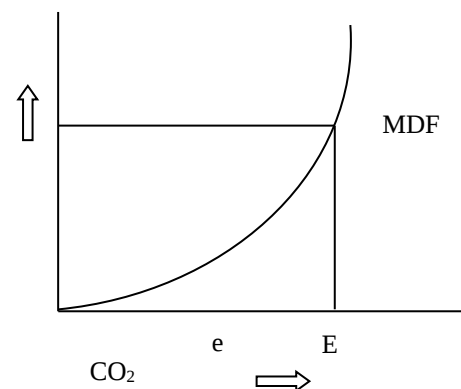


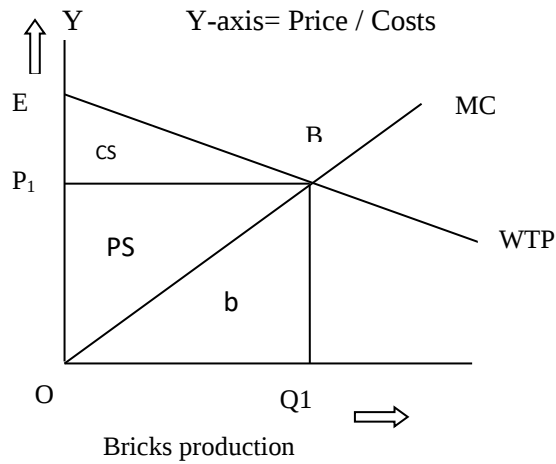
Fig 2: Market failure when brickfields are free from regulation



MDF = Marginal damage function

Fig 3: CO₂ emission from brickfields

The corresponding market level of reforestation planting is Q_1 and optimal



MCP = Marginal cost for the kiln
 WTP = Willingness to pay
 CS = Consumer surplus
 PS = Producer surplus
 B = Resource cost or Opportunity cost

Fig 4: Resource cost for producing bricks

level is Q^* (for Bangladeshis) that are generated by reducing soil erosion, a

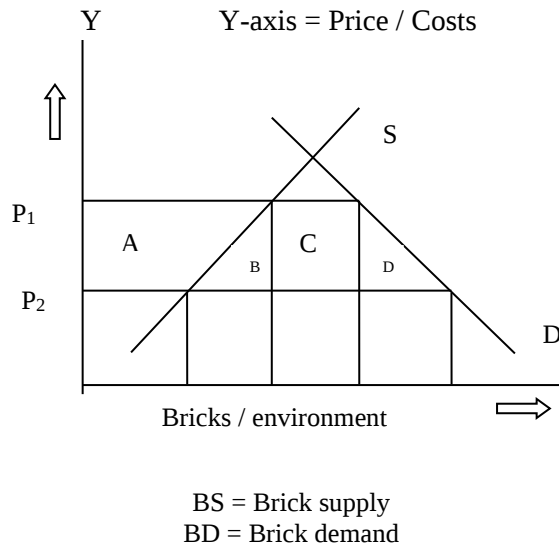


Fig 5: Welfare aspect of producing bricks with CO_2 emission

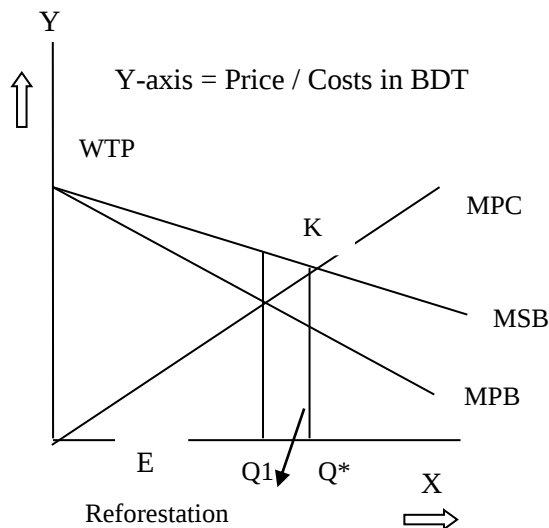


Fig 6: Welfare from reforestation

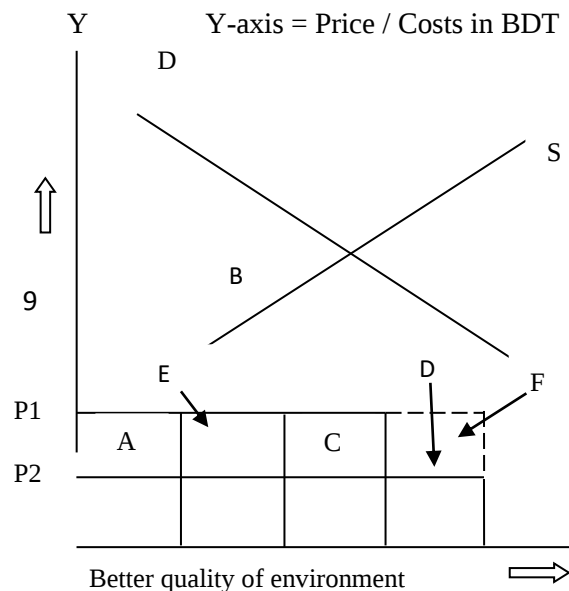


Fig 7: Welfare aspect from better quality of environment via Government subsidies / company charity

higher degree of a better environment. generated by reducing soil erosion, a higher degree of a better environment. Area K represents net social gains that are generated by planting trees. The following three approaches can be considered.

- i) If brick-kiln industries are involved in planting, then the companies can pay the planting cost as a charity (public service) to the society where DoE will monitor the actuality
- ii) On the other hand, if government is involved in planting, then government will collect these environmental costs or taxes from the companies responsible for emitting CO₂ from individual brickfield in Bangladesh. In this case environmental clean- up or pollution prevention is a task for the government like any other public infrastructure (road, telecommunications etc.). This dual approach ratifies sharing the cost among Bangladeshis for the better environment.
- iii) Government can encourage its populations in different ages to celebrate individual birthday by planting a tree(s) beside roads & highways and near train-lines with the approval of local assigned officer(s) under the DoE. In this process, authority(s) can issue Celebration Certificate. This message can be communicated via schools, colleges and universities for effective and continuous outcome.
- iv) Motivation is to be strengthened that a forestation is a social and moral obligation for every citizen. It should begin with introducing the message in institutional education system i.e. part of curriculum in classroom.
- v) Research on identification of fast growing species of trees, having

better fuel and timber values shall be strengthened keeping local climate and social condition in view. Also research on utilization the technique of using sugarcane

Welfare Analysis: Considering government subsidies or brick kilns' charity in Fig 7, area (A+B+C+D+E) is consumer surplus. Company pays area (A+E) as charity. Government subsidies are area (E+B+C+D+F) that is collected from Bangladeshis as taxes. Net loss to Bangladeshis is (E+F). Area E reflects a net loss of producer surplus, underutilized resources, subsidies or charity. Area F is deadweight loss that is just lost.

Taxation: Taxation is one of the most important means by which the growth of an economic activity can be controlled. This is because the imposition of a tax can act as a catalyst to create incentives for investment in curtailing CO₂ emission (Denver and Nixon, 1989). The basis of taxation may differ. Addressing CO₂ emission reduction in Bangladesh, new taxes can be based on the rate of emission instead of taxes on number of bricks produced. Taxes on bricks usages do necessarily cause a reduction of CO₂ emissions from the brickfields. This study examines only the option "taxes on emission". The term "taxes on emission" can also be represented as an abatement cost.

Emission abatement level can be determined by setting marginal damages (MD) equal to marginal abatement cost (MAC) as it is shown in Fig 8(a). Here, emission level is set at E₁ and it is curtailable via CO₂ sinks in atmosphere. Brickfield "A" abates E₁ / n units via regulation.

Assumptions:

- i) Government (DoE) intensively monitors each brick kiln's CO₂ emission level
- ii) Government does not know brick kiln industries marginal cost (MC)

and it is ambiguous measuring in BDT of both marginal damages caused for CO₂ emission and marginal abatement cost required for abating emission. The idea of optimal level of emission need not be static but may change or be adjusted over time and it assists to overcome this constraint.

- iii) Government sets the target at “a” in Fig 8(b) but brick kiln say A’s emission level is at E₂. As E₂ > E₁, therefore, brick kiln “A” pays taxes for (E₂ – E₁) in a certain fashion.

Welfare Analysis: This policy manoeuvre reduces producer (kiln A’s) surplus by (A+B+C+D) in Fig 8(c). Variable inputs in this illustration move into other competitive technology or inputs to improve plant's performance and energy efficiency to minimize the losses of producer surplus. Now the question is: how does PS loss spread throughout economy of Bangladesh. The value (A + B) becomes an increase in CS which can be interpreted as the improvement of environment comparing other environment where “command and control” is not in practice. The value D picked up as tax revenue to the government collected on the volume of (E₂ – E₁). This leaves the triangles C and E to be accounted for. Here C represents loses to the society and it will be equal to zero by adjusting the target level over time. Area E is deadweight loss that can't be picked up by any economic entity.

Effluent gases such as CO₂ Emission control technology: The Clean Air and Sustainable Environment (CASE) project supports a whole range of activities including introduction of energy-efficient brick making technologies and also is demonstrating the viability of alternative building materials.

Such technologies as Improved Fixed Chimney Kiln (IFCK), Improved Zigzag

Kiln (IZigzag), the Vertical Shaft Brick Kiln (VSBK), and Hybrid Hoffmann Kiln (HHK) are substantially cleaner, consume less energy and emit lower levels of pollutants, (World Bank). In most of the methods, other than HHK, coal is used as fuel to burn the bricks. The regulator also suggests that the production of hollow block bricks needs to be prescribed, even though it is costlier, as the method contributes nothing harmful to the environment. Bricks are made with silt, cement and stone crush, and later are dried in the sun. These bricks are sound proof and earthquake-friendly.

Fuel Switching and Reappearing power plants: Furthermore, CO₂ emissions may also be reduced by fuel switching brickfields²⁴. But the question of cost effectiveness is a serious concern in this regard. It is very expensive to “scrub” carbon from combustion waste gases. It was determined, in one study that the collection and disposal of brickfields, the effluent gases emissions would at least double the cost of coal-fired brickfield²⁵.

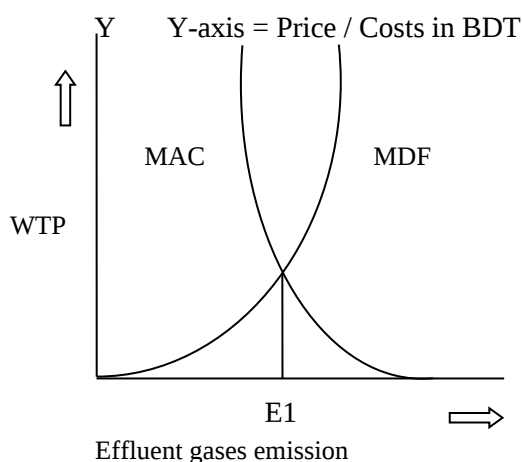
Clean Coal Technology: Clean coal technology refers to new and advanced coal utilization technologies, which are more efficient (in most cases), resulted lower cost and are more environmentalism sounds comparing traditional coal burning exposure. The use of quality raw materials may facilitate better kiln firing process in overall. The development of green belt around the brick kiln industries may be an effective mitigation mechanism. Furthermore, with clay, usages of sugarcane bagasse ash have been recommended as brick materials in literature²⁶. It can be an instrumental curtailing the magnitudes of emission from brickfields in Bangladesh where government’s inspirational efforts are important.

Monitoring number of brick kilns and conducts Mobile Court Drive:

Bangladesh Government report *entitled*: National Strategy for Sustainable Brick Production in Bangladesh¹⁰, clearly shows that there are total 7000 brick kilns in Bangladesh. However, report on total number of brick kilns in Bangladesh varies from government information to private information. Like many private entities, the Financial Express reported that there are more than 11000 brick kilns that

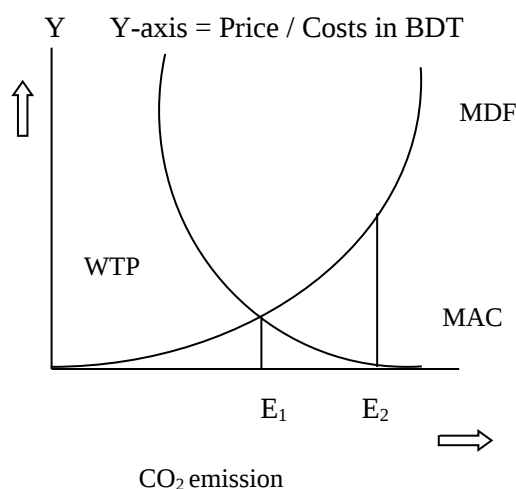
currently in operation in Bangladesh where a significant number are not registered with the government¹¹.

To overcome this dilemma along with immediate efforts for curtailing the magnitudes of CO₂ emission level from brickfield, government should play active roles conducting Mobile Court Derives. This policy and effective efforts will be a win-win for the society as a whole where it can ensure generating adequate revenues



MAC= Marginal abatement cost
MDF= Marginal damage function
E₁= Optimal level of emission, which is consistent with protection of health
WTP= Willingness to pay

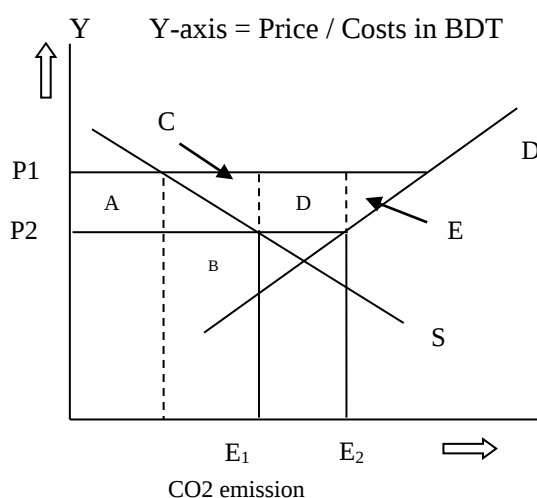
Fig 8 (a): CO₂ after regulations



E₁ = Emission under regulation
E₂ = Brick kilns actually produce

Fig 8(b): CO₂ emission under command & control

Social responsibility on bioethics perspective: Social responsibility and business ethics are often regarded as the same concepts. However, the social responsibility movement is but one aspect of the overall discipline of business ethics. The social responsibility movement arose particularly during the 1960s with increased public consciousness about the role of business in helping to cultivate and maintain highly ethical practices in society and particularly in the natural environment²⁷.



E₁ = Emission under regulation E₂ = Brick kilns actually produce

Fig 8 (c): Welfare analysis under command and control

as well curtailing magnitudes of CO emission, which can be appreciated by the relevant international organizations including UNO where it would not be hesitated granting monetary support underpinning Kyoto Protocol Agreement.

The premise here is that the type of social standards or contracts in place may determine how consumers through their individual and collective behaviours, can play a direct role influencing corporate or business behaviours, when it fails to meet social responsibility standards. This is because it is well knowing that individual and collective consumers' power can narrow down the governance gaps related to issues say environmental and can reduce the likelihood of corporate or business's responsibility failures²⁷. Thus time to time ethical training among employees should be practiced where government's provisions can enforce the corporate or businesses to do so. Teaching social responsibility issues in can be instrumental, which can be a win-win for parties involved. However, it requires government's involvements in multi-faucets including redesigning academic curriculum based education level.

Steps involved in developing ethics-training program can begin from classroom to corporate level. The referred training can begin with emphasizing the following

1. Stand for something for all – *bioethical grounds*
2. Identify different types of ethical training the respective authority can include
3. Train students, employees where they are
4. Get leadership involved
5. Consider incentives –Corporate, Organization and Government can initiate
6. Create common goals and identity – by Corporate, Organization and Government

7. Make it fun in every step
8. Facilitate to develop consumers' potentials to monitor corporations' licenses to operate through their consumption responses to corporate social responsibility failures.

Future Research: If research grants are available, multi-faucets studies can be conducted examining the possibility of utilization of green tech in brick industry using opinion-survey of management & employees in brick kilns in Bangladesh. Factor Analysis and hypothesis development & testing can be carried out so that the expected findings can be educational enhancing the growth of utilizing green tech meeting the challenges. *Lastly*, studies can be conducted in multi-faucets addressing strict-implementation for productive roles and contributions of corporate or businesses on ethical responsibility efforts when it come environmental issues.

Conclusion: Since the beginning of civilization, bricks have been playing important roles for construction of houses and other infrastructure, which are major catalysts for economic progress in Asian countries where Bangladesh is no exception. Bangladesh bricks are the most important building material in urban areas. In recent years, rapid urbanization and then rural to urban migration has created an increasing demand for residential, commercial, industrial, public buildings and other infrastructures. As a result, the brick industry in Bangladesh has risen dramatically. However, this industry largely uses inefficient, dirty technology, informal seasonal employment methods and haphazard growth. Thus, it emits huge volume of effluent gases such as CO₂ and other gases in environment. More specifically, burning wood and coal in brick kilns produces mainly high level of SO₂, NO_x, CO₂, CO and CH₄. Thus

brickfields inject them into atmosphere and deplete atmospheric O₂.

For policy guidance on the issue, this study analyzes the basic issues of effluent gases such as CO₂ from brickfields in terms of marginal damage (MD) analysis and the neoclassical partial equilibrium demand & supply theory. It further analyzes the reasons of disparity between social and private cost by conventional marginal damage analysis. So, the findings can be utilized as guidance in policy design in Bangladesh. Findings show that because of effluent gases emission from brickfields, the marginal social costs are higher than marginal private (producer of bricks) costs. In other words, brick kilns are benefiting with the expense of Bangladeshi society as a whole. Continuation of increasing number of brick production under traditional fuels (woods and coal) usages in Bangladesh, it results higher welfare loss incurred from higher social costs. Also, because of high rise demand of bricks due to continuation of rising per capita income, prices of bricks are becoming upward trends in Bangladesh, which have been dominating the increases of producer surplus (PS). By using inefficient fuels in brick industry, producers continue generating higher revenues and consumers facing higher prices, which creates higher deadweight loss year after year. This is because consumers allocate this expenditure away from now more expensive bricks. The unplanned development of brick industry in Bangladesh is absolutely unsustainable.

Therefore, there is urgency for national strategies and policy actions underpinning bioethical grounds for cleaner and sustainable brick production in Bangladesh. Reforestation efforts can be achieved in multi-faucets including brickfields' charity, govt. policies on planting trees, govt.'s policies on motivational efforts inspiring citizens of this country. Bioethics responsibility trainings in multi-

faucets are needed where government's roles in designing program(s) can be instrumental. For effective outcome, the proposed training can be incorporated into academic curriculum for different academic levels and corporate and businesses will be required to conduct it time to time within its employees. These motivational can be in multi-faucets: i) inspiring celebration of individual's "Birthday, Having 1st Child in family and Event of a marriage" by planting trees ii) forcing to utilize green tech in brick kilns and iii) conducting research in both phases including govt. and academic arena where financial supports are in need.

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