CHAPTER-2

PROFILE OF BRICK INDUSTRY AND STONE CRUSHING INDUSTRY IN BARAK VALLEY

Before discussing the profile of the Brick Industry and Stone Crushing Industry, it is necessary to give the profile of Barak Valley.

2.1. PROFILE OF BARAK VALLEY

2.1.1. INTRODUCTION

Assam is situated in the North-East region of India-bordering seven States viz. Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and West Bengal and two countries viz. Bangladesh and Bhutan. With a geographical area of 78,438 sq. km i.e. about 2.4 per cent of the country’s total geographical area, Assam provides shelter to 2.58 per cent population of the Country. The State divides itself into two natural divisions such as the Plains Area and the Hills Area. The Plains area of the state consists of two valleys viz. the Brahmaputra Valley and the Barak Valley. Barak and Brahmaputra are two major rivers in Assam.¹ (Map No. 2.1.1)

The Barak Valley is situated in southern region of the Indian State of Assam. The main town of the valley is Silchar, Cachar District. The Valley is named after the Barak River. Barak Valley mainly consists of three districts namely Cachar, Karimganj and Hailakandi, covering a geographical area of 6922 sq. km. excluding 2 (two) hill districts. The Valley is surrounded on the north by the North Cachar Hill District of Assam and the Jaintia Hills District of Meghalaya, on the east, by Manipur, on the south by Mizoram, while on the west by Tripura and the Sylhet District of Bangladesh. The boundary clearly reflects that the Barak Valley is surrounded by Hills from three sides and plain land from one side. The local rainfall run off of the valley along with that of adjacent hilly areas flows through river Barak and its various tributaries and is drained out to Bangladesh. The Katakhal, Jiri, Chiri, Modhura, Longai, Sonai, Ruksni, and Singla are the main tributaries of the valley. The tributaries are mainly rain fed and cause flood problems when precipitation occurs. Flood and erosion are two main natural disasters being faced by the state. The Valley constitutes 8.82% of the geographical area of the State (Map No. 2.1.2).

2. Ibid, pp. 77
2.1.2. ADMINISTRATIVE SET-UP

The administrative establishment of the Barak Valley is independently separated district wise. The district headquarters of Cachar, Karimganj and Hailakandi are Silchar, Karinganj and Hailakandi respectively. The official language of the Barak Valley is Bengali. The majority of the people are sylheti and they speak sylheti a dialect of Bengali. Table No.-2.1.1 deals with the District wise Number of Villages, Gaon Panchayat, Community Development Block, Anchalik Pancyat and Zila Parisads in the Barak Valley, Assam.

Table No.-2.1.1

District wise Number of Villages, Gaon Panchayat, Community Development Block, Anchalik Pancyat and Zila Parisads in the Barak Valley, Assam

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>District</th>
<th>Number of villages(As per 2011 Census)</th>
<th>Number of Gaon Panchayat as on 2011</th>
<th>Number of Community Development Block as on 2011</th>
<th>Number of Anchalik Panchayat as on 2011</th>
<th>Number of Zila Parishad as on 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Karimganj</td>
<td>936</td>
<td>96</td>
<td>7</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Hailakandi</td>
<td>331</td>
<td>62</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Cachar</td>
<td>1040</td>
<td>163</td>
<td>15</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Barak Valley</td>
<td>2307</td>
<td>321</td>
<td>27</td>
<td>27</td>
<td>03</td>
</tr>
</tbody>
</table>

Source: Economic Survey, Assam, 2012-2013, Directorate of Economics and Statistics, Assam, Planning and Development Department, Govt. of Assam, pp. 1
2.1.3. CLIMATE

The climate of a particular place has its effects on the social and economic conditions of the people. The general climate of the Barak Valley is neither too hot nor too cold, it is rather humid. The valley is shut in by hill range from three sides which have great influence on climate and its geographical location. The uncertainty of monsoon over all the North-Eastern Region never shows uniform rainfall in the valley.
The climatic condition of the valley is characterized by high humidity to the extent of 89 per cent. Average rainfall is as high as 2700 mm and the minimum and maximum annual rainfall have been recorded to be 1700 mm and 4000 mm respectively. The minimum and maximum temperature observed in the valley during winter and summer respectively are $8^\circ$ C and $37^\circ$ C. 3

2.1.4. DEMOGRAPHIC SCENARIO

It is a demographically congested region as it has experienced unprecedented inflow of population from Bangladesh and its towns and suburb have absorbed substantial quantum of middle class migration from the rest of the North Eastern Region owing to social tension. The total population of Barak Valley as per 2011 census was 3612581. The percentage of rural population in the valley was 86.87 per cent in 2011.

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### Table No.-2.1.2

**District wise Demographic Profile of Barak Valley, Assam, 2011 Census**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Karimganj</td>
<td>1106745</td>
<td>110257</td>
<td>1217002</td>
<td>1809</td>
<td>673</td>
</tr>
<tr>
<td>2</td>
<td>Hailakandi</td>
<td>611087</td>
<td>48173</td>
<td>659260</td>
<td>1327</td>
<td>497</td>
</tr>
<tr>
<td>3</td>
<td>Cachar</td>
<td>1420309</td>
<td>316010</td>
<td>1736319</td>
<td>3786</td>
<td>459</td>
</tr>
<tr>
<td>4</td>
<td>Barak Valley</td>
<td>31,38,141</td>
<td>4,74,440</td>
<td>36,12,581</td>
<td>6922</td>
<td>522</td>
</tr>
</tbody>
</table>


### Diagram No. 2.1.2

**District wise Population of Barak Valley, Assam, 2011 Census**

![Diagram showing population distribution by district](image-url)
The decadal growth rate of population in the Barak Valley during 1991-2001 was 20.23 per cent and 2001-2011 was 20.59 per cent which was higher than that of Assam 18.92 per cent and 16.93 per cent respectively. In Barak Valley the density of population was 522 in 2011 whereas in Assam it was 397 in 2011.  

2.1.5. POPULATION BY RELIGION

In context of, religious composition of the Barak Valley population is that 42 per cent are Hindus, 50 per cent are Muslims, 4 per cent are Christians, and remaining 4 per cent are others religions. Hindus are majority in Cachar District having 60 per cent, while Muslims are majority in Karimganj District and Hailakandi District having 53 per cent and 58 per cent respectively.

2.1.6. EDUCATION SECTOR

As per 2011 census, literacy rate of Assam was 73.18 per cent with male literacy rate was 78.81 per cent which is behind the national rate of 74.04 per cent and male literacy rate 82.14 per cent respectively. In the Barak Valley total literate population was 23,76,791 in 2011 and total rural literate population was 1568639 in 2011.


The different types and number of educational institutions are very much available in the Barak Valley. The table no. 2.1.3 shows the different categories of educational institutions situated in the Valley in 2011-2012.

**Table No. 2.1.3**

**Various Categories of Educational Institutions in the Barak Valley, 2011-2012**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Categories of Educational Institutions</th>
<th>Name of Districts and Number of Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cachar District</td>
</tr>
<tr>
<td>1</td>
<td>Primary School</td>
<td>1855</td>
</tr>
<tr>
<td>2</td>
<td>Middle School/ Upper Primary School</td>
<td>460</td>
</tr>
<tr>
<td>3</td>
<td>Upper Primary School with High School</td>
<td>62</td>
</tr>
<tr>
<td>4</td>
<td>High School</td>
<td>243</td>
</tr>
<tr>
<td>5</td>
<td>Higher Secondary</td>
<td>77</td>
</tr>
<tr>
<td>6</td>
<td>Junior College</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Jawahr Navodaya Vidyalaya</td>
<td>01</td>
</tr>
<tr>
<td>8</td>
<td>Provincialized/Non</td>
<td>18</td>
</tr>
</tbody>
</table>
There are three civil hospitals, 61 primary health centres, 591 sub-centres, 06 community health, one cancer hospital, 35 private hospitals and 18 Registered Diagnostic Centres. 690 beds are available in different types of Government hospital in 2011.  

The table no. 2.1.4 depicts the number and different types of medical and health institutions of Cachar, Karimganj and Hailakandi Districts of the Barak Valley.

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Table No.-2.1.4

Various Types and Number of Medical and Health Institutions in the Barak Valley in 2011

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Categories of Medical and Health Institutions</th>
<th>Cachar District</th>
<th>Hailakandi District</th>
<th>Karimganj District</th>
<th>Barak Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Civil Hospital</td>
<td>01</td>
<td>01</td>
<td>01</td>
<td>03</td>
</tr>
<tr>
<td>2</td>
<td>Primary Health Centre</td>
<td>27</td>
<td>12</td>
<td>22</td>
<td>61</td>
</tr>
<tr>
<td>3</td>
<td>Sub-Centre</td>
<td>269</td>
<td>105</td>
<td>217</td>
<td>591</td>
</tr>
<tr>
<td>4</td>
<td>Community Health Centre</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Cancer Hospital</td>
<td>1</td>
<td>---</td>
<td>---</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>No. of Beds in Govt. Hospital</td>
<td>260</td>
<td>208</td>
<td>222</td>
<td>690</td>
</tr>
<tr>
<td>7</td>
<td>Private Hospital</td>
<td>29</td>
<td>6</td>
<td>00</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>Registered Diagnostic Centre</td>
<td>15</td>
<td>3</td>
<td>00</td>
<td>18</td>
</tr>
</tbody>
</table>

2.1.8. AGRICULTURAL SCENARIO

The Barak Valley is basically agriculture oriented and about 66 per cent of the working population depends on agriculture for maintaining their livelihood. “Agriculture in the rainy months is mainly confined to the high lands which are free from water logging. In winter, the depressions grow excellent crops like pulses and oil seeds. Besides rice, Jute and sugarcanes are also grown here with no land available for reclamation and bringing under cultivation, agriculture cannot support more people in
The table no. 2.1.5 depicts area under high yielding variety of rice total production in the Barak Valley.

**Table No. -2.1.5**

**Area under high yielding variety of Rice in the Barak Valley, Assam, 2011-12**

(Area in hectares)

<table>
<thead>
<tr>
<th>District</th>
<th>Autumn Rice</th>
<th>Winter Rice</th>
<th>Summer Rice</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cachar</td>
<td>6338</td>
<td>55662</td>
<td>7824</td>
<td>69824</td>
</tr>
<tr>
<td>Karimganj</td>
<td>1903</td>
<td>41886</td>
<td>6256</td>
<td>50045</td>
</tr>
<tr>
<td>Hailakandi</td>
<td>4047</td>
<td>27340</td>
<td>3281</td>
<td>34668</td>
</tr>
<tr>
<td>Barak Valley</td>
<td>12288</td>
<td>124888</td>
<td>17361</td>
<td>154537</td>
</tr>
</tbody>
</table>


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The problems of agriculture in the Barak Valley are not different from that of Assam in general. The agriculture in this valley is “characterised by many impediments such as small and uneconomic farm units, lowest intensity, low productivity, lack of proper irrigation facilities, inadequate credit. Besides in agriculture and rural economy, tradition persisted very deep reducing the total productivity to a large extent. Extensive rain, flood and sometimes drought conditions
here and there and pest attack on standing crops are some of the other problems which agriculture willy-nilly has to face every year.”

Apart from these, Lakhipur of Cachar District produces one of the best varieties of pineapples in the world. Efforts have been made for establishment of canning and preservation units for pineapples which may provide some employment directly and indirectly.

2.1.9. INDUSTRIAL SCENARIO

The principal industry of the valley is the Tea industry. There are 185 small tea growers and they have occupied 672.98 hectares of land area under tea cultivation in Barak Valley in 2012. Some of the other important industries set up in the Barak Valley are Cachar Paper Mill, with an annual production capacity of one lakh ton at Pachgram under the auspices of Hindustan Paper Corporation Limited, Union Flour Mill, Silchar, Barak Valley Cement Limited, (BVCL) Badarpurghat, Karimganj. There were 356 registered factories providing employment to 11245 workers in 2011 in the Barak Valley. These factories are mainly manufacturers of food products and wood products. There are also some industrial units based on timber, engineering, chemical, textile, cement, grinding etc. giving employment to a small number of people. Again, traditional cottage industries like weaving, sericulture, bamboo, cane

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11. (i) [Table-15.01 to 15.03] Tea Board of India, Regional Office, Guwahati, Assam,
crafts etc. are providing subsidiary sources of income to a large number of rural populations.

There are 226 registered units of Micro, Small, and Medium Enterprise during the year 2009 to 2012 where 1684 workers are working in the Barak Valley.\(^{13}\)

2.1.10. TRANSPORT AND COMMUNICATION

The transport bottleneck is the main cause for the backwardness of the Barak valley. The national highway 53 (Jowai-Badarpur road) connects Silchar with Guwahati via Shillong. The other important roads are Silchar-Imphal, Silchar-Aizwal and Silchar-Agartala. These roads are metalled and black-topped. Again, there is a fair weather road from Silchar to Haflong, the head quarter of Dima Hasao District. During the rainy season, these roads remain suspended frequently owing to landslides. The Barak Valley is covered by the Northeast Frontier Railways, the Valley is only connected to Lumding Junction (Assam) and Agartala (Tripura) through single route meter gauge rail-line to both the location. The work has been started to convert the meter gauge rail-line to broad-gauge rail-line from Silchar to Lumding Junction. There is only one airport in the Valley which is situated at Kumbhirgram, Silchar. Indian Flights connections are there Silchar to Kolkata, Silchar to Imphal, and Silchar to Guwahati.

\(^{13}\) Economic Survey, Assam. (2012-2013). Directorate of Economics and Statistics, Assam, Planning and Development Department, Govt. of Assam, pp. 136
2.1.11. CONCLUSION

From the above analysis, it is clear that the valley exhibits high density of population, excessive agricultural dependence, low level of agricultural productivity, uneconomic size of operational holding, low rate of industrialisation, high incidence of registered as well as disguised unemployment, low level of capital formation and enterprise, lack of transport and other infrastructural facilities etc. It is one of the backward regions of India.

2.2. PROFILE OF BRICK INDUSTRY

2.2.1. INTRODUCTION

A brick is a block of clay or other similar material, usually in the shape of a rectangle that is baked so that it becomes hard enough to be used for building houses, constructions and other structures. Bricks are one of the oldest types of building blocks. These are ideal building materials which are relatively cheap to make, very durable, and require little maintenance expenditure. Bricks are usually made of kiln-baked mixtures of clay. People who work with brick are called brick masons or bricklayers. Among the numerous jobs they perform are the laying of walkways, building of external walls on office buildings, and building and repairing of fireplaces, chimneys walls, floors, and other structures.\(^\text{14}\)

In ancient times, bricks were made of mud and dried in the sun. Modern bricks are made from concrete, sand and lime, and glass. The physical and chemical characteristics of the raw materials used to make bricks, along with the temperature

at which they are baked, determine the colour and hardness of the finished product.¹⁵

Burnt bricks are the most popular building material in our country. The conventional brick making practices in India, including Clamps and Bull Trench Kilns are highly energy inefficient and polluting.

According to the Columbia Electronic Encyclopaedia (2004) a brick is a block of ceramic material used in masonry construction, laid using mortar. Brick is ceramic structural material that in modern times is made by pressing clay into blocks and firing them to the requisite hardness in a kiln. Bricks in their most primitive form were not fired but were hardened by drying in the sun. Sun-dried bricks were utilized for many centuries and are used even today in regions with the proper climate.¹⁶

‘Sunny Brick Industry’-a brick kiln of Karimganj (Powamara), Barak Valley, Assam, India

¹⁵. Ibid, 1 Jan, 2008.
Most of the brick making units in India are carried out as small-scale industrial sector. The brick making industries are unorganized and dispersed throughout the length and breadth of the country. The status of their technology has remained virtually stagnant over the last 100 years, with very few improvements in brick making procedures. At present, brick manufacturing is very labour-intensive, since bricks are usually hand-molded and sun-dried before firing in the kiln. The burning of the bricks is often done in the traditional process such as in bull’s trench kilns (BTKs) and in clamps. BTKs are generally the choice of medium and large scale industrial sector and covered approximately 70 per cent of the total production in the country, while clamps are often used in operations with limited production capacities. The primary raw material used for bricks is the soil, which is often taken from prime agricultural land, causing land degradation as well as economic loss due to diversion of agricultural land. Use of traditional technologies in firing the bricks results in potential local air pollution. The green bricks are dried up under sun for 24 to 48 hours, depending on whether they are lime route or cement route; the dried up bricks are stacked and subjected for water spray curing once or twice a day, for 7-21 days, depending on ambience.

2.2.2. BRICK MANUFACTURING

Brick making is a traditional and an important unorganised industrial sector in India and other developing countries. The construction sector is an important part of the Indian economy with the contribution of 10 per cent in the GDP and is registering an annual growth of 9 per cent. Clay fired bricks are the backbone of this sector. The Indian brick industry is the second largest producer of bricks in the world after China.\textsuperscript{19} Brick kilns are small scale sector which uses manual labour and traditional firing technologies. It is estimated that more than 100,000 kilns produce about 80 to 100 billion bricks per year in India.\textsuperscript{20} The present demand is estimated as 120 billion bricks per year.\textsuperscript{21} There are about 50,000 Tile and Brick Industries which belong to the small scale sector in India. The employment of brick kilns is approximately eight million people. These industries supply bricks for constructions of the housing sector, bridges, roads and canals etc. in both rural and urban areas.\textsuperscript{22} According to Pollution Control Board, Guwahati, (2013) the state has 912 permanent brick kilns.\textsuperscript{23} As per the report of Pollution Control Board, Regional Office, Silchar, Cachar, Assam, there are 182 brick units in the Barak Valley as on 26th Feb, 2013.

\textsuperscript{20} Maithel, S. et al. (2000). Environmental regulations and the Indian brick industry. Environmental Practice Journal of the National Association of Environmental Professionals. 2 (3): 230-231, the Energy and Resources Institute Creating Innovative Solutions for a Sustainable future.
\textsuperscript{22} Kumar, N. N. Sampath. R & D Centre for Clay Roofing Tiles, Bricks and Other Ceramic Products. National Institute of Technology, Karnataka. Karnataka State, India, Retrieve from www.nitka.ac.in.
\textsuperscript{23} Articles on ‘Save the Earth’ - Eco friendly solutions to iron ore tailings.htm
\textsuperscript{23} The Telegraph 10th Jan, 2013
The number is expected to grow further keeping in view the future plans for development of infrastructure of roads, canals, bridges, buildings and constructions which are required for overall development of the nation. Thus, there are two categories of issues in brick making industry such as environmental and social. The choice of technology for firing of bricks depends on factors viz. scale of production, soil and fuel availability, availability of skilled manpower, marketing and business considerations like profitability and availability of finance and capital. The traditional brick making technologies are clamps, movable chimney and more recently fixed chimney kilns. The small scale brick entrepreneurs are confronted with environmental regulation and face numerous challenges for survival, considering the situation that there are very limited options for them to adopt for their brick business.\(^{24}\)

Brick industry is seasonal in nature and employs labourers through contractor(s). The brick moulder families were contracted through middlemen. Earlier most of them came from the different districts of Uttar Pradesh, Bihar, Chattisgarh and Orissa.\(^{25}\) Nowadays, it is observed that limited workers are migrated from other states in the Barak Valley. Local workers also get employment in the brick kiln unit. The work force is paid on the basis of quantum of work and against completion of certain tasks. Operations are mostly manual and under present conditions the working schedule for the workers is mainly in the dry season in between the months of October and April. This industrial sector provides not only a large number of

\(^{24}\) Environmental Systems Branch, Development Alternatives, op. cit. pp. 1.

\(^{25}\) Ibid, pp. 2
employment opportunities for rural unskilled illiterate and less educated workers but also enriches the economic growth of the country.

The limited efficiency in brick firing leads to high levels of PIC (product of incomplete combustion) emissions. In addition to these emissions from combustion, the life cycle of brick making involves significant fugitive emissions. In India, after the introduction of Bull's Trench Kilns (BTK) in the late 19th century, there was no significant improvement in brick firing practices until the mid-1990s. In 1996, the Government of India has set-up emission standards for brick kilns. These regulations have brought about some technological improvement in the brick industrial sector (mainly in large brick industrial units). In addition to reductions in emission, the regulations have resulted in some fuel savings. The brick making process usually start around about 20-40 days before the actual firing of the kiln. This is done to build up a decent stockpile of dried green bricks for continuous operation of the brick kiln. The firing up process of the brick kiln takes 10-20 days to make the kiln reach its appropriate temperature for the bricks to solidify and acquire its pre requisite fired brick attributes. The entire process is continual and once the firing is initiated, very rarely is the kiln operation course halted.

2.2.3. BRICK UNITS IN THE BARAK VALLEY

According to Pollution Control Board, Regional Office, Silchar, Cachar, Assam, there are 182 brick units in the Barak Valley as on 26th February, 2013, comprising 117 brick units in Cachar District, 39 in Karimganj District and 26 in Hailakandi District (Annexure-5). But as per Office of the DI&CC, out of 182 brick kiln units, only 28 were registered under DI&CC in the Barak Valley as in February, 2012 (Annexure-3). It may be mentioned here that the registration of brick units is not mandatory for setting up the unit and commencement of the production, but permission from the Pollution Control Board and license from the District Factory Office, Government of Assam, Cachar, Karimganj and Hailakandi District, are mandatory before commencement of production process in the unit.

2.2.4. ENVIRONMENTAL IMPACT IN BRICK PRODUCTION

Brick manufacturing industrial sector use energy intensive, resource depleting and highly polluting technologies and production methods. In India, most of the processes deployed in brick producing are with low inputs of technology and archaic techniques. This industry is responsible for different types of pollution viz. soil, air, and water resulting in environmental imbalance in the society. 28

28. Environmental Systems Branch, Development Alternatives, op. cit. pp. 2
2.2.5. CONSUMPTION OF FUEL AND ENERGY UTILIZATION IN BRICK INDUSTRY

The principal fuel consumed for energy in brick industry is Coal. It is observed from the field survey that there are two types of brick kilns in the Barak Valley such as Clamp (Bangla Battas) and Bull’s Trench Kilns (BTKs). A few units within the cluster or clamp use sawdust / wood along with coal for the firing of bricks in the Barak Valley. Electric power is not used in the brick producing process, although it is used for lighting purpose in the night in brick units.

Brick industry is included in the unorganized sector of the economy. More than 100,000 brick kilns set-up across rural and semi-urban areas and produce bricks under small and medium scale of production in the country. Brick making is a highly energy intensive process, in case of coal consumption in brick industry, 18 tons of coal require. For producing one lakh bricks, an average consumption of coal is 18 tons. This brick industry consumes 24 million tons of coal approximately every year that is approximately 8 per cent of the total coal consumption for different purposes in India. Moreover, this industrial sector consumes several million tons of biomass fuels. The share of energy in total cost of brick production is 35 per cent to 50 per cent. This consumption of coal and biomass is responsible for environmental pollution.\(^{29}\)

\(^{29}\) Ibid, pp.2
2.2.6. RESOURCE UTILIZATION

The environmental pollution in the brick industrial sector has been exacerbated by cheap access to resources such as soil, water, coal, biomass and labour. This results in irreversible environmental damage in terms of depletion of top soil, water and coal. Utilization of resources in brick industry is mostly inadequate as the raw materials needed in brick production are not used extensively and at the same time also leads to environmental degradation. The top layer of the soil gets depleted which makes the land infertile for agricultural purposes. Also the other raw materials like water and coal being used in huge quantities leads to further environmental degradation.

2.2.6.1. Soil

Soil is the primary raw material for brick making; consumption of soil in brick industry requires huge amount for its ultimate production. The kiln itself occupies considerable land which is subjected to high temperature making, and unfit for agriculture in future (after the site is abandoned). The industrial unit set up in non-agricultural land and non-residential area where the soil for brick making is available. The employer of the unit occupies considerable land for soil and making of brick within their campus. Thus, the fast depletion of arable land caused due to brick making is a matter of grave concern in our country. Addressing this issue, utilization

30. Ibid, pp. 2
of fly ash by all kilns within 100 km radius from thermal power plants has been made mandatory.\textsuperscript{31}

2.2.6.2. Water

Brick industry uses considerable amount of water for its production. Nowadays, there is an arrangement made for considerable amount of water within the campus of industrial unit, so that the unit can continue with uninterrupted work in the entire season of its production processes. There is no scarcity of water in the brick units in this Valley. So, water utilization is not regulated by Local Government authorities.\textsuperscript{32} Water pump machine is also used in almost all the brick units in brick manufacturing process and spraying water to control dust in the unit created in the operation in brick kilns in Barak Valley.

2.2.6.3. Coal

Coal is a valuable national resource. The brick sector consumes it for its production purposes. The use of coal is a prime fuel for burning of green brick / sun fired brick, it is ingredient of fuel for burning of green bricks in the Barak Valley. The complete dependence on Meghalaya, an adjoining state for supply of coal poses a serious threat in the production process as maintaining a reasonable quantity of coal is a pre-condition for uninterrupted burning of bricks. The road transport on which the supply of coal is solely dependent often plays truant, forcing the manufacturers to go for maintaining a stock of sufficient quantity of coal even before the commencement of production. Availability of coal in the state would have wiped out the crisis of fuel

\textsuperscript{31} Ibid. pp. 2
\textsuperscript{32} Ibid, pp. 2
in the industrial unit. Using of wood as a component of fuel in the brick unit is stopped by the issue of a ban order by the Ministry of Environment and Forest, Government of India. For smooth operation of the unit, slack coal is an important raw material for this industry.

2.2.7. POTENTIAL SOURCE OF AIR POLLUTION

The brick industry uses sub-grade coal due to unabated increase in the price of coal and higher costs of transportation. The low quality of coal (low calorific value) increases the consumption rate. This factor added with the inefficient combustion technologies cause high level of air pollution. While the emission standard for Suspended Particulate Matter (SPM) is 750 mg/Nm$^3$ to 1000 mg/Nm$^3$, the actual emissions from existing technologies range from 600 mg/Nm$^3$ to 1770 mg/Nm$^3$. The high level of suspended particulate matter thrown out by the kilns causes damage to property and crops.\textsuperscript{33} The Table No. 2.2.1 shows the average consumption of coal and stake emission in different types of brick kiln units.

\textsuperscript{33} Ibid, pp. 3
Table No. 2.2.1

Comparison of Various Traditional Brick Making Technologies

<table>
<thead>
<tr>
<th>Type of Kilns</th>
<th>Production Capacity (lakh bricks/year) of Different Type of Kilns</th>
<th>Coal consumption (tones per lakh of bricks production)</th>
<th>Stack Emission (mg/Nm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTK-Fixed Chimney</td>
<td>30-100</td>
<td>18</td>
<td>600</td>
</tr>
<tr>
<td>BTK-Moving Chimney</td>
<td>20-80</td>
<td>18</td>
<td>1770</td>
</tr>
<tr>
<td>High draft or zig-zag firing or down draft kiln</td>
<td>30-50</td>
<td>&lt;18</td>
<td>850</td>
</tr>
<tr>
<td>Clamps</td>
<td>0.5-10</td>
<td>&gt;18</td>
<td>Similar to movable chimney (not monitored)</td>
</tr>
</tbody>
</table>

High usage of coal as a fuel leads to considerable amount of Green House Gas (GHG) emissions. Except High Draft or Zig-Zag Firing or Down Draft Kilns all other three types of brick kilns are in operation in the Barak Valley.

2.2.8. CREATION OF DIFFERENT TYPES OF POLLUTANTS

The possible pollutants from Brick Industry are:

1. Carbon dioxide (CO₂).
2. Carbon monoxide (CO).
3. Sulphur dioxide (SO\textsubscript{2}).
4. Nitrogen Oxides (NO\textsubscript{x}).
5. Suspended Particulate Matter (SPM).

Apart from these, there is a problem of high volume of bottom ash as residue.\textsuperscript{34} The large quantity of coal is used for firing of bricks. The bottom ash obtained as a residue from combustion of coal causes air pollution. Some part of this bottom ash is used as an insulation material for the firing chamber, while the rest gets dispersed by wind and rain.\textsuperscript{35}

\section*{2.2.9. SOCIAL IMPACT IN BRICK INDUSTRY}

The social impact of brick manufacturing is basically related to workforce. There are two types of brick production on the basis of scale of production. Clamps which are having small production capacity are owned and operated by brick making people as a traditional occupation. Brick making people live in permanent settlements and earn their living through selling bricks. On the other hand, a large number of producers of Bull’s Trench Kilns (BTKs) employ workers on the contract basis in the unit. They are paid against completion of specific tasks such as moulding of 1000 bricks, transportation of 1000 green bricks, and carrying of 1000 sun-fired brick, unloading of fired brick from the kiln and loading of sun-fired bricks in the kiln etc. Some of the workers are generally internal migrated from one place / state to another.

\textsuperscript{35} Environmental Systems Branch, Development Alternatives, op. cit. pp. 3.
with their families. They live in make shift shelters in the campus of the unit and shelter is provided by the employer of firm.\textsuperscript{36}

2.2.10. EMPLOYMENT AND PAYMENT MECHANISM

The brick industry is seasonal so the workforce gets employment for a particular season (October to April) every year. During monsoons the production of this industry is closed down and labourers have to search alternative employment. Most of the labourers move out to agricultural fields. But on the advent of the next brick making season, there is no security of job for workers. They are paid wages on the basis of quantum. For different types of jobs, the rates are different in the brick industry.

2.2.11. TYPES OF BRICK KILNS

Brick kilns can be classified into three categories based on production capacity:

**Small Brick Kilns** which are having capacity of producing less than 1 million bricks yearly are known as clamp kilns and are located mainly in rural areas. **Medium Brick Kilns** have a capacity of producing in between 1 and 2.5 million bricks yearly. **Large Brick Kilns** have a capacity of producing more than 2.5 million bricks yearly. Medium and large kilns are of Bull’s trench kiln (BTK) type and are generally located near urban and more densely populated rural areas.\textsuperscript{37}

\textsuperscript{36} Ibid, pp.3-4
2.2.12. LOCATION OF PLANT AND MACHINERY

The minimum area of land for establishing a brick kiln unit should be such that after establishing plant and machinery and leaving sufficient space for material stock and movement of vehicles, enough space is available all around for planting at least two rows of trees, shrubs or bamboo along the periphery.\textsuperscript{38}

2.2.13. TECHNOLOGY INSTALLATION IN BRICK INDUSTRY

Nowadays, most of the brick producing units operate with natural draft within their chimneys. During the extreme hot summer season (March-June); the ambient air temperature is almost similar to the temperature of the flue gases within the chimney. Due to the low temperature gradient between the chimney flue-gases and ambient air, there is a significant loss of pressure and slow propagation of fire travel within the kiln heating areas. Installation of fan powered by an outside motor inside the chimney to raise the draft inside the firing area ensures substantial exhaust gases draft within the kiln operational areas.\textsuperscript{39}

The main technologies for brick manufacturing\textsuperscript{40} are as under:

- Fixed Chimney Bull’s Trench Kiln (FCBTK - India)
- Zig-zag Kiln (natural and forced draft - India)
- Vertical Shaft Brick Kiln (VSBK – India and Vietnam)

\textsuperscript{40} Maithel, Sameer., et al. \textit{Brick Kilns Performance Assessment, A Roadmap for Cleaner Brick Production in India, Monitoring of brick kilns & strategies for cleaner brick production in India}, A Shakti Sustainable Energy Foundation and Climate Works Foundation Supported Initiative, pp. III
2.2.14. VARIOUS SECTIONS OF BRICK UNITS

There are different sections of brick unit. All the sections of brick unit are equally important for production of bricks. The following are the some of the important sections of bricks unit:

1. Kiln-baked mixtures of clay;
2. Bricks making section;
3. Unfired bricks carrying section;
4. Unfired bricks loading & setting in the kiln;
5. Fire section;
6. Coal section;
7. Fired bricks unloading section;
8. Stock-at storage piles and bins;
9. despatch of bricks-loading and unloading of fired bricks;
10. Rubbish section;
11. Management section;

According to the field survey, it is clear that large number of workers/labourers are required in the making of bricks in the brick unit. In other sections, less number of workers are required. Workers are engaged on the basis of their skill and the requirement of the owner of the bricks unit. Of course, it is true that

41 Field Survey of Bricks Units of Cachar, Karimganj and Hailakandi District, as in February, 2013
the workers of fire section, loading of unfired bricks in the kiln and unloading of fired bricks from the kiln are always skilled and efficient. They are aware about their assignment and at the same time are also supervised properly by the owner of the unit. Workers are identified as well as classified as per their assignments and tasks. Workers are employed in the bricks firm according to the scale of production of the firm.

2.2.15. THE STATUS OF WORKERS OF BRICK INDUSTRY

According to the field study, it is clearly observed that a large number of workmen are required in the making of bricks in the brick industry.
It is revealed that the workers both male and female are engaged in bricks unit, but female workers are very limited in number. From the field survey, it is obviously clear that the brick industry uses coal, fire, clay, kiln and chimney to convert kucha soil (raw soil) etc. for production of bricks into hard dry fired bricks. As the bricks industry use fire and coal through chimney kiln and work is done by workers manually, so there may be a possibility of accident or injury to workers. Therefore, the researcher intends to study the happening of accidents, safety measures available and implemented by the owners or managers for safety and security at work place for the workers in brick industry. An idea is also mooted to know the compliance of the employers’ attitude towards the payment of compensation as per Workmen’s Compensation Act 1923. It has been observed from the field study that accidents or injuries occurred in the brick industry for which employer or manager maintains provisions of first-aid treatment within the campus of the brick firm. It is also noted that the workmen expressed their views that there is an arrangement from the part of the employer to provide medical treatment to the workers, if necessary during the working season. If the accidents or injuries are more fatal they send the workers to Govt. hospital and the cost of the medical treatment is provided by the employer. There is an arrangement for toilets and drinking water facilities for the workers in the campus of the industrial unit. The work force is paid on the basis of quantum of work and against completion of particular work as well as monthly salary basis. Operation processes are mostly manual and under present conditions the working schedule for the workers is mainly for dry season in between the months from October to April.
2.2.16. OCCUPATIONAL HEALTH HAZARDS / DISEASES CAUSED BY POLLUTION OF BRICK INDUSTRY

The area around the brick unit is constantly polluted by dusts and smoke that spread in the atmosphere, thus causing damages to the environment and lives of the residents living nearby. The brick units by emission of substantial quantity of dust and smoke are responsible for various types of health hazards and respiratory diseases to the workers of the units as well as surrounding population.

Brick making involves crude techniques causing considerable worker drudgery. Brick workers, especially moulders are exposed to the sun for long hours. They are exposed to high concentration of dust and smoke while they are engaged in manual breaking of coal. There is also the risk of exposure to dust (from bottom ash spread on the kin) and open fire during manual coal feeding. The workers have to walk on hot surface (top of the furnace) while monitoring and regulating the fire. They are also exposed to high concentrations of respirable suspended particulate matters (RSPM), during monitoring and regulating the fire, as the furnace chamber is covered with ash (ash acts as insulator). Generally 9 to 12 green and burnt bricks are carried at a time as head load. Carrying head loads on a regular basis causes health problems, especially in women.42

During the kiln unloading and shipping process it may produce a lot of dust and particulate matter pollutants that come from the surface of the bricks and have the same chemical components as brick itself. The kilns are a semi tight environment and

the average temperature in the kiln is higher than that outside the kiln. Work exposure to the high temperature and the high density dust and particulate matter over a long period of time can result in occupational health problems; including serious disease e.g. lung cancer. Brick kiln workers are exposed to dust particles and are susceptible to multiple pulmonary complications. Problems like asthma, chronic obstructive pulmonary symptoms, and silicosis are common diseases among brick-kiln workers.

Brick manufacturing plant uses many different raw materials and produces many intermediates, by-products and products. Among these, there are many substances potentially harmful to the health of brick kiln workers. Hazardous dust is one of the most important exposures in brick kiln workers who are suffering from various diseases such as eye problem, skin allergy, throat and lungs diseases due to living and inhaling in the polluted air in and around brick units.

2.2.17. CONCLUSION

From the field survey, it is found that 16 out of 20 number of the selected brick units installed single fixed chimney and remaining others are used double movable chimney (tin sheet) which are dangerous or harmful for the industrial activities. The height of the fixed chimney is 80 to 100 feet but height of the movable chimney is 30 to 40 feet, which is less than half the height of the fixed installed chimney, and this causes pollution and gives rise to occupational health hazards. Installation of movable (tin sheet) chimneys generates pollution. In this regard, Gauhati High Court has directed the Assam State Pollution Control Board to take steps to close down brick kilns which do not have its mandatory permission. The high
court, at the same time, has also cracked its whip on temporary industrial establishments manufacturing bricks using only tin sheet chimneys, which are not allowed by the pollution control board. Kamal Kalyan Dutta, member secretary of the board, said over phone from Guwahati that all the deputy commissioners in the state have been asked to take steps within a month to wind up the temporary tin-chimney kilns for the sake of environment. Thus it is observed that provisions and pollution control measures are implemented for the sake of protection of environment and health hazards of workers.

According to Pollution Control Board in Guwahati, the state has 912 permanent brick kilns, set up mostly on agricultural land and of these, 193 do not even have the necessary permission of the board to operate. As a result, several kiln units, the sources pointed out, have been daily contributing to pollution. Kamal Kalyan Dutta also said that the Barak Valley in South Assam has most of such tin sheet chimney kilns, numbering 62 as against 38 in the rest of the state. He said the pre-closure notice was already issued to all these brick units to wind up within a fortnight.

So, it is observed that close supervision, awareness and proper instructions lead to safety and security of the workers and also prevent and control the injuries or accidents of the workers. This also helps workers enrich their knowledge, attitude, behavior, skill and efficiency for their safety at work.

43. The Telegraph 10th Jan, 2013.
44. Ibid.
2.3. **PROFILE OF STONE CRUSHING INDUSTRY**

2.3.1. **INTRODUCTION**

Stone Crushing Industry is an important industrial sector in India involved in manufacturing crushed stone and chips of various sizes depending upon the requirement. These crushed stones are utilized as raw materials for various construction purposes such as construction of Roads, Highways, Bridges, Buildings, Canals, etc. It has been estimated that there are more than 12,000 stone crushing units in our country. The Stone Crushing Industrial Sector was estimated to have yearly turnover of Rs. 5000 crores and hence it is an economically important sector. This sector has been estimated to be providing direct and indirect employment of manpower to more than 500,000 people who work in different activities such as mining, crushing plant, transportation of mined stones and crushed products etc.\[45\]

The crushers are located nearer to the source raw material such as stone mines, river beds etc. This stone crushing industry by emission of substantial quantity of fine fugitive dust creates the problem of health hazards to the workers of the unit as well as surrounding population by way of causing respiratory diseases. The dust also adversely affects visibility, reduces production and growth of vegetation and hampers aesthetics of the locality. In order to prevent/control these emissions, Central Pollution Control Board has already evolved Emission Standards and guidelines in 1989, which has been notified under Environment (Protection) Act, 1986. Realizing the trend of pollution in various environmental media like air and water, soil etc.,

Government of India adopted multi-pronged strategies in the form of regulations, legislations, agreements, fiscal incentives and other measures to prevent and abate pollution.\textsuperscript{46}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image.jpg}
\caption{A Stone Crushing Unit, Udarband, Cachar District of Barak Valley, Assam, India}
\end{figure}

There are numerable types of stone and rock in nature. Most of these stones and rocks are used in construction and many other applications. Major rock types processed by the crushed stone industry include limestone, granite, dolomite, trap

\textsuperscript{46} Ibid, pp. 1.1-1.2.
rocks, sandstone, quartz, and quartzite. Minor types include calcareous marl, marble, shell, and slate. Major mineral types processed by the pulverized minerals industry, a subset of the crushed stone processing industry, include calcium carbonate, talc, and barite.  

2.3.2. TYPES OF STONE CRUSHING INDUSTRY

There are different types of stone crusher unit set up across the country depending upon geographical locations, requirement of the product, demand of the crushed stone, closeness to urban areas, type of raw material, availability of plant and machinery locally etc. Primarily the stone crusher industrial sector is divided into three categories. These are briefly discussed as under:

2.3.2.1. Small Size Stone Crushing Units

There are different types of small stone crushers which have been set up in the different states of the country for producing various sizes of stone chips. The small stone crushers generally have one Jaw type crusher which is used as primary or secondary crusher along with one or maximum 2 screens. These type of crushers are labour intensive as the big boulders first have to be broken manually to a size of 8 to 10 inches and then only can be sent to the crushers for fine chips.

2.3.2.2. Medium Size Stone Crushing Units

The unit is having more than one crusher such as one primary and one secondary or one/two primary and two secondary crushers along with one or more vibratory screens are categorized as medium size crusher unit. The mined stones are transported mostly by trucks/dumpers and unloaded in to elevated stone wells. The stones are fed by gravity to primary crushers. The Crushed stones are conveyed to vibratory screens. The screened products of various sizes are conveyed to stock piles by belt conveyors. The oversize is returned to secondary crushers for further crushing and back to the vibratory screen. These types of crushers are mostly located near to the bigger cities and in the vicinity of major construction projects such as Highways, Canals, Dams, etc. These crushing units are available in the States like Maharashtra, Andhra Pradesh, Tamil Nadu, Punjab, Haryana, Gujarat, Madhya Pradesh, Rajasthan, etc.

2.3.2.3. Large Size Stone Crushing Units

This unit is having two or more numbers comprising of primary, secondary and tertiary type of crushers with at least 2 or more vibratory screens with mechanized loading, unloading conveying operations. The large stone crushers are owned by bigger construction companies like L&T, Dodsal Construction, etc. which are engaged in their own large construction projects. These crushers generally have their own/leased open-cast stone mines and a fleet of mechanical mining equipment, trucks and dumpers, loaders etc. The unit invests a large amount of capital and mostly
operate round the clock. All conveying operations are done through proper belt conveyors.

2.3.3. STONE CRUSHING UNITS IN THE BARAK VALLEY

According to Pollution Control Board, Regional Office Silchar, Cachar, Assam, there are 94 stone crushing units in Barak Valley as on 26th February, 2013, comprising 63 stone crushing units in Cachar District, 27 in Karimganj District and 04 in Hailakandi District (Annexure–6). While 60 stone crushing units are registered in Barak Valley as per the report of District Industry and Commerce Centre (DICC) of three districts as in March, 2012. Out of these 14 units are situated in Karimganj District, 02 in Hailakandi District and 44 in Cachar District (Annexure–4). It is observed that the registration of stone crushing units is mandatory for getting loan from subsidized scheme by the banks / financial institutions. Permission from the Pollution Control Board and license from the District Factory Office, Government of Assam, Cachar, Karimganj and Hailakandi District, are mandatory before commencement of production process in the unit.

2.3.4. OPERATIONS AND TECHNOLOGIES OF STONE CRUSHING UNITS

The different unit operations and technologies of stone crushers49 are briefly described as follows:

2.3.4.1. Crushing Technologies

Various types of crushers are used in the stone crushing industry such as Jaw Crushers, Roller Crushers, Cone Crushers, Impactor, and Rotopactor etc. Generally, primary crushers are only Jaw Crushers. The secondary and tertiary crushers are either of Jaw, Cone, Roller, Impactor or Rotopactor crushers. In Barak Valley in all the units Jaw Crushers are used.

2.3.4.2. Screening Technologies

There are two types of Screening:

(i) Coarse screening is achieved through Grizzlies, Vibratory screens, Revolving screens or Shaking screens.

(ii) Fine screening is achieved through vibrating screens, shaking screens.

2.3.4.3. Material Handling Technologies

Several types of material handling technologies are used in the stone crushing industry for the purpose of moving the stones from one to other equipment. These are used from the point of raw material unloading up to stock piling of the products. Primarily, almost all crushers use feeders and conveyors for handling materials.

2.3.5. RAW MATERIALS, TYPES OF RAW MATERIALS AND SUPPLY ZONES

Raw stone can be purchased directly from the quarry lease holder. Owner of crushing unit may hold or occupy his own quarry lease to produce raw stone. It is beneficiary to obtain a quarry lease holding for solving crisis of raw stone and avoid
any possible threat in procuring raw stone. Owner of the crushing unit can gain more and to keep the project economically stable.\textsuperscript{50}

Various types of raw materials are used in stone crushing unit such as Granite, Black Trap, River Bed Pebbles, Semi Grade Stone, and Soft Rock etc. which are available in different geographical locations and as per the demand of the requirements. The type of material depends on the colour, hardness, inherent moisture content etc. The supply zones for the different types of raw materials are local hillocks, open-cast mines, river bed, cliffs and other miscellaneous sources. Sources of raw materials of small size stone crushing units are from the supply zones like local hillocks, river bed and other miscellaneous sources. Medium and large size stone crushing units are having permanent type set up source for their raw materials either from leased or owned open cast mines. The depth of open cast mines is quite common up to 80 to 90 meter. Overburden is removed from the mine top layers and stacked along periphery of mined area.\textsuperscript{51}

2.3.6. STONE CRUSHING PROCESS AND STONE CRUSHING PLANT IN INDIA

The main machinery involved in the stone crushing industry is Hammer Crusher, Screen, Conveyers, etc. Rock and crushed stone products generally are produced by drilling and blasting, and then the materials are conveyed to the processing operations. Techniques used for extraction differ due to the property and


\textsuperscript{51} Comprehensive Industry Document Series. op. cit. pp. 2.12.
location of the deposit. The rock and stone processing comprises of crushing, grinding, screening, size, classification, material handlings and storage processes. There are mainly three categories of stone crushing which are primary crushing, secondary crushing and tertiary crushing. The machinery involved in processing of the stone crushing units are jaw crusher, impact crusher, hammer crusher, cone crusher, mobile crusher, and some auxiliary plants of vibrating screen, vibrating feeder, belt conveyor etc. The newly designed sand making machine is called vertical shaft impact crusher which is a perfect stone crushing plant. The crushed stone is screened to separate the produce in different sizes by the separator. The crushed stone is conveyed by the conveyors to trucks for transport to the market place or storage area.

A Stone Crusher Unit, Karimganj District of Barak Valley, Assam, India

2.3.7. PROCESSING DESCRIPTION OF STONE CRUSHING UNITS

The raw materials viz. black stone from the mines consists of stones of different sizes from fines to big boulders. It is unloaded into the primary crusher. The material is fed to the primary crusher via feeder. After primary crushing, the material is conveyed to the hopper of the secondary crusher by belt conveyor. The material is further crushed and transferred to the screen for first screening. The ‘oversize’ from this screen goes to the tertiary crusher for crushing the stone. The crushed material goes to the primary screen via the same belt conveyor which used to transfer the secondary crusher material. The products are discharged from the screen via conveyor belts to various stockpiles from which the product is loaded into the trucks with the help of loaders.¶53

The major responsibility of stone crushing process is to crush the big size stone boulders into different sizes of crushed stones depending upon the demand of requirements. The important stages involved in stone crushing activity are primary crushing, screening, secondary or tertiary crushing, screening, conveyance, storage of raw boulders and crushed stone and transportation of crushed stones. The raw stone boulders are obtained from mining of the stone from quarries and hand picking etc.

2.3.8. TYPICAL PROCESS OF STONE CRUSHING UNITS

Chart No. 2.3.1

The typical process of stone crushing units is exhibited in the chart 2.3.1.

Mined Stone → Transportation to Crusher Site → Raw Material Hopper → Primary Crusher → Tertiary Crusher - Primary Vibratory Screen - Secondary Crusher - Secondary Vibratory Screen - Products to Stockpiles - Products to Stockpiles → Transportation to user end.

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2.3.9. EMISSIONS FROM STONE CRUSHING INDUSTRY

The sources of emission during the stone processing\textsuperscript{55} are given below:

2.3.9.1. Emissions during mining activity

Fugitive emissions are generated during various mining activities such as drilling, blasting, excavation, breaking and loading etc.

2.3.9.2. Emissions during transportation

During transportation of mined stones by heavy vehicles like tailors, trucks, dumpers, fugitive dust emission occur due to movement of heavy vehicles on earthen roads.

2.3.9.3. Emissions during Stone crushing operation

During crushing operation, emissions are generated inherent and most apparent at crusher feed and discharge points. The greater the reduction in size during subsequent crushing stages from primary, secondary to tertiary crushing, the higher the emissions.

2.3.9.4. Emissions during screening

Forceful movement of the crushed stones in the screening process releases fine dust, this dust gets air borne as fugitive dust emissions. The released dust particles escape from the openings around the screen as well as from the bottom of discharge

\textsuperscript{55} Ibid, PP. 26-27.
locations. The screening of fine dusts produces higher emissions than the screening of coarse sizes.

2.3.9.5. Emissions during material handling

In the materials handling section, several handling devices such as feeders, belt conveyors, bucket elevators and screw conveyors are used to transport crushed materials from one point to another. Particulates may be emitted from any of the material handling operations.

2.3.10. VARIOUS SECTIONS OF STONE CRUSHING INDUSTRY

There are different sections of stone crushing industry. All the sections of stone crushing industry are equally important for crushing of different sizes of stones. It has been studied that the following sections\textsuperscript{56} are very vital in the stone crushing unit for its manufacturing:

1. Management section;
2. Operation section;
3. Boulders unloading and storage;
4. Storage piles and bins;
5. Broken stones loading and dispatch, etc.

According to the survey, it is clear that the limited number of workers/labourers is required in the stone crushing unit for production. Nowadays,

\textsuperscript{56} Field survey of stone crushing units of Karimganj and Hailakandi Districts, as in February & March, 2013
most of the stone crushing units are automatic running system of crushing machine and using excavator cum loader (pay loader) of various companies like L&T, TATA and JCB etc. for the purpose of production activities. As a result, physical work of the workers is quantitatively less. Using of excavator cum loader (pay-loader) in stone crushing industry is not only reduction of risk & accident but also smooth & speedy work of the industry and hence maximum production is possible. Excavator cum loader (pay-loader) is being used for both loading of stones, shifting & carrying of stones and directly linked with dump of the stone crushing unit. In this context, workers are identified as well as classified as per their assignment and task. Workers are employed in the stone crushing unit according to the scale of production of the unit.

2.3.11. HEALTH HAZARDS / DISEASES CAUSED BY POLLUTION OF STONE CRUSHERS

The area around the stone crusher is constantly polluted by dusts that spread in the atmosphere, thus causing damages to the environment and the resident’s lives nearby. The stone crusher by emission of substantial quantity of fine fugitive dust creates and causes the diseases / health hazards to the workers of the unit as well as surrounding population by source of causing respiratory diseases. The residents of the area and specifically the labourers working in the units are suffering from various diseases such as skin allergy, throat and lungs diseases due to living and inhaling in the polluted air by stone crushing. Although laws addressing environmental problems specifically for labour health protection exist; its effective functioning seems to be absent.
The stone crushing units are involved in manufacturing of different sizes of broken stone as per the requirement of the different constructions like roads, bridges, building, etc. As a consequence, the stone crushing units create dusts, gases, heat, emission and pollution. There are a number of sources from which high pollution level is generated, some continuously and some intermittently. Due to different functions of stone crushing units, noise levels have been a matter of concern. To regulate and control noise pollution, the Government has issued various notifications under the Environment (Protection) Act, 1986. The vibratory screen of the stone crushing industry is the most predominant way of continuous noise. Especially vibratory screens are operated at higher frequency and without enclosures can give rise to abnormally high noise levels. Intermittent noise level is also generated at the crusher during the time of the breaking of stones. Intermittent noise is also generated during un-loading and loading operations. Belt conveyor movement of the stone crusher is also a source of continuous noise, particularly the poor-maintained and cheaper end conveyor system of the unit create high noise. There are two principal causes of pollution:

- Population Growth, &
- Industrialisation.

2.3.12. CONCLUSION

Stone crushing industry is an unorganized sector which is directly involved for production and manufacturing of different sizes of broken stones and chips in our country. Most of the workers are from rural and economically backward regions where employment opportunities are very limited. It is a way of survival and earning
for uneducated poor unskilled rural people. Stone crusher needs electricity for its operation and production. It also needs access to roads for the movement of mined stone as well as crushed stone products. It is observed that this industry is basically based on automatic operation system of crushing machine and seasonal activities of production. Limited number of workers are working in each unit in Barak Valley due to installation of pay-loader/excavator cum loader.