https://doi.org/10.20896/saci.v10i2.1279

RESEARCH OPEN ACCESS

# Environmental and Social Effects of Stone Quarrying in Bangladesh: A Study in the Khasi People Area in Sylhet

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**Abstract**

This study investigates how the unregulated and unscientific manner of stone quarrying in Bangladesh degrades the environment and affects the life and livelihoods of the local people. The recent countrywide construction boom and infrastructural development kept the GDP growth constant in Bangladesh. This construction boom generates colossal demand for stones, and the Sylhet region is its major supplier. Although there are laws and legal mechanisms to regulate stone quarrying in the country, the miners do not follow these. This study found that the local Khasi people of the stone quarrying area have been experiencing systematic and forcible dispossession due to merging their lands into stone quarrying sites. These people are the victims of different forms of pollution due to unregulated stone quarrying. And the area has been experiencing a social transformation because of the settling of the people of the mainstream Bengali community from the poverty porn areas of the country to sustain their life by managing their livelihoods by working in the stone quarries. The study also explores how the lack of monitoring and corruption of the state and non-state actors in the stone quarrying sectors degraded the environment and transformed society in the last decades.

**Keywords**: Unregulated Stone Quarrying; Environmental Degradation; Khasi People; Sylhet Region; Bangladesh.

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## Introduction

Bangladesh is called an 'emerging Asian tiger' for its economic strength in maintaining a high GDP growth rate in the last decades (Hossain, 2018). The economy of Bangladesh has done well by any standard (World Bank, 2016). As the fastest growing economy in the world (World Bank, 2019), Bangladesh faces a couple of challenges to development. Among these, the challenge of infrastructure development is the most important. Bangladesh needs to improve its infrastructure to keep this constant economic growth.

Nevertheless, the country achieved a remarkable improvement in infrastructural development, including the construction and improvement of roads and highways, bridges, tunnels, building structures and river embankments in the last few decades. The infrastructure can help Bangladesh to accelerate and sustain its growth (World Bank, 2016). Urbanisation and growth go together in Bangladesh. The country has been urbanised rapidly. The construction of urban structures is a prominent aspect of urban development (Haghshenas et al., 2022). The foremost raw material of these infrastructures is stone. The government declared stone quarries in different districts to supply stones to keep moving the vehicle of infrastructural development countrywide. Although these stone quarrying sites have an essential role, to ensure the increased supply of stones to the development sector, stone quarrying has become a threat to the environment and the social system. These stone quarries have a remarkable contribution to development; however, nobody denies their adverse environmental and socio-economic effects (Lad and Samant 2013; Ardejani et al., 2022). The effect of stone quarrying in Bangladesh is a topical subject in the fields of development studies, geography, environment and social science. Among different stone quarrying sites, the situation of Jaflong in Sylhet is more vulnerable to environmental and social effects. The Jaflong area is known as the Khasi people area. The Khasi people simultaneously experience marginalisation and environmental degradation (Hoque, 2018). This qualitative study investigates the environmental and social effects of stone quarrying in the Khasi people area in Sylhet, Bangladesh.

The study begins with a brief description of the study area, outlining its aims and objectives, followed by a description of the methods deployed. It then critically discusses the research findings demonstrating how the stone quarrying process has impacted the study area's Khasi people, pushing them further to the brink of vulnerability.

## Study area

Sylhet district is located between 24.8917°N and 91.8833°E in the north-eastern part of Bangladesh (Figure 1). There are four districts in the Sylhet division — Sylhet, Moulvibazar, Habiganj and Sunamganj. Among the four districts, Sylhet is unique for its massive stock of stones. It is the major supplier of stones in Bangladesh. This area covers 75 per cent of the stone supply throughout the country (Khan, 2009a, 2009b).

Along with the stock of natural resources, Sylhet is one of Bangladesh's most important destinations for tourists from home and abroad. There are many natural attractions in Sylhet. These include *Lalakhal, Sadapathar, Bichhanakandi, Lawacherra National Park, Sathchari National Park, Madabkunda Waterfall, hundreds of Tea Gardens, Tanguar Haor, Hakaluki Haor, Ratargul Swamp Forest, Sripur*and *Jaflong*. Among these, Jaflong is a unique place famous for both natural resources and beauty. However, the natural beauties of Jaflong are under threat and systematic destruction by unregulated stone extraction for the last two decades (Al-mahmood, 2009; Hoque, 2017, 2018, 2019). Hills, water bodies and river basins make this area distinctive from the other parts of the country. This study takes the Jaflong area of Sylhet as a case to investigate the research question (Figure 2). This area is known as a hill station and an area for stone quarrying in Bangladesh, also known as the

home of the Khasi ethnic people. Currently, the environment and the life and livelihoods of the Khasi people are at risk due to stone quarrying. On the contrary, the Bengali people have migrated here from poverty-prone areas of the country to sustain their life by working in the stone quarries.

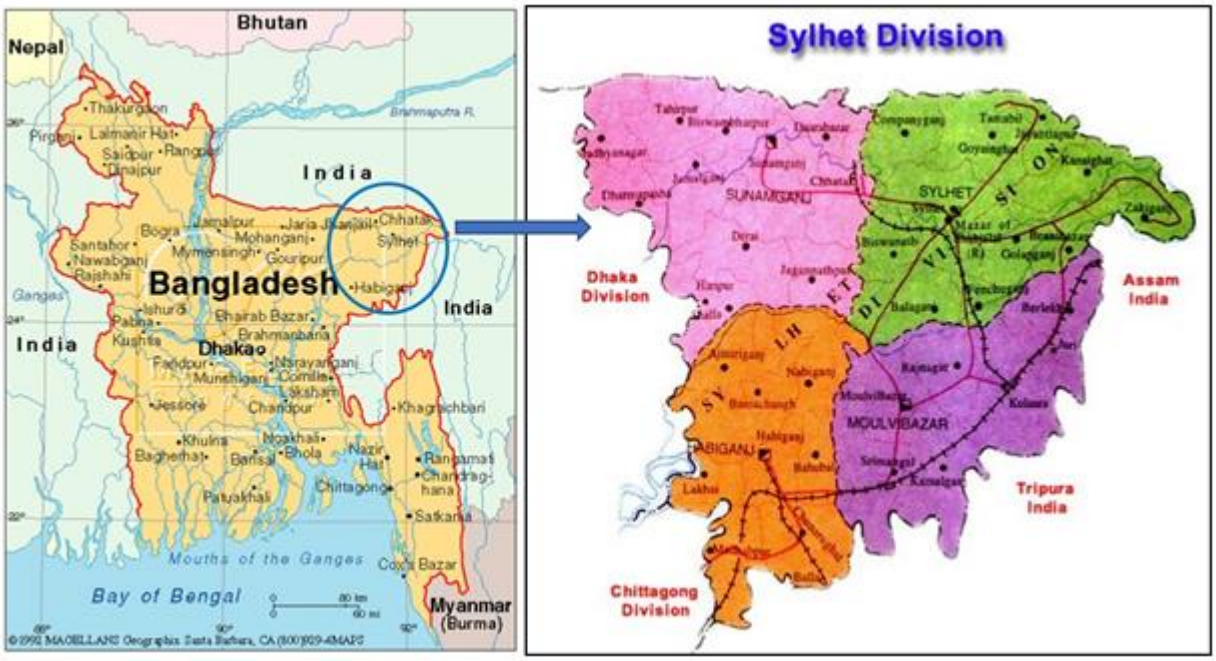


**Figure 1: Map of the Sylhet region and its location in Bangladesh (Hoque, 2018).**

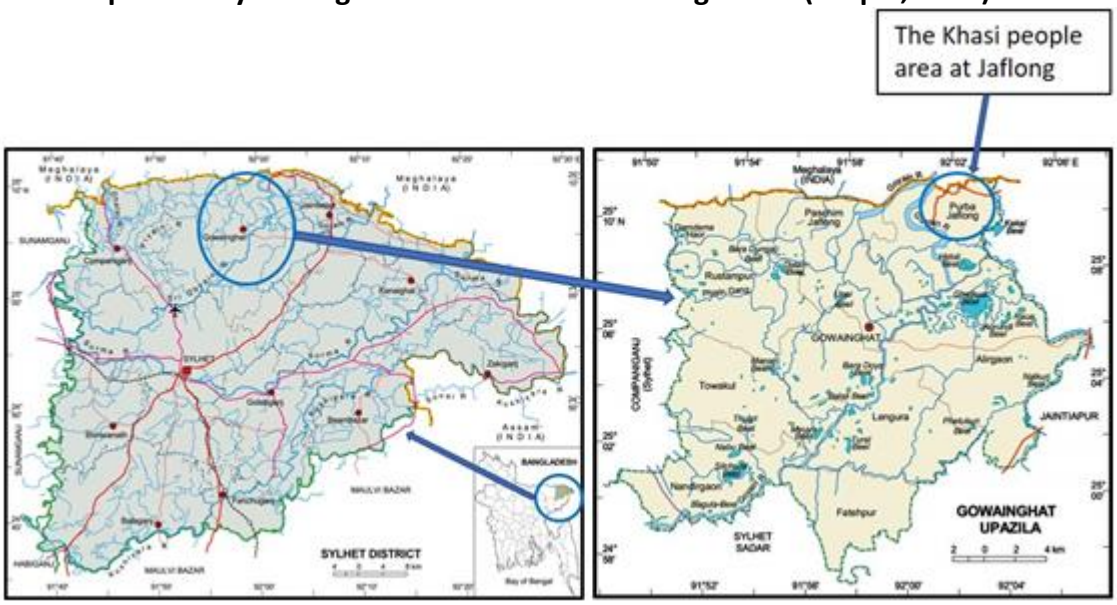


**Figure 2: The Khasi Punjis at the Jaflong Area at Gowainghat Upazila in Sylhet (Hoque, 2018).**

**Objectives of the study**

This study aims to investigate how stone quarrying affects the environment and social system to pursue the following objectives:

- To look into the actors and factors behind the stone quarrying at the Jaflong;
- To investigate how the stone quarries pollute the environment;
- To explore how the social system has been changed by stone quarrying; and
- To propose how one can minimise the harmful effects of stone

quarrying on the environmental and social system of the study area.

**Research question**

***Central research question (CRQ)***

How and to what extent does stone quarrying affect the environment and social system?

***Research sub-questions (RSQ)***

- How does the environment become vulnerable due to stone quarries?
- How does the operation of stone quarries affect the social system?

**Methodology and methods**

***Research methodology***

This study is qualitative. It takes an exploratory approach to social research to investigate the environmental and social effects of unregulated stone quarrying at the Jaflong in Sylhet, Bangladesh.

***Unit of observation and unit of analysis***

The unit of observation and unit of analysis are two forms of measurement (Blalock, 1972). The unit of observation in this project is the 'individual' who directly or indirectly involves the stone quarrying sector as well as who is affected by this sector at the Jaflong. Another unit of observation is 'event', which is related to the processes of environmental and social changes in the stone quarrying sites of the Jaflong area in Sylhet, Bangladesh.

Moreover, a unit of analysis can be an individual, group or even an entire community (Trochim, 2006). In this context, the unit of analysis in this research follows two levels of analysis. First, the 'individual' who is directly or indirectly involved in the stone quarrying as well as who is affected by the stone quarrying in the study area. This level is the most commonly used unit of analysis in social science research (Babbie, 2001). Second, the event relating to the processes of environmental and social change is considered a single entity for the unit of analysis.

**Sources of data**

***Primary sources of data***

The primary sources of data in the case of this study range from in-depth interviewing the local people and people involved with stone quarries to interviewing government officials, social and political leaders, human rights activists and environmentalists. The observation of different events at the stone quarrying sites is also a source of primary data.

***Secondary sources of data***

Secondary data include government policy documents, notifications and reports, laws and acts, previous study reports, datasets, census reports and reports of international organisations and donor agencies for this research project. The validity and reliability of data are maintained through cross-checking.

***Sampling***

This study selected the men and women from the study area as key respondents (15 from the Khasi community[1] and 15 from the mainstream/settler Bengali community[2]). Purposive sampling which is known as judgmental sampling too (Marshall, 1996) is used to select the respondents.

**Methods of data collection**

This study used qualitative methods of data collection. It includes in-depth interviews with the local people, people involved with stone quarries, and interviewing government officials, social and political leaders, human rights activists and environmentalists.

***In-depth and unstructured interview***

An in-depth interview is a useful qualitative data collection technique (Guion et al., 2011). This study used in-depth interviews to understand the experiences of the Khasi people at a holistic level. It not only helps to capture the 'language'

[1]Around 3000 Khasi people live in the five punjis in Jaflong area.

[2] 50,891 people live at East Jaflong Union and 43,776 people live at West Jaflong Union. However, around 7000 Bengali people live in the quarrying area of Jaflong.

of respondents but also allows us to understand the 'behaviour' of the respondents (Maykut et al., 1994). The informal conversational interview is used as a tool to know their experiences with environmental and social changes and how these changes play a role in generating threats to the local area. A basic checklist of questions is prepared to use in interviews to ensure that no topic is uncovered. In addition, an open-ended questionnaire is used in interviewing the selected respondents. The standardised open-ended interview allows the respondents to express their views comprehensively and independently.

**Stone quarrying process**

The term 'quarry' is interchangeably used with 'surface mine', 'opencast mine', 'pit' or 'open-pit.' National Geographic Encyclopaedia states that a quarry is a "place where rocks, sand, or minerals are extracted from the surface of the earth" (National Geographic, no date). Sometimes 'quarry' is used interchangeably with 'mine.' However, the quarry and mine are entirely different. This is because quarry indicates extracting something from the ground to produce materials for construction, but a mine refers to extracting minerals to produce metals or coal. The quarry is a term mainly related to excavating stones from sources to extract for use in construction. However, quarry also refers to excavating rock, sand, gravel, and slate from the ground. Quarry usually indicates open cast excavation (Lad and Samant , 2014).

Quarrying is a process of excavating hard or soft rocks/stones, which are relatively massive and deep deposits of hard or soft rocks (Coppin and Bradshaw, 1982). Cambridge Dictionary states that a quarry is "a large artificial hole in the ground where stone, sand, etc. is dug for use as building materials like granite, limestone, marble, slate" (Cambridge Dictionary, no date). The Institute of Quarrying (IQ) takes the term 'quarry' into a broader concept. This organisation prefers to use the term 'process' rather than the 'static' concept. IQ states that quarrying is the process of removing minerals like rock, sand, gravel, etc. from the ground for using different purposes e.g. producing materials for construction or other uses.

According to IQ, the 'quarrying' process has eight steps or stages. These are (Institute of Quarrying, 2020):

- Stage 1: create a plan to map;
- Stage 2: remove the top layer of material;
- Stage 3: drill holes;
- Stage 4: transport materials for processing;
- Stage 5: a. process materials using crushing; and b. add extra value to processed material;
- Stage 6: transport finished products;
- Stage 7: products used to create sustainable solutions; and
- Stage 8: products recycled or re-used.

**Findings and Discussion**

***State of stone quarrying in Sylhet, Bangladesh***

There was a huge stock of stones in Sylhet, Bangladesh, for centuries (Hoque, 2018). Stone quarrying on the rivers and streams at the Jaflong area in Sylhet was instigated after the beginning of the Second World War, for instance, in the late 1940s (Khoda, 2007). However, the newly formed government of Bangladesh after the independence of Bangladesh in 1971 declared the 188.70 ha area at Jaflong as a stone quarrying site in 1980. A high volume of turbulent water flows during the monsoon (June to October) and carries stones in the two transboundary rivers Piyain and Dawki. In the beginning, stones were mined merely during the monsoon. The stone miners used *Barkees* (small boat), *Belcha* (spade), *Chaluni* (sieve) and buckets to collect the stones from the rivers' bodies. They stocked the collected stones on the banks of these two rivers. These stocked stones were carried by small trucks and tractors to different regions of Bangladesh. This manual quarrying did not affect the natural flow of water. The crystal-clear water of these two rivers and different colours of naturally laid stones, the

diversified lifestyle of the local Khasi people and the natural beauty of the hills attract millions of tourists from home and abroad every year.

The rivers become stagnant due to a lack of water flow from the highland during the drought season (November to May). So, the miners did not mine the stones from this area during this season. The stocked stones on the bank of the river were transported throughout the country in the winter that is in the drought season. Tourists from home and abroad prefer the drought season to visit this area to avoid heavy rains and tropical storms of the monsoon.

Indeed, the countrywide demand for the stones for infrastructural development pushes (or pulls) the miners to continue the quarrying around the year. Since the 1990s, the stone miners did not follow a sustainable manner to quarry the stones from this site. They instigated their own invented mechanised stone quarrying in Jaflong in the 1990s. For instance, during the drought season, the miners excavate stones from the ground of the river bed and its adjacent lands in an unscientific and unplanned manner.

The government permits the extraction of the stones manually from two rivers called Piyain and Dawki. As already stated above, in the beginning, stones were collected manually using *Barkees* (small boat), *Belcha* (spade), *Chaluni* (sieve) and buckets. However, this study found that this practice is rare at Jaflong due to instigating industrial quarrying. The miners use locally invented shallow machines which are known as *booma machines* to dig the river banks, hills, and hillocks from 60 to 70 feet off the ground. *Booma Machine*is used to excavate stones from the ground. These machinesare locally invented, which work like dredgers. The machines generate heavy sounds like bombing during the excavating of stones. Therefore, these machines are called *Booma Machines* in Bengali. The Bengali meaning of bomb is *booma.* These machines are very harmful to the ecology and environment (Dev, 2014). The miners use locally known to dig the river beds and banks of the two sides to excavate stones. Not only from the river beds and banks, but also they dig the hills and hillocks of Jaflong to excavate stones from the ground. The massive demand for the stones and the enormous profit-making mentality of stone miners resulted in mechanised stone quarrying twenty-four hours a day and seven days a week.

At first, extracted stones in both forms are carried by a small boat or small truck/tractor to stockpile for crushing. The extracted stones are measured to pay the wage to labour and revenue to the government before transporting for stockpiling to crush. The crushing plants make the stone chips for constructing roads, bridges, buildings and other structures. Then, the stone ships are loaded on the truck to transport throughout the country.

Beyond quarrying the stones, the traders illegally set up hundreds of stone crushers in this area. They operate these stone crusher plants round the clock. Thousands of people from different parts of the country are employed in the Jaflong area's stone mining and crushing sector. These people are mainly from those areas affected by river erosion, flood-prone, and jobless from various parts of the country who moved to this area to sustain their life based on the Jaflong's stone quarrying and crushing industry. In a few months, they permanently settle in this area and bring other family members and relatives to migrate there. This internal migration based on stone quarrying has a massive effect on this area's environmental and social systems.

### *Effects of stone quarrying*

The environment of the Jaflong area in Sylhet is in critical condition due to air and noise pollution from the stone quarries (The Business Standard, 2020). However, quarrying has social, economic and environmental impacts (Lad R. J.; Samant J. S., 2013; Hajkazemiha et al., 2021). The miners have a concern to minimise the effects of quarrying at level best. The administration should also sincerely monitor the operation of the stone quarries. But the current scenarios of the Jaflong area seem that the miners do not follow minimum health and safety and environmental rules and regulations during the extraction and crushing of stones in this area. There are at least 200 quarries surrounded by five Khasi *punjis* (Khasi Villages) Sengram, Nakshia, Borla, Lama and Protappur in the

Jaflong area (Islam, 2018). About 3000 Khasi people of these five *punjis* have been directly affected by quarrying activities. This unrestrained stone quarrying in the Sylhet region is going unabated (Jasim, 2020).

The local people have been suffering from air, water and noise pollution for the last decades. The extraction of stones using *booma machines* causes landslides and river erosion there. The entire land of a punji called old *Sengram* had been merged with the river due to digging the area using *booma machines* to extract stones from the ground. The bed and banks of both rivers of Piyain and Dawki have been dug by the miners in the last few decades. This unplanned and unscientific extraction of stones caused the shifting of the flow of water in both rivers.

Beyond this, the water of these rivers has become polluted due to disposal of wastes of the *booma machines.* Besides, linkages of diesel and burned mobile oil used as fuel, fordigging several ditches on the river beds and banks to extract the stones, throwing of stone dust emitting from the stone crushers and garbage of migrated Bengali people. These two rivers are at threat of extinction due to illegal, unplanned and unrestrained stone mining. For this, these two rivers—Piyain and Dawki, were declared Ecologically Critical Area (ECA) in 2012 and 2015, respectively. Although the government banned extracting stones from these two rivers, the miners violated the conditions fixed for the excavation.

The miners cut the extracted stones to make chips for use in the construction. The miners excavate different sizes of stones from the ground and rivers. These primarily extracted stones are not feasible to use as composite materials in construction because of their sizes. Sometimes the primarily extracted big stones are used on the rivers, lakes, haor and coast embankment to protect the flood. The construction sector uses small size stones or stone chips. For this, extracted stones need to crush for converting into small sizes and chips. Therefore, stone crushing is an important part of the stone quarrying process.

The stone crushing process includes the following stages:

- Stage 1: Hammering of boulders to make them into smaller pieces;
- Stage 2: Slicing of the smaller pieces of stones by mechanised choppers;
- Stage 3: Sorting of chopped stones passing through into conveyor belts;
- Stage 4: Stacking of stone chips according to size; and
- Stage 5: Loading of stone chips on the truck to transport throughout the country.

There are 300 authorised and at least 250 illegal stone crushing plants in operation at the Jaflong(Hoque, 2018). These stone-crushing plants are set up on the riversides, roadsides, arable lands, hillocks, forest lands and *khas* lands (government abandoned land). These stone-crushing plants are being operated 24 hours a day and seven days a week. About 50 to 100 labours work in each stone-crushing plant based on its size. Among the stone-crushing labours, most of them are women. In addition, the stone-crushing sector employs uneducated poor, and unskilled rural people from different parts of the country. As stated above, these labours mainly come from flood-prone and river erosion areas of Bangladesh.

Land grabbing is another problem in the Jaflong area. The miners and stone traders grabbed government *Khas* lands, lands of the forest department and agricultural lands, and the local Khasi people's agricultural lands to excavate stones and set up stone crushers (Daily Star, 2019). The Khasi people of five *punjis* in the Jaflong area faced eviction from their lands due to encroachment by the miners and stone traders. Besides, the migration of Bengali people from other parts of the country intended to work in the stone quarrying and crushing sites caused land grabbing in the Jaflong area. The Bengali miners grabbed the lands of the Khasi people by producing forged documents in most cases. Sometimes, they forced the Khasi people to sell their lands for

money (Islam, 2018). This systematic eviction of the Khasi people from their lands changed the ethnographic scenario of this area.

In the past, the Jaflong was known as the area of Khasi people. However, the Bengali people became the majority in this area due to the massive settlement of these people based in the stone quarrying sector. Consequently, this area experiences changes in social systems along with changes in ecology.

Social conflict is another feature of the Jaflong area. This area experiences increased social conflicts with divergent groups of people. The rivalry between different groups of people intended to control the stone business leads to various conflicts among the people. Most of the social conflicts are related to land grabbing issues.

The Jaflong area has experienced different forms of crimes in the last decades. These crimes include drug trafficking, smuggling, extortion and bribes. The local people who work in the stone quarries involve in these crimes (field note).

***Effects of stone quarrying on the environmental system***

Jaflong is ecologically important not only for the Sylhet region but also for entire Bangladesh. In the past, this area was famous for its ecological richness. However, this study found that the environment of the Jaflong area has been under threat due to unregulated stone quarries for the last three decades. As discussed above, the miners grabbed the lands of the Khasi people, arable lands, lands of the roads and highway department, lands of tea gardens and the lands of the forest department. They level the hills and hillocks, clear the forests to mine stones, and set up the stone crushing plans at the Jaflong.

Following discussions present the data relating to the effects of stone quarrying on the environment of the Jaflong area:

***The environment is vulnerable to mechanised quarrying***

This study found that the government permits manual extraction of stone quarrying in the Jaflong area. However, the miners extract the stone using mechanised excavation. As already mentioned above, they use locally invented dredger machines by the shallow engine to excavate stones from the ground of rivers, riverbanks, forest lands, arable lands, hills and hillocks and lands of the tea garden. As a result, this area's hills, hillocks, rivers and arable lands have been systematically destroyed for the last three decades. Furthermore, this study revealed that the maximum amount of stones is extracted from the Jaflong area through industrial stone quarrying rather than government-approved manual quarrying. A report published in the Daily Star supported the findings of this study too. The Daily Star stated that about 90 per cent of total extracted stones come through *Booma Machines* (The Daily Star, 07 December 2015). Consequently, the environment of this area has become vulnerable to mechanised quarrying.

***Destruction of landscape***

This study found that there are hundreds of holes and dunes on the rivers, riverbanks, hillocks and arable lands. According to the deed with the government, the miners have to cover many holes and dunes (if any) with sands after extracting the stones. However, this directive is not maintained at the Jaflong stone quarries. Consequently, the landscapes are being destroyed in this area.

***River erosion***

Unregulated and uncontrolled stone quarrying from the rivers and river banks caused changes in the natural water flow in two rivers— Piyain and Dawki. Excavating stones from the riverbeds and banks has led to lateral river erosion at Jaflong. Consequently, the width of both rivers has extended. This study revealed that the lands of Khasi punji and tea garden have already been submerged into the river. The tea garden authority reported that more than 300 acres of land of the Jaflong Tea Estates have already disappeared due to river erosion.

As discussed here above, the lands of the entire Khasi punji—Old *Sengram* punji were merged with Piyain River as the outcome of the flash flood. The turbulent water comes down from

several falls of the Meghalayan, Khasi and Jaintia hills during the summer through the two rivers of Piyain and Dawki. These holes and dunes hinder the natural flow of water. Consequently, the flash flood has become a common incidence in this area. These flash floods and obstructions in the natural flow of water by the holes and dunes caused massive river erosion in this area. As a result, one Khasi punji has already disappeared, and the other four *punjis* remain vulnerable to river erosion.

### *Environmental pollution from illegal stone crushing plants*

The operation of illegal and unplanned stone-crushing plants affects the environment seriously. This study found that these stone-crushing plants have no control mechanism for dust emitted while crushing the stones. The air of this area carries the dust from the crushing plants. The dust deposits into rivers, ponds, canals, arable lands, roadsides, hillocks and open spaces. A study found that about 80,000 CFT of stone dust is generated from the stone-crushing plants each month (Ahmed et al. , 2010). This dust contaminates the air and pollutes soil, water and river systems. The soils of arable lands lost fertility and became incapable of growing any kind of crops. The existing trees are covered with dust evicted from the stone-crushing plants. These trees have not bloom any flowers or fruits in the last decades.

Along with air, water and soil pollution, this area experiences sound pollution for the operation of stone-crushing plants. The process of crushing the boulders into chips generates extreme noise, polluting the sound in this area. A study is done on the health hazards of the stone-crushing plants at the Jaflong. This study found that every stone-crushing plant exceeds the acceptable level of noise set out by the Department of Environment of Bangladesh (Farzana et al., 2014). For example, the Department of Environment of Bangladesh sets 60 decibels (DB) as the maximum noise level in the case of stone-crushing plants. However, the stone-crushing plants in the Jaflong area exceed this level. It is revealed that the minimum and maximum noise level at the stone crushing plants at Jaflong is 88 DB and 120 DB, respectively (Farzana et al., 2014). Another study revealed that local people suffer from headaches, sleep interference, hearing deficiency, heart disease, high blood pressure, irritation, coughs and other respiratory infections from the noise pollution of the stone-crushing plants (Hoque, 2018).

### Effects of stone quarrying on the social system

Apart from the environmental effects, the stone quarries of the Jaflong have a considerable impact on the social system of this area. The following discussion depicts the effects of stone quarrying on the social system of the Jaflong:

### *Eviction of the Khasi people*

The Jaflong area was known as the land of the Khasi people. This area was popular for the culture and heritage of the matrilineal Khasi people. The tourists from home and abroad visited this area to see the lifestyle, their punji-based governance system, Khasi Rajbari, betel leaf cultivation-based agroforestry system of the Khasi people, *Puancktumai* and their New Year celebration events. However, these people have become marginalised due to stone quarries.

This study found that two forms of eviction of the Khasi people that continue to occur at the Jaflong. These are systematic eviction and forcible eviction. It may raise the question how eviction becomes systematic and forcible. This study revealed that several Khasi families left their lands for their interest in leading a better life in other places. In some cases, the Khasi people willingly sold their property to the Bengali stone miners at a high price which was satisfactory for them.

In some cases, the Khasi people had to leave their lands as they faced problems in natural resource management based on livelihoods. The miners destroyed Khasi *punjis* to extract the stones. The operation of quarries caused a loss of fertility of lands as well as destroyed the betel leaf gardens of the Khasi people. For this, they left their lands and settled in other areas where they could lead their life based on their traditional livelihood system of betel leaf cultivation based on natural resource management. This is called systematic eviction.

This study also reveals that the Khasi people of five *punjs, Sengram, Noksiar, Protappur, Borla*and *Lama* are in threat of eviction, and many of them had already been evicted forcibly. There was no demarcation, and land documentation was not maintained when the government declared this area as site for stone quarries. In the absence of demarcation, most of the lands of the Khasi people became part of the stone quarries. Moreover, there is a considerable stock of stones in the lands of the Khasi *punjis*. For this, the stone traders propose the Khasi people sell their lands for a 'handsome' amount of money. If the Khasi people do not agree to sell their lands for stone mining or to set up of stone-crushing plants, the Bengali stone traders grab their lands by producing forged documents.

Consequently, the Khasi people left their lands forcibly. Although the Khasi people informed that they filed the case with the local civil courts, the court has solved no dispute yet.

***Endangered the culture and lifestyle of the Khasi people***

The Jaflong area is well-known for its Khasi culture and heritage. This study found that this Khasi culture and heritage are in threat due to the stone quarrying operation. Several Khasi people, as already stated above left their traditional livelihood and were involved in the stone quarrying business. In some cases, the Khasi people had to work in the stone quarries as their lands became infertile to cultivate betel leaf. The practice of punji based traditional governance system is also absent in all of the five *punjis.* Although Mantri heads a punji management committee*,* the form of administering the affairs of punji is different from traditional Khasi heritage, which is a practice in other *punjis* located in Kulaura, Srimangal and Kamolganj Upazila of Moulvibazar district.

***Transformation of traditional housing pattern of the Khasi people***

This study found that the housing pattern of the Khasi people at Jaflong has changed considerably in the last decades. The housing pattern of the Khasi people seems the same as the mainstream Bengali community to some extent. The mass settlement of Bengali people has led to this change. This study found that change in landscape and forest cover is also another cause of change in the housing pattern of the Khasi people. The Khasi people mainly live in the thick forest, mountainous ranges and on top of the hill. They usually live close to nature. For this, they build their house specially designed to protect themselves from the attack of beasts, common natural hazards of thick forests and considering their social and religious rituals. However, changes in landscapes, destruction of forests and hills and changes in the environment due to the operation of the stone quarrying process have led to the transformation of the housing pattern of the Khasi people at the Jaflong.

***Transformation of society from Khasi people to Bengali***

It is already mentioned that Jaflong is known as the area of the Khasi people. However, this area has become the land of mainstream Bengali people as an outcome of an immense settlement of people from throughout the area to work in the stone quarries. There is no statistic in the government office about the number of people who settle at the Jaflong in the last decades. This study found that the settlers become the majority at the Jaflong. The settler Bengali people dominate all sectors of stone trading, small business, hotel and restaurant business, tourism industry and all spheres of life in the society of the Jaflong. The Chairman of the local Union Parishad has been elected from the settler Bengali community. This study found that these people came to seek work to sustain their life in this area from different country's flood-prone and river erosion districts. Most of the settlers belong to *Tangail,* Mymensingh*, Netrokona* and *Cumilla* districts.

In two to three years of coming to this area, they built their house on the *khas* lands, roadside and hillocks. Their settlement is called *basti* by the local people. Jaflong *basti* is the largest settlement of Bengali people who migrated to this area. Beyond this, there are few small *bastis*

in this area. Many settlers bought the lands from the Khasi and local Bengali people to build their houses. Few families leased the *kash* lands for a certain period with the condition of payment of rent from the office of the Deputy Commissioner. This study revealed that the settler people grabbed lands of the forest department, roads and highways and Khasi people to build their houses or shops or stone-crushing plants.

***Dropout of the children from education***

The employment of child labour in the stone quarries is another problem in the Jaflong area. This study found that a significant number of labours in the stone quarries within the age range of 10 to 16. Poverty forced them to work in the stone quarries with their entire family to earn money. Dropout of the children in the local primary schools is typical at the Jaflong. A 13-year old student said:

> *I can earn Tk 600 every day by working in a stone mine. Why should I study in school?*(Chowdhury, 2018).

Most students remain absent during the peak season of stone extraction as they work in the quarries.

The operation of stone crushing in the yard of the school makes a hindrance to the teaching and learning of the children. Moreover, this study found that the primary school was being closed during the weekdays due to noise pollution generated from the operation of stone-crushing plants. In these circumstances, illiteracy becomes a problem at the Jaflong. The literacy rate of Bangladesh is 74.91 percent where the literacy rate at Jaflong is 22.81 percent.

**Recommendation and conclusion**

Central aim of this study was to examine the environmental and social effects of stone quarrying in Bangladesh and its impact on the Khasi people dwelling in Jaflong area of Sylhet. The surrounding area of stone quarrying sites in Jaflong has been experiencing environmental degradation for the last decades. Along with environmental hazards, this area has also been undergoing social transformation. The local Khasi people of Jaflong have been experiencing systematic and forcible dispossession. Their betel leaf cultivation based on the agroforestry practice of natural resource management has also been destroyed by unregulated stone quarrying. Due to the polluting effect, the Khasi people cannot cultivate crops on these lands. As betel leaf cultivation based on natural resource management is the prime and only livelihood of the Khasi people, therefore, destroying betel leaf gardens pushed these people to leave this area. Subsequently, this area has been experiencing a social transformation.

Moreover, the quarrying activities need to be operated sustainably. This includes the environmental, economic, and social dimensions (Pouresmaeili et al. , 2020). This study found that the quarrying sector of Bangladesh prioritises on economic dimension and neglects environmental and social dimensions. As a result, the quarrying sector of Bangladesh is not operated in a balanced manner. For this, it hinders achieving the goal of sustainable development.

In these circumstances, this study proposes the following recommendations:

- The government must not compromise with the current acceleration of the country's growth. We need economic development. Infrastructural development is the precondition of economic development. The extraction of stones is essential to meet the challenges of infrastructural development and urbanisation. Therefore, the government should not stop the extraction of stones. However, this study recommends extracting the stone during the monsoon through manual quarrying.
- The government declared the two rivers of Piyain and Dawki as ECA considering their ecological importance. Therefore, local administration should be more vigilant to ensure the criteria of ECA.
- The government should complete the demarcation of the stone quarries

immediately to stop the quarrying from the lands of the forest department, hills and hillocks and arable lands.

- Using *booma machines* must be banned at the Jaflong. The administration should take deterrent measures against the operators of *booma machines.*
- The government should ban the illegal operation of stone-crushing plants. Stone-crushing plants need to be set up in a designated area with the no objection declaration from the Department of Environment. The supercritical stone crushing plant should be introduced at the Jaflong.
- The government should take action against the land grabbing by producing forged documents at the Jaflong.
- The systematic and forcible eviction of the Khasi people from their lands by the stone miners should be stopped immediately. The government should take the initiative to set free the grabbed lands of the Khasi people by the stone miners and the people of the Bengali community.
- The settlement of the Bengali people in the area of Khasi people must be stopped.
- The lands of the Kashi people must not be sold without the permission of the Deputy Commissioner.
- The government should establish a separate environment court in Sylhet to resolve the disputes of the cases relating to the degradation of the environment by stone miners.

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**Conflict of Interest Statement**

There is no conflict of interest in this study.

**Acknowledgement**

This study is funded by SUST Research Centre, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh. Project ID: SS/2018/2/33

**Author Contribution Statement**

**Mohammad Jahirul Hoque**(corresponding author): Conceptualisation, collecting references, developing the first draft incorporating new ideas and relevant resources, data collection, methodology, reproduction of maps, re-writing the final draft, final reviewing of the draft and final editing.

**Hajera Aktar**: Collection of references, secondary and primary data collection, editing, data transcription.

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