International Journal of Research in Social Sciences
Vol.10 Issue 08, August 2020,
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Underground Stone Collection and Its Impact on Environment: A Study on Panchagarh District

Md. Forhad Ahmmed, PhD[1]

Abstract: *In most countries of the world, underground mining resources are considered as important contributors to economic development. But quite often these works cause a lot of damage to the environment and put many lives under threat. In the northern part of Bangladesh, there* are *huge quantities of stones stored beneath the surface in some districts. Local people collect these stone and supply them to different places for construction and development work. The researcher chose this important area of study to explore the environmental impact of underground stone collection. The study was an exploratory one based on sample survey, where the researcher tried to show the environmental impact of underground stone collection. The study conducted in the farthest district of Bangladesh-Panchagarh. The researcher collected data from four categories of respondent. A total of 317 respondents were considered as the sample of the study. It is observed from the findings of the study that though due to stone collection the socio-economic condition of the local people had developed, it has left some negative impacts on environment of the study area. Because of underground stone collection, soil erosion, destruction of soil composition and loss of soil fertility had become very common. Besides, it is observed that, underground stone collection is responsible for riverbank erosion, deforestation and main cause of reduction in cultivable land.*

Key Words: Environment, Underground Stone, Environmental Degradation, Land Seller.

1. Introduction: Many countries resort to various activities to exploit natural resources in order to achieve rapid economic development. One such activity is mining. Consequently, mining is an important economic activity, which has the potential of contributing to the development of areas endowed with the resource. There has been a consistent give and take relationship in the mutual balanced condition gradually built up between the sun, gaseous components of the atmosphere, plant and animal world over the last 450 crore years. Directly or indirectly, there is a fixed and consistent dependable relationship between the elements of the environment. By this, a suitable habitation has been built for the animal world, and on the other hand, the animal world itself has changed the environment. Human capability to transform his environment can bring in the benefits of socio-economic development and an opportunity to enhance the quality of life. However, the incorrect application of such power can cause incalculable harm to the natural environment, and consequently to human life and society. Man in earlier times believed in 'nature-nurture' concept. During the past fifty years, relationship between man and environment has changed considerably. Human beings are affecting the environment through economic functions of different kinds. It is quite complex, because changing a normal condition and process notifies the continuous change of the organic and inorganic structural elements of the environment. Peoples' impacts on the

[1] Md. Forhad Ahmmed, PhD, Lecturer, Department of Social Work, Bangamata Sheikh Fojilatunnesa Mujib Science and Technology University, Jamalpur, Bangladesh, e-mail: forhadapilot@gmail.com

environment fall in two classes, namely: 1. direct impact and 2. indirect impact. Human beings' functions or international impacts are direct or pre-planned, because they are aware of the negative and positive effects of changing natural environment in order to develop a particular area. Changes in environment caused by humans are seen in a very short time. On the other hand, indirect impacts of human functions on the environment are not pre-planned and these impacts are helpful for economic growth and industrial development. After a long time, these indirect impacts can be understood in a cumulative form. Unwise activities of human beings are creating environmental degradation and disasters, which reaches a dangerous level and causes irreparable damage to the human society.

Geologically, Bangladesh occupies a greater part of the *Bengal Basin* and the country is covered by *tertiary* folded sedimentary rocks (12%) in the north, north-eastern and eastern parts; uplifted 'Pleistocene Residuum' (8%) in the north-western, mid-northern and eastern parts; and 'Holocene Deposits' (80%) consisting of unconsolidated *sand*, *silt* and *clay*.[i] Because of a different geological environment, important mineral deposits of Bangladesh are: Natural Gas, Coal, Limestone, Hardrock, Gravel, Boulder, Glass Sand, Construction Sand, White Clay, Brick Clay, Peat, and Beach Sand Heavy Minerals.

Hardrock is a term used loosely for igneous and metamorphic rock, as distinguished from sedimentary rock. The hardrocks of Bangladesh are of four types: (i) Maddhyapara sub-surface hardrock, (ii) Bholaganj-Jaflong hardrock concretions, (iii) Tetulia-Patgram-Panchagarh Hardrock Concretions, and (iv) Chittagong-Chittagong Hill Tracts sedimentary concretions.[ii] The items (ii), (iii) and (iv) are usually considered as Stone or Gravel deposits.

Wide areas of Northern and Northeastern parts of Bangladesh are covered with underground stone or gravel beds. In the north, the gravels are well-exposed at Dahagram-Angorpota, Patgram, Dalia, Chapani, Kaliganj in greater Rangpur and Tetulia, Vazanpur, Boalmari, etc. in Panchagarh. According to the survey of Korean Development Corporation, the amount of underground stone deposit is about 8 crore cubic feet.[iii] These stones are quite large (maximum recorded elongation is 30 cm) and are alternated with very coarse to medium sand. They are quite fresh and well rounded, with a smooth surface. Composition of these stones or gravels is identical with that of the Daling series of the Himalayas. These gravel beds are grouped together as the Panchagarh 'Sandy-Gravel' beds belonging to the Upper Pleistocene series. They are overlain by the 'Holocene' series represented by alluvium and sometimes-fine sand, silt and clay.

The geological history and the environment of deposition of the Panchagarh 'Sandy-Gravel' beds are quite interesting. During the last glacial maximum (i.e. 18,000 years BP), the 'Himalayas' were quite high and were glaciated. The glaciers extended up to the foothills.[iv] Dry climatic conditions prevailed during that time and the melted water was flowing over the Bengal plain through some narrow and deeply incised river systems. At the end of the last glaciation (upper part of Upper Pleistocene),

monsoon rainfall was quite prominent and the glacier also started melting. The melt water plus the amplified monsoon water flowed over the Bengal plain. The narrow river systems were over-loaded and surplus water flowed over the *Braind Tract*. During that time, *Barind* initial surfaces were dissected leaving some north-south elongated red bed islands as exhibited by the present morphology of the *Barind Tract*. These enormous water flows carried the gravels up to the Panchagarh-Dahagram-Dalia area and were deposited as some piedmont deposits.

In the district of Panchagarh, stone collects in two ways, viz. 1. Underground collection by removing the upper layer of the soil; 2. collecting the floated away stone with the flow of water from the river by filtering. In the case of collecting underground stone, 10 to 30 feet of the cover of the ground is removed with spade from the upper layer of the soil and then underground stone is collected. Usually, stone businesspersons buy land from the landowners. The landowners sell this land on condition that after stone collection, the real owner will get back the ownership of land. After buying the land from the landowners, businesspersons appoint laborers during dry season and eliminate 10-20 feet soil from the upper layer of the land in order to collect the stone. In this case, the land digs in such a manner that later on some part of the land becomes ditch and the rest of the land becomes uneven as the stratification of soil damage. This method of stone collection does not rely on machines; rather it relies totally on the manual labor of human beings and through this, a lot of people get the opportunity to work. Later on, other businesspersons buy these stones; classify them into different grades according to field and then by crashing them with machines they are turned into different sizes which are sold for construction work.

In the district of Panchagarh, around fifty thousand people got the opportunity of employment because of collecting stones by digging the soil. Besides, stone collection has contributed to create employment for a huge part of the population. Though Panchagarh is one of the poorest districts, because of stone collection for the last 20-25 years, a visible improvement is noted in the economic and social sectors of this area. Lot of people opine that people of this district have developed a lot in the economic and social sectors because of stone collection, and employment opportunities have increased for all classes of people of this area. Though some visible improvements are noted, there are also some negative impacts on environment of stone collection. The researcher conducted the study to explore the potential threats of underground stone collection on physical environment.

2. Objectives of the Study: The principal objective of the study was to know the environmental impact of underground stone collection. There were some specific objectives which as follows:

1. To identify the potential threats of underground stone collection on the physical environment;
2. To know the environmental changes that occurred after starting underground stone collection as well as their effect;

3. To know the people's attitude regarding stone collection; and
4. To explore the opportunities of environmental development.

3. Definition of Key Terms:

a) Environment: In general, we know what environment is but a concrete definition is not always available to us. In simple words, environment is 'Where we all live'. In this study, the researcher only assessed the impact of underground stone collection on the physical environment; so the term 'Environment' used in the study to refer to the Physical Environment.

b) Underground Stone: Underground stone refers here to the stone or Hardrock collected from 10 to 30 feet depth from the surface of the soil and used for construction. The Underground Stone or Hardrock is usually considered as gravel deposits in environmental science.

c) Environmental Degradation: Environmental Degradation refers to the process by which the components of environment are being lost and the unbalancing condition affects the living organism of the earth. Here the researcher used the term Environmental Degradation only to refer to those negative effects which are caused by underground stone collection.

d) Land Seller: In the present study, land seller refers to the person who sold his land to the stone businessmen for collecting underground stone. Here land seller does not refer to that person who sold his land for ordinary purpose. Land owners of the study area do not sell their land permanently; they only sell their land for a specific period for collecting underground stone. So, in the study the term 'Land Seller' has used in such case.

4. Justification of the Study: There is no doubt that environmental degradation may cause huge loss to human lives and the country's economy. It can slow down overall development activities. It hampers social and economic progress and washes out all development efforts. It is also a threat for biodiversity conservation. People are getting money by selling stone and operating development activities, but development will not sustain until and unless environmental degradation is minimized. So, it is a crying need to justify the impact of underground stone collection. It appears that studies so far done on environmental issues in Bangladesh are limited to a specific area. In this perspective, this study is a pioneering work in this field.

5. Research Methodology: The study carried out using an exploratory social survey based on primary data. Data had also been collected in required fields from secondary sources. Primary data were collected from the people of the study area through interview and Observation. The study was carried out in Panchagarh district of northern Bangladesh. The researcher selected the area because it was one of the large sources of underground stone in Bangladesh. The researcher has selected eight villages of Panchagarh district for the study. Among the people of the study

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villages, 870 persons were involved with underground stone collection. All the people of the study villages who were engaged in underground stone collection were considered as the population of the research and each respondent was considered as the unit of analysis. As it was an exploratory research and the area of study was very large, so the researcher used sampling procedure for conducting the study conveniently. He used multistage sampling method and stratified sampling method for selecting representative sample from the universe. Sample Size and Sampling Procedure shown in the following table:

Table: 1
Sample Size and Sampling Procedure

Category of Respondents	Number of Respondents Included in the Sample	Sampling Procedure
Stone Labourer	153	Multistage and Purposive
Stone Businessmen	84	Multistage and Purposive
Land Owners	30	Multistage and Purposive
Total Sample Size (Directly Involved)	**267**	
General People	50	Multistage and Purposive
Grand Total (Directly Involved + General People)	**(267+50)=317**	

6. Data Collection: Primary data for the study collected for the study through interview and observation. Interview schedule was used for conducting interviews with different categories of respondents. Field investigation was carried out during the period April 2010 to October 2010.

7. Brief Introduction of the Study Area: Panchagarh is a district of Rangpur division in the extreme northern part of Bangladesh. It is bounded on three sides by 288 km long Indian border, having Darjeeling district on the north, Jalpaiguri and Kuchbihar districts on the north-east, West Dinajpur and Purnea districts on the west, Dinajpur and Thakurgaon districts on the south, Nilphamari district on the east. It lies between 26º00' and 26º38' north latitudes and between 88º19' and 88º49' east longitudes. The total land area of the district is 1404.62 sq. km. (542.00 sq. miles).

Top Soil of the study area is deep sandy loam to clay sandy loam, alluvial and bears close affinity with the soil of the old Himalayan basin. Water preservation capacity of most of the land is very low; for this reason a large portion of the total land is not suitable for crop production. The pH of the soils ranged from 5.4 to 6.26. The organic matter contents as well as total nitrogen of these soils were, in general, low.[v] Total agricultural land of the study area is 107785 hectare,

where crops are grown at once in a year in 13024 hectare, twice a year in 72245 hectare and thrice a year in 22516 hectare. Among the total land area, 46.5 percent is high, 42.5 percent is slightly high, 3.5 percent is slightly low and only .05% is low land.[vi] The cropping intensity in Panchagarh district is about 209%.

The major crops grown in this area are paddy, jute, wheat, potato, tomato, sugarcane, *kaun*, etc. At present, tea and orange is being cultivated in the study area. The land climate of the area is very much suitable for tea and orange cultivation. Therefore, it has become an important area for tea and orange cultivation.

Panchagarh has 23 rivers. Among them, the main rivers are Karatoa, Atrai, Teesta, Nagor, Mahananda, Tangon, Dahuk, Pathraj, Bhulli, Talma, Chawai, Kurum, Versa, Tirnoi, and Chilka.[vii] The climate of the study area is a little bit different to that of the major areas of the country. The yearly average rainfall is 2700-3000mm which is evenly distributed nearly for six months of the year.[viii] High relative humidity is always found in Panchagarh district. The average annual temperature of Panchagarh district is 25.5-33.1°c and maximum temperature is 30.2°C, while the minimum temperature is 10.1°C. The winter is comparatively long in comparison to other parts of Bangladesh.

8. Findings of the Study: Environmental impacts like land degradation and pollution of various forms (that is, air, water and noise) in the surrounding communities of Panchagarh district are associated with underground stone collection. Land degradation has resulted mainly from surface (open pit) mining. Air pollution has emanated from emission of dust and other particles into the air. Noise and vibrations are essentially the effects of crushing stone with sound producing machines. These have had adverse effects on food production in the district, as many lands have either degraded due to loss of nutrients or kept reserved for mining activities, resulting in a significant reduction in yield of major crops. Evidently, the proportion of farmers in the district has reduced drastically due to shifts (of labor) to the mining and commerce sectors, hence the situation. In this section, the researcher has presented the impact of underground stone collection on the physical environment.

8.1. Environmental Impact of Underground Stone Collection: The huge impact of surface mining on the topography, vegetation, and water resources has made it highly controversial. There are issues of land degradation, loss of biodiversity and pollution of various forms. Surface mining can have adverse effects on the surrounding surface and ground water if protection measures are not exercised. The result can be unnaturally high concentrations of some chemical elements, notably arsenic and sulfuric acid, over a significantly large area of surface or subsurface.[ix] In the table 2, different kinds of impact on soil, water, air, trees, lakes etc. due to underground stone collection have been shown on the basis of the opinion of respondents.

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Table: 2
Environmental Impact of Underground Stone Collection

		Category of the respondents					
		Stone Labour	Stone Businessman	Land Seller	Mass People	Total	Column (N%)
Impact on soil	Loss of Soil Composition	43.80%	34.50%	33.30%	30.00%	121	38.20%
	Land slide	34.00%	29.80%	46.70%	36.00%	109	34.40%
	Loss of fertility	15.00%	13.10%	13.30%	14.00%	45	14.20%
	Loss of water preservation capacity	0.00%	2.40%	3.30%	0.00%	3	0.90%
	Land Erosion	0.70%	0.00%	0.00%	8.00%	5	1.60%
	No impact	6.50%	20.20%	3.30%	12.00%	34	10.70%
Impact on water	Water surface dropped	41.80%	61.90%	76.70%	48.00%	163	51.40%
	Shortage of drinking water	21.60%	8.30%	16.70%	16.00%	53	16.70%
	No impact	18.30%	20.20%	6.70%	32.00%	63	19.90%
	Water contamination	18.30%	9.50%	0.00%	4.00%	38	12.00%
Impact on natural disaster	Increased	31.40%	13.10%	10.00%	20.00%	72	22.70%
	Decreased	23.50%	45.20%	40.00%	34.00%	103	32.50%
	No change	45.10%	41.70%	50.00%	46.00%	142	44.80%
Impact on trees	Decreased trees	51.60%	44.00%	43.30%	52.00%	155	48.90%
	Decreased forest	33.30%	29.80%	40.00%	34.00%	105	33.10%
	No change	15.00%	26.20%	16.70%	14.00%	57	18.00%
Impact on animal biodiversity	Decreasing various animal	15.00%	11.90%	10.00%	24.00%	48	15.10%
	Decreasing domestic animals	66.00%	67.90%	70.00%	66.00%	212	66.90%
	No impact	19.00%	20.20%	20.00%	10.00%	57	18.00%
Impact on water body	Water body increasing	75.20%	84.50%	76.70%	84.00%	251	79.20%
	Water body decreasing	20.30%	13.10%	13.30%	8.00%	50	15.80%
	Decreasing water preservation capacity	0.70%	1.20%	10.00%	2.00%	6	1.90%
	No change	3.90%	1.20%	0.00%	6.00%	10	3.20%
Impact on air	Air polluted	56.20%	42.90%	36.70%	54.00%	160	50.50%
	Not polluted	9.20%	22.60%	10.00%	12.00%	42	13.20%
	No idea	34.60%	34.50%	53.30%	34.00%	115	36.30%

8.1.1. Impact on Soil: From the above table, it is seen that among the total respondents, 38.2% said that soil composition was being damaged due to underground stone collection, 34.4% said that landslide was occurring as a result of this, 14.2% respondents said that soil fertility of land is decreasing and 10.7% said that there was no impact of underground stone collection on soil. Analyzing the opinion according to respondents' category, it was seen that 43.8% of the stone

laborers thought that soil composition was being damaged due to underground stone collection; it was 34.5% among the stone businessperson, 33.3% among the land sellers and 30% among the general people. Again, among the stone laborers 34% thought that landslide occurred due to underground stone collection, it was 29.8% among the stone businessperson, 46.7% among the land sellers and 36% among the general people. Among all the environmental effects of stone collection, the most deadly impact was, in most cases were damaged soil composition and the lands becoming uncultivable after stone collection.

8.1.2. Impact on Water: Underground stone collection influences hydrologic systems in ways that cause changes to both water quality and quantity. Ground water can be affected by mine subsidence in various ways, including lowering of ground water levels, changes in flow rates, and impacts to water quality. Lowering of ground water levels may decrease the ground water supply and result in the reduction or loss of well water, and decreased surface transmission to springs, seeps and other surface water sources.[x] To know the hydrologic impact of underground stone collection, the researcher asked the respondents what kind of impact was observed on water. Responding to the question, most of the respondents (51.4%) said the layer of underground water was getting lower, 19.95% of the respondents said that no impact was seen on water. Discussing category-based opinion, it was seen that 41.8% of the stone laborers thought that the layer of underground water was being lowered, it was 61.9% among the stone businessman, 76.7% among the land sellers, and 48% among the general people; among the stone laborers 18.3% opined that no impact was observed on water, among the stone businessman it was 20.2%, among the land sellers it was 6.7% and among the general people it was 32%.

8.1.3. Impact on Natural Disaster: Responding to the question on what sort of impact was observed on natural disasters, 22% among the total respondents said natural disasters have increased and 44.8% of the respondents said that natural disasters had not increased or decreased. Analyzing the opinion according to respondents' category, it was seen that 31.4% of the stone laborers opined that natural disasters increased due to stone collection, among the stone businesspersons it was 13.1%, among the land sellers it was 10% and among the general people it was 20%. Among the stone laborers 45.1% thought that natural disaster did not increase or decrease due to underground stone collection, it was 41.7% among the stone businessperson, 50%, among the land sellers and 46% among the general people.

8.1.4. Impact on Trees: In the study area, the researcher observed that underground stone was collected from scrublands. To know the opinion regarding the issue, the researcher asked the respondents what kind of impact was visible on trees. Responding to it, 48.9% respondents said that the number of tree was decreasing, 33.1% of the respondents said that the amount of forest

was decreasing and 18% of the respondents said that there was no impact of underground stone collection on trees.

8.1.5. Impact on Animal Biodiversity: Views gathered from respondents in the study area revealed that loss of grazing land vegetation had been the most important negative effects of underground stone collection, and for those reasons, the number of different species of animal was declining. Responding to the question whether there was any impact on the animals of this area, 15.1% of the total respondents opined that the number of animals of different species were being lessened, 66.9% of the respondents thought that the number of domestic animals were reduced and 18% of the respondents opined that there was no impact of underground stone collection on animal biodiversity.

8.1.6. Impact on Water Body: Responding to the question on the impacts made on water-bodies, 79.2% of the total respondents said that the number of water-bodies were increasing, 15.85% of the respondents said the number of water-bodies remained the same. Analyzing the opinion according to the category of respondents, it was seen that 75.2% of the stone laborers, 84.5% of the stone businesspersons, 76.7% of the land sellers and 84% of the general people thought that the number of water-bodies was increasing a lot in the study area due to underground stone collection. According to their opinion land gets lower due to underground stone collection and most of the time they were not filled up; as a result they turned into lakes. As these lands were not planned and as the depth was substantial it was also not available for fish farming.

8.1.7. Impact on Air: Effects of the Biological Oxidation method includes air pollution as higher concentrations of chemicals used such as carbon, sulphide and arsenic trioxide are often released into the air. In addition, ore which has been processed is known as tailings, and is generally slurry.[xi] Responding to the question if there was any impact on air due to stone collection, 50.5% of the total respondents viewed that the air was being polluted, 13.2% thought that the air was not being polluted and 36.3% of the respondents opined that they had no idea about this.

8.2. Degree of Impact on Environment: The following section discusses the degree of environmental impacts caused by underground stone collection. The researcher categorized the opinion of the respondents in terms of degree. The following table shows the degree of impact of underground stone collection.

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Table: 3
Degree of Impact on Environment due to Underground Stone Collection

		Category of the respondents					
		Stone Labour	Stone Businessmen	Land Seller	Mass People	Total	Column (N%)
Loss of soil fertility	Very much	14.40%	8.30%	6.70%	16.00%	39	12.30%
	Much	69.90%	64.30%	76.70%	62.00%	215	67.80%
	Little	9.80%	16.70%	13.30%	18.00%	42	13.20%
	Very little	2.00%	6.00%	0.00%	4.00%	10	3.20%
	No impact	2.60%	4.80%	0.00%	0.00%	8	2.50%
	No comments	1.30%	0.00%	3.30%	0.00%	3	0.90%
River bank erosion	Very much	2.60%	0.00%	0.00%	0.00%	4	1.30%
	Much	32.00%	22.60%	16.70%	26.00%	86	27.10%
	Little	39.20%	45.20%	50.00%	46.00%	136	42.90%
	Very little	13.10%	14.30%	26.70%	20.00%	50	15.80%
	No impact	9.80%	14.30%	3.30%	4.00%	30	9.50%
	No comments	3.30%	3.60%	3.30%	4.00%	11	3.50%
Impact on flood	Very much	4.60%	1.20%	3.30%	0.00%	9	2.80%
	Much	30.10%	15.50%	16.70%	26.00%	77	24.30%
	Little	31.40%	39.30%	26.70%	32.00%	105	33.10%
	Very little	15.00%	25.00%	36.70%	24.00%	67	21.10%
	No impact	13.70%	16.70%	16.70%	10.00%	45	14.20%
	No comments	5.20%	2.40%	0.00%	8.00%	14	4.40%
Impact on deforestation	Very much	9.20%	6.00%	3.30%	0.00%	20	6.30%
	Much	49.00%	44.00%	50.00%	46.00%	150	47.30%
	Little	16.30%	23.80%	26.70%	36.00%	71	22.40%
	Very little	10.50%	11.90%	16.70%	16.00%	39	12.30%
	No impact	9.80%	10.70%	3.30%	0.00%	25	7.90%
	No comments	5.20%	3.60%	0.00%	2.00%	12	3.80%
Impact on sound pollution	Very much	14.40%	8.30%	3.30%	2.00%	31	9.80%
	Much	20.30%	40.50%	26.70%	34.00%	90	28.40%
	Little	11.10%	14.30%	10.00%	22.00%	43	13.60%
	Very little	23.50%	13.10%	13.30%	16.00%	59	18.60%
	No impact	15.00%	13.10%	13.30%	6.00%	41	12.90%
	No comments	15.70%	10.70%	33.30%	20.00%	53	16.70%

8.2.1. Soil Fertility: Fertility of land is reduced because of stone collection. Stone is collected by making a hole after removing the upper layer of soil; so the fertility of the soil is reduced and the land becomes unfit for plantation. Responding to the question on the impact observed on land fertility, 12.3% of the respondents said that underground stone collection was very much responsible for loss of soil fertility, 13.2% claimed that it was a little bit responsible, 67.7% said much, and only 2.5% said that it was not responsible for loss of soil fertility. Among the land sellers, 6.7% of the respondents said that underground stone collection was very much responsible for loss of soil fertility, 76.7% said much, and nobody denied the negative impact of underground stone collection on soil fertility.

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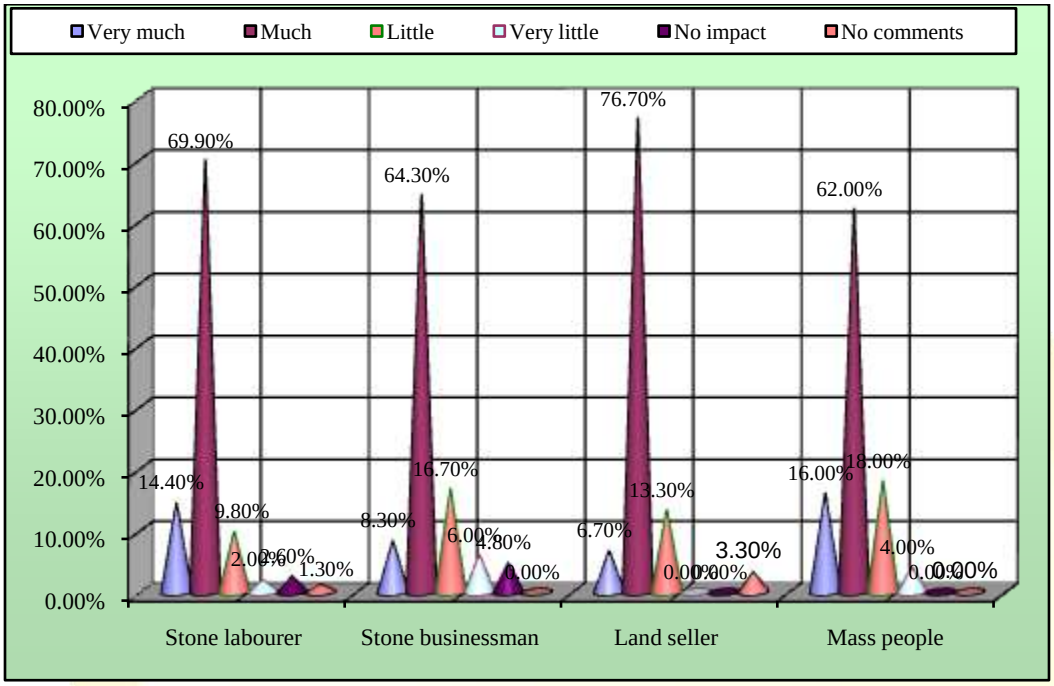
Figure: 1
View of Respondents Regarding Loss of Soil Fertility due to Underground Stone Collection



8.2.2. River Bank Erosion: Another important finding of the study was the occurrence of underground stone collection along rivers and other water-bodies. Mining activities along these rivers could retard free flow of the water course. As indicated by Sandecki, such direct in-stream mining could alter the channel geometry and bed elevation and might involve extensive clearing, diversion of flow, stockpiling of sediment, and excavation of deep pits.[xii] This could also result in significant distortion of the channel morphology, which often caused silting as a result of erosion of the banks and consequent flooding, which may worsen especially during high precipitation.[xiii] Many people believed that stone collection was responsible for river erosion in this area. Due to underground stone collection from river banks or adjacent areas, people of this locality became victims of river erosion during the rainy season. Among the respondents 49.2% thought that stone collection was a little bit responsible for river erosion whereas 27.1% termed it as one of the main reasons. Here, it is noteworthy that 50% of the land sellers held stone collection responsible for river erosion.

8.2.3. Flood: Floods occurred due to river erosion and for this reason some respondents held stone collection responsible for flood. Among the total respondents 24.3% believed that stone collection was very much responsible for flood, 33.1% thought that it was a little bit responsible, whereas 21.1% believed that its responsibility was too little. It was noteworthy that 14.20%

respondents did not believe stone collection was at all responsible for flood in the study area. Panchagarh district is elevated, 60-85m high from sea level, well-drained and free from normal flood hazards;[xiv] so the probability of flood was very low. Underground stone collection from the riverside and river can increase the probability of flood in the study area. According to the category of the respondents, the researcher observed different views in this respect. It was seen that among the stone laborers 4.6% blamed stone collection for flood very much, 30.1% much, 31.4% a little and 15% blamed it very little. Among the stone businesspersons, 1.2% blamed stone collection for flood very much, 39.3% a little and 25% blames it very little. It is noteworthy that among the stone businesspersons 16.70% thought that stone collection was not responsible for flood at all. Among the land sellers16.7% and among the general people 10.00% of the respondents opined that stone collection was not responsible for flood, whereas the other respondents held the view that stone collection was responsible for flood to different degrees.

8.2.4. Deforestation: In the study area, stone was being collected not only from the cultivable land but also from the forests and bushes. For this reason, stone collection had a linkage with deforestation. Among the total respondents, 47.3% believed that because of the lessening of forests, stone collection was very much responsible, 22% opined that it was a little bit responsible, 12.3% respondents claimed that it was very little responsible and 6.30% viewed that it was very much responsible. Among the land sellers, 50% opined that stone collection was very much responsible for deforestation, whereas the same opinion was expressed by 49% stone laborers, 44% stone businesspersons and 46% general people. Stone collection was very little responsible as believed by 16.3% stone laborers, 23.8% stone businessmen, 26.70% land sellers and 36% general people. That means, most of the respondents held the view that stone collection was responsible for deforestation.

8.2.5. Sound Pollution: Sound pollution was also predominant in communities that were close to mining areas, and the surrounding communities of Panchagarh district did not escape from this environmental problem. The sources of sound and vibration in the area included mobile equipment, air explosion and vibration from blasting and other machineries. In the study area, diesel-run machines were used for stone collection and stone crushing machines were used for crushing stones which generated huge sound and black smoke. Analyzing the opinion of the respondents, it was observed that 9.80% respondents believed that because of stone collection sound pollution was taking place in this area on a large scale, 28.40% thought that sound pollution was taking place, 13.6% opined that sound pollution was taking place on a very minimal scale, 12% claimed that there was no sound pollution and the rest 16.70% opined that they had no idea about it. From the category-wise analysis, it was seen that 20.3% laborers believed that a huge amount of sound pollution was happening, whereas the same opinion was tendered by 40.5% stone businessmen, 34% land sellers and 28.4% general people. Again, stone collection did not play any role in sound pollution was believed by 15% stone laborers, 13.1% stone businessmen, 13.30% land sellers and

6% general people. That means, in spite of the differences in level, the people of the study area believed that sound pollution was being caused by stone collection.

8.3. Underground Stone Collection and Potentials of Natural Disaster: In this part, data on method of underground stone collection and its relations with natural disaster was analyzed. In Bangladesh, two kinds of methods are using for stone collection. One is removing the upper layer of the soil manually and the other is with the help of dredging machine. In the study area, the first method is being used for stone collection. In this method, stone is collected by digging the upper layer of the soil manually with spade. The benefit of collecting stone through this method is that more laborers can work and the chances of natural disaster became less. But the problem in this method is that the cost of stone collection increases and a huge area of soil's upper layer cut off; for this reason the land or the place becomes uneven and it becomes unfit for cultivation. Because of the chances for employment of more people and lesser scope for natural disaster, most of the respondents (96.2%) were in favor of collecting stone manually and only 3.8% of the respondents were in favor of collecting stone by using the dredging machine.

Table: 4
Methods of Stone Collection and Potentials of Natural Disaster

		Count	Column n %
Method of stone collection	Digging	317	100.0%
	Dredging machine	0	0.0%
Which method you support	Digging	305	96.2%
	Dredging machine	12	3.8%
Do you think agricultural land has been decreased	No	26	8.2%
	Yes	291	91.8%
Which method is profitable	Produce crop	50	15.8%
	Stone collection	267	84.2%

Mining activities usually scar the landscape with excavated pits and trenches, leaving behind unsightly views which as well render the land unsuitable for any productive purpose.[xv] From the time when stone was being collected manually, stone had been collected from a huge expanse of land and as the soil was not filled up properly, holes were created which made the land uncultivable. Among the respondents, 91.8% thought that because of stone collection by this method, the amount of cultivable land started to lessen and just 8.2% opined that the area of cultivable land had not lessened. Though after collecting stone, the land becomes unsuitable for

International Journal of Research in Social Sciences
Vol.10 Issue 08, August 2020,
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

cultivation, 84.2% respondents were in favor of stone collection than cultivating land, as it was more profitable and just 15.8% considered cultivating land as more profitable.

8.4. Condition of Land after Underground Stone Collection: For stone collection in the study area, there is a tradition of selling land. In the study area where stone is found on a large scale below the earth, the lands are bought by the stone businessmen from the land owners for an amount of money. But this purchase is not for permanent. The stone businessmen buy the land for a specific period within which they collect stone from that land. After collecting underground stone, the land owners get the land back.

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Selling Land for Underground Stone Collection

		Count	Column n %
Have you sold land for stone collection last five years	No	266	83.9%
	Yes	51	16.1%
Which type of land it was	Agricultural land	33	64.7%
	Not arable land	16	31.4%
	Vita	1	2.0%
	Bushes	1	2.0%
Can you produce crop now	No	48	98.0%
	Yes	1	2.0%
If crop not produced, why	The land become very low	22	45.8%
	The land become uneven	14	29.2%
	Water preservation capacity lost and the land become very sandy	12	25%

The price of the land depends on the depth of the land from where stone can be collected and the thickness of the layer of stone. For selecting land for collecting stone, these two things are seen. Among the respondents, 51 sold their land in the last five years. In response to the question what type of land it was, 64.7% respondents informed that they had sold cultivable land for stone collection, 31.4% sold their uncultivable land, 1% sold their living land and 1% bushes. Among the respondents, 98% opined that the lands they sold for stone collection had become unfit for cultivation. Among these lands, 45.8% lands became uncultivable because they become too low, 29.2% because of turning uneven and 25% because they become too sandy and were not capable of preserving water. That means, the land became uneven because of stone collection and lost the ability of preserving water for which agricultural production is hampering.

9. Recommendations:

1. Collecting stone from cultivable and fertile lands must be stopped and stone must only be collected from those lands where crops do not grow well or those which are not suitable for cultivation.
2. At present, the land from where the stones are being collected gets damaged due to the method applied in collecting underground stone. To make sure that the lands do not get damaged, the lands have to be covered when open mining method is followed and while covering sticky and fertile soil must be put on the upper layer of the land. Through this, cultivation will be again possible in the land.
3. On those uncultivable lands from where stone is collected, trees must be planted after stone collection.
4. At present there is no interference of the Government on the manner stone is being collected in the district of Panchagarh. In this regard, supervision of the Government has to be increased not only to ensure the right use of mineral resources but also to make sure that the Government earns revenue from it.
5. Stone collected by destroying forest and from rivers and river bank areas increases the possibility for natural calamities; for this reason, stone collection from the rivers and river bank areas have to be stopped. Here the government needs to take strict measures.
6. To break stone, many stone crushing machines are built in disorderly fashion at various places of this area. Not only this, machines create a lot of noise and produce a lot of dust, which pollutes the environment by mixing with air. For this reason, a particular place should be fixed for this instead of building stone crushing machines everywhere. Through this, people will be saved from sound and air pollution.
7. Before collecting stone from the land, taking permission from the government or the local administration should be made mandatory and a written obligation should be provided pledging that the land will be filled perfectly after collecting underground stone.
8. More intensive research work should be carried out on the environmental impact of underground stone collection in this area. For this reason, more authentic and scientific research should be conducted where the inclusion of geologists is required.

10. Conclusion: From the findings of the study, it was revealed that besides creating job opportunities and positive socio-economic changes, underground stone collection practices had already caused ecological impacts in the study area. These problems included land degradation, damage to water, loss of productive farmlands, destruction of landscape and land beauty, spread of diseases and harm to wildlife and biodiversity. Unfortunately, the government, the NGOs and the local people showed totally indifferent views towards these issues and they are not taking any initiative to address the potential environmental threats. Again, it was also found that existing

laws and regulations were also not enforced in the study area while collecting underground stones. However, the regulatory authorities for land use policy and mineral resource management are very reluctant to take necessary initiatives to ensure optimum use of this resource. Comprehensive measures are required to minimize environmental threats, ensure sustainable development and bring about more economic development.**End Notes:**

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International Journal of Research in Social Sciences
Vol.10 Issue 08, August 2020,
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

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