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Economic Importance of Stone Quarrying in Rural Livelihood and Its Impact on Environment: A Case Study of Saltora Block, Bankura, West Bengal

***Bhattacharjee Subhasis[*], Siddique Giyasuddin and Roy Arindam**

Research Scholar, Department of Geography, The University of Burdwan,
E-mail: subhasis2014@yahoo.in

ABSTRACT

Despite serving the rural economy in a positive way, the negative impact of stone quarrying activities in the Saltora CD Block of Bankura District on the local ecology cannot be ignored. The unplanned extraction and crushing of stones have detrimental effects on natural as well as human ecology of the area. In absence of other choices, the poor rural folk have to work in the stone *khadans* (mines) to meet their basic needs. The present article is an attempt to appraise the importance of the stone quarrying in the village-level micro economy as well as to study the adverse effects of such destructive activities on nature. With a sample size of 350 respondents, data and information on the study was collected by means of questionnaires and oral interactions. The study has placed more emphasis on the data generated through the interactions with the workers to find out the positive as well as negative feedbacks of the activities on their physical and economic life. Normalized Difference Vegetation Index (NDVI) technique has been used to assess the change in vegetation cover. The final result has been elaborately discussed with the bi-faceted impact of the quarrying on the physical and sociological aspects.

KEY WORDS: Micro economy, Positive and negative feedback, Stone *khadans*, Stone quarrying, NDVI technique

***Corresponding author**

Subhasis Battacharjee

Research Scholar Department of Geography

The University of Burdwan Golapbag Campus, Pin: 713104

E-mail: subhasis2014@yahoo.in Mob. No.8514082981

1. INTRODUCTION

Development-environment conflict is the obvious consequence of the unplanned and haphazard human intervention to ecological set-up. Intensive agriculture, industrialization, extension of roadways/railways, construction of dams etc. are few of the examples. Almost each and every human activity puts some negative impact on the landscape, ecology and environment. Mining and quarrying are such activities in which human intervene with the environment in complex and entwining ways. Quarrying is a form of mining distinguished by the fact that the extracted product is used for building or construction purposes, rather than subjected to further processing, as in the case of an extraction of a metalliferous component of a rock, or the combustion of coal to obtain energy[1]. Though, human lives in many cases have sustained with those economic activities, sustainable development then still are not eco-friendly.

Mining plays an important role in the development of human societies and economies. The extraction of minerals, stones and coal have provided a foundation for local economies in many parts of the world. In most places, local communities are involved in extraction processes, although mining is responsible for bringing unanticipated changes to a region's social fabric[1]. Over 20 million people in the world are dependent up on the extraction of mineral resources on an informal basis for their survival[2]. The figure is surprisingly higher than the number of workers employed in formal mining industries. These small mines and quarries are part of the burgeoning informal or 'unorganised' sector of the third world economies[3]. A sizable number of rural households in India have to depend largely upon such non-farm activities in order to make a living[4].

Stone quarrying is one of the key economic activities in the Saltora CD Block, supplying the bulk of stone of varying aggregates to the construction industry within the district and beyond. It has been proved very efficient in strengthening the local economy. Concurrently, it has negatively influenced the ambient soil, air and water qualities and has degraded the entire environmental set-up of the area. Such kind of destructive activities of humankind generally has raised serious environmental concern. Besides, it has adversely affected the health of the poor workers. In recent years, the mining and quarrying activities have further expanded to meet the internal demand of the country and the importance of this sector in the economy has been increased. But, illegal, unplanned and unscientific mining in the present day have resulted enormous loss of exchequer to the country. It has not only weakened the economic structure but also put its negative impact on the environment. Illegal sand quarrying from the bank as well as from the beds of the rivers like Damodar and Ajay is the glaring example that exposes the unethical nexus between local political leaders and *mafias*. The informal stone quarrying activity in the western part of West Bengal is another example of such

association. Despite being one of the prime sources of livelihood of a group of poor rural people of the locality, unscientific extraction of stone has negatively affected the environmental set-up of those areas.

The stone quarrying activities in Saltotra Block of Bankura District has influenced the life of rural people, rural economy as well as the local environment, both in positive and negative ways. The present study strives to assess the economic importance of the small scale stone quarrying as well as the adverse feedbacks of quarrying on the local ecology and environment.

1.1. *Objectives*:

The principal objectives of the present work are:

- To present a brief account of the small scale stone quarries in Saltora CD Block;
- To assess the importance of the stone quarrying in the rural economy as well as in the life of quarry workers; and
- To appraise the impact of quarrying on local environment

2. MATERIALS AND METHODS:

The study is based on both secondary and primary data that have been collected from different sources. A mixed method approach has been used, employing both quantitative and qualitative techniques. Various books and articles have been widely reviewed to construct the framework of the study. Data on demographic attributes of the area has been collected from Census 2001and 2011, whereas, detail description regarding the physical characteristics of the area has been acquired from District Gazetteer of Bankura, 1962. Different topographical sheets and cadastral maps are used to prepare the base map. Normalized Difference Vegetation Index (NDVI) based on Landsat TM data is used for assessing the temporal changes in land cover and land use.

On the other hand, primary data, both in quantitative and qualitative form has been collected during different months of 2016-17 through rigorous field survey and direct interaction with the quarry workers with the help of semi-structured questionnaire schedule. In depth oral interviews and focus group discussion have been done to acquire qualitative primary data. Three *mouzas* namely *Krishnapur, Dightor* and *Pathardihi* were surveyed and nearly 350 respondents (quarry workers) have been approached by random sampling method. Noise level and pH level has been measured by the authors with the help of scientific instruments.

All the collected data and information have been analyzed with use of different statistical techniques and the final report has been prepared through an elaborative description with the suitable

cartographic diagrams. The final conclusion of the research endeavour has been made after the analysis of data and intensive review of the available literatures.

2.1 *Geographical identity of the study area*:

The Saltora CD Block of Bankura District in south-western West Bengal has been selected as area under study.

2.1.1 Location and administrative identity:

The Block is located in the north-western part of the Bankura District (under Bankura*Sadar* Sub Division). Geographically it extends from 23°25′N to 23°40′N latitudes and 86°53′E to 87°06′E longitudes covering an area of 312.62 km^2. It comprises one *Panchayat Samity*, composed of 8 *Gram Panchayats*, 157 *mouzas* of which 145 are inhabited. Among the *mouzas*, three *mouzas*, namely *Pathardihi* (JL no. 95), *Krishnapur* (JL no. 96), and *Dightor* (JL no. 97) have been intensively surveyed to assess the reality as the stone quarrying is well established in these *mouzas*. The study area is surrounded by Salanpur and Barabani CD Blocks of Paschim Bardhaman District, across the Damodar River, on the north, Mejhia and Gangajalghati CD Blocks, on the east, Chhatna CD Block, on the south and Santuri CD Block of Purulia District, on the west (Fig. 1). The region lies in the lap of majestic Biharinath hill (467 m), the highest hill of Bankura district.

2.1.2 Physical characteristics of the study area:

The greater part of the District of Bankura consists of a rolling country composed of laterite and alluvium. The topography in the western part of the District generally consists of lateritic ridges covered with thin forest growths and pleasant valleys. Towards the extreme north-west, the undulations become more distinct as the Chotanagpur plateau is approached. The small hills like Susunia and Biharinath hills stand out in this part prominently from the adjoining region. The Block is situated in the extreme north-west part of the District, over the undulating plateau fringe of the west of the district, on the wavy eastern margin of the Chotanagpur plateau. The topographic expression of the area is characterized with undulating plain, dotted with low mounds and hillocks. Gneiss and schist of Archaean age are found in the Block under review. The area is comprised mainly of crystalline rock. Sedimentary rocks of the Gondwana system have been found between Mejhia and Biharinath hill of the area that contains some useful seams of coal[5,6].

The study area is well drained by the Damodar River system, which plays the most important role in forming the terrain of the area as well as in nourishing its economy and culture. The area lies under tropical, dry and sub-humid climate characterized with oppressive hot summer, high humidity and well distributed rainfall during the monsoon. The monthly temperature varies between 5℃ in

winter to 40℃ in summer. The hottest month is May and coldest is December. The district receives a mean annual rainfall of less than 1200 mm. About 70% of rainfall occurs during the four months from June to September.

The Saltora Block has recorded a total forest area of 38.18 km^2 (12.21% of the total area)[7]. According to the standard classification of the forest types of India, the climax vegetation in this area is northern tropical dry deciduous – dry Sal[8]. The formation is dominated by Sal *(Shorea robusta),* which occurs almost pure with a sprinkling of associated Eucalyptus (*Eucalyptus globules*), *Akarshmoni* (*Acacia auriculiformis)*, *Asan* (*Terminalia elliptica*), *Bahera* (*Terminalia bellirica*), *Kendu* (*Diospyros melanoxylon*), *Palash* (*Butea monosperma*), etc. Some other common floral species in this area are *Pipal* (*Ficus religiosa*), Banyan (*Ficus benghalensis*), Mango (*Mangifera indica*), *Jiyal* (*Odina wodier*), Date Palm or *Khejur* (*Phoenix sylvestris*), *Tal* (*Borassus flabellifera*), *Bel* (*Aegle marmelos*), *Sajina* (*Moringa oleifera*), *kurchi* (*Holarrhena antidysenterica*) etc. The uplands are covered with *kul* (*Zizyphus jujuba*), *babla* (*Acacia arabica*), and *kuchila* (*Strychnos nux-vomica*), whereas, *Sal, kendu* and *Mahua* (*Madhuka latifolia*) have chiefly occupied the low hill areas.

2.1.3 Demographic characteristics:

The total population of the Block has continuously increased since 1961. The Block has recorded the total population of 135,980 in 2011 with the population density of 430/$km.^2$ (Census, 2011). of them, 69,732 (51%) are male and 66,248 (49%) female. The Scheduled Caste population has comprised 34.19% of the total population, whereas, the Scheduled Tribe population has accounted for 18.90%. Decadal growth rate of the Block has been 11.63% for the period 2001-2011. Among the selected villages, minimum population of 331 people is found in *Pathardihi* village, whereas, *Dightor* has recorded the maximum population of 1677. It has been found that, the total population of every village has increased during the last three decades.

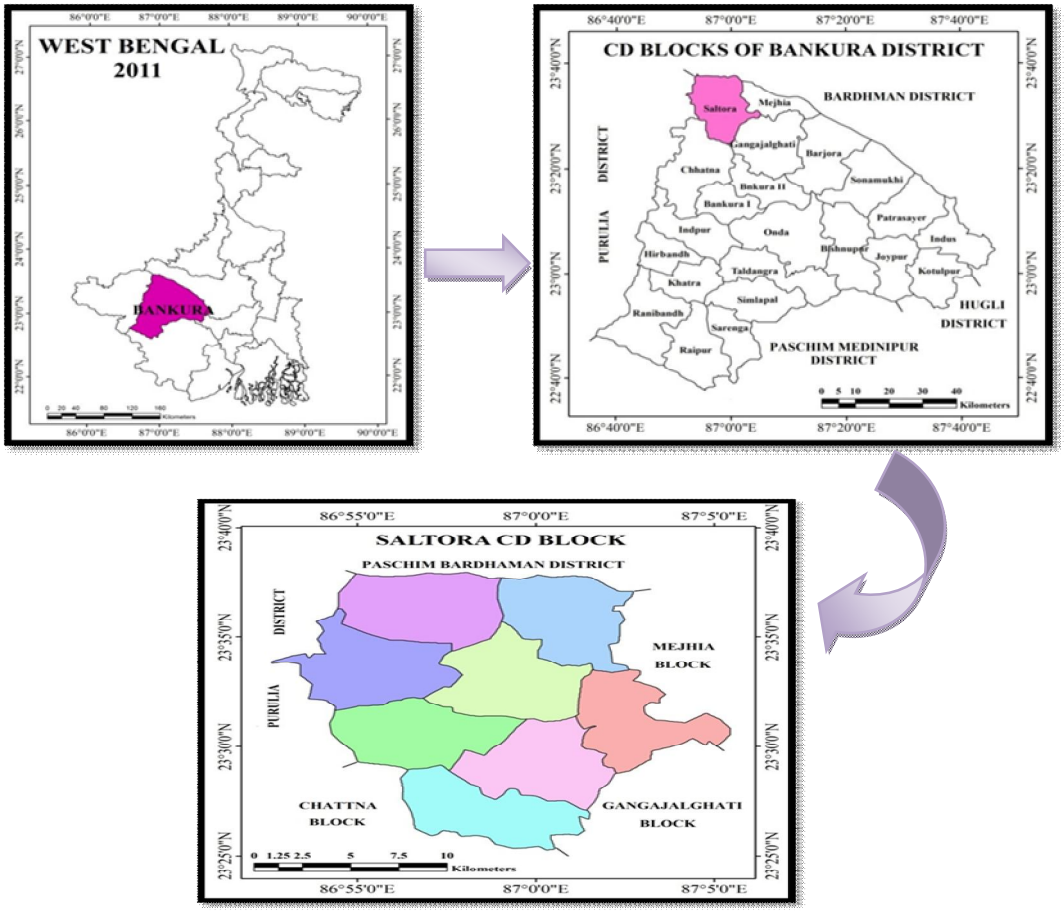

Figure-1. Location of the study area

Source: Prepared by authors

3. RESULTS AND DISCUSSION:

3.1 *Location of the quarries and crushers*:

In spite of being located in the eastern most part of the Chotonagpur plateau, the geology of the area under review is not solely formed by igneous rocks with the absence of severe volcanic eruption of fissures or explosive types. Geological surveys have found the existence of an igneous intrusion of Archean age in this area. The area lies within the basin area of the River Damodar. Therefore, the region has experienced gradual deposition of sediments over a prolonged period and has gone through the process of lithification. As a consequence, the geology of the region is characterized with the assemblage of great variety of igneous, sedimentary and metamorphic rocks. The primary field visit has revealed the presence of varieties of rocks like sandstone, red sandstone, dolomite, apatite, pink granite, various composites of gneiss and schist, anorthosite, epidorite, quartzite etc. in the study area.

The geological formation of the Chotonagpur Plateau region has encouraged the stone quarrying in the area. The quarrying in the neighbouring state of Jharkhand has been flourished long before the initiation of stone quarrying in the Bankura District of West Bengal. Pakur in Jharkhand is a classic example of large scale quarrying, whereas, the western part of West Bengal is still characterized with small scale stone quarrying.

Till the end of 70s of the last century, agriculture was the prime source of livelihood to the large proportion of the population of Saltora C.D. Block. The scenario began to change after this period due to the low agricultural productivity caused by climatic extremity characterized with less precipitation coupled with infertile lateritic soil. Absence of industrial units or any other scope of employment, the poor and marginal people of the area have to commute to the nearby markets or towns in search of job and income. In these circumstances, the initiation of stone quarrying in the Block has opened a new avenue to earn livelihood for sustainability.

Figure-2. Location of crusher belt along Mejhia-Saltora road

(Source: Google Earth Imagery, 15/04/2017)

The Saltora- Mejia quarry belt in Saltora Block is a typical example of small scale quarry site where stone has been extracted by semi-mechanized opencast mining method. These quarries are extended for a continuous stretch of 50 km. from *Tiluri* in the North West to *Kusthalia* in the South East. *Ardhagram* and *Kustore Gram Panchayat* in Mejhia Block have a few numbers of small quarrying sites. Among the surveyed *mouzas, Pathardihi mouza* has 3 quarries, *Krishnapur* has 10 quarries and *Dightor* has 8 quarrying sites of various extents. The extracted stones are mainly crushed in the nearby local crushers. The area has nearly 85 crusher units, located along the both side of Mejia – Saltora road (Fig: 2).

3.2 *Impact analysis*:

❖ **Positive impact: Importance of quarrying in the life of rural people and economy**

Employment and income generation:

Stone quarrying and crushing have generated an alternative source of employment and earning. Poverty or insufficient income, lack of agricultural development, poor agricultural productivity, absence of substitute economic activities, low level of education and unemployment are some of the instrumental factors that have pushed the local people to be engaged in this manual sector as low-paid daily laborers. The acute and prolonged jobless condition of six months of the rural people has easily been compensated for by the employment opportunities offered by the quarrying and crasher sector. A rural poor worker can earn `120 per working day that has definitely increased the family income.

Workers profile:

The people engaged in the quarries may be classified into two categories i.e. Owner class and Labour class on the basis of their hierarchy. Educated and wealthy people, who generally belong to quarry and crusher association or assemble are the members of the owner class, comprising less than 5 % of the total workforce involved in the sector.

The poverty stricken, illiterate, mal-nourished and down trodden people of the adjacent rural areas work as casual labour in this sector. This labour class mainly engaged in toilsome activities such as breaking of stones, loading and unloading of stones in the trucks, operating of the crusher machines and removal of debris etc. Majority of the workers belong to Scheduled Tribe (like *Santals, Kurmi, Ho, Oraon, Munda* etc.) and Scheduled Caste (like *Bagdi, Bauri* etc.) categories, whereas, the owner class is generally belong to General Caste people.

The proportion of women among the workers in small mines and quarries varies from country to country, according to location, nature and value of the mineral, processing techniques used, marketing systems, local social milieu, availability of alternative occupations and other factors[3]. According to Hinton *et al.* (2003), in actual mining jobs, panning, processing, transportation and related jobs on the fields, the percentage of women varies from10 % to 50 % [9]. In India, large number of women miners are still employed at rudimentary, labour-intensive, small and surface bound operations[1]. Participation rate of women labourers in the quarrying activities along with their male counter parts is significant in the study area as nearly 40% workers in the quarrying sites of the study area are women (Primary Survey, 2016-17). Employment of women workers is very popular in open cast mines because they are more regular and dependable and do not indulge in excessive drinking. Food insecurity of the family, responsibility of providing food for young

children and the non-availability of better paid and regular jobs force them to engage in the toilsome work in the quarries. Their life is full of hardships associated with long hours and unscheduled overtime, lack of benefits and social protection, occupational health hazards, high indebtedness and periodic/seasonal shocks to work, insecurity of work and income, variability and volatility of income, lack of training, lack of legal status, organization and voice[3]. The laboures are bound to live in a miserable condition- clustered throughout the quarries amid the poverty, noise, dust, disease and difficulties[10]. Nearly 96 % of the workers live within 2.5 km. of the crushers in the study area (Primary Survey, 2016-17).

1. **Enhancement of trade and other quarry-related economic activities:**

The stone quarrying activity has encouraged the development of stone crushers for producing various grades of stone chips, boulders and stone dusts that have been used for various purposes especially for construction of roads and buildings. As a consequence, the trading activity related to this building material has enhanced in the area that has put a positive effect on the economy.

2. **Development of local economic nodes and construction of roads:**

The small scale stone extraction sites don't have the capability to pull human settlement or to encourage the development of large towns like as the areas of extraction of coal, iron ore or other valuable resources. In this area, stone quarries has failed to established new habitat, but the agglomeration of crusher in *Krishnapur mouza* has facilitated the development some shops, hotels, truck repairing centre and a petrol pump. Notwithstanding, quarrying is a source of raw material (chipping and other stone aggregates) for building and road construction projects[11], the truck owners have constructed a *kuccha* road with *morrum* but the condition of the road is worse due to the frequent movement of heavy loaded trucks.

3. **Formation of water tanks: sources of irrigation and other human uses**

Rejected *khadans* as well as running ones, often, have turned into surface depression. Significant share of runoff goes to this quarries and the depression stores sufficient amount of rain water and thus becomes a temporary or permanent source of water to the nearby agrarian fields in post-monsoon as well as in summer season. The cold water of those tanks is often used by the local people for bathing, washing of cloths and utensils and several other domestic purposes.

- **Negative impact on workers: Occupational hazard and disease profile of the quarry workers**

The poor workers have suffered from health hazard especially various types of respiratory diseases caused by inorganic dust particles, as a consequence of a long period of exposure in the quarrying sites. About 83% of the respondents had a history of an

ailment, which is related to quarry activities (Primary Survey, 2016-17). The main health problems complained about include respiratory diseases like asthma and tuberculosis, eye problems, muscle pains, malaria etc. with the domination of respiratory diseases (Fig. 3).

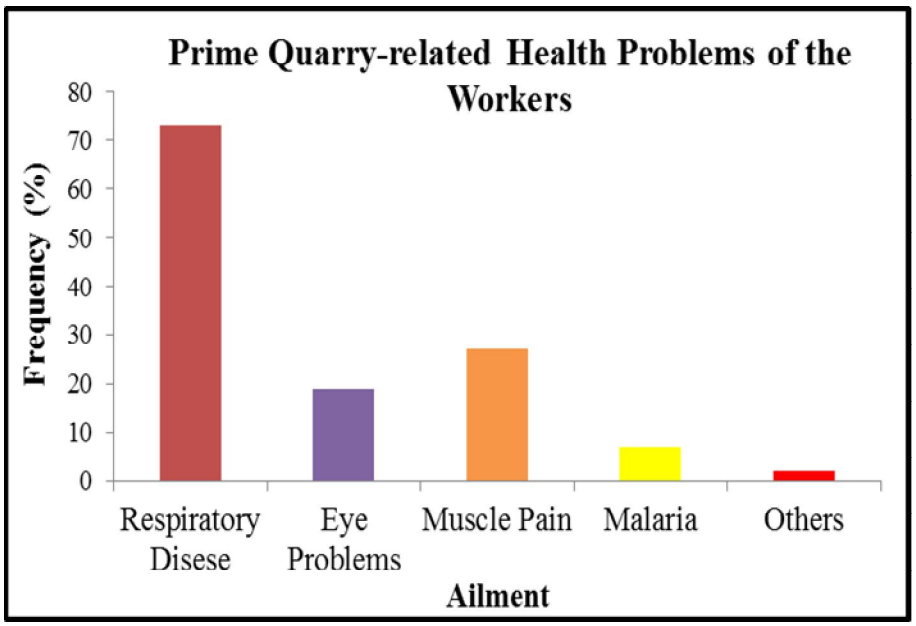

Figure-3. Prime quarry-related health problems of the workers

Source: Primary Survey, 2016-17

Nearly 4 million people in the developing countries die each year due to acute respiratory problems caused by environmental pollution emanating from quarrying, sandblasting and emission of dangerous chemicals[12].Silicosis (a lung disease) is the main occupational disease found among the workers in the quarrying sites for inhaling the air with higher concentration of stone dust of the varying sizes ranging from 0.5 to 3 micron. High amount of ejected dust from crushers has caused various respiratory problems to workers as well as the local people. In addition, movement of heavy-duty trucks adds to the dust problem. Sometimes it leads to permanent disability and often has become a cause of death. Chemical composition of the mineral, duration of exposure in the work place, smoking habit, concentration of dust in the air, health status of the exposed person are some of the contributing factors of Silicosis. Till now, there is no specific cure for silicosis, so primary prevention is still the best way to avoid the disease[13]. Removing the source of silica exposure, rigorous dust control measures (e.g. substitution, complete enclosure, isolation, hydro blasting, and good housekeeping) and personal protective measures (including regular physical health check up) are important means to prevent the disease from getting worse.

The locational proximity of residential houses of the workers to the crushers combined with the unhealthy habit of smoking of the male labours has made them more vulnerable to silicosis. More

than 70% male workers have consumed *bidi*, cigarettes or *ganjas* that has enhanced the risk of silicosis and many other respiratory diseases (i.e. Pneumoconiosis) (Primary Survey, 2016-17). The extent of the dust ejected by the crushers on the human health can be easily accessed through the analysis of general disease pattern of the area. Block level health data has revealed that among 2703 reported cases in hospital, 1180 (43.66%) cases were related with respiratory problem during first three months of 2013 (BPHC, Saltora). The reported cases of respiratory diseases have been increased to 1538 (54.77%) among the total admitted patients of 2828 during first three months of 2018 (BPHC, Saltora). Of them 638 patients are children and 900 adults. These statistics has clearly depicted the increasing trend of respiratory disease in the area over time. The local doctors have agreed that the number of patients suffered from respiratory diseases has been constantly increased (Primary Survey, 2016-17). Higher concentration of inorganic silica particles around the crusher areas has increased the intensity of Acute Respiratory Infections (ARI) among the people residing near the crusher units. It is also found that 23% of the deaths in the workers have been caused by silica dust induced tuberculosis (TB) (Primary Survey, 2016-17). It has clearly indicated that the occupational diseases like tuberculosis are culminating into death.

❖ **Negative impact on environment:**

1. **Impact on air:**

Extraction and crushing of stones associated with the activities of drilling, blasting and transportation detrimentally affect the ambient air quality through ejection of huge amount of inorganic dust particles (<10 micrometers in diameter) or suspended particulate matter with the diminishing magnitude with the increasing distance from the point of extraction or crushing. The polluted air is harmful to the health of the workers exposed to the mine environment and has become the prime cause of discomfort, allergic reaction, lung infection and long term respiratory diseases. The people who reside near the crusher units (within 0.5 km. buffer zone) are the worst sufferer of the dust particles. Excessive concentration of dust particles in the atmosphere has reduced the visibility and has put a veil of dust over the natural (like green plants) as well as artificial objects (like house, cars etc.). Precipitation of such dust particles has also contaminated the soil and water and has affected the plant species of the area. More than half of the respondents (53%) have agreed that the mixing of dust particles significantly affect the local environment. Consultation with the local doctors has revealed that the number of patients with lung diseases or respiratory diseases has been increased due to the higher concentration of dust particles after the establishment of crusher units in the area.

2. Impact on water:

Both, the quantity and the quality of the surface as well as subsurface waters have been adversely affected by quarrying activities. The physico-chemical properties of water get deteriorated by the surface runoff of contaminated water from the quarrying sites or due to the precipitation of dust particles ejected by the quarrying/crushing units. The contaminated water may affect the quality of ground water. Besides, groundwater is also negatively affected by residues from explosives used in rock quarries. Alterations in surface characteristics by removal of topsoil and dumping of waste materials have modified the water cycle through changes in the amount and direction of the flowing water at the surface as well as have altered the soil quality[14]. The laboratory analysis of the twelve water sample collected from several points of a quarry converted into pond nearby a crasher has recorded the pH value of 4.32 (average), which is less than the natural pH level (7.00) of neutral water (Primary Survey, 2016-17). So the water in the tanks formed by the excavation of stones is highly acidic and injurious to human health.

3. Impact on land: dumping of waste, derelict landscape and wasteland formation

Quarrying activity has significantly degraded the amount of forest land and has generated vast tract of wasteland [15]. Uncontrolled and inefficient stone quarrying leads to degradation of land, loss of fertile top soil, intense soil erosion, loss of pristine habitat and wetlands etc. Nature of rocks and method of extraction have controlled the amount of waste generation in quarrying areas. Manual quarrying methods in the study area has produced huge quantities of waste materials that have often been dumped near the quarrying sites. It not only deteriorates the soil quality but also converts the area into wasteland. After abandonment of quarries, the whole area with its pits, grooves and heaps of waste rocks/debris becomes a derelict land. It also damages the surface natural beauty of the area concerned. Systematic mining has neither been attempted nor has any effort been made to reclaim the mined areas. Huge artificial hillocks have been created and no attempt has ever been made to vegetate them with plantation through large scale afforestation or social forestry programm

4. Noise and vibration hazard

Extractive industries are generally associated with much noise and vibration generating activities. Primary data has revealed that the noise levels are comparatively higher in the active zones such as drilling and blasting, which are sporadic in nature and form point sources only. The activities like uses with heavy machineries for extraction and crushing of stones, drilling and blasting of rock, stone hammering, screening of aggregates have generated loud, deafening and incessant noise that often exceeds the permissible level. Transportation of raw materials and finished products by trucks,

tractor-trollies also generate noise levels beyond threshold limits. The recorded noise level at a crusher unit (at full swing) and a quarrying site are 113dB and 95 dB respectively (Primary Survey, 2016-17) (Fig. 4), which is quite higher than the permissible limit of 75 dB prescribed by WHO for day time industrial area [16,17].

This high noise level not only causes annoyance, nuisance and sleep disturbance, rather it may cause permanent damage of the ears of the local people. Blasting at quarrying sites can give rise to vibration, which is potential to damage the man-made structures of the area especially the housing units.

5. Changes in land cover and land use: deforestation and ecological imbalance

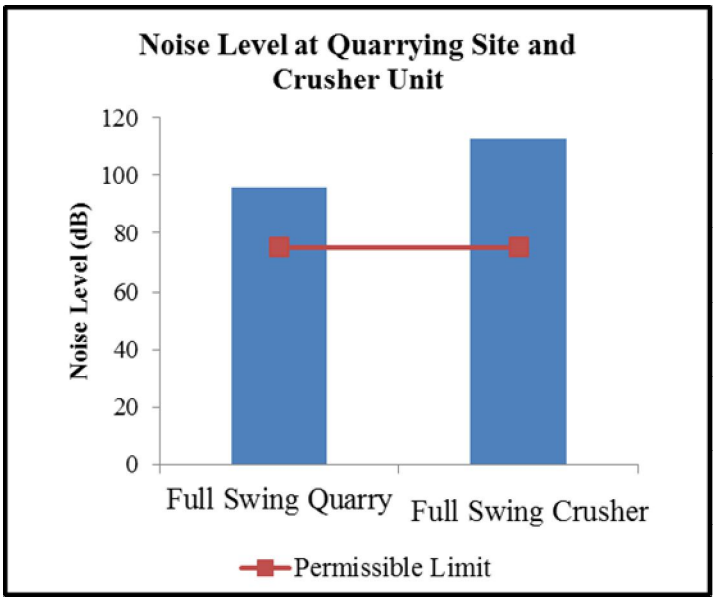

Figure- 4. Noise level at quarrying site and crusher unit

Source: Field Survey, 2016-17

Although mining has positively influenced the regional economy through various way and has provided several inputs in the regional development process, especially in less-developed areas of developing countries [18], but indubitably mining, being a destructive activity, has constituted a major hazard to man and environment and can drastically alter the landscape as well as the environment[19]. Unfortunately, in most parts of the world, the underground mineral resources are superimposed by the biological resources especially, the forests. Therefore, in most of the cases, the extraction of mineral resources has become possible only after the destruction of the existing resource base at the surface. Thus mining operations lead to the removal of forest cover, destruction of natural habitat and significant loss in biodiversity[15].

Changes in land use and land cover are the most vulnerable aspect in the area. The percentage of vegetated area has been decreased greatly due to the expansion of stone quarrying and as a consequence, the percentage of barren and fellow land has been increased. Besides the areal shrinkage of virgin forest, the dense green cover has been reduced owing to the alterations in the species composition. Number of water bodies has increased due to the transformation of the abandoned quarries into the water tanks. Increment in barren land is the reflectance of unplanned growth and mismanagement of quarries in the study area.

The Normalized Difference Vegetation Index (NDVI) has been used to detect the change over the periods of 1990 to 2006 (Table: 1). The following maps have clearly shown the significant reduction in the areas with green cover (0.2-0.6) and simultaneous increase of the barren land (0-0.2) (Fig: 5). The loss of forest leads to instability in the natural systems of the lithosphere, hydrosphere, atmosphere and the biosphere. The destruction of forest land also influences the rural economy and livelihood pattern of the area.

Table: 1

Decrease in vegetation cover, 1990-2006

Land Use Class	Area in 1990		Area in 2006		Areal Decrease	
	km ^{2}	Percentage	km^2	Percentage	km^2	Percentage
Vegetation	75.33	68.19	58.86	52.95	16.47	15.24

Source: Calculated by authors

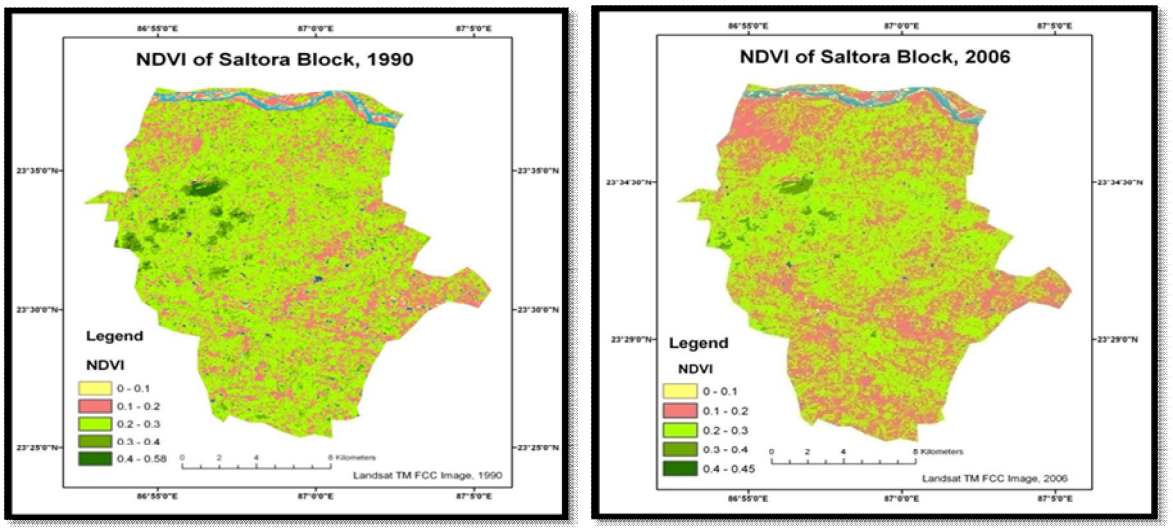

Fig: 5 Changes in land cover and land use, 1990-2006

Source: Prepared by authors

CONCLUSION:

It is clear from the discussion that the informal and illegal small-scale stone quarrying activities and associated crushers in Saltora CD Block is environmentally unsustainable. It has detrimentally affected the local environment and definitely has enhanced the vulnerability of the local people. It leads to degradation of land that poses serious threat to the other resources. Atmospheric dust concentration coupled with the physical nature of the quarrying process creates negative health consequences. On contrary, the activity has provided employment and income opportunities for sustaining their livelihood. Economic poverty coupled with permanent/periodic unemployment due to the absence of industries and social marginalization are some of the instrumental forces that has forced the poor folks both male and female to be engaged in the hard and unhealthy jobs to feed the stomach of their children and their own. But it should be noted that in a non-resilient environment, development definitely becomes unsustainable. Therefore, the geological resource of the area under review should be properly/scientifically extracted and utilized for sustaining the social environment with minimum negative feedback to the physical environment. The illegal way of extraction of stones should be restricted to preserve the geological resources of the area. There is need to ensure that mining operations are conducted in such a way that in broader scale it benefits the society and that concerted efforts are made to ensure that these benefits can be sustained even when mining activities become stopped. Generation of alternative economic opportunities is earnestly needed to shift the marginal people from stone quarrying activities to reduce the dependency of the poor people on such unsustainable activities to sustainability of the environment as well as the human health. Scientific planning and effective collaboration involving all the stakeholders would make the extracting activity socio-economically beneficial to the communities as well as environmentally sustainable. Proper and organized maintenance of small-scale quarry operations will create better opportunities for diverse livelihood, income and assets that will promote positive livelihood outcomes.

List of Photographs:

A. Unskilled Manual job in Quarry
B. Wasteland generated by quarrying
C. Women working amidst dust
D. A Crusher Site
E. Women Workers in Quarry site
F. Measurement of Noise Level

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