

# A Study on Mining Industry Pollution in Chapagaon, Nepal

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## Abstract

Stone mining industries in Chapagaon, Lalitpur area is in regular operation since more than 35 years. In this long period, the operators of mines and stone crushing have cleared up the vast area of forest for the purpose of stone mining. As a result the fragile forest ecology, biodiversity and scenery beauty of this area have been widely devastated. Environment of Chapagaon indicates that the destruction of forest area has already affected the local population in terms of declining fresh water sources; drying of wells, reduction on ground water level, livestock productivity and loss of scenic beauty of the place. The agriculture crop yield has also decreased vastly and the area is gradually converting into dry land, the top soils have been eroding and crop plants are being covered with pollutants which are effecting directly or indirectly to the local people.

In this paper, health impact of local people, environmental and economic impact of locality by mining industries are examined and evaluated considering questionnaire and available data from several sources such as government publications, related researches, websites and other references.

This paper concludes with recommendations in order to control environment pollution, to reduce the impact of gravel, sand and stone mines.

**Keywords:** stone mining, stone-crushing, biodiversity, scenic beauty, pollutants

## 1. Introduction

Chapagaon is located in the outlying area of the south part of Kathmandu Valley. It is dense traditional settlement area inhabited predominantly by the Newars. The area of Chapagaon VDC (Note 1) is 6.76 km<sup>2</sup> with total population of 12789, out of this 6516 male and 6273 female. It is taken one of the fastest growing VDC in Kathmandu Valley. The development prospect of proposed outer ring road of Kathmandu Valley and closeness to the city center of Kathmandu, this area has been an attractive residential location for many migrants (CBS, 2011).

In this VDC no proper considerations are made for settlement planning, mining, crushing and management of these. The mining industries of this area are taken problematic not only because of the lack of proper considerations about the environment but also because of the narrow road networks of this area. The hauling trucks of this area create the sound whole the day and pollute the air. Mining industries in Chapagaon are concentrated in Ward no. 6 which is adjoining Ward with Lele VDC. This ward is taken as the best for crushing and stone mines because of lots of open spaces and availability of stones. Streams of Chapagaon; Nakhu and Karmanasa are disturbing by stone mines and crushing industries, the volume of drinking water has been reduced gradually because of the extraction of upper layer stones and soil of spring catchment area. In the past years (2010/11) there were more than 30 stone and crushing industries but in 2012 gradually these reduced below No. 9 in Chapagaon and shifted in other neighboring VDCs like Lele, Nallu, Bhardeu etc. (VDC Profile, 2010).

## 2. Objective of the Study

The general objective of the study is to show environmental, social and health impacts of the disordered natural resource exploitation, the specific objectives are as follows:

- i. To find out the consequences of mining industries in study area;
- ii. To assess the condition of natural resources; and
- iii. To recommend some of the ways of natural resources conservation to the concern agencies

### 3. Justification

The criteria adopted for categorizing the mines units as small, medium and large scale, differ from country to country and there exists no universal yardstick (Ghose & Roy, 2007). Recognition of the fact that small-scale mining can make a significant contribution to development objectives, which has been one of the principal motives for this persistent interest (Noetstaller, 1994).

Mining was a flourishing activity in the remote past. But it was conducted with crude technique and to a limited scale. Iron ore, copper, slate, mica, marble, lead, lignite, etc. were the chief minerals exploited and utilized in those days. Subsequently, it was gradually abandoned due to three basic reasons: (a) Exhaustion of easily accessible top deposits (b) Lack of improved techniques (c) Negligence of the then ruling classes (Shrestha, 2004).

Rapid development has been spurring the mining industry in Nepal. Until the early 1990s, there were just few mining sites producing gravel for house and road construction. During the 1990s the population in Nepal's cities grew rapidly and building construction techniques changed requiring greater quantities of gravel (CLSR, 2009) (Note 2). At the same time the road network was expanding in many districts which increased demand for gravel. As well as mining industries are taken as the main sources of building materials. Stone crushers are small scale industries in the unorganized sector. They provide basic material for road and building construction. They are highly labor intensive. The various unit operations involved in stone crushing viz., size reduction, size classification and transfer operations have the potential to emit process and fugitive dust (Sivacoumar, Jayabalu, Subrahmanyam, Jothikumar, & Swarnalatha, 2012). The three stages of mineral development, viz exploration, mining and processing, have caused different types of environmental damages, which include ecological disturbance, destruction of natural flora and fauna, pollution of air, land and water, instability of soil and rock masses, landscape degradation and radiation hazards (Aigbedion & Iyayi, 2007).

The industries in and around large and small urban areas are increasing day by day. In Nepal, The Mines and Mineral Act, 1985 A.D., its amendment, 1993 A.D. and Regulation 1999 A.D. introduced for the management of mines and mineral industries of the country. After this time the mines and mineral industries are regulated by the Department of Mines and Geology under the Ministry of Industry, Commerce and Supplies. The responsibility of regulation of established mines and mineral industries in Nepal remains on the hand of government with its several local bodies but the proper follow-up and regulation seems very weak.

The case of Chapagaon remains the same; the mining industries established are found not within the parameters of government's approval, these are out of the limitations because of which the local environmental resources are degraded on greater extent. Mainly the mining industries are responsible to decrease the scenic beauty of the place, degradation of the productivity of land, dust and smoke pollution etc. So this study attempts to find out such impacts which are related to the consequences of mining industries in this area.

### 4. Study Area

Chapagaon is the village which is spread in 68 km<sup>2</sup> with the shape of conch shell. It is very close to Mangal Bazar (palace area of Malla Kings) which is just 10 km<sup>2</sup> away from Chapagon. Chapagon can also be known as "Wadey", "Champapu". However the presence of Bajarnarahi temple helps to identify the village more easily. Historically, the village was full of forest with Chanp trees. At first, the village was named as Champapur, as it was developed by demolishing the forest of Chanp tree and later the name was revolted into Chapagaon, Similarly, the name Wadey was assigned from Newari Wa which means rice and Dey means state. Thus, the name Wadey means state of rice. This name was specifically selected as the village has large number of rice production with better quality as compared with other areas of Patan. In various manuscripts, this village was generally indicated with the names of Wadey, Chapagon and Champapur. However, the village is commonly familiar with the name Chapagaon in all government sectors. In order to retain its traditionalist, the municipality of this village is named as Champapur. During the period of Shivadev the Lichhavi king, the village was found to be well development and act as an important business center. For instance, business man from other areas had to pay tax for selling their fish in Chapagaon. Till now, the village has specific plans like Bhansar Tole to execute their implications. This has been evident from the script written on the statue of Jalahari situated near Brahma (Note 3) statue in the ear of Basantadev. From this, it is understood that Chapagon is a well-developed and planned village as of the ancient times. Several historical evidences indicated that Chapagon was highly developed during the period of Malla kings. The culture and religious values are higher in Chapagaon. The most important function of this village is Jatra. This function is celebrated twice a year, one on the Astami (Note 4) of Kartic and other on full Moon Day of Chaitra. At present, Jatra on Astami of Kartic is not celebrated because of the mislaid of idol in 2046 B.S. Bulu and Pyangaun has their own Jatra of Chandra Bhairav and Jatra of

Mahadev. Apart from this, there are other ceremonies also conducted such as Dipankar Walk, Samaydhyo Bwayagu, Ganesh and Saraswati Jatra of Jhyalipati (Note 5), Bhairab Jatra (Note 6), Juga Chareor Samyak Dan (Note 7), Pond Fair of Khasimar and Tika Bhairab Jatra (Note 8).

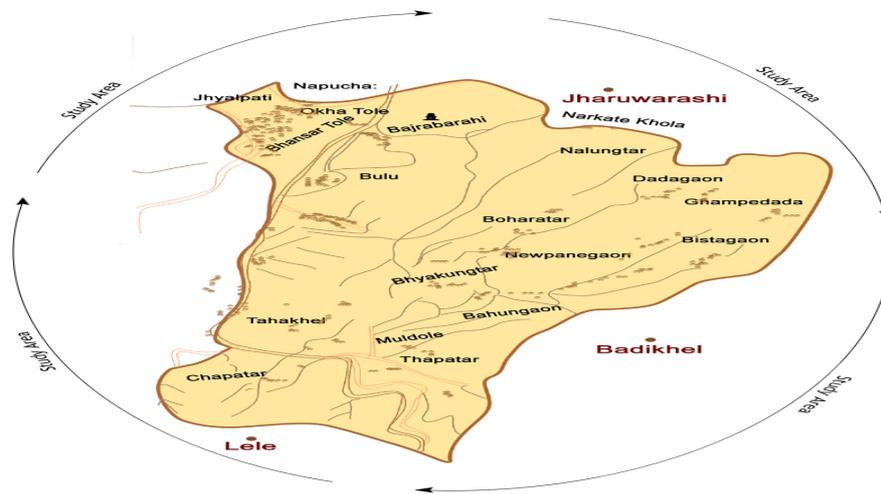


Figure 1. Area map of Chapagaon

## 5. Mine and Mineral Acts and Regulations in Nepal

There are two acts and regulations concerning mines and minerals in Nepal, they are as follows:

- i. The Mines and Mineral Act, 2042 B.S. (1985 A.D.) and its amendment, 2050 B.S. (1993 A.D.).
- ii. Mines and Mineral Regulation 2056 B. S. (1999 A. D.).

Source: Ministry of Industry, Department of Mines and Geology, 2066 B.S. (2009 A.D.).

These two mines and mineral acts and regulations encompass with policies for handling, monitoring, and administrating the mineral department of Nepal. These policies are open to all qualified aspirant. The main intention of promulgating such policies is to regulate, manage, and operate mining of all minerals excluding natural gas and petroleum. The license system for mining minerals is of two stages. Such license can be obtained by any person having technical and financial competency to perform mining operation. Two kinds of license are provided include:

- To target mineral source, Prospecting licenses are provided wherein volume and grade of mineral has not been identified and
- Mining licenses are provided to perform mining operation wherein amount and quality has been previously determined by corresponding department.

Mining license holders are allowed to do mineral exploration not more than 25 km<sup>2</sup> and not less than 0.25 km<sup>2</sup> in the first 10 to 30 years based on the level of minerals. This period may extend up to 1 to 10 years. Mining license can be provided by Department of Mines and Geology by identifying the mineral deposits of applicants through exploration activities (Pradhan, 2011). The expense encounter by the department in exploration activities can be either converted into share or it can be retrieved from qualified aspirants.

Similarly, prospecting license holders are not allowed to perform mining operation more than 25 km<sup>2</sup> and below 0.25 km<sup>2</sup> for the first 2 to 4 years of operation. This is with a provision of extension up to 1 to 2 years. Eligible candidate must complete the exploration activity within 2 years for ordinary nonmetallic minerals and 4 years for valuable nonmetallic and metallic minerals. Further, the Mines, and Mineral Act and Regulation of Nepal provide the subsequent provision with reference to:

- Improve safe and secure of mine and miners' workers.
- Proper usage of land.
- Undertake mining activities in an environmental responsible manner.

- Get approval from corresponding department through sending sample for lab testing and exploring outside the country.
- The Government of Nepal has all rights to conduct the mining activities either directly or by selecting eligible persons to conduct activities. They also have rights to participate in the mineral developing activities directly or by any form of contribution.

The Mining Act and Regulation also provide several offers and rights for lessee while performing mining operations. It includes:

- Right to access the land and materials for mining operations.
- Right to trade and export the mining products.
- Payment renewed on the basis of minerals productions and commodities.
- Right to import equipment and machines for mining activities.

The expense for perceiving Prospecting and Mining license is very cheap in Nepal when compared with other countries. The Government provides royalty of mineral products based on the quality, its type, and volume of mineral production. Consequently, the minerals are categorized into non-metallic, fuel, metallic and construction minerals. For metallic minerals, the royalty can be fixed based on metal production. For others, it can be fixed based on the minerals production. At present, 25% income tax is amended for corporate governance. Further, extra charges are not imposed on the interest on foreign loans. The Government also provides tax deduction from corporate income. In addition to this, the Government of Nepal also regulates some legal policies to prevent double taxation on FDI during agreement or providing license for investment (MOI, 2009).

## 6. Methodology

This section deals briefly with the research methodology applied in the study. This is purely academic research based on social science.

### 6.1 Rationale for the Selection Study Area

The selection of the study area is one of the critical issues while undertaking research work. I admit that my study site is pro-urban area, considered to be one of the famous mining industries site. The rationale for the selection of study area includes:

- i. The mining industries were operated in this site before 35 years.
- ii. The mining industries in this site are operated in forest areas.
- iii. The mining industries in this site are operated out of the limit of government's approval.
- iv. The researcher is familiar with the ecology and environment of this site.

### 6.2 Research Design

- i. The research design is based on descriptive and exploratory.
- ii. It is descriptive as it is based on detailed investigation and record of the mining industries in this area.
- iii. It is exploratory in the sense that analysis focused on exploring whether mining industries in this site are rationale to the environment or not. An attempt has been made to make the mining industries more responsible to the local environment.

### 6.3 Nature and Source of Data

Both primary and secondary data have been collected for the purpose of study.

- i. Primary data are based on household survey, observation, and interview.
- ii. Both published and unpublished documents, records, books and relevant materials related to the subject matters have been incorporated as secondary data.

### 6.4 Universe and Sampling Procedure

This study has been confined within Chapagaon VDC of Lalitpur District, Nepal. This VDC contains 12789 as total population of the VDC. Among these the 100 households of Ward no. 6 were selected for the survey and 6 mining industries were assessed for the purpose of this study. There are all together 10 mining industries in Chapagaon VDC but 6 mining industries were operating in this field visit period.

### 6.5 Data Collection Technique and Instruments

For the collection of primary data, the following techniques were adopted.

**Household Survey:** Household survey was conducted to gather more information about the impacts of mining industries. Various information regarding to the pollution and other impact was collected from structured questionnaire.

**Observation:** Non-participatory observation was applied during research to study the location, and concerning environmental impacts of mining industries.

**Interview with Key Informants:** Some knowledgeable persons such as elderly persons, members of forest-user group, community based representative personnel, teachers and local leaders were selected as key informants to carryout research. Checklist and guidelines were prepared for key informant's interview.

### 6.6 Method of Data Analysis

The collected data were edited, coded, classified and tabulated for data organization. The quantitative data have been presented in tabular form and suitable statistical tools like percentage, ratio, mean etc. has been adopted for data analysis. Bar-diagram and trend analysis have been presented to make figure attractive. The quantitative data have been interpreted and analyzed in descriptive way based on their numerical characteristics.

## 7. Results

### 7.1 Increased Trend of Mining Industries in Chapagaon VDC

The following figures show the increasing trend of mining industries in Chapagaon VDC in 5 years period of time (2007 to 2012):

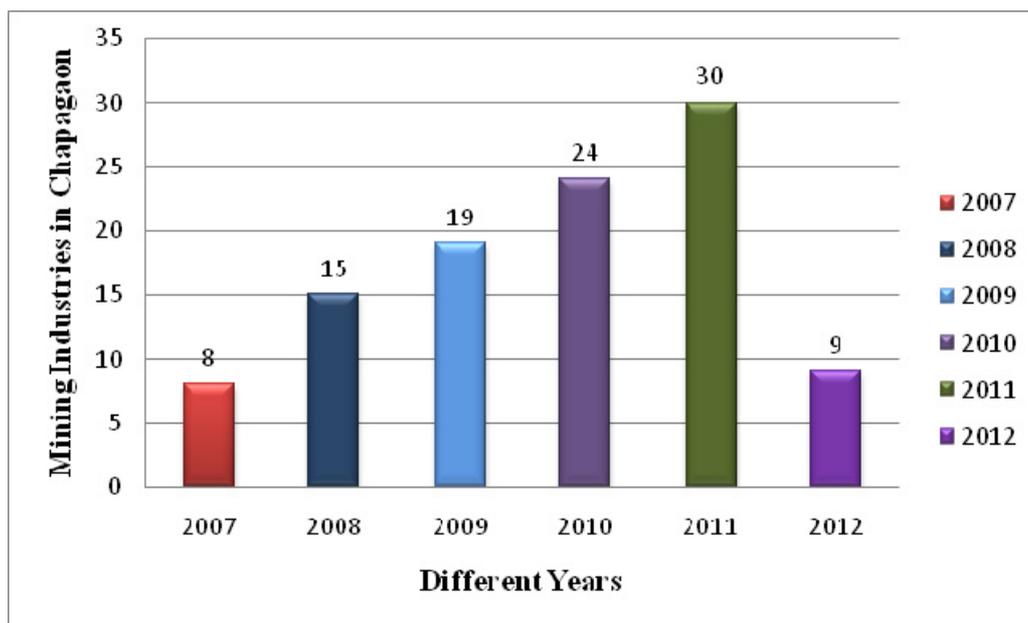


Figure 2. Yearly average income of Chapagaon VCD through mining industries (adopted from field survey, 2012)

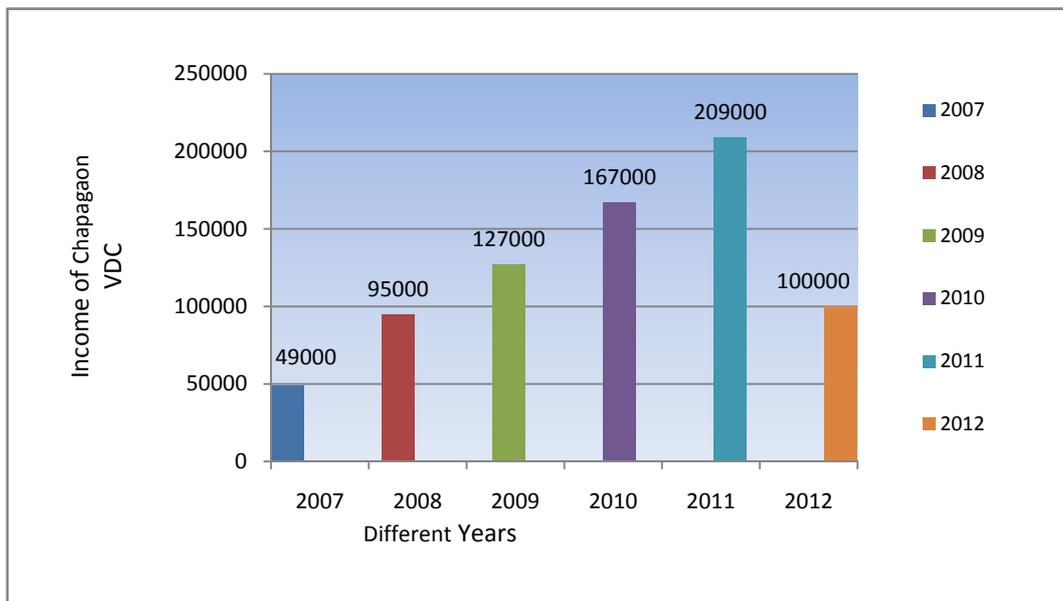


Figure 3. Increase trend of mining industries in Chapagaon (adopted from field survey, 2012)

Figure 2 and Figure 3 show that the income of Chapagaon VDC in the year 2007 by 8 mining industries is Rs. 49000 (about 500 US\$-in the rate, 1 US \$ = Rs. 98), in 2008 by 15 mining industries is Rs. 95000 (970 US\$), in 2009 by 19 mining industries is Rs. 127000 (1296 US\$), in 2010 by 24 mining industries is Rs. 167000 (1704 US\$), in 2011 by 30 mining industries is Rs. 209000 (2132 US\$), and in 2012 by 9 mining industries is Rs. 100000 (1020 US\$). The fluctuation of income amount of the VDC symbolizes the increasing rate of tax and the system of tax pay of the VDC. Sometimes, because of the disturbances over mining industries the tax amount were not paid by the mine owners.

But Figure 2 doesn't represent the regulation of mining industries whole the year, this only represents the establishment of mining industries in Chapagaon in year basis. Some of the industries established there but production activities remained very less because of the disturbances of workers and local people too, so the income is not as equal to the number of mining industries.

7.2 Positive and Negative Impact Assessment of Mining Industries in Chapagaon

In Chapagaon 100 households of mining area (Ward No. 6) were survived, the responses of them about negative and positive impacts of mining industries are mentioned in the table below:

Table 1. Positive and negative impact of mining industries in Chapagagon

No. of Respondents	Positive Impacts of Mining Industries	Negative Impacts of Mining Industries	Positive Percentage	Negative Percentage
100	41	59	43	57

Table 1 shows that majority of the respondents of Chapagaon respond negative impacts of Mining industries in their area. Out of 100 respondents 41 percent only respond the positive impacts of these industries rest of these respond the negative impacts. They were also asked about the aspects of negative impacts too, most of them were agreed on dust, smoke, vehicular congestion, sound pollution and loss of scenic beauty of the place. At the time of survey, about 50 percent respondents were unknown about the tax payment system of mining industries in this area.

7.2.1 Positive Impacts

- Income generation for the VDC.
- Employment generation for the local people.

- Frequent maintenance of local roads by mining industries owners.
- Construction materials on their site on cheap price.
- Use of local resources/mobilization of local resources.

### 7.2.2 Negative Impacts

- Disturbance: Sound pollution, water pollution, land pollution.
- Degradation of scenic beauty of the area and degradation of tourism resources.
- Extinction of flora and fauna (plants and animals).
- Extinction of aquatic diversity (water species).
- Gradual drying of drinking water bodies causes the scarcity of drinking water.
- Loss of grazing land for the cattle.

### 7.3 Demographic and Land Use Features of Chapagaon

Table 2. Demographic and land use features of Chapagaon

Male/Female		No of Male/Female	In percentage (Male/Female)			
Male		6516	50.95%			
Female		6273	49.05%			
Total		12789	100.00%			
Ward-wise Households and Population			Area Coverage		Land Use	
Ward No.	No. of Households	Population	Ward-wise Area Coverage		Land Use Coverage	
			Ward	Area in km <sup>2</sup>	Use in	Area in km <sup>2</sup>
1	189	960	1	0.23	Settlement	0.12
2	211	1114	2	0.76	Bushes	1.22
3	258	1242	3	0.64	Cultivable Land	4.76
4	301	1565	4	0.5	Forest	0.99
5	252	1219	5	0.31	Useless Land	0.02
6	481	2580	6	1.77	Sandy Land	0.09
7	294	1442	7	1.44	Land Cover by Water	0.02
8	219	1073	8	0.96		
9	326	1594	9	0.61	Total	7.22
Total		12789	Total	7.22		

Source: CBS (2011).

Table 2 shows the total population and land area of Chapagaon VDC according to the preliminary results of census survey, 2011. As per this report this VDC contains 12789 total populations and 7.22 km<sup>2</sup> total land area. Out of this settlement area covers 0.12 km<sup>2</sup> area, bushes, 1.22 km<sup>2</sup>, cultivable land 4.76 km<sup>2</sup>, forest area 0.99 km<sup>2</sup>, useless land 0.02 km<sup>2</sup>, sandy land 0.09 km<sup>2</sup> and land covered by water 0.02 km<sup>2</sup> area. This further indicates that the large amount of land area in this VDC is cultivable. The mining industries which have been established on the useless land (means out of human use) are not disturbed by the local people but which have been established on cultivable land, bushes area and pasture land are being disturbed frequently by the local people.

#### 7.4 Concentration of Mining Industries in Chapagaon and Their Production

Mining industries in Chapagaon are concentrated in Ward no. 6 which is adjoining Ward with Lele VDC (Village Development Committee). This ward is taken as the best for crushing and stone mines because of lots of open spaces and availability of stones. Streams of Chapagaon; Nakhu and Karmanasa are disturbing by stone mines and crushing industries, the volume of drinking water has been reduced gradually because of the extraction of upper layer stones and soil of spring catchment area. In the past years (2010/011) there were more than 30 stone and crushing industries but in 2012 gradually these reduced in Chapagaon and shifted in other neighboring VDCs like Lele, Nallu, Bhardeu etc. (Field Survey, 2012).

The following table shows the Crushing and Stone Mines currently existed in Chapagaon VDC with production capacity of these:

Table 3. Crushing and stone mines existed in Chapagaon VDC

Name of Crushing/Stone Industry	Location	Total Worker	Production Type	Production Capacity
Bajrabarahi Roda Dhunga Udyog	Ward No. 6	5	Gravel and stones	69 Mini Truck/day
Bhanjyang Dhunga Khani	Ward No. 6	6	Gravel and stones	71 Mini Truck/day
Bhuwaneshwor Roda Dhunga Udyog	Ward No. 6	7	Gravel and stones	75 Mini Truck/day
Champapur Dhunga Roda Udyog	Ward No. 6	6	Gravel and stones	72 Mini Truck/day
Excel Stone Crusher	Ward No.6	5	Gravel and stones	67 Mini Truck/day
Lalit Concrete P.vt.Ltd.	Ward No. 6	7	Sand, gravel, and stones	73 Mini Truck/day
Nepal Roda Dhunga Udyog	Ward No. 6	6	Gravel and stones	71 Mini Truck/day
Purna Dhunga Khani	Ward No.6	6	Gravel and stones	69 Mini Truck/day
Santi Roda Dhunga Udyog	Ward No.6	5	Sand, gravel and stones	65 Mini Truck/day

Source: Field Survey, 2012.

These Mining industries of Chapagaon produce mainly 5 types of stones which use in buildings and road construction such as a large stone for the basement of building, small stones for the flooring, and gravel for the road construction, next product has been used for the wall painting dust.

#### 7.5 Tax Payment by Mining Industries in Chapagaon

The mining industries of Chapagaon pay the tax to the VDC as according to their volume of export of mine products, the tax has been approved by DDC and VDC has taken the tax on the following manner:

- i. Large Truck per trip Rs. 400 (about 4.08US\$-in the rate, 1 US\$=Rs. 98).
- ii. Mini Truck per trip Rs. 150 (about 1.53US\$-in the rate, 1 US\$=Rs. 98).

Above tax payment system further symbolizes the contribution of mining industries for the development of this VDC. Chapagaon VDC's record shows that yearly in average 100,000 taxes has been collected, this tax has mainly used for the maintenance of road and environmental cleanliness.

#### 7.6 Pollution from Mining Industries in Chapagaon

Mining and mineral activities generally affect the outside environment. In the process of making products pollution and waste are produced which ultimately threaten the human health and the surrounding environment. The similar cases are found in Chapagaon area especially from the production and transport of gravel, sand and stones. Different types of impacts of these productions and transport are analyzed below:

##### 7.6.1 Health Impact to Local People

Exposure to heavy dust concentration from stone crushers may produce several diseases, chief among them being pneumoconiosis (Zenz et al., 1994). Silicosis, caused by inhalation of dust containing silica, is an important form of this disease. The impact caused by gravel, sands and stone mines in in Chapagaon area is air pollution and its associated health impacts to the local people those located in nearby mine area. In open areas of

Chapagaon, the impact of such mines on human health is not likely to be significant. But in the residential areas, when one truckloads of sand and gravel from its excavation and starts transport to its destination mostly in Lalitpur Sub-Metropolitan City and Kathmandu Metropolitan City it fills dirt, smoke, and sound pollution. The following are the main impacts caused by sand, gravel and stone mines.

- Increased air pollution which directly impacts the health of surrounding people
- Dissemination of dust and fumes from gravel and sand at the mining area
- Dispersion of dust due to lack of proper monitoring and lethargic operations
- Fleeting of dust and fumes from exposed or opened dump trucks
- Contamination of ground water due to mixing of waste water from mines.

Each of the impacts listed above produces greater impact to the human health but these are hard to measure. In earlier times, minimal populations and establishment of few mines in Chapagaon made these impacts less noticeable. But now these are observed further serious most of the local people who are on the side of narrow black-topped road area like Pyanggaon, Chapakot, Bajrabarahi etc. are facing several health problems such as headache, dry nose, eye dimming problem, asthmas, respiratory diseases and lungs problems. The field survey has revealed that about 30 people per month directly or indirectly are affected by the cause of pollution from stone and stone-crushing industries in this area. In a day 1264 times the hauling trucks inter and exit from this site which produce the large amount of pollution not only smoke and dust but also sound.

#### 7.6.2 Pollution on Agricultural Land

The stone and sand extraction process entails the removal of large amounts of waste too, which becomes pollution for the agricultural land. The deposits and wastes from the stone and stone-crushing mines disturb the general flow of streams and rivers that causes river and stream bank cutting in the rainy season. Most of the agricultural lands especially paddy fields are on the side of Nakhu and Karmanasha streams in Chapagaon which are under the threat of stone mine and crushing industries. The field survey of this area has recorded that about 5 Ropani paddy field of this VDC has been destroyed in average per year especially in rainy season. Moreover, the local people are agree on the fact that the vegetables farmed on about 11 Ropani of land of this VDC are also destroying per month by the dropping sand, gravel and stones on the side of road because of the unsafe coverage of hauling trucks.

#### 7.6.3 Impact on Soil Quality

In Chapagaon, soils over large area are destroyed by mining activities. Moreover, agricultural lands near mining and crushing site are particularly affected. The fugitive dust has created significant impact over the agriculture land of Chapakot, Pyanggaon and Bajrabarahi area. Erosion of exposed soils, wind-blown dust, dropped pieces of sand, gravel and stone are usually posing the greatest risk over the soil quality.

#### 7.6.4 Water Pollution

In most mines, the soil potential and sedimentation get contaminate and thereby affecting quality of water. As the mining activities occupy large area of land and hence large amount of ground materials exposed at site generate soil erosion, which is the major concern at hard-rocking mining sites. Due to erosion, considerable loading of sediments to nearby water bodies, especially during severe storm events and rainy season. In rainy season, excess of contaminated particles are mixed with rain water and drained in rills, natural channels or gullies.

In Chapagaon VDC, two streams namely Nakhu and Karmanasa are polluted through the flow of mine waste. The main factors influencing water bodies pollution includes the volume and velocity of runoff from precipitation events. The stone mines are located on upper slope area of Karmanasa stream and the mine depositions of dry season slip down with the volume of wind and runoff. The heavy rainfall in rainy season sweeps down all deposited items of mines, it causes several floods to the stream and full of sedimentation on Karmanasa stream. The case of Nakhu stream is different than that of Karmanasa. Nakhu stream is affected by the quarrying practices on the sides of it. Due to the cause of heavy quarrying, the paddy field of both sides of this stream has converted as a water flowing area of stream, this stream is widening year by year. The water of both of these streams is polluted so the people of adjoining areas are facing the problem of drinking water and the use for secondary purposes.

Some cumulative impacts of mining in Chapagaon area on water bodies and water species are mentioned below:

- Lost access of locals to the clean water;
- Deposition of mining waste on the water bodies;

- Extinction of water diversity i.e. fishes, frogs, snakes, leaches, worms etc.
- Lost access of locals to the secondary use of water such as irrigating, swimming, washing, fishing etc.

#### 7.6.5 Erosion/Sediment of Mining Industries

Major sources of erosion/sediment loading at mining sites can include open pit areas, heap and dump leaches, waste rock and overburden piles etc. A further concern is that exposed materials from mining operations may contribute sediments with pollutants, principally heavy deposits of gravel. The types of impacts associated with erosion and sedimentation are numerous, typically producing both short-term and long-term impacts. In surface water the erosion and waste rock of mines fills up the depth of water level which causes toxic effects in fish. Sometimes the waste materials especially from mines flow to the stream with huge chunks and these make the heavy sediment and the fishes displace from their original dwells. With these chunks of rock and other materials flow the topsoil chemicals as used by miners.

Sediments deposited in layers in flood plains or terrestrial ecosystems can produce many impacts associated with surface waters, ground water, and terrestrial ecosystems. In Chapagaon area erosion/sediment from the upper slope areas of Nakhu and Karmanasa Streams causes the several impacts on water aquatic fish and other species. Field survey has recorded that due to the cause of erosion/sediment the streams of this area are now out of indigenous fish species and other water species, but in past years several fish species were available such as before 3 years in Karmanasha and 15 years in Nakhu Stream.

#### 7.6.6 Socio-Cultural Impact

Gravel, sand and stone mining in Chapagaon area has increased traffic congestion and safety hazards. When operating these mines, several trucks run via Chapagaon for more than 10 hours each day. As a result of this, there has been increase in air pollution due to dust, diesel fumes and so on. In Ward no. 6 of Chapagaon VDC, where many crushing and stone mines are located, so heavy traffic hazards like trucks and other heavy vehicles are transported several times per day. In spite of this, the aesthetic degradation due to stone mining and crushing altered land mass of Chapagaon area and vanished green vegetation. Public nuisance is another important impact created by these mines. The state has not been formulated essential regulations for the operation of stone, sand and gravel mines in this area. The conversion of open spaces into built form has degraded the balance of built and non-built spaces that existed in traditional settlement planning and made the place more congested and traffic jam for the longer time. The single lane road of Chapagaon area has been carried 1262 times of transactions of hauling tracks per day. Cumulative impacts of ripping, drilling, blasting Overall, the local residents are highly affected by mining, blasting, transport, drilling, grinding and ripping. All types of above mentioned equipment produced vibration but vibration from blasting drastically affect building structure, people of local residents in a large manner. In Chapagaon area the traditional buildings are gradually disappearing because of the easy access of construction materials of new buildings. And the traditional buildings which are existed at present time are covered with thick dust flying from hauling trucks on the narrow road existed almost at the center of traditional settlements. The traditional identity of Chapagaon area and the great influence of Bajrabarahi Temple has found now on crisis.

#### 7.6.7 Economic Impact

The social impact of large scale mining is controversial and complex to describe. Though the mining operation can create employment, roads, and schools, the profit from such operation cannot be uniformly distributed among people. The Chapagaon Village Development Committee fines only 200 rupees per month from a mining industry and takes Rs. 400/trip (about 4.08US\$-in the rate, 1 US\$=Rs. 98) from large truck and 150 Rs. (about 1.53US\$-in the rate, 1 US\$=Rs. 98) from mini truck but in reality it has not found paid by each and every. The mining entrepreneurs of Chapagaon VDC are found stronger than locals, the response and social demands of locals are not found fulfilled by industry owners. The perception of inhabitants of this area is that the community has not got any social contributions from mines. But at the time of observation, only 2 mine owners were not paid the monthly tax to the VDC office. Three mines were not operated because of the disturbance of local people. In conclusion, mining industries are not fully negative, these are contributed Rs.100, 000 (about 1,020.40 US\$-in the rate, 1 US\$=Rs. 98) per month. Respondents (57%) insisted that the amount paid by them is not sufficient only for the maintenance of road and environment, so the mines are not beneficial for them. Local people have taken mines as the major causes of pollution. Economic contribution of mining industries to the local has found not visible, Village Development Committee fines and takes the money from them but allocates as the total income of VDC, so the contribution of mining industries has found contradictory.

### 7.6.8 Impacts on Flora and Fauna

Generally, the term Wildlife refers to non-domesticated vertebrates, but in broader terms it refers to all plants and animals. By degrading green vegetation and top soil, dissemination of pollution, dislodgment of fauna, the mining operation disrupted the life of flora and fauna. Some of the cumulative impacts of mining on wildlife in Chapagaon area are mentioned below:

#### 7.6.8.1 Loss of Habitats

The living pattern of wildlife species depends on conditions such as local weather, soil, altitude, and other local features. The existence of wildlife is directly or indirectly affected by mining operation. Influences of mining to wildlife are primarily from dislocating animals from its place of origin due to pilling of mining wastage. Moreover, the alteration created by land distribution disturbed the living pattern of wildlife and thereby reduced the survival of such species. In Chapagaon area wildlife species like bird species, reptiles, small mammals, amphibians etc. are found disappeared.

#### 7.6.8.2 Habitat Fragmentation

Habitat fragmentation has found in Chapagaon area wherein the habitats are dispersed in to smaller groups which resulted in the increased isolation of habitat patches. Due to this, majority of the species are found disappearing from its native places.

## 8. Discussion

Gravel, sand, and stone mines are common across Chapagaon. Although these mines are not regulated under the Mines and Minerals Acts and Regulations of Nepal, they are registered with District Development Committee and some on Village Development Committee only. The primary environmental impact from gravel, sand and stone mines in Chapagaon area are degraded air quality from blowing dust particles, smoke, and dropping sands. Deposition of mine on the side of Karmanas and NakahLake contaminate the surface water quality of Chapagaon. Other impacts of mining operation on environment includes aesthetic degradation, gravel deposition, increased traffics on roads creates high level dust, diesel fumes which impacts the quality life of local residents.

Moreover, current environmental laws in Chapagaon area also not so effective in regulating gravel, stone crushing and mining operations. As compared with smaller minim, larger mines are considered as minor determinant for air pollution and hence these mines are allowed to work with minimal quantity of emission. This may create nuisances to local communities. However the state government did not consider the influence of these impacts. Prevailing regulations failed to consider the location of these mines near residential areas.

Modifications in existing rules and regulations may reduce the impact of gravel, sand and stone minim on environment.

## 9. Conclusion

Mining operations are considered one of the main sources of environmental degradation. Depletion of available land due to mining, waste from industries, conversion of land to industry and pollution of land, water and air by industrial wastes, are environmental side effects of the use of these non-renewable resources. The environmental damage has in turn resulted in waste of arable land, as well as economic crops and trees.

The number of mining industries in Chapagaon has found decreased in 2012, but the environmental impacts have found rather increased. Chapagaon is an adjoining VDC of Lele, Bhardeu and Nallu VDCs, especially the gravel, sand and stone productions of Lele VDC are to be passed through the way of Chapagaon, so the environment of Chapagaon has degraded even after shifting the mining industries from Chapagaon. The income of Chapagaon VDC in the year 2012 has found Rs. 100000 (about 1,020.40US\$-in the rate, 1 US\$=Rs. 98); this symbolizes the reduction of income of Chapagaon VDC. The tax from gravel, sand and stones in Chapagaon remains less while the productions are not existed in Chapagaon. The productions of other VDCs just pay the tax to Chapagaon on large and small truck basis. The impacts regarding to environment of Chapagaon are related to the degradation over the scenic beauty of Chapagaon, loss of soil quality, reduction on agricultural production, air pollution, drying the source of drinking water, soil erosion, sedimentation on local streams, habitat loss and fragmentation of wild life, health impacts on local people etc.

Economic impacts of mining industries in Chapagaon have found some positive too. The collected taxes from mining industries in Chapagaon VDC have utilized for the maintenance of local roads and local environment, the tax has also been utilized for the infrastructures development too. In gist, it can be said that mining industries of Chapagaon are detrimental to the environment but beneficial to the local people. But the perception of local people has found just partially positive.

## 10. Recommendation

In order to control environment pollution, the following recommendation will be useful to reduce the impact of gravel, sand and stone mines.

- a. Refuse to provide permission to start new mines or reject permission to re-open the mines. Permission should be given only if the required materials are not existed in given area. This would be appropriate where the damage has already occurred and prevention of incoherent and random accumulation of sand, gravel and stone mines is required.
- b. Enforcing existed emission permits strongly and consistently. To obtain this, the state would recruit more competent inspectors to take more appropriate actions against mining operations.
- c. Refuse to give permission for operating mining in unsuitable locations. It should be ensured that the permission should not for mines to be operated in historical area of Chapagaon, residential area, rural communities as the mining will destroy charming of such areas.
- d. Motivate to use re-processed materials such as recycled stones, gravels etc. This would definitely reduce the beginning of new mines and aids to resolve the overloading problems in mining areas.
- e. The historical and natural sites of Chapagaon are to be protected for the prospects of tourism in this area, so the mining industries are essential to be shifted to the other places than presently existed.
- f. The areas which are far from the local area, these kinds of areas should be managed for the mining.
- g. Miners need to use environmentally friendly equipments.
- h. People awareness programme should be conducted from the Miners and from government about the impact of mining industries.
- i. Tree planting programme should be conducted from Miners and local people.

## References

- Aigbedion, I., & Iyayi, S. E. (2007). Environmental effect of mineral exploitation in Nigeria. *International Journal of Physical Sciences*, 2(2), 33-38.
- CBS. (2011). *Preliminary Results of National Population Census*. Government of Nepal: National Planning Commission Secretariat.
- Child Labour report. (2009). *Children Working in Mining Industry*. World Education and its Ngo partners, Kathmandu.
- MOI. (2009). *Mines and Minerals Acts and Regulations*. Government of Nepal: Ministry of Industry, Department of Mines and Geology.
- Ghose, M. K., & Roy, S. (2007). Contribution of small-scale mining to employment, development and sustainability—an Indian scenario. *Environment, Development and Sustainability*, 9(3), 283-303. <http://dx.doi.org/10.1007/s10668-006-9024-9>
- Noetstaller, R. (1994). *Small-scale mining, practices, policies, perspectives*, In: *Small-scale Mining—A Global Overview* (pp. 3-10). In A. K. Ghose (Ed.). New Delhi: Oxford & IBH Publishing Co.
- Shrestha, S. H. (2004). *Economic Geography of Nepal* (2nd ed.). Kathmandu: Educational Publishing House.
- Sivacoumar, R., Jayabalu, R., Subrahmanyam, Y. V., Jothikumar, N., & Swarnalatha, S. (2012). *Air pollution in stone crushing industry, and associated health effects*. National Environmental Engineering Research Institute. CSIR, Taramani-600 113, INDIA.
- Zenz, C., Dickerson, B., & Horvath, E. B. (1994). Occupational medicine, Mosby, St. Louis, 167–236. Gavin Hilson, Pollution prevention and cleaner production in the mining industry: an analysis of current issues. *Journal of Cleaner Production*, 8(2), 119-126.

## Notes

Note 1. Village Development Committee (A VDC has a status as an autonomous institution and authority for interacting with the more centralized institutions of governance in Nepal).

Note 2. Child Labour Status Report

Note 3. Brahmā is the Hindu god (deva) of creation and one of the Trimūrti, the others being Viṣṇu and Śiva.

Note 4. Astami is the eighth day (Tithi) of Hindu lunar calendar.

Note 5. SaraswatiJatra (Puja) or Shree Panchami is the day to celebrate the birthday of Saraswati (the Goddess of Learning).

Note 6. A festival of Bhairab, Bhairava, sometimes known as Bhairo or Bhairon, is the fierce manifestation of Shiva associated with annihilation. He is one of the most important deities of Nepal, sacred to Hindus and Buddhists alike. Bhairava is invoked in prayers to destroy enemies.

Note 7. The Newari Festival of Samyak Mahadan occurs once every five years.

Note 8. A local festival of Tika Bhairab; Lele, Nepal.

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