Water Security in Peri-Urban South Asia

Adapting to Climate Change & Urbanization

REPORT ON STATE OF SAND MINING AT PERI-URBAN KATHMANDU: CASE OF JHAUKHEL VDC

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1. Introduction

Rapid urbanization in Kathmandu valley since 1980s has increased the demand of sand for construction purposes. Demand of sand was fulfilled from river bed sand mining mostly located at northern regions of the valley until government of Nepal prohibited riverbed sand mining in the valley in 1991 AD. Government of Nepal had prohibited river bed sand mining as a response to collapsing of Bagmati Bridge linking Kathmandu and Lalitpur resulted from haphazard exploitation of sand in 1991AD. Similarly, destruction of bridge at Shankhamul and exposure of foundation of different bridges compelled government to enforce prohibition of riverbed sand mining in Kathmandu Valley. As an alternative, sand deposited on hillocks at northern regions were started to be quarried to meet demand of sand in the valley. In 2007, about 40% of market demand was supplied from terrace sand mining from Rahultar, Baniyatar, Adhikarigau, Aryalgau, Baluwapati, Gothatar and Mulpani (Sayami *et al*., 2007), most of which located at northern region of the Valley. Recently, terrace sand mining has extended to northern hillocks at Duwakot, Sarswoti Khel, Changu Naryan and Jhaukhel of Bhakatpur district.

This study brings out the trajectory of sand mining in Jhaukhel including the current status of sand mining and investigates the financial gains that have been created by sand mining. Furthermore, it highlights upon the social and environmental impacts of sand mining that have been observed and perceived by the local communities of Jhaukhel which is expected to be helpful in guiding the concerned regulatory authorities for more serious consideration of the potential long term consequences of widespread sand mining.

1.1 Problem Statement

Following the rapid urban expansion of Kathmandu valley, there has been a significant boom in sand demand which has attracted the miners towards terrace sand mining especially after 1990s, after the restriction was posed on river bed sand mining. Sayami and Tamrakar (2007) estimation shows excessive growth of infrastructure demanded about 3100 m^3 of sand per day in the Kathmandu Valley, most of which is extracted from the peri-urban areas of the valley.

Sand mining contributes to the construction of buildings and development and provides both economical and social benefits. However, studies have shown that intensive sand mining with disregard to the environmental significance is accompanied by a series of socio-economic and environmental problems. Sand mining has adverse impact on groundwater recharge (Nagaraj, 1968; Hemalatha et al., 2005; Rao, 2006; Chandrakanth *et al*., n.d and Rodrigo, n.d). Studies have also shown its negative effects include the permanent loss of sand in areas, as well as habitat destruction (Rabie *et al*., 1994; Byrnes and Hiland, 1995). The impacts of sand mining inform of destruction of public assets,

degradation of water sources pauperizes the livelihood of local communities. Agrarian communities are highly vulnerable to the impacts of sand mining due to loss of soil quality due to mining or deposition of waste or increased natural calamities as consequences of indiscriminate sand mining (Viswanathan, 2002; Ashraf *et al*., 2011; Aromolaran, 2012).

Extensive and uncontrolled sand mining has been ongoing in Jhaukhel VDC. It is in this context the study has been conducted to understand the state of sand mining in this VDC and implications that have been affecting the local communities.

1.2 Objectives

The general objective of the study was to document the trend and the current state of sand mining including its socio-economic implication. The specific objectives are:

1. To review the history of sand mining, document the current state, locations of sand mines, extraction mechanisms,
2. To estimate the volume of sand extraction and financial transactions involved in sand mining operation,
3. To examine the socio-environmental impacts of sand mining based on the experiences, observation and perceptions of local people.
4. To understand the regulatory mechanism established for the sand mining and to analyze whether or not the field realities conform to the prescribed terms and conditions.

1.3 Limitations

The contract with Bhaktapur DDC for the sand mining provides license for four years. During discussions with the mine operators it was revealed that practically, it was not possible to extract both authorized and unauthorized sand within the contract period. In such case the mine operators renew their mining contract for successive year at the payment of the renewal charge defined by the DDC. This allows the same miners to continue the sand extraction till the total extractable sand is dredged out.

Though sand extraction may extend over four years, the total volume of sand extracted is same and has been going without considering prescribed environmental management aspects. The sand miners continue to extract the sand deposit intensively until the land is devoid of extractable sand. Therefore, the study puts significance on the total volume of sand extracted rather than the duration within which the sand extraction is accomplished. The annual volume of sand extracted calculated in the study is thus based on the condition that sand mining is accomplished within four years contract period.

2. Methodology

The study is based on qualitative research design involving direct field observation and semi-structured interviews with local residents, government and non-governmental officials from DDC, tax collectors and sand mine operators to capture the information on

sand extraction at Jhaukhel. The sand mines were visited to obtain the overview of those places and the heights of the hillocks were identified using GPS (Global Positioning System). Semi-structured interviews and informal discussions were conducted with the local people and the mine operators at four sand mining sites in the VDC to understand the perceptions on positive and negative implications of the sand mining expanding over the area. Secondary sources of data from local organizations, VDC and DDC have been reviewed to substantiate the findings from the formal and informal interactions.

3. Study area

Jhaukhel Village Development Committee (VDC) is located at 85°24” East and 27° 40” North and lies about 2 km north of the city core of Bhaktapur Municipality. Located at the northern flange of Bhaktapur Municipality, this VDC covers an area of 5.41 sq. km. The VDC is inhabited by total of 7721 people (Male- 3908 and Female- 3813) in 1631 households (CBS, 2012). In the last decade, the population in the VDC increased by 1.56% with the addition of 435 (3.68%) households. This VDC lies in the northern ground water recharge zone among the three distinct groundwater zones in Kathmandu Valley identified by JICA (1990).

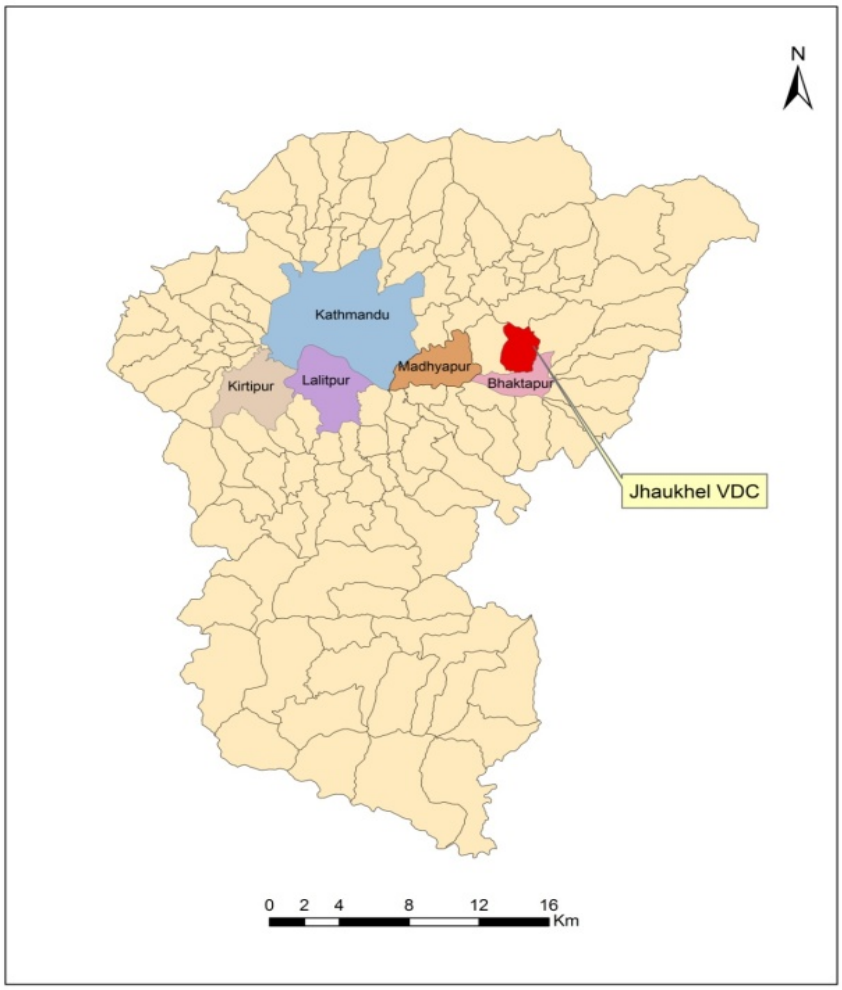

Figure 1: Study area: Jhaukhel VDC

4. Result and Discussion

4.1 Existing legal Procedure for Sand mining

The Mines and Mineral Act, 1985 and its amendment in 1993 and the Mines and Mineral Regulation, 1999 constitute the legal framework for operation, regulation and administration of the mineral development activities in Nepal. This Act and Regulation has endowed minerals of Nepal as property of Government of Nepal as it states, “All minerals lying or discovered on the surface or underground in any land belonging to an individual or the government within Nepal is property of the government of Nepal”. Furthermore, it has stated exclusive power to carryout mining operation is entitled to government of Nepal and may undertake mining operation by itself or it may issue license any person to operate mining.

Since fiscal year 1977/78 AD, sand deposits have been leased, licensed and extracted under the supervision of the District Development Committee (DDC). The Local Self

Governance Act 1999 empowers the local governments- Municipalities and Village Development Committees (VDCs) as custodian of natural resources at the local level, and hence they are expected to ensure conservation and restoration of natural resources, within their jurisdiction. After implementation of Local Self Governance Act and Regulation, 1999, DDC has been the authorized institution for approving mine operation in the district. The conditions formulated by DDC for operating the mines in the district include clear demarcation of borders, placing pillars around the mine, use of mine without harming the environment, protection of canals, water outlets and roads and prior permission for digging. Permission for sand mining is approved by DDC through licensing mechanism. The documents which need to be submitted to acquire license include as topographical map indicating sand mine, consents from land owners along with copy of certificate of land ownership and their citizenship certificates.

Compliance with the terms and conditions led by the Environment Protection Regulation (EPR) 1997 is considered the most important criteria for approval. Proof of public notice published for conducting public hearing for Initial Environmental Examination (IEE) and IEE report are mandatory to obtain approval from DDC. Recommendation letter from Village Development Committee or local government agency for operating mines and certified letter mentioning status of mine operator with a capacity of Rs.1 million running investment has to be included along with citizenship certificate of mine operator. The sand mining contract license is awarded at general meeting participated by Local Development Officer, Chief District Officer, Planning Officer, and representatives from Department of Mines and Minerals and Income tax Officer.

Jhaukhel VDC lies in Bhaktapur district. Bhaktapur DDC grants mining license for a maximum period of 4 years at a deposit of Rs. 600000, Rs. 400000 and Rs. 200000 based on capacity of mine as medium, small and ultra small (though no any such definition of medium, small and ultra small is defined. It is based on decision made by officers). This has to be renewed on an annual basis at the payment of 8% of deposited amount. In addition it charges a royalty of Rs. 25 and a tax of Rs. 300 per mini truck (5.6m^3). As per the discussions with the mine operators and officials at the Bhaktapur DDC, the sand mines in Jhaukhel are medium scale sand mines. However the IEE report submitted by sand mine at Tajale shows and annual deposit of Rs. 50,000 which is the amount defined by the DDC for small scale sand mine. This could be due to the absence of clear criteria and norms for the categorization of the mine sites.

VDC charges Rs. 2.5 per truck as local development fee in addition to a tax of Rs. 300 per truck.

4.2 Trajectory of Terrace Sand Mining in Jhaukhel VDC

Terrace sand mining in Jhaukhel VDC started since 1978 when sand required for construction of bridges and other infrastructure during construction of Araniko Highway was extracted from sand deposited on the hillock located at ward number 8. The hillock covered an approximate area of 16000 m^2 with an approximate height of 20m from the ground level and had a gentle slope. In an average 175000 cubic meters of sand was dug

out from the hillock. Thereafter trend of extracting terrace sand mining initiated in local level with land owner extracting deposited sand manually from their land.

By 1986 massive extraction of sand was observed in hillock located at Pipalbot in ward number 8. Sand deposited in an approximately 40000 m^2 of hillock was quarried manually by the land owners. The quarry was finally brought to end in 1993 after one of local resident cased a file in Bhaktapur DDC against sand miners stating quarrying activity has increased landslides during rainy season and his house will fall sooner if quarrying was continued. Bhaktapur DDC then issued an order to stop quarrying of sand and also declared if anyone interested on quarrying sand, has to receive license.

By 1990s continuous increase in sand demand with rapid urbanization of Kathmandu valley in Kathmandu valley and prohibition of riverbed sand mining in 1991 from Government of Nepal created more attraction towards large scale terrace sand mining. It was during 1993, license was issued to carry out mining activity in hillock located at Sarkiguan, a village inhabited by oppressed communities in ward number 8 of Jhaukhel. With the beginning of large scale extraction of sand deposited in hillocks of Jhaukhel, began the use of modern technology such as benching and excavator were used in order to extract large scale of sand deposited in the hillocks. Application of hydraulic excavator assisted mine operator to extract sand even from the depth of approximately 10 meters below ground level. Bhaktapur DDC stepped forward to shut down the mine in 2008 after a case was filed by households residing very close to mine site after the households were being increasingly exposed to risk of landslides as impact of mine operation. During this period small scales sand mining with manual extractions by land owners were also observed in ward number 3. These small scales sand mining were neither registered to any government offices nor had obtained license to extract sand deposited in their land.

High profit from terrace sand mining over a short time period attracted more local residents and farmers in Jhaukhel VDC towards manual sand mining or leasing out land to contractors for large scale sand mining. In 2006 terrace sand mining extended to hillock located in Kolpakot in ward number 6 of the VDC. The area of mine site was approximately 5000 m^2 with an approximate height of hillock was 24 m from the ground level. Extraction of sand from this area continued for three years and was finally brought down in 2009. After prohibition of terrace sand mining in Sarkigaun, in 2009 the mine operator started to extract sand from hillock located at Lakhaju in the same ward 8. The site was distributed in an approximate area of 12900 m^2. The maximum elevation of hillock was 1358 meter above sea level (absl) and ground elevation of 1335 m absl. The mine operators at Lakhaju were accused of illegal mining from deep below at water table and dredging sand from unauthorized land causing higher risk of landslides of the settlement. Operation of this sand mine was forbidden in 2011 after continuous protest from local residents in Baniyagaun against the mine operators. Table 1 gives the trajectory of terrace sand mining in Jhaukhel.

Currently three sand mines in Jhaukhel are in operation. These are hillocks at Tajale and Devdole located in ward number 8 and a small hillock at Sundarthali located in ward

number 5. Sand mining site at Devdole is a part of Sarkigaun sand mining site where the extraction was prohibited in 2009. After DDC banned the sand extraction from Sarkigaun, the mine operator has shifted towards Devdole for sand extraction. A large scale sand mining has been ongoing from sand deposited hillock located at Tajale, a boundary between Jhaukhel VDC and Duwakot VDC. Bhaktapur DDC has approved and provided license to extract sand from an approximate area 26000 m^2 since 2011. Similarly small scale terrace sand mining has operated in Sundarthali in ward number 5 since 2012. The approximate area of this mine site is 1400 m^2.

Table 1: Trajectory of terrace sand mining in Jhaukhel.

S.N.	Location	Started	Closed
1.	Ward no. 8	1978	1984
2.	Pipalbot, ward 7	1986	1993
3.	Sarkiguan, ward 8	1993	2008(Prohibited)
4.	Kolpakot, ward 6	2006	2009
5.	Lakhaju, ward 8	2009	2011 (Prohibited)
6.	Tajale,ward 8	2011	ongoing
7.	Devdole, ward 8	2011	ongoing
8.	Sundarthali	2012	ongoing

4.3 Terrace sand mining technology and estimated volume of minable sand

4.3.1 Sand Excavation Techniques

Hydraulic excavator is used to extract sand deposited from the hillock. Generally topsoil is removed with excavators until sand deposited in hillock is exposed. Excavator is also used for removing impermeable layer between sand layers and digging pit when sand deposited below ground surface of the hillock has to be extracted. Exposed sand from hillocks are extracted manually and loaded in trucks using tools like shovel, crowbars, peak and spade. Open cast mining with benching of minimum 5m x 5m is suggested to extract sand as a part of safety measures of laborers against potential cave-in and other accidents. However sand mines are operated without keeping them benched or sloped as prescribed in the agreement increasing risk of accidents in mine site and insurmountable environmental destruction for the residing communities.

Thus the total sand extracted from sand mine include

i. Extraction of sand deposited in hillock and
ii. Extraction of sand deposited at underground (below lowest surface of hillock).

Mine operator have authority and approved to extract sand deposited in hillock above lowest ground elevation according to terms of reference signed between DDC and mine operator. Hence extraction of sand deposited underground below lowest ground surface of hillock is illegal and hereafter termed as unauthorized mine.

In the study area, sand miners extract sand deposited in the hillocks within the approved area. These areas may include multiple sand deposited hillocks. Once the authorized sand

deposited in a hillock is mined out, the miners begin the extraction of authorized sand in other hillock and unauthorized sand underneath the mined out hillock simultaneously. Such a situation helps the sand miners to extract unauthorized sand illegally.

Figure 2: Sand mining in progress using an excavator

4.3.2 Estimation of volume of sand extracted

Authorized minable volume of sand deposited in hillocks is calculated based on the area of hillock and its height. In all mines, approximate thickness of topsoil is at the range of 1m and in every successive depth of 5m, approximate thickness of 1m impermeable soil is found which is considered as waste by operator. Thus total volume of sand deposited in the hillock is obtained after deducting top soil and waste soil. Minable volume of sand is further obtained as 2/3rd of total sand deposited in hillock as per experience of sand miner and considering slope of the hillock. Hence total authorized minable volume of sand is calculated as

$$V_{dep} = A \times (h_1 - h_2)$$

Where $\begin{cases} Vdep = Total\ Volume\ of\ sand\ deposited\ on\ hillock \\ h_1 = height\ of\ hillock \\ h_2 = total\ depth\ of\ topsoil\ and\ other\ waste \\ A = total\ Area \end{cases}$

$$V_{act} = \frac{2}{3} \times V_{dep}$$

Where, V_{act} = *Actual authorized Volume of minable sand*

Similarly unauthorized volume of minable sand extracted from the mine is calculated based upon area of mine site and depth of pit dug below lower surface of hillock with deducting volume of waste.

The height of the hillock at Tajale was obtained to be 15 m and the approximate height of waste as observed in field was 3 m. The estimated volume of authorized sand deposited at Tajale excluding topsoil and other waste was found to be 208000 m^3 as shown in Annex 1. As mine site has approved for operating for four years, potential volume of authorized sand that can be extracted annually is 52000 m^3. As the mining continues for eight months (240 days) annually except in rainy season, this volume of sand extracted amounts to an average of 39 trucks (each of 5.6m^3) per day. Similarly calculated unauthorized sand extracted annually from underground by digging pit is 34667 m^3 which amount to 26 truck/ day (Annex 2). Therefore annually a total of 86667 m^3 including both authorized and unauthorized sand is extracted from this site at the rate of 65 trucks per day continuously for 240 days. It has to be noted that as per the IEE report submitted for the licensing process shows a minable sand of only 40,320 m^3 as annual production. This massive variation between the permissible level and the actual trend not only indicate the weaknesses from the concerned monitoring authority but at the same time raises major issues of damages to local environment and endangered livelihood of local people over the short term profit created by unsustainable mining.

Similarly estimation shows the authorized volume of minable sand extracted at sand mine in Devdole is 266667 m^3. This amount to an annual extraction of 66667 m^3 of authorized minable sand which can amounts to an average rate of 50 trucks per day extracted continuously for 240 days. An unauthorized estimated volume of sand annually extracted from underground at this site is 50000 m^3 amounting to an average rate of 37 trucks per day. Thus total of both authorized and unauthorized extraction of sand from this site is estimated to 116667 m^3 annually at the rate of 87 trucks per day. The daily record book kept by tax collector for the year 2011 and 2012 shows a maximum daily transport of 60 trucks and an annual transaction of 4118 trucks (Annex 3) which equals to 23060 m^3 at the rate of 5.6m^3 per truck. This again unfolds the variation in the record maintained for the regulatory purpose and the sand extraction ongoing at the field. Sand mine at Sundarthali has comparatively less volume of estimated minable sand deposited in the hillock. Estimated authorized minable sand deposited is 42667 m^3, annually 10667 m^3 of sand is extracted at the rate of 8 trucks per day. Unauthorized minable sand extracted at the site is estimated to be 5333 m^3 annually at the rate of 4 trucks per day. Thus annually total of 16000 m^3 of both authorized and unauthorized volume of sand is extracted from the site. Thus estimated 129334 m^3 of authorized sand is extracted from Jhaukhel VDC per year which amounts to an average of 97 trucks per day when extracted continuously for 240 days. Similarly estimated 90000 m^3 of unauthorized sand deposited underground is extracted at the rate of 67 trucks per day. Thus the total sand extracted annually from the three operational mines of Jhaukhel is 219333 m^3. The table shows calculation of estimated authorized and unauthorized volume of sand deposited in the sand mining site of Jhaukhel.

Table 2: Estimation of the sand extracted

Descriptions	Unit	Locations			Total
		Tajale	Devdole	Sundarthal	

				i	
Maximum Elevation	m	1350	1360	1380	
Ground Elevation	m	1335	1340	1360	
Elevation at pit	m	1325	1325	1350	
Height of waste and top soil in the hillock	m	3	4	4	
Depth of waste and soil in the pit	m	2	3	2	
height of extractable sand excluding waste (authorized sand)	m	12	16	16	
Depth of pit from lowest surface of hillock	m	8	12	8	
Area of hillock	m^2	26000	25000	4000	55000
Total volume of sand deposited in hillock (authorized sand)	m^3	312000	400000	64000	776000
Actual authorized volume of minable sand (2/3 of Total)	m^3	208000	266667	42667	517333
Authorized volume of sand extracted annually	**m^3**	**52000**	**66667**	**10667**	**129333**
Actual total number of trucks of sand extracted		37143	47619	7619	92381
Number of trucks of authorized sand extracted per year		9286	11905	1905	23095
Number of trucks of authorized sand extracted per day		39	50	8	97
Volume of waste from hillock (area* height),	m^3	78000	100000	16000	194000
Total Volume of unauthorized sand deposition	m^3	208000	300000	32000	540000
Potential Volume of unauthorized extracted sand	m^3	138667	200000	21333	360000
Unauthorized volume of sand extracted annually	**m^3**	**34667**	**50000**	**5333**	**90000**
Number of total trucks of unauthorized sand extracted		24762	35714	3810	64286
Number of trucks of unauthorized sand extracted annually		6190	8929	952	16071
Number of trucks of unauthorized sand extracted per day		26	37	4	67
Total number of trucks of sand extracted in a year both authorized and unauthorized		**15476**	**20833**	**2857**	**39167**
Volume of waste from unauthorized extraction	m^3	52000	75000	12000	139000
Total Volume of sand extracted both authorized and unauthorized annually	**m^3**	**86667**	**116667**	**16000**	**219333**
Total number of trucks of sand extracted daily from both authorized		**65 (39+26**	**87**	**12**	**163**

and unauthorized		**)**			

4.4 Fixed Capital Investment, Annual Operation Cost and Profit Generated

Fixed capital investment on sand mine includes land compensation given to land owner, expenses on removal of top soil and preparation of benches in the mines. An approximately 57.6% of total fixed capital invested is allocated for this purpose. Similarly 16.7 % budget is allocated for expenses on civil works such as construction of track to the mine site, office building in mine site as mandatory conditions set by to terms of reference between DDC and mine operators and expenses to minimize environmental degradation caused from mining of sand. For purchases of manual tools for extraction of sand and its loading 15 % out of total fixed investment is allocated. Finally 10.7 % of fixed capital investment is allocated for furniture and services that includes service charges for consultancy and mining license. According to document submitted by mine operator at Tajale and approved by DDC, the total fixed capital investment was Rs. 1,737,000.

In addition to the fixed capital investment, total cost for extraction of sand comprise of the annual operation cost which includes salary and wages for staffs and labors. Approximately 47 % of annual operation cost is estimated for salary and wages. Similarly approximately 53% annual operation cost is estimated for miscellaneous expenses such as depreciation on fixed investment of physical infrastructure and tools, royalty, insurance, soil filing and social welfare. An approximately Rs. 15,501,550 is estimated annual operation expenses for extraction of sand at Tajale.

Annual profit generated from extracting sand mining is obtained by deducting total annual operation cost from total annual income from selling of sand. The document submitted to DDC in 2011 shows an estimated volume of sand minable annually from Tajale is 40320 m^3. This volume of sand accounts to 7200 number of trips per year by truck with a capacity of carrying 5.6 m^3 of sand in every trip. The selling price of sand at the mine is Rs. 2500 per truck and at this rate, the total income generated annually from selling of 7200 trucks of sand is Rs. 18000000. Hence annual profit is Rs. 2498450 and return period of fixed capital investment is 0.7 years. The fixed capital, annual operation cost and profit of mine operator are given in Annex 2.

4.5 Compliance of mine sites with the agreed Terms and Conditions

The terms and conditions in the administrative documents required for license approval prescribes a certain conditions to certain the win-win situation between land owner of the mine, local community, safety measures against the potential accidents and the environmental sustenance including the financial feasibility for the investor. However the relalities at the mine site varied from those agreed in the paper.

Fixed capital investment on land compensation, removal of topsoil and preparation of benching is observed to be lower as estimated submitted by mine operators to DDC. In absence of strong legal provision to safeguard proprietorship of land, land compensation is only given to those land owners able to resist and oppose against the sand mafias until

they are compensated. This often results no financial gain for the land owners rendering the land into useless condition after the sand miners walk away or are shut down without restoring the land. Even in cases of compensation, with no rate predefined for sand removal, the amount given to land owner as compensation is fixed through negotiation between the owner and extractor which is not disclosed by both parties. Thus capital investment shown for land compensation in the IEE report is limited within the document required for official in gaining mining license.

Field observation of mine site and report of monitoring and evaluation from DDC shows benching technology is not followed for extraction of sand. Similarly no any safety arrangement was found to be provided to labors. Thus fixed capital investment is much lower than that mentioned in the IEE report. Annual operation cost differs with differences with those mentioned in IEE report submitted to DDC with the variation in technology applied, volume of authorized minable sand and extraction of unauthorized minable sand. All three sand mining sites at Tajale, Devdole and Sundarthali used excavator for removing topsoil, waste and digging pits. This increases total annual operation cost as charge for excavator and required fuel is higher as compared to manual extraction. Similarly operation cost increases as royalty, development fee, land owners share and labor cost increases due to increased volume of authorized minable sand and unauthorized extraction of sand and with extension of mine operation time period.

Though the regulatory body has formulated the environmental management plan such as construction of siltation pond and drainage, dump yards, slope stabilization and drinking water management, no significant expense for these activities was made onsite and outside the premises of sand mine sites. It is worthwhile to notice that tax collected by VDC and DDC each with Rs. 100 and Rs. 250 per truck is paid by costumer during transaction rather than mine operator as mentioned on their document provided to DDC. Thus in an over all, annual operation cost based on field observation was higher than estimated by mine operators due to unchecked mining. However cost per unit volume of sand decreases as volume of both authorized and unauthorized minable sand is increased. Thus annual profit generated by mine operators is much higher despite of increasing total annual operating cost.

Table 3 gives the details annual cost and profit through authorized and unauthorized extraction of sand which shows an annual profit of Rs. 2,275,0174, Rs. 33,317,090 and Rs. 3,196,421 at Tajale, Devdole and Sundarthali respectively. This illustrates strong inference for sand mining activities that has been ongoing in full swing. It also creates doubt on the monitoring and regulatory activities from the concerned authority which has been conniving to the extensive sand mining that has been spreading rampantly despite irretrievable long term losses and local opposition.

Figure 3: Sand mine site at Jhaukhel

Table 3: Total annual cost, income and profit through authorized and unauthorized extraction of sand

Annual Operation Cost								
Salary and Wages		Tajale			Devdole		Sundarthali	
S.N.	Particulars	Estimated by mine operator	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining
1	Supervisor	195000	195000	195000	195000	195000	180000	180000
2	Accountant	130000	130000	130000	130000	130000	12000	12000
3	Peon/Guard	208000	208000	208000	208000	208000	-	-
4	Labours	6720000	4643000	7738000	5952500	10416500	952500	1428500
	Sub total	**7253000**	**5176000**	8271000	6485500	10949500	1144500	1620500

Other operating Cost			Tajale			Devdole		Sundarthali	
S.N.	Particulars	Unit Cost	Estimated by mine operator	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining
1	Depreciation @ 20% fixed cost		260550	260550	260550	260550	260550	*	*
2	Mining License renewal		50000	50000	50000	50000	50000	30000	30000
3	Office expenses		60000	60000	60000	60000	60000	20000	20000
4	Royalty (7200 trucks)	Rs.25/ truck	180000	232150	386900	297625	520825	47625	71425
5	Local Development Fee	Rs.2.5/truck	18000	23215	38690	29762.5	52082.5	4762.5	7143
6	Mining Implements (Repair, Replacement for 8 months)	Rs.10000/month	80000	80000	80000	80000	80000	*	*
7	Land Owner Share	Rs.500/truck	3600000	4643000	7738000	5952500	10416500	952500	1428500

8	Cost of environment Management Plan	Rs.20000/month	240000	*	*	*	*	*	*
9	Tax (DDC, VDC)	Rs. 300/truck	2160000	*	*	*	*	*	*
10	Soil Filing		1000000	1000000	1000000	1000000	1000000	160000	160000
11	Incidental Expenditure		200000	200000	200000	200000	200000		
12	Social Welfare		200000	200000	200000	200000	200000	200000	200000
13	Insurance		200000	200000	200000	200000	200000	200000	200000
14	Excavator Charge	4000 /day	*	960000	960000	960000	960000	960000	960000
15	Fuel and Maintenance		*	2550000	4233000	4233000	4233001	677280	677280
	Sub Total		**8248550**	**10458915**	**15407140**	**13523438**	**18232959**	**3252168**	**3754348**

Cost Benefit Analysis of transaction of Sand									
			Tajale			Devdole		Sundarthali	
S.N.	Descriptions	Unit	Estimated by mine operator	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining	Estimated on authorized mining	Estimated including unauthorized mining
1	Salary and Wages	Rs.	7253000	5176000	8271000	6485500	10949500	1144500	1620500
2	Operating Cost	Rs.	8248550	10458915	15407140	13523438	18232960	3252168	3754348
	Sub Total	Rs.	15501550	15634915	23678140	20008938	29182460	4396668	5374848
3	Production of sand per year	m^3	40320	52000	86667	66667	116667	10667	16000
4	Cost per cubic meter of sand	Rs./m^3	384	301	273	300	250	412	336
6	Cost per production of truck	Rs./5.6m^3	2153	1684	1530	1681	1401	2308	1881
7	Selling Price of truck of sand	RS/5.6 m^3	3000	3000	3000	3000	3000	3000	3000
8	Profit per truck	Rs./5.6m^3	847	1316	1470	1319	1599	692	1119

	Annual Profit	**Rs.**	**6098450**	**12222604**	**22750174**	**15705762**	**33317090**	**1317920**	**3196421**

4.6 Social and Environmental Impact of Sand Mining

Landslides, debris flow and depletion of ground water has been major impact due to terrace sand mining and improper management of slope, dumped area and unauthorized extraction of sand deposited underground. *Dalit Basti*, a settlement of oppressed community in Sarkigaun and Baniya Tole at ward number 8 is most affected from continuous sand mining in Jhaukhel VDC. These marginalized and discriminated communities are vulnerable to landslides with due to unstable and unmanaged gradient of slope after extraction of sand.

The traditionally practiced livelihood by the households in Sarkigaun is to make and repair shoes. The only property owned by the eight poor households residing in this village is the land in which their houses stand. Terrace sand mining at hillock on their settlement (*Sarkigaun*) began in 1993. Large scale sand mining approached very close to their settlement in 2008 with an intention to relocate these households to other place by mine operators. Mine operators tried to lure them with compensation of Rs. 500000 to Rs. 1000000 for shifting of their house temporarily until sand is extracted from their settlement. However, proposed compensation was rejected as amount was insufficient to construct temporary house as no any other land was owned by them. Instead they registered an application letter at Bhaktapur DDC requesting to prohibit sand mining in their settlement for protecting their settlement from the potential landslides emerging with unchecked sand mining. After continuous 6 months of hue and cry against sand mining, Bhaktapur DDC raided the mine sites and finally issued a notice to suspend sand mining until mutual understanding get established between two parties.

Suspension of sand mining has not provided permanent solution as the mine operators have not proceeded towards slope stabilization that is demanded as per the regulatory mechanism. Thus the settlement is under extreme risk due to the landslide occurring in every rainy season. Landslide due to haphazard terrace sand mining and mud slide thereafter stripped off the traditional source of drinking water in the settlement. With an aid of Rs. 40000 from DDC they have constructed a well but level of water is insufficient their water requirements. Furthermore continuous sand mining has deprived this marginalized community of transportation facility after sand mining incurred complete loss of traditional foot trail that connected their settlement to main road.

Sarkigaun is not the only settlement stressed due to the consequences of sand mining. Similar has been the case in Baniya tole located at ward number 8 which is vulnerable to landslide due to large scale sand mining at Lakhaju. Sand mining at Lakhaju began in early 1991 without any consent of local resident at Baniya tole. By 2011 sand mining had extended to almost only 200m from the settlement. It was only then that the local residents noticed sand was also being dredged from lands which were not leased out. The local residents protested against mine operator for their illegal mining and requested DDC to immediately ban sand mining to protect the settlement from landslide. The site was inspected by DDC authority after collective agitation by the local residents and Environment Conservation Forum, a local NGO made at sand mine site and DDC office. DDC has imposed ban on extraction of sand when mine operator were found guilty after

monitoring. However no any slope maintenance procedure was implemented leaving 40 households at Baniya tole vulnerable to landslide.

Figure 4: Households vulnerable to landslide due to unmanaged slope after sand mining

4.6.1 Debris Flow from Dumped Area into Farm Land

Debris flow and mud wash to farm land nearby mine site is another major environmental problem created with terrace sand mining. In every rainy season heavy rain, wash away waste dumped at mine site to farm land and traditional drains. Debris from sand mine damages cultivated crops and add burden to farmers for maintaining their farm land fertile. The most remembered debris flow from sand mine was during rainy season in 2009 at farm land located at down hills of Tajale. The local residents recalled farm land and crops worth around Rs. 1600000 was damaged due to the incident. They accused mine operator for the incident as siltation pond was not constructed and thus unmanaged deposition of waste generated during extraction of sand caused the devastation. However none of these farmers precede legal action to be taken against culprit. Thus no any compensation was given to farmers.

Figure 5: Cultivated farm lands exposed to debris flow from sand mining

4.6.2 Loss of Traditional water sources

Local residents noted increasing water scarcity after terrace sand mining started in the area. They recalled a traditional stone spout known as Khujocha Hiti (Newari term for stone spout) located at ward number 8 with discharge of almost 2000 litres per minute disappeared in late 1980s as an impact of mining the sand required for construction of Araniko Highway. The stone spout used to be reliable source of domestic water requirement for the local residents. It also served large number of households from Bhaktapur Municipality to carry out washing of their clothes. Additionally the discharge from the stone spout used to contribute in irrigating a large area of land. The stone spout and a spring in Nabala area had been a reliable source of irrigation for the farms located at Lukhondole area. Sand mining at Lakhaju tole since 1991 and unauthorized extraction of sand from underground to the level of water table has decreased discharge in Nabala spring. Farmers in this area have experienced decrease in discharge from Nabala spring to 95% during dry season since 2010.

Figure 6: Discharge at Nabala Spring source during monsoon and dry season

4.6.3 Depletion of Groundwater Table

In order to investigate impacts of sand mining on groundwater table an assessment of groundwater table was carried out. The level of water in dug wells during dry season was recorded in Baniya tole and Lamsal Tole at a distance of 200m and 300m from sand mine site at Lakhaju. Similarly assessment was carried at Lakhaju and Devdole a high level sand extraction site which measured the current depth of well and level of water during dry season. To obtain information on depth of well and water in it at past, group discussion is organized in the settlement.

The depth of the oldest dug well in Baniya tole constructed during 1984 was 28 ft. The single public well served almost every households till 1993 and level of water recorded was 6 ft with continuous discharge even during dry season. As per the local residents, depletion of water level was noticeable since 1993 with terrace sand mining at Lakhaju. As a response, depth of the well was increased to 30 ft but could not succeed to provide sufficient water to every household during dry season. Thus a trend of constructing dug well at household began since 1993.

While the average depth of well constructed during 1984 to 1993 was 29 ft, the average water level during dry season had declined from 6 ft to 5.1 ft. Depletion of water table significantly increased after 2002 when unauthorized extraction of sand from underground increased at mine site. The analysis of the depth of the wells constructed between 2002 and 2011 shows an average depth of 34 ft. Thus there was a progressive increase in the depth of the wells with an average increase of 5 ft compared to 1984. On the other hand the level of water in well during 2011 was only 2.7 ft. Thus level of water table had depleted by 2.4 ft during the same period.

Table 4: Depth of well and water level at Baniya Tole at different time period

S.N.	Deepest well in Baniya Tole (ft)	Depth of water level During dry season (ft)	Year	No. of wells
1	28	6	1984	1
2	30	6	1993	1
3	31	5	2002	3
4	35	4.5	2008	5
5	35	2.7	2011	5

Similarly the average depth of wells at Lamsal tole constructed during 2005 and 2006 was 31 ft. Initially average level of water during dry season was 6.25 ft and local residents experienced gradual depletion of water table since 2008. In 2011 average depth of water level in wells is 4.25 ft at constant depth of 31 ft well. Hence average depletion of groundwater in Lamsal Tole is recorded to be 2ft since 2008.

Severity of groundwater depletion due to sand mining is prominent through a case in Lakhaju. During 2005, a farmer in this area had constructed 80 ft deep well for irrigating his field. Though the water level during that period was available at 40 ft deep having witnessed the massive groundwater depletion in Sarkigaun due to sand mining, he decided

to dig well much deeper so as to escape the groundwater depletion that could result due to ongoing sand mining at Lakhaju. Despite his preplan, during dry season in 2011 the level of water in his well was 14.5 ft resulting scarcity for irrigation. Similarly another farmer in Lakhaju became victim of unchecked sand mining after sand mining resulted into a massive drop in the water table in his well. He had constructed the well 25 ft deep in 2007. The yield of well was enough for lifting through 2 inch polythene pipe continuously for 2 to 3 hours to irrigate his field. After extraction of sand mining both on the hillocks and underground, since 2009, the level of water in his well was only around 1.5 ft. Despite using electric pump of 1Hp capacity, it was possible to uplift water only for 15 minutes through a 0.5 inch polythene pipe.

Maximum depletion of water table was recorded at Devdole where unauthorized extraction of sand is highest. The assessment carried on new settlement established on flat terrain after extraction of sand. Continuous extraction of sand is still ongoing at only 20 m away the settlement. The oldest deep boring in the settlement was constructed by immigrant Chandra Maya Yogi in 2007. The depth of deep boring was 105 ft and the water table water was observed at the depth of 45 ft. However anticipating the drop in water table, the submersible pump was fitted at 60 ft from the ground level. Despite her advance precautions, the depletion of water table by 10 ft by 2007 and she had to readjust the submersible pump at the depth of 70 ft. Similarly another immigrant Krishna Prasad Nepal has constructed deep boring of 120 ft during 2010and the water level was observed at the depth of 60 ft. By 2012, the water table dropped by 30 ft adding expense of readjusting the submersible pump to a depth of 90 ft. Despite additional investment the discharge had reduced significantly. It took only 10 minutes to uplift 1000l of water using 1 Hp submerged pump in 2010 and by 2012 it took around 25 to 30 minutes to uplift the same quantity of water. He considered this was the impact of large scale underground sand extraction which had continued even after the conversion of the hillock into a flat terrain due to sand mining.

Another resident Arjun Khadka with 120 ft deep boring constructed in 2011 have attached submerge machine at the depth of 75 ft but the expense could not resolve his water problem. With very less discharge during dry season, the boring has not been a reliable water source.

The local residents including the farmers in the area appreciate the significance of sand as natural reservoir of water and its role in the groundwater recharge. They considered the unsustainable extraction expanding for short term monetary benefit disrupting the natural environment and the filling up of the pit with impermeable soil blocking the soil water movement has been responsible for the massive decline in water table.

4.7 Perception of Local Residents and Sand Miner

The analysis of the perception of the local people and the mine owners showed that local people commonly perceived sand mining as an easy means of money making at the cause of environmental degradation. They perceived sand mine operator and land owner were the ones most benefitted from mining. Land owner and mine operators on the other hand

perceived mining as utilization of the local resource. They argued mining as a helpful way of converting unproductive and unfertile hillock into valuable flat land. As per them, sand mining additionally contributes to the economic growth in VDC and provides with job or informal income opportunity for local residents.

Interaction with the local residents regarding continuity of mining revealed majority of respondents (75%) perceived that it should be stopped immediately. Around 15% of respondents perceived that sand mining activities primarily the labors had promoted the business at their grocery or tea shop shops. Though sand mining had created benefits in the short terms, there was a understanding among there group that the long term damage due to unsustainable sand mining could be terrible and hence had no clear idea whether or not the ongoing sand mining should be promoted or seized. 10% of local residents were for some reason unwilling to express their perception or had no idea regarding terrace sand mining.

Local residents listed decrease in ground water level, drying of natural water sources and instability of slopes/ mud slides as the main negative impact of unmanaged terrace sand mining. 75% of respondents ranked decrease in ground water level as most serious impact followed by instability of slopes and increased risk of landslides ranked by 58%. The improper management of waste from mine, the flow of which into the agricultural land devastation the crop and land fertility was ranked as the third serious impacts induced from sand mine. Drying of natural spring and damage to the settlement and public structures primarily potential damage to roads during excavation and transportation was considered other serious negative impact with 33% of respondents mentioning these impacts. The chart of negative impacts and its rank with percent of their mentioning by local residents is given in Table 5.

Table 5: List of negative impacts and its rank

S.N.	Negative impacts	Percentage of respondents
1.	Decrease in groundwater level	75
2.	Instability of slopes/ mud slide	58
3.	Degradation of agricultural land	42
4.	Danger to shelter	33
5.	Damage to road	33
6.	Drying of natural springs	33
7.	Change in natural drainage system	25
8.	Air pollution	8

Majority of local residents with 65% perceived prohibition of terrace sand mining as better solution for problem induced by sand mining. 25% of respondents perceived proper management of mine sites and effective monitoring and regulation of the sand mines by the concerned authority can reduce environmental impacts and at the same time provide better solution to extract sand. Similarly 10% of respondent perceived unauthorized sand mining as major cause of decreasing groundwater level and drying of natural spring and

stressed that unauthorized extraction of sand from the underground should be strictly prohibited.

5. Conclusion

Sand deposited hillocks are local resource that provides opportunity for economic growth through its mining and Jhaukhel VDC definitely has prospect of economic growth through its sand resource. However, ongoing haphazard extraction of sand deposited in the hillocks and additionally dredging sand from under surface without following the established regulatory mechanisms has been benefiting limited mine extractors while damaging the local ecosystems as well endangering the livelihood practices of the local people. The negative impacts have been manifested in water resources, agriculture as well as pose threat to the public structures and the entire settlement. This has been bringing confrontation between community and mine extractors.

The unchecked sand mining in the VDC explains the weak monitoring and control mechanism from the concerned agency. This has encouraged the mine extractors to mine in contravention of the regulatory agreements. Furthermore the absence of any activity towards environmental management despite warning from the regulatory bodies also creates doubt on the effectiveness regulatory mechanisms. Such a situation is very likely to result into outbreak the violent conflicts.

Therefore the study shows that though sand mining has contributed to generate revenue to different administrative levels, mine extractors are primarily driven by the interest of earning maximum profit. The absence of obligations among the mine extractors towards their social and environmental responsibilities has made the local community highly vulnerable to multiple hazards that can follow as consequences of rampant sand mining. Therefore, the study stresses on the need of intensive monitoring of the mine sites, regular interaction with the local community and strengthening the regulatory mechanism. The study also suggests the mine extractors for the sustainable extraction of the resource and at the same time it recommends local community to be proactive towards the controlling haphazard extraction and bringing the economic benefits for the local development.

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Annexes

Annex 1:

Calculation of volume of sand being mined (Authorized)

i. At Tajale

$Area\ of\ the\ mine\ site\ (A) = 26000m^2$

$Height\ of\ the\ hillock\ (h_1) = 15m$

$Height\ of\ waste\ and\ topsoil(h_2) = 3m$

$Minable\ height\ (h) = (15 - 3)m = 12m$

$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h = 312000m^3$

$$\boldsymbol{Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}}$$
$$\boldsymbol{= 208000\ m^3}$$

$$\boldsymbol{Authorised\ sand\ minable\ annually = \ = \frac{V_{act}}{4} = 52000\ m^3}$$

ii. At Devdole

$Area\ of\ the\ mine\ site\ (A) = 25000m^2$

$Height\ of\ the\ hillock\ (h_1) = 20m$

$Height\ of\ waste\ and\ topsoil(h_2) = 4m$

$Minable\ height\ (h) = (20 - 4)m = 16m$

$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h = 400000m^3$

$$\boldsymbol{Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}}$$
$$\boldsymbol{= 266667m^3}$$

$$\boldsymbol{Authorised\ sand\ minable\ annually = = \frac{V_{act}}{4} = 66667\ \ m^3}$$

i. At Sundarthali

$$Area\ of\ the\ mine\ site\ (A) = 4000m^2$$

$$Height\ of\ the\ hillock\ (h_1) = 20m$$

$$Height\ of\ waste\ and\ topsoil(h_2) = 4m$$

$$Minable\ height\ (h) = (20 - 4)m = 16m$$

$$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h = 64000m^3$$

$$\boldsymbol{Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}}$$
$$\boldsymbol{= 42667m^3}$$

$$\boldsymbol{Authorised\ sand\ minable\ annually = = \frac{V_{act}}{4} = 10667\ m^3}$$

Note: Height of hillock is obtained using altimeter, height of waste is based on field observation.

Annex 2.

Calculation of volume of sand being mined (Unauthorized)

i. At Tajale

$Area\ of\ the\ mine\ site\ (A) = 26000m^2$

Depth of pit from lowest surface of hillock$(h_1) = 8m$

Depth of waste and soil in the pit $(h_2) = 2m$

$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h_1 = 208000m^3$

$Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}$
$= 138667\ m^3$

$\boldsymbol{Unauthorised\ sand\ minable\ annually = = \frac{V_{act}}{4} = 34667\ m^3}$

$Volume\ of\ waste\ from\ unauthorised\ extraction = A \times h_2 = 52000m^3$

ii. At Devdole

$Area\ of\ the\ mine\ site\ (A) = 25000m^2$

Depth of pit from lowest surface of hillock $(h_1) = 12m$

Depth of waste and soil in the pit$(h_2) = 3m$

$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h_1 = 300000m^3$

$Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}$
$= 200000\ m^3$

$\boldsymbol{Unauthorised\ sand\ minable\ annually = = \frac{V_{act}}{4} = 50000\ m^3}$

$Volume\ of\ waste\ from\ unauthorised\ extraction = A \times h_2 = 75000m^3$

iii. At Sundarthali

$Area\ of\ the\ mine\ site\ (A) = 4000m^2$

Depth of pit from lowest surface of hillock $(h_1) = 8m$

Depth of waste and soil in the pit$(h_2) = 2m$

$Volume\ of\ deopsited\ sand\ (V_{dep}) = A \times h_1 = 32000m^3$

$Volume\ of\ minable\ sand\ (considering\ slope\ of\ the\ hillock) V_{act} = \frac{2}{3} \times V_{dep}$

$= 213333\ m^3$

$\boldsymbol{Unauthorised\ sand\ minable\ annually = = \frac{V_{act}}{4} = 5333\ m^3}$

$Volume\ of\ waste\ from\ unauthorised\ extraction = A \times h_2 = 12000m^3$

Annex 3. Fixed capital investment, annual operation cost and Profit

Fixed Capital Investment			
1. Land and Land Development			
S.N.	Description	Amount (Rs)	
1	Land Compensation	800000	
2	Removal of Top Soil	100000	
3	Development of Benches	100000	
	Sub total	**1000000**	
2. Civil Works			
S.N.	Description	Amount (Rs)	
1	Road Construction	50000	
2	Office Building	100000	
3	Environment		
	i. Construction of siltation ponds and Drainage	20000	
	ii. Construction of dump yards	100000	
	iii. Drinking water/Sanitation	20000	
	Sub total	**290000**	
3. Tools			
S.N.	Description	Unit	Amount (Rs)
1	Pick	10	7000
2	Shovel	50	30000
3	Spade	20	20000
4	Wheel barrow	30	30000
5	Safety Equipment		50000
6	Pump	2	75000
7	Polythene Pipes	A.R.	25000
8	Others	A.R.	25000
		Sub total	**262000**
4. Furniture fixture and Services			
S.N.	Description	Amount (Rs)	
1	Furniture	20000	
2	Stationary	20000	
3	Telephone	20000	
	Sub total	**60000**	
5. Pre-operation expenses			
S.N.	Description	Amount (Rs)	
1	Consultancy Fees	75000	
2	Mining Licenses	50000	
	Sub total	**125000**	
	Grand Total	**1737000**	

Annual Operation Cost

Salary and Wages				Proposed
S.N.	Particulars	Quantity	Monthly Salary	Annual Salary
1	Supervisor	1	15000	195000
2	Accountant	1	10000	130000
3	Peon/Guard	2	2x8000	208000
4	Labours (240 days @ 400per day)	70	400	6720000
	Sub total	74		**7253000**

Other Operating Cost

S.N.	Particulars	Unit Cost	Annual Cost
1	Depreciation @ 20% fixed cost		260550
2	Mining License renewal		50000
3	Office expenses		60000
4	Royalty (7200 trucks)	25/ truck	180000
5	Local Development Fee	2.5/truck	18000
6	Mining Implements (Repair, Replacement for 8 months)	10000/month	80000
7	Land Owner Share	500/truck	3600000
8	Cost of environment Management Plan	20000/month	240000
9	Tax (DDC, VDC)	300/truck	2160000
10	Soil Filing		1000000
11	Incidental Expenditure		200000
12	Social Welfare		200000
13	Insurance		200000
	Sub Total		**8248550**

Annual Profit Calculation

Annual Production is 40,320 m3 of sand	
Production cost/m3	384.4630456
Production cost/ truck	2153
Selling Price at the mine/truck	2500
Profit per truck	347
Production of Sand in Year	7200
Annual Profit	2498450

(Source: IEE report submitted by sand mine at Tajale at the Bhaktapur DDC)

Annex 4. Daily Transaction report obtained from mine operator at Devdole

Month	Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
November, 2011	No. of Trips	*	*	*	*	3	3	1	8	6	14	12	10	7	15	11	15	20	11	5	*	*	3	8	19	13	9	15	5	20	12	2	247
December		26	6	35	23	3	32	21	11	10	18	23	28	33	32	31	29	32	37	6	45	24	13	5	2	5	13	23	21	26	30	27	670
January, 2012		43	37	36	55	24	22	21	25	36	46	13	21	31	22	2	21	20	18	24	11	13	29	27	25	23	16	19	9	6	15		710
February		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	29	17	37	33	28	39	37	39	20	37	18			334
March		8	38	41	65	45	45	14	53	41	36	40	38	39	51	35	50	31	47	49	38	54	15	38	41	11	48	41	21	31	20	16	1140
April		29	32	25	28	37	28	37	4	1	4	10	4	14	7	11	18	37	40	60	28	16	1	11	8	5	15	16	1	0			527
May		1	8	23	15	2	15	17	19	8	8	21	8	20	10	31	4	8	7	6	16	7	30	27	33	8	12	20	13	49	44		490
Total																																	4118

(Source: IEE report submitted by sand mine at Tajale at the Bhaktapur DDC)