

Environmental Aspects of the Brick Factory

Batu Uprety

Intermittent kilns (Clamp Kilns or Thado Bhatta), and continuous kilns (Chimney Bhatta or Bull Trench Kiln, and Chinese Bhatta or Hoffman Kilns) are operated in Kathmandu Valley. About 125 brick kilns of these two categories are in operation in the Valley with a production capacity of 40 thousand to 45 million pieces per year. The 2001 study reported that BTK constitute about 90 per cent of the total brick kilns and they share about 87 per cent of the total brick production in Kathmandu Valley.

Location of the brick kilns are selected with due consideration on the quality of soil, availability of water, and proximity to the market area to minimise transportation cost. The number of brick factories has been noticed increased till early 1990s and there is a declining trend on the establishment and production of such industries since 1994. They are registered with the Department of Small and Cottage Industry. Some of the brick kilns, particularly the CK may have been operated without license. Brick kilns provide seasonal employment in Kathmandu Valley. Over 29,000 people were employed as labourers in 2001.

In general, brick-making process includes clay winning (digging and excavation), clay preparation, brick moulding, drying, loading, firing, and unloading. This could be done manually and by machine. In CK and BTK, bricks are manually produced while in the HK brick extrusion machines are used. The following table summarises the main characteristics of these brick kilns.

Types of Brick Kilns and Environmental Concerns

SN	Considerations	Types of Brick and Tile Industries in Kathmandu Valley			Remark
		<i>Clamp Kilns</i>	<i>Bull's Trench Kilns</i>	<i>Hoffmann Kilns</i>	
1	Brick Use	Personal or commercial	Commercial	Commercial	
2	Location	Agricultural land	About 509 ha of agricultural land rented in 2001, 55, 49 and 9 in Bhaktapur, Lalitpur and Kathmandu	Agricultural land, 2 in Lalitpur and 1 in Bhaktapur	
3	Number in the Valley	9	113	3	
4	Production Trend between 1993 & 2001	Only 0.34 million pieces produced in CK in 2001	Decreasing by 0.66 per cent	Decreasing by 4.31 per cent	
5	Type	Movable	Movable or fixed chimney	Fixed chimney	
6	Brick quality	Uneven quality	About 60% best quality, 20 and 15 % second and low grade and 5% waste	Good quality	
7	Labour Employment in 2001	162	27,798	1,200	
8	Advantages of production process	Burning of all shape and size bricks, low level of skill, low capital investment	Re-use of heat, low capital investment and high benefits, labour intensive	Supply of bricks continuous and regular, pre-heating of bricks by hot gases, reduced fuel consumption, bricks burnt evenly and quality maintained, control of particulate and flue gases by chimney	
9	Disadvantages of production process	Very slow burning process, more non-uniform (over-burnt or under-burnt) bricks	No permanent roof and use of ash, low chimney height, massive emission	High capital cost	
10	Fuel Consumption	Crushed coal, rice-husks and cow-dung	Steam and Assam coal, saw dust, fuelwood, rice-husk and agriculture residues	Steam, coal and fuelwood	

¹ This case is based on the report prepared by ESPS/ENPHO, 2001; and other reports.

Note: Case studies were prepared in Nepali language and have been translated for this report.

11	Quality of fuels	Assam coal	Jahria coal	Wood	Assam coal seems better
	Calorific value	6800-7200	4900-5600	3500-4000	
12	Air pollution	Insignificant	Stack emission massive	Stack emission reduced	Smoke and particulate emission due to improper feeding, firing and operating practices of fuel

The Nepal Bureau of Standard has released national standard (NS: 1-2035) for fired bricks. As per the standard, brick making methods, dimensions, and minimum compressive strengths have been considered to classify the brick, both hand moulded and wire cut bricks. Quality control of the bricks produced in the Valley has not been maintained due to inadequate implementation of standards.

Environmental Issues in Brick Industry

Environmental problems are more pronounced in BTK than other types of brick kilns operated particularly in the Kathmandu Valley. Integration of the environmental aspects in BTK is required to minimise air pollution problem significantly. Almost all the environmental problems are emerged during the operational stage.

1. Loss of Fertile Topsoil: Operation of the brick kilns in the prime agricultural field, particularly in the valley floors, have induced loss of fertile topsoil. Brick kiln owners are involved in leasing an area of 40 - 120 ropani (2 to 6 ha) for the period of about 5 to 10 years depending upon the availability of the raw materials and production capacity of the kilns. The kiln owners pay NRs. 1,200/ to 2,400/ropani to the landowner annually. On an average, about 4 ha of land are leased per kiln and about 509 ha of land are used by the BTK in Kathmandu Valley.

The topsoil having good water holding and retention capacity, and excellent texture is used for making the bricks. Once the quality soil is exhausted the movable kilns are operated in another agricultural land. Operation of the brick kilns has a direct impact on the precious and fertile top soil. However, this problem is inevitable for producing the bricks and meeting its growing demand.

2. Depletion in Water Retention Capacity

The brick and tile industries are operated in the agricultural soil having good water holding capacity, and proximity to water resources. Once the soil having water retention has been lost due to brick making, the remaining unproductive soil will loose water due to percolation and the water may not be available to water-loving plants – the cereal crops – in the post-operation stage of the brick kilns. The clay also requires water before moulding. Water demand for the labourers is also significant and it may accelerate water extraction by any means, thereby depleting the water sources.

3. Loss of Paddy Production

Taking note of the present use of agricultural land in the Kathmandu Valley for brick and tile production, there is a production loss of about 2,413 MT of paddy/year. This figure is based on the assumption that paddy is produced only once in the year. Assuming that one metric ton of paddy provides about 300 kg of coarse rice, about 724 tons of coarse rice could be produced from the above figure. In terms of price at the rate of NRs. 20/kg of coarse rice in 2000, a total of NRs. 14.48 million could be earned from this total production. However, the land in Kathmandu Valley is very productive and there is no practice of leaving the area fallow. The cropping intensity is over 250 per cent in the Valley.

The average land rent is documented as NRs. 1,200/ to 2,400/ropani (NRs. 24,000/ to 48,000/ha). Based on this figure, the landowner receives in between NRs, 12.218 to 24.437 million a year. It seems that the landowners are benefited on the higher price and they do not have to spend money and labour for crop production.

Agricultural Land Used by the Brick Kilns and Possible Loss of Paddy Production

SN	District	Land Area Used (ha)		Average Yield Rate of Paddy (mt/ha)*	Production Loss (mt) of Paddy in 2001	Remark
		1994	2001			
1	Kathmandu	74.80	36.90	4.89	180.44	
2	Lalitpur	303.2	229.65	4.65	1067.87	High loss
3	Bhaktapur	257.35	242.55	4.80	1164.24	High loss

	Total	635.35	509.10	Average 4.78	2412.55	
--	--------------	---------------	---------------	---------------------	----------------	--

Source: MOAC, 2000 (*Yield Rate of Paddy)

Once the soil is exhausted for brick production, the loss of fertile topsoil is inevitable. Soil fertility will decline after brick production and it is likely that crop production also declines, at least for some years. Crop yield could be returned back by heavy use of chemical fertilisers. However, Site-specific production rate of the land in the post-brick making period is not documented.

4. Chemical Contamination

The landowner uses more chemical fertiliser to maintain and/or return back the soil productivity. In 1999/2000, a total of 6,625 mt of chemical fertiliser (urea, DAP, potash and sulphate) was sold in Kathmandu, which is about 9.3 and 41.4 per cent of the total sale in Nepal and central hills respectively. In 2000, about 325 kg/ha of chemical fertilisers have been used in the Kathmandu Valley whereas the national average is only 46 kg/ha. This clearly indicates the heavy dose of chemical fertilisers used in the Valley. People use pesticides to increase cereal and vegetable production. The high dose of agro-chemicals may have degraded the soil quality and changed its composition. Although data is not available for the accumulation of agro-chemicals in the food item (crops) of Kathmandu Valley, it could be predicted that some chemicals may have been accumulated in the food items through biomagnification process.

5. Solid Wastes

Two types of solid wastes may be a problem in the brick and tile factories. Under-fired, over-fired and broken brick is about 5 per cent of the total production. About 15 per cent of the total bricks are of low quality but they are mixed with and sold in the market. About 344.65 million pieces of bricks were produced in 2000 by BTK in Kathmandu and hence the waste totals to about 17.23 million pieces per year.

Furthermore, 29,460 labourers were employed in the year 2001. Factories often do not have sanitation facilities thereby posing sanitation problem. During the hot dry season, labourers and local people may have been suffered from water-borne or poor sanitation related diseases.

6. Gaseous Emission

The brick factories use different quality of fuel ranging from coal to cow-dung. Majority of the brick kilns use firewood to start with fire, and then use coal and sawdust. Stack emission depend on fuel quality. Usage of sub-standard coal emits more gases. Emissions may contain significant amount of sulphur dioxide, particulates, carbon monoxide, and nitrogen oxides. Sulphur dioxide may have been increased from the combustion of coal and carbon monoxide from poorly designed kilns due to incomplete combustion of fuels. Emissions may have been increased due to low height of the chimneys, particularly in the BTK.

As 90 per cent of the brick kilns in Kathmandu Valley are BTK, the combined effect of stack emission and fugitive emission would have been significant to workers and people living in and nearby the factory. The cumulative effect may also be attributed to air-circulation and bowl-shaped valley.

7. Dust

During the dry season, dust is also a problem in the brick factory. In addition, the earthen roads used for transportation of the bricks create unimaginable dust and pose difficulty in respiration. Over 25 per cent of the brick owners and many of the local people residing nearby the factory and earthen road consider dust problem as a major environmental threat.

8. Health Problem

Almost all the labourers play with soil in the dry season. They are also involved in loading and unloading of bricks in the trucks. Increased stack emission also increase concentration of gaseous emission and particulates. These all may have cumulative effects on human health of labourers and the local people. Besides, gaseous and dust emission may affect the agricultural productivity around the brick kilns. The biomass productivity may also have been affected.

These problems have emerged as none of the factories have adopted pollution control facilities, and introduced clean and improved technologies. Studies have reported that BTK which accounts to about 90 per cent of the total brick and tile factories in the Valley are the most polluters.

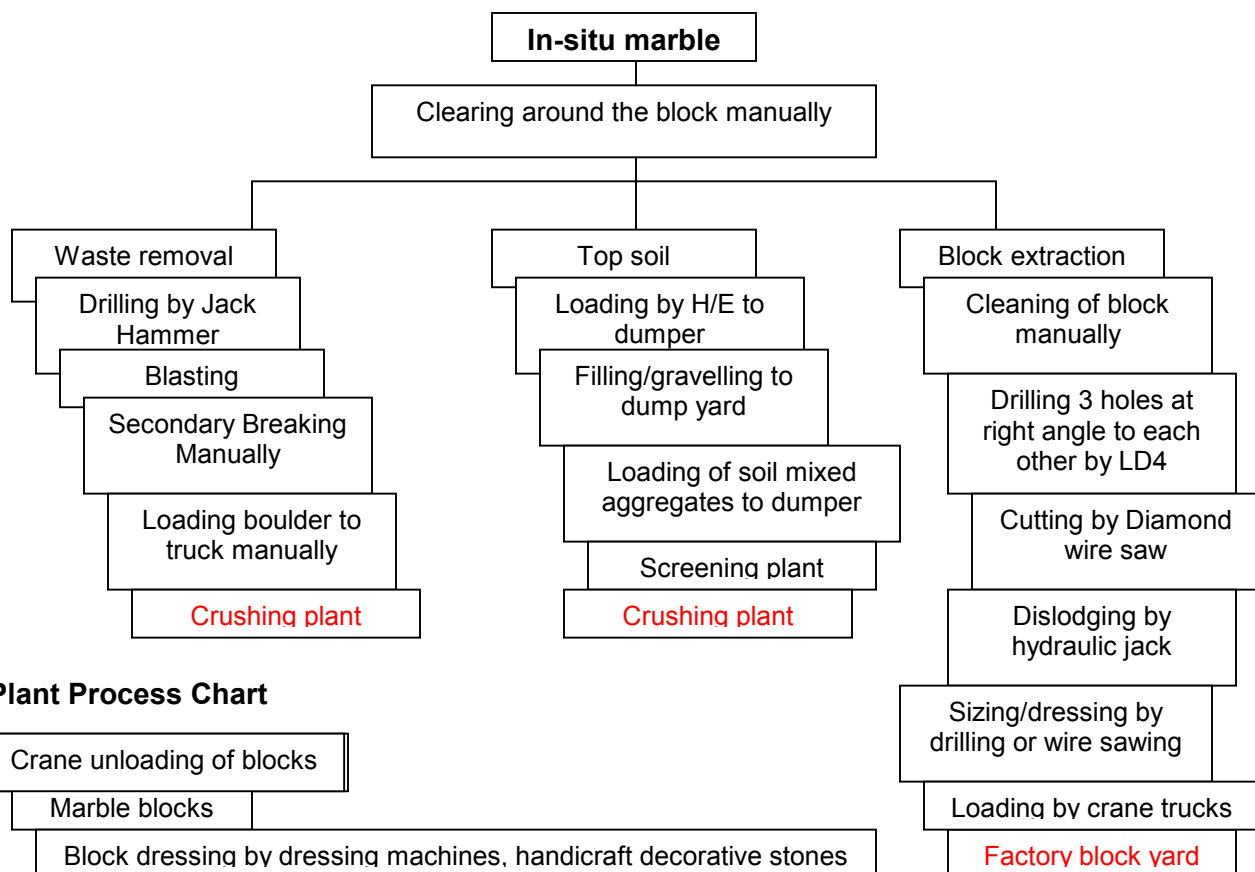
Environmental Aspects of the Godavari Marble Industry

Batu Uprety

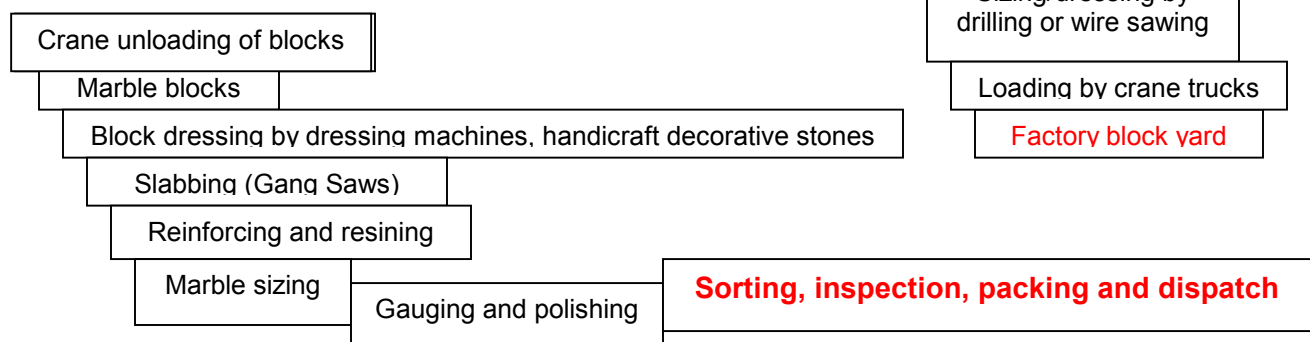
Marble extraction was started at Godavari, located 15 km south of Kathmandu, from 1934 AD (B.S. 1987) in a small scale. The present management took it in 1976 AD in the leased area of 1.5 square miles (3.88 km²). It is a surface mining. It produces polished marble slabs and by-products such as aggregates, marble chips and marble handicrafts. In this mine, the production of marble has increased from 2,50,000 square feet/year in 1992/93 to 9,00,000 square feet/year by the end of 1997/98. In 2004, the marble production was 6,00,000 square feet.

This marble industry has provided employment to 500 (325 direct and 180 persons indirect). The turn over of the industry for the year 2002/03 was about 75 million rupees. The industry implemented Quality Circle System in 1996/97 and environmental management system (EMS) under the Environment Sector Programme Support.

In this marble industry, the following mining process has been used.



Plant Process Chart



² Based on papers on (i) Experience of Godavari Marble Industry in Quality Control and Environmental Management Practice prepared by G. R. Manandhar (24 June 2004); (ii) Problems and Issues in Operation of Mines and Mineral Based Industries in Nepal, prepared by G.R. Manandhar, and R. Mandal (15 August 2002); and (iii) Brief Note on Environmental Management System of Godavari Marble Industries (2061/11/28).

The Godavari marble factory is operated to extract marble, the decorative stone. In mid-1990s, marble deposit/reserve was estimated at 0.625 million m³ (246,400 m³ white marble, 130,200 m³ brown marble and 248,400 m³ pink marble). Of this, the industry received license to extract 2,000 m³ of marble block, 0.4 million square ft of marble slabs and tiles, and 40,000 square ft of crazy marbles. Other products such as by-products were not quantified. The main by-products are aggregates. In this marble factory, the deposit is geologically faulted, jointed, weathered and crushed resulting in very poor recovery of blocks. The marbles are located in the steep topography and hence difficult in quarrying, road construction and bench formation.

During mining and processing activities, the common environmental issues are the following:

- a) Removal of plants and top soil to extract marble, landscape change and land degradation
- b) Noise and dust from drilling activities
- c) Soil erosion and mines mud during the rainy season
- d) Noise, possible accident and vibration from the use of explosives and operation of heavy equipment
- e) Dust generation in the quarry, during transportation activities, and in the crushing plant
- f) Factory sludge – generated during marble cutting
- g) Haphazard disposal of by-products etc.

Several Committees Formed

In the past, several committees were formed. In 1988, an environmental overview of this factory was prepared. In 1990, the NEFEJ president participated in one of the committee. In 1993, a report was also submitted to the Natural and Cultural Heritage Conservation Council. Till early 1990s, the committees recommended to close down the factory and not to extract the iron ore from the Phulchoki area taking into consideration the biodiversity richness and its unique landscape. The major issues raised were on (i) change in landscape; (ii) loss of top soil and erosion; (iii) effect on aesthetic value of the site; (iv) dust pollution; (v) noise pollution due to drilling, blasting and transportation; (vi) water pollution during monsoon due to eroded soil from mining area into Kuna Khola; (vii) loss of forest cover and plants due to site clearance for mining purposes; (viii) disturbance to and loss of wildlife habitat, and so on. However, the decisions were made to extract the marble with due consideration on the environmental aspects.

Major Environmental Activities implemented by the Factory

Because of environmental problems realised by the industry, and issues raised by the local people, NGOs and the media, this factory implemented environmental activities from 1990 onwards.

- a) Air pollution management – water spraying in dusty areas, and use of cyclone dust collectors, and bag filters in crusher and chips machines
- b) Noise Level – use of noise enclosures in stationary equipment, blasting charge reduced to 25kg to reduce ground vibration and avoid fly rocks (Kuna khola acts as the natural trench for preventing spread of seismic waves)
- c) Water pollution management – drainage and sedimentation pond constructed to avoid water runoff from the quarry and factory area, sludge ponds operated, river training and gabion check dams
- d) Forest conservation – afforestation completed in the quarry 4 (closed by the decision of the Environment Protection Council in early 1990s), plantation of 3 lacs saplings in and around the Godavari area (within and outside the leased area), nursery operation, grass and shrubs planted for nitrogen fixation and erosion control, salary to forest guard
- e) Waste management – waste reused, planned dumping by mechanical compaction, land reclamation

Other activities implemented from 2001 onwards include the following:

- f) Joined pilot Environmental Management System, an undertaking of the HMG/ESPS
- g) Environmental policy (Effective from 2059/5/20) (Box)
- h) Receipt of the ISO 14001 certificate on 1 February 2003
- i) Commitments of the industry for reduction of energy consumption, waste minimisation by reusing, and reduction in natural resource utilisation

- j) Provided personal protective devices to ensure safety and health of workers, medical check from time-to-time, training to workers on OHS
- k) One crore revenue to HMG annually
- l) Financial and material support to locals in maintaining and developing school, village roads, drinking water, temple and religious places, youth clubs and their activities, health services, library, forest enrichment etc.
- m) Support to students for field study of the industry

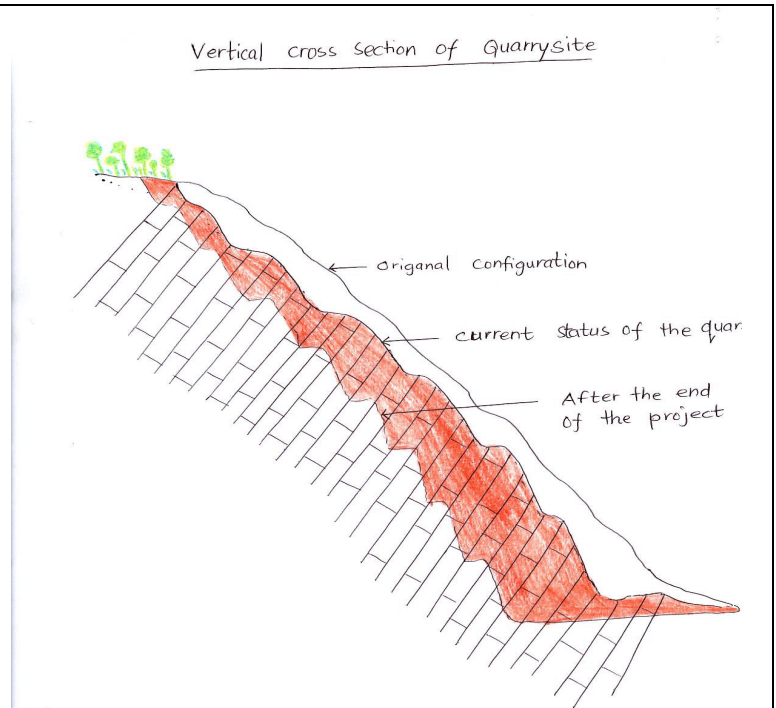
Based on the information of the factory, the environmental management system (EMS) includes organisational structure, planning activities, responsibilities, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy. This practice has been adopted in conformity with the guidelines of ISO14001, 1996. Implementation of the EMS has been effective due to commitment of the top level management, support and commitment of the workers, external parties, local community, and the government. The EMS implementation has benefited the factory in financial benefits, better documentation, better communication, awareness in the employees and workers in environment and quality, confidence building and job satisfaction, better relation with the neighbours, and better satisfaction to the interested parties and NGOs.

Environmental Policy

1. We Godavari Marble industries are committed to leadership role in the environment and natural resource management
2. We shall adhere to the policy of continual improvement and prevention of pollution in order to achieve better utilisation of resources and minimisation of waste, to conserve energy and resources with the emphasis to assure quality production.
3. We will carry out quarrying with minimum ecological damage.
4. We are committed to comply with all applicable environmental laws and regulations.
5. We will communicate the benefits of good EMS and safety practices amongst our workers and others
6. We will work with the local community for the improvement of socio-economic conditions and surrounding environment.

The factory has made the EMS effective through internal and external audit each twice a year, and monitoring of activities as per the guidelines of ISO14001,1996. The factory has reduced energy consumption, produced bigger size marble slabs. It has planned to utilise the marble sludge which is about 20 percent of the raw materials, and has commitments for continual improvement. The factory is also analysing water and air quality regularly.

Out of total 117 ha leased from the government, only 5 ha is presently used to extract marble. It seems that the factory has improved its environmental quality over the years. The use of diamond wire saw to extract marble in the quarry, sludge management, deposition of top soil, and handling of wastes are "positive outlook" of the industry towards environmental management.



Stone Quarry and its Environmental Impacts

Batu Uprety

Background

The agricultural lands in three districts of Kathmandu Valley - the capital of Nepal - have been converted to settlements due to increased population growth and migration. The development activities such as construction of buildings, roads and industries have demanded more construction materials, in particular the stones, aggregates and sands. The stone quarries have been operated in and around the forested hills of the valley to provide such materials. Of them, Purna Aggregate Industry is one which is operated at Chapagaon - 7 of Lalitpur district since 1959. Initially it produced 171 m³ of stone/day. The quarry site has an estimated reserve of 1.04 million m³ of stones and it could be operated for about 93 years if excavated at the rate of 45 m³ per day. About 50 people are employed in this industry and the average sale rate is Rs. 350/ m³ at the factory site.

The quarry is operated in the forests. Its expansion will lead to the loss of luxurious growth of vegetation.



Excavation Process

The factory has adopted benching method and uses small equipment such as drilling, pick, hammer, crowbar, and chisel etc. for the excavation of stones from the upper part of the forest hill. The factory has stored fertile soil to rehabilitate the degraded land. During the excavation, 1.5m high and 4m wide benches will be maintained. The excavated stones will be sent to the market with trucks. It is estimated that about 20 percent of the total material excavated are spoils (wastes) which are disposed in and around the factory site.

Biodiversity in the Stone Quarry Site

The mixed forests dominate the surrounding area of the quarry site. The major plant species reported include silk tree (*Albizia julibrissin*), alder (*Alnus nepalensis*), mountain ebony (*Bauhinia variegata*), tanki (*Bauhinia purpurea*), chestnut (*Castanopsis indica* and *C. tribuloides*), Himalayan ash (*Fraxinus floribunda*), lapsi (*Choerospondias axillaries*), walnut (*Juglans regia*), champ (*Michelia champaca*) (legally protected species), kafal (*Myrica esculenta*), *Myrsine capitulate*, kawala (*Machilus odoratissima*), *Phyllanthus emplica*, chir pine (*Pinus roxburghii*), *Prunus cerasoides*, mayal, *Rhodendron arboreum*, khirro, *Schima wallichii*, bayar etc. Being in the mid-hill, *Schima-Castanopsis* forest is dominant with other number of plant species. Species of *Choerospondias* and *Michelia* are considered endangered. In addition, the area is also a habitat of *Berberis asiatica*, *Adhatoda vasica*, daturo, *Lyonia ovalifolia*, *Rubus ellipticus*, *Vitex negundo* etc. The different species of orchids reported in the study area are included in the CITES appendices.

Above the quarry site on the south, the District Forest Office has handed over 45 hectares of the national forests to Jhyalungtar community forests for the development, conservation, management of forests and its sustainable use. Nepal has enhanced such handing over to bring the people in the mainstream of forests management. So far over 1.1 million ha of forests have been handed over to about 13,000 community forestry user group. In this forest, a total 242 families are the users who reside in ward numbers 6 and 7 of Chapagaon Village Development Committee. This forest was handed over to the community in 1999 and the users group has to manage it based on the approved operational plan. The forest is divided into five blocks and its second block is joined with the quarry site. This forest is a good habitat for several species of birds including the spiny babbler which is the endemic bird. The growing stock of this forest is estimated at 25.42 m³/ha with 593 pole-sized trees and 2391 small poles per hectare. At about 2km north of this quarry site, a religious forest is managed at Bajrabarahi.

The forests also provide habitat for barking deer, porcupine, malsapro, jungle cat, hare, leopard and other mammals. The birds such as pheasant, spiny babbler, dove, owl, titra etc. are also found in good number.

³ Based on Group Report of the EIA Training, February-March 2005

Different species of snakes and lizards have been reported from this area. The local stream has some fish species (asala, hile and buduna etc.).

Although the stone quarries are operated in the specified area having no site alternative, its operation should be based on sound and environment-friendly operational plan (mining scheme) taking into consideration methods of excavation, timing of operation, quality of raw materials, quantity of overburden materials (spoils) and species richness. If the area is the habitat for species of national and international importance, attention should be given even to prohibit such works. As the area is a good habitat for endangered species such as spiny babler (bird), champ, lopsi and orchids, environmental mitigation mitigations should be a part of the quarry operation.

Environmental Impacts

Direct impacts are identified and predicted taking into consideration the area within 100m on all sites of the quarry site, and 50 households living within 100m surface distance from the quarry. The major impacts include, *inter alia*, the followings:

1. Local people have been employed and their per capita income has been increased over the years.
2. The quarry has triggered landslides and accelerated soil loss. Soil deposition and sedimentation in farm land and streams has adversely impacted on agriculture production and fish habitat, in particular during the rainy season.
3. The quarry will further change the land use, increase air and water pollution, and noise level.
4. Disposal of spoils (overburden materials) would affect the aesthetic value of the landscape, and its haphazard disposal will again impact on agriculture production.
5. Expansion of quarry site will lead to tree cutting and vegetation clearance which will affect the habitats of endemic species such spiny babler, endangered species such as lapsi, champ and orchids.
6. Transportation of stones through the dense settlement areas will further degrade the air quality, increase dust pollution and noise level. Furthermore, dust particles would also affect the photosynthetic ability of the nearby plants.

At the End,

The stone quarry will ensure the supply of construction materials for buildings, roads and other development works in the Kathmandu Valley. It will also increase the income of the local level due to employment. If it is operated based on its five-year scheme, it will likely reduce the destruction of biodiversity-rich mixed forests. Its expansion towards the southern side will adversely affect the wild species and ecosystem including the loss of habitat of spiny babler. Operation of the stone quarry should focus on its adverse effects and impacts on the natural environment and biodiversity. It should attempt to avoid and mitigate the impacts. If the mitigation measures are exhausted, the factory should establish new habitats of similar nature nearby the quarry site.

6 April 2005 (Wednesday)