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ENVIRONMENTAL IMPACT ASSESSMENT

OF INDUSTRIAL DEVELOPMENT AROUND LUMBINI, THE BIRTHPLACE OF THE LORD BUDDHA, WORLD HERITAGE PROPERTY

Prepared by IUCN Nepal with support from UNESCO Office in Kathmandu and Oriental Cultural Heritage Sites Protection Alliance

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THE STUDY TEAM

A multidisciplinary team of expert was involved in the study:

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EXECUTIVE SUMMARY

Lumbini, the Birthplace of the Lord Buddha and a UNESCO World Heritage Site is a destination for both pilgrims and visitors from within Nepal and around the world. As a World Heritage Site, it is the pride of Nepal and a major source of revenue for the Government of Nepal.

The route from Bhairahawa to Lumbini has been for many years a productive region of fertile farmland but rapid change to the environment can be seen due to rapid industrial development that poses an ongoing threat to the area. Increasing environmental pollution caused by growing and existing carbon emissions from industries within the Lumbini Protected Zone (LPZ) also threatens the Lumbini World Heritage site.

According to the Industrial Promotion Board (IPB), an agency under the Government of Nepal's (GoN) Ministry of Industry (MoI), the LPZ is a region covering a 15-km aerial distance from the north, east and west boundary of the Lumbini Project Area (LPA) and up to the Indian border from the southern boundary of the Lumbini Project Area.

The expansion of the carbon emission industries has caused several problems such as threats to biodiversity, health hazard to local residents, archaeological properties, social and cultural values etc. As per the Environmental Protection Act (EPA) 1997, an Environmental Impact Assessment (EIA) is mandatory for the protection, conservation and sustainable management of heritage properties. With this view in mind, the study titled: "Environmental Impact Assessment of Industrial Development around Lumbini, the Birthplace of the Lord Buddha, World Heritage Property" has been drawn up to prepare a detailed environment impact assessment of industrial development around the Lumbini World Heritage Site.

Specifically the study covers several objectives such as: to identify and locate industrial activities in the study area; develop the zoning classes with a guideline for clarifying the type of development and industrial activities permitted or prohibited in the protected zone; and prepare an environmental plan and monitoring strategy to reduce the potential detrimental impacts caused by industrial activities in the protected zones. The problems caused by industrial expansion within the zone need to be addressed to preserve the sanctity of Lumbini; to promote the sustainable development of the surrounding communities; and to conserve the biodiversity of the region. In order to address these issues, comprehensive information about existing industries; multi-dimensional impacts caused by the industries; land use planning for the promotion of livelihoods of the locals; and preservation of cultural values of the Lumbini area are required to be integrated in the overall conservation and development plans of the zone.

The methodologies adopted in the study were: literature reviews, expert consultations, field observations and laboratory analysis etc. The primary data was collected by using some key research tools such as focus group discussions, transect walks with relevant stakeholders, key informant interviews, field observations and survey questionnaires to collect biophysical, socio-political data and community perception on the issue of industrial expansion in the region.

Likewise, comprehensive literature reviews were done to collect secondary data on native flora and fauna, environmental conservation and protection governing tools and mechanisms to identify the key issues of the study area. Scientific tools used in the study were: GIS environment for the delineation, base maps and other thematic maps preparation and a Geographical Position System (GPS) survey for the identification of existing industries etc.

Data analysis was done by using laboratory analysis of samples of soil and water for the identification of organic matter in soil, and physical and bio-chemical contamination in water. Likewise, some statistical tools such as Likert's Attitudinal Model, the Chi-square Model and the Correlation Coefficient Model were used for an assessment of the community's perception and experiences about existing industrial impacts.

The study identified industrial activities and their location in the region. The study also developed a concise zoning guideline and prepared an environmental plan and monitoring strategy linked to a set

of zoning guidelines in order to reduce the impact of industrial activities in the zone. The study revealed that industries prefer this particular region for new operations because of the availability of cheap labour, water sources and easy road accessibility to the border. They gain preferential access to the existing infrastructure (i.e. electricity supply and paved roads). About 57 industries including brick factories (30), cement and clinker production factories (11), steel production (2), noodles production (1), paper production (1) and flour production (2) and others (10) are registered in the study area. Of these, 23 industries were in a functional condition. About 15 industries (11 cement industries, two steel factories, one Paper mill and one noodles factory) are categorized as a major industry in terms of their production and potential impact on environment.

About 15 lakhs 33 thousand metric ton cement is produced annually in the region. Likewise, the particulate matters produced by the industries are: cement compounds, alkaline dust, sludge, plastic etc. Furthermore, by-products such as sludge and pollutant water have been directly discharged (without treatment) into the natural river systems, such as the Dano River and the Tinau River. Sludge has also been discharged into open drainage.

Most of the factories operating in the Lumbini Road Industrial Corridor are clearly violating the Environment Protection Act (EPA), 1997 and related guidelines which were formulated for the protection of the environment. This has created a detrimental impact on the environment, the flora and fauna, and the health of local people and workers. The condition of the surface and groundwater quality varies from “medium to bad” conditions. Meanwhile, the study found that the soil is slightly alkaline however no toxicity was found in it. Analysis found that the soil alkaline level and the organic matter level were lower than normal standard levels.

This indicates that the soil absorbs fugitive effluent due to the activities of the cement factories. The study delineated the LPZ, covering 828 sq.km including 44 Village Development Committees (VDCs) in Rupandehi district and 25 VDCs in Kapilbastu district. The LPZ expands up to Dharmpur in Siddharthanagar Municipality in the east, Pokharbari in Motipur VDC in the northeast, Piparhawa in Bagauli VDC in the southeast, Ajma in Ama VDC in the south, Pipra in Pipra VDC in the southwest, Dupripur in Dharmapaniya VDC in the west and Pahadibuta in Gajedi VDC in the north.

The study recommended short-term and long-term recommendations in order to address environmental issues in the region. Mitigation measures, environmental management plans and compliances are recommended for the reduction of air, water, and noise and soil pollution. The auditing frameworks to audit environmental impacts in future are presented in this study. For the long-term, the study recommended five protection zones in the LPZ : Zone 1-Restricted Zone; Zone 2-Buffer Zone; Zone 3- Special Conservation and Management Zone; Zone 4-Community resource Management Zone; and Zone 5-Ecological Economic Development Zone on the basis of guiding principles and approaches such as those contained in the provisions of a UNESCO World Heritage priority, IUCN Conservation Protection priority and Government of Nepal priority on the conservation of World Heritage Sites and the conservation of natural systems, community-centred approach, the Kenzo Tange Master Plan insights, and the findings of this study.

The study also recommended a sustainable approach to address these issues. A transfer of the existing carbon-emitting industries from the LPZ is needed within a certain timeframe in order to facilitate the long-term development of Lumbini. In order to achieve this, a detailed study at the government level needs to be carried out by implementing an assessment of compensation means and alternative operating procedures for industry owners.

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ACRONYMS AND ABBREVIATION

AAPA	Aquatic Animals Protection Act
BCN	Bird Conservation Nepal
BOD	Biological Oxygen Demand
CaCO3	Calcium Carbonate (limestone)
CaO	Calcium Oxide (lime)
CBD	Convention on Biological Diversity
CO2	Carbon dioxide
CE	Critically Endangered,
DAO	District Administrative Office
DDC	District Development Committee
DFO	District Forest Office
DHM	Department of Hydrology and Meteorology
DHO	District Health Office
DHUD	Department of Housing and Urban Development
DO	Dissolved Oxygen
DOA	Department of Agriculture
DOI	Department of Irrigation
DOS	Department of Survey
DRO	District Road Office
DTO	District Technical Office
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPR	Environmental Protection Regulation
FGDs	Focus Group Discussions
FNCCI	Federation of Nepalese Chamber of Commerce and Industry
GHGs	Emission of Green House Emissions
GIS	Geographical Information System
GoN	Government of Nepal
GPS	Geographical Position System
IA	Industrial Act
IEE	Initial Environment Examination
IPB	Industrial Promotion Board
IUCN	International Union for Conservation of Nature
Km	Kilometre

LDT	Lumbini Development Trust
LEPA	Lumbini Environnemental Protection Alliance
LMP	Lumbini Master Plan
LPA	Lumbini Project Area
LPZ	Lumbini Protected Zone
LWHP	Lumbini World Heritage Property
MoLD	Ministry of Local Development
MOEnv	Ministry of Environment
MoICS	Ministry of Industry, Commerce and Supply
MoPE	Ministry of Population and Environment
Mt	Metric tone
ml	mile
N	Nitrogen
NGOs	Non-Government Organizations
NO3	Nitrate
NPC	National Planning Commission
NTFP	Non-timber Forest Products
PM	Particulate Matter
PO4	Phosphate
RCCI	Rupandehi Chamber, Commerce and Industry
SN	Serial Number
SO2	Sulphur dioxide
TDS	Total Dissolved Solid
UN	United Nation
UNEP	United Nation environment Protection
UNESCO	United Nations Educational, Scientific and Cultural Organization World
WHC	World Heritage Committee
VDC	Village Development Committee
VSBK	Vertical Shaft Brick Kiln
WB	World Bank
WHS	World Heritage Site
WQI	Water Quality Index
ZEMP	Zoning and Environmental Management and Development Plans

CHAPTER 1

Introduction

1.1 Context

Lumbini, the Birthplace of the Lord Buddha lies in the district of Rupandehi, which falls in the Western region of Nepal. It is a World Heritage Site (inscribed in the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage list in 1997 during its 21st Session) and is a destination for pilgrims and visitors from Nepal and around the world. As a World Heritage Site, owing to its cultural, spiritual and religious values, Lumbini is the pride of Nepal and has the potential of becoming a major source of revenue for the Government of Nepal.

The areas from Bhairahawa to Lumbini have been for many years a verdant region of fertile farmlands with paddy and wheat fields and plantations of various vegetables and mustard. It also provides a good habitat for flora and fauna. However in recent times, the scenario has been changing rapidly due to an increasing number of industrial sites in the area. The communities in the region are still involved in farming but rapid changes are creating an extremely hazardous situation for all forms of biodiversity and also for the World Heritage Site (WHS) in the region[1]. In the last ten years, this region has witnessed a significant increase in the number of industrial establishments and the area in the periphery of the highway from Lumbini to Bhairahawa has the potential of becoming a major industrial zone. Environmental pollution from existing and the growing number of industries has increased noticeably and had an adverse effect on the environment surrounding the World Heritage Site. An awareness campaign, including a petition of environmentalists, has alerted civilians as well as environmental conservationists to take positive action for its protection and conservation.

The ongoing industrial growth possesses a threat to the archaeological remains in Lumbini (the Kenzo Tange Master Plan), and the other archaeological sites surrounding Lumbini, namely Tilaurakot and Ramgram. Both Tilaurakot and Ramgram are included in the UNESCO tentative list for inscription onto the World Heritage List. The master plan covers an area of 5 ml x 5 ml which was approved by the UN and the Government of Nepal in 1978. Rapid industrial development could see the World Heritage Site of Lumbini surrounded by a cement production industrial park thereby creating detrimental environmental pollution that threatens the very existence of Lumbini. The expansion of industrial development at this site is creating a very serious threat to the archaeological and religious value of Lumbini. This unplanned industrial expansion also poses a very serious barrier to the sustainable economic development of surrounding local communities. In view of the threats to this particular WHS, UNESCO Kathmandu has provided financial support to the International Union for Conservation of Nature (IUCN Nepal) in order for it to undertake an environmental impact assessment of the area.

1.2 Rationale of the Study

The Lumbini World Heritage Site located in the Rupandehi district of Lumbini Zone lies within the Master Plan prepared by Kenzo Tange in 1978. The master plan covers the Lumbini Project Area (LPA) of 1 ml x 3 ml (7.77 sq km) around the main archaeological remains. The rapid and uncontrolled growth of carbon-emitting industries within the LPZ threatens the WHS causing an adverse impact on the biodiversity, health of the local people and visitors. However, on the reverse side, these same industries are becoming an important source of revenue for some local people.

The adverse impacts caused by industrial expansion within the zone needs to be identified and assessed urgently to preserve the sanctity, spirituality as well as the biodiversity of the region by promoting the sustainable development of the surrounding communities in a deliberate and tactful way. Furthermore, environmental pollution created by the emerging and existing industries has progressively demolished the environment around the WHS – the hugely important birth place of the Lord Buddha. In order to assess the situation, comprehensive information about the existing industries; multi-dimensional impacts caused by the industries; land use planning for the promotion of

1 B.vivekanada and et al., 2009.

livelihoods of the locals using non-carbon emissions sources of income generation; and preservation of cultural values of the Lumbini area are needed to be integrated into the conservation and development plan of the region in order to reduce the environmental degradation.

In this regard, as per the Environmental Protection Act 1997, an Environmental Impact Assessment (EIA) is mandatory for the protection, conservation and sustainable management of the environment. The scope of the work mentioned includes an assessment study of current industries and their impact on the region. This study puts forward the most effective ways to protect the environment from increasing pollution caused by the burgeoning industrial development and recommendations for environmental-friendly development initiatives in the region.

1.3 Objectives

The general objective of this study was to prepare a detailed Environment Impact study of the industrial development around the Lumbini heritage site.

The specific objectives of the study were:

- Identify and locate the industries in the study area.
- Review the relevant environmental impact documents.
- Assess the baseline information of the study area.
- Develop an environmental plan and monitoring and auditing frameworks.
- Propose land use zoning and develop a guideline to guide future infrastructure and industrial activities within the region.

1.4 Scope

The scope of the study included the following areas of work:

- Collection of detailed information on industries within the area including their location, size, nature, production capacity, use of raw materials and use of energy sources in order to establish a baseline. Their emissions, wastage and by-products if any, are accounted for evaluating their multiple impacts on the prevailing environment of the area.
- Baseline information about the zone; baseline information regarding the geographical, socio-economical and cultural and bio-physical environmental status were undertaken in this study
- Preparation of an environmental management plan, monitoring strategies, and proposals for the most effective mitigation measures, including auditing plans and matrices for the monitoring of various pollution parameters at the industrial site.
- Classification of existing land use and land cover of the study area into different zoning classes for the protection and conservation of the region and recommendation of a guideline for the development of industrial activities permitted or prohibited in the protected zone

1.5 The Study Area

The study area; the Lumbini Protected Zone (LPZ) covers a 15-km aerial distance due North, East, West and South (within Nepal), running rectangular in shape within the boundary of LPA (1ml x 3ml) of the Kenzo Tange Master Plan. The aerial distance of 15-km was decided by the Government of Nepal (IPB/GoN, 2009) and the coverage landscape defined as “LPZ”. It is an alluvial plain built by the depositional work of the river. The relief of the area is 83 metres to 135 metres in height from the Indian mean sea level. The study area lies between 27^0 19’ 34.803” to 27^0 38’ 31.992” N and 83^0 6’ 58.011” to 83^0 26’ 7.977” E both in Rupandehi and Kapilbastu districts in the western development region of the country (Figure 1.1).

The region has a subtropical monsoon climate with a warm wet season from mid-June to September, a cool dry season from October to February, and a hot dry season from March to mid-June.
The annual rainfall is about 1,700mm of which 85 per cent falls during the monsoon season. The mean temperature is about a maximum 45^0 C during May and a minimum of 10.5^0 C from December to January.

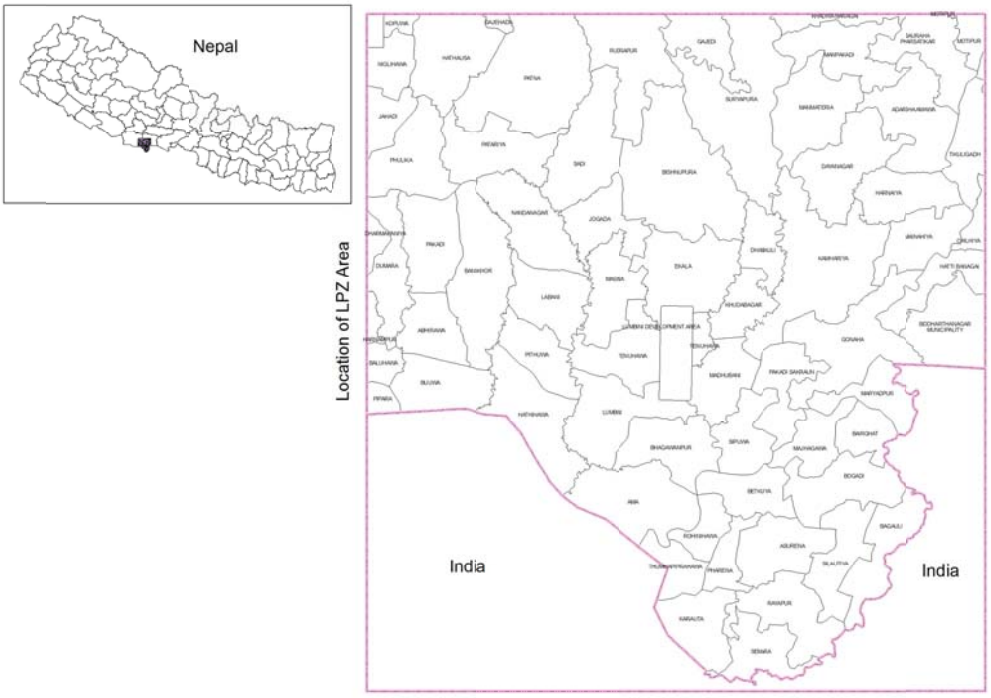

Figure 1.1: The study area

The farmlands of Rupandehi and Kapilbastu districts encompass a large rural area. There are plains in the south and Churia Hills to the north. A number of perennial and seasonal rivers and streams including the Telar, Tinau, Sundi and Dano rivers flow through the area. The forest, scrub, wetlands and grasslands surrounding Lumbini are an important refuge for wildlife. A total 210 bird species have been categorized and listed in Rupendehi district (Sual, et al., 2010).

1.6 Limitations of the Study

The limitations of the study as follows:

- The EPA 1997 and the EIA guideline 1997 steers the Environmental Impact Assessment for any new development project(s) to be established. However this study was carried out for the impact assessment of the current operational industries located in the study area based on the guideline and the Act.

- The study was conducted within a very tight time schedule and with limited resources. Due to such constraints only a rapid analysis was possible.

- Because of limited time and a lack of monitoring equipment, data in regards to air, water, soil and noise pollution has been constrained.

- Getting meteorological data such as wind profiles and ambient temperature (hourly-based data) of the study area was also one of the limitations of the study. As a result, the analysis of dispersions, diffusion and transportation of particulate matter and emissions has been limited.

- The unfavourable weather condition (monsoon) and flooding in the river disturbed the field survey and sampling.

- There was also difficulty in getting meeting appointments with industry authority officials during the field visits.

- The water quality and soil assessments carried out in the study were insufficient to represent the entire region of the study area. For more comprehensive information, more soil and water samples, backed by more sufficient resources, are needed so more analysis can be undertaken.

1.7 Expected Outcome

The major expected outcomes of the study are an assessment of the condition of the existing industries and bio-physical environmental impacts due to on-going industrial activities.

In addition, the other expected outcomes are as follows:

- The reduction of unfavourable impacts by using an environmental plan and monitoring and auditing frameworks.

- Recommendations for the sustainable development of the study area in order to protect religious and cultural insights and the conservation of archaeological values through the use of proper land use zoning guidelines.

CHAPTER 2

Methodology

2.1 Introduction

This chapter deals with the methodologies adopted in the study. The study adopted the basic guidance given in the national EIA guidelines in 1993. As per the guidelines, the basic processes are: scoping for EIA, identification of environmental impacts, assessment of mitigation and monitoring measures with the environmental auditing framework, etc. The following steps were carried out while adopting the processes mentioned above.

2.2 Data Collection and Preparation of Maps

Primary data or information on the public's attitude and experiences regarding the impacts of industrial expansion on bio-physical and socio economic features etc., was collected from the field by using some key research tools such as focus group discussions, transect walks with relevant stakeholders, key informant interviews, field observations and survey questionnaires. Likewise soil and water samples were also taken for analysis.

The secondary data was collected through literature reviews. Information about industrial profiles, socio economic status of the study area and archaeological values of Lumbini's heritage were collected during literature review. This information was obtained from different literary sources such as UNESCO, IUCN, the Lumbini Development Trust (LDT), the Department of Industry (DOI), the Department of Small Industry and Cottage (DoSIC), the Lumbini Institution, the Department of Survey (DoS) and the Department of Archaeology, etc. Steps and tools used for the data collection are described below.

2.2.1 Expert Consultation

Since the EIA required information on a variety of topics, the study attempted to hold consultations with concerned experts to understand their point of view regarding the critical issues. The consultations were done with UNESCO Kathmandu and the United Nation Environment Protection (UNEP), line ministries, and the departments of the Government of Nepal and the LDT Liaison office.

2.2.2 Desk Work

The following activities were carried out as desk work.

Literature reviews

Several published and unpublished reports, journals and texts books from different sources such as IUCN Nepal, UNESCO, LDT, the Ministry of Environment, Science and Technology (MoEST), and the Department of Industries (DoI) etc., were reviewed to conceptualize the scope of the study. Furthermore, literature on zoning practices for the conservation of heritage sites were reviewed from different sources such as IUCN conservation guidelines. Zoning practices previously carried out by UNESCO for similar types of heritage sites in other countries such as Cambodia were also reviewed.

Delineation of LPZ and Preparation of the Base Map using GIS

About 13 topographic maps of scale 1:25000 in digital form were taken out from the Department of Survey (DoS) in order to delineate the LPZ. The selected sheets of maps were: 2783A06, 2783A09, 2783A10, 2783B05, 2783B06, 2783B09, 2783B10, 2783C05, 2783C06, 2783C10, 2783D05, 2783D06, and 2783D10. The Arc GIS 9 x was used for the delineation of the LPZ and development of the base of the region. The base map of scale 1:110,000 included land features, land use and land covers, location of industries and river networks etc.

Formulation of the questionnaire for field survey

The checklists and semi and structured questionnaires for focus group discussion, key informant's interviews and industry owners' interviews were also formulated. The developed checklists and questionnaires were finalized after discussions between the study team. The final checklists were

used for the generation of socio-political and economic data about the field (Annex 1). Based on discussions with the management and study team, a work plan was prepared for the field work (Annex 2).

Selection of sampling sites

The sampling sites were selected with the help of the Google map by considering various parameters such as water, soil and air quality, public health, natural resources and archaeological sites in the region. The criteria for the selection of sites was determined on industrial location, residential area, agriculture land, slope of the land surface, surface and ground water flows location, topographical land of upstream and downstream of the industries, channels adjacent to irrigated fields, potential areas of polluted water and the location of the industrial drainage and its discharge into river systems. The selected sampling sites are located in the map (Annex 4).

2.2.3 Field work

The following activities were carried out during the field work:

Transect walk and field observation

This was conducted in order to observe the physical, biological, socio-economic and cultural environmental impacts of industrial establishment. A team comprising of representatives from the study team and key informants and the field enumerator conducted the transect walk. The observation and transect walk was done along with the filed enumerator and representatives from local communities. The delineated base map of the LPZ was verified in close coordination with local stakeholders and communities. The environmental impacts caused by industrial activities experienced and seen by the local communities were marked on the base map during the transect walk in the field. The local stakeholders, including industry authorities, LDT's authorities, government officials, local leaders, communities, journalists etc., were aware about the concept of LPZ and the location of the existing industries. The thematic maps like land use maps, base maps etc., were verified and changes were made as per the field observations.

The following key activities were carried out during the field visits:

Focus Group Discussion (FGD)

Due to the homogeneity in the population composition and potential impacts of existing industrial activities, only six VDCs out of 69 VDCs were selected randomly for the FGD. FGDs were done during the field visits at Kalidaha (Aama village development committee VDC, Rupandehi) communities in south-west, Labani (Labani VDC Kapilbastu) in west, Budawa (Gohana VDC, Rupandehi) in south-east, Mahilwar (Madhubani VDC, Rupandehi) in south, Gurwaniya (Gonaha VDC and Kamariya VDC, Rupandehi) in the industrial corridor, Panditaram Bipasana, Lumbini, and Arindihawa (Bishnupura VDC, Rupandehi) north of the study area.

Focus group discussions were carried out to identify problems, their causes and consequences related to the impacts of industrial activities in the region. The scopes of the study were also shared among the local people during the discussions.

The discussions mainly focused on: issues of industrial impacts, mitigation strategies of those impacts, and zoning conditions for the sustainable development of the region and protection of Lumbini's heritage. In addition to this, discussions were held on environmental conditions such as the physical environment including water quality, air quality, noise status, soil status, land use; the biological environment including forest and vegetation composition, flora, fauna; socio- economic and cultural environments including population, ethnicity, religion and language, education and literacy, health and sanitation, road and transportation, economic activities etc., as well. The list of participants participated in the FGDs has been attached in Annex 3.

Key Informant Interview (KII)

The interviews with key informants were carried out separately. The key informants involved in the discussions were farmers; individuals living around the industries; VDCs secretariats; teachers; local leaders; social workers; experts; journalists; members of Rupandehi Chambers of Commerce and

Industries; pilgrims, members of Lumbini institute and LDT; User Committee etc., The checklist prepared for KII has been attached in Annex 1.1.

Stakeholder consultations

Consultations with stakeholders' were separately carried out and they included LDT, Rupandehi Chamber of Commerce and Industry (RCCI), industry owners, local government organizations such as the District Development Committee (DDC)-Kapilbastu, Rupandehi, Small Cottage Industry Rupandehi, District Administrative Office (DAO), Kapilabastu and Rupandehi, Schools, VDCs, Lumbini Institute Alliance etc. The view of the stakeholders on the issues of existing industrial impacts on different sectors such as physical, biological, socio-political environments etc., were also collected during these consultations. Additionally, the purpose of the discussions was to familiarize the stakeholders on the issues of the study.

GPS survey

A Geographical Position System (GPS) survey was carried out in order to identify the locations of the existing industries within the study area. Likewise, land use changes and specific features of the terrain were also located using GPS and the results of the changes were marked on the base map.

2.3 Water, soil and seeds sampling

Water sampling

Water samples from hand pumps and rivers were taken from the study area. About ten samples (four samples of hand pumps water and six samples from river and industrial drains) were sampled in order to assess the water quality status of the study area. The samplings points are shown in the map (Annex 4).

Soil sampling

Soil samples were also taken to assess the soil quality in relation to organic contents in the soils. The sampling points from locations where water and soils samples were taken are shown in Annex 4.

Seeds sampling

Paddy, wheat and mustard seeds produced in the study area were sampled in order to find out about any significant changes due to industrial impacts.

2.4 Data processing and data analysis

Both qualitative and quantitative data from primary and secondary sources were analyzed by using different analytical tools and approaches. Those tools were: laboratory analysis, GIS environmental tool, statistical tools such as Likert's Attitudinal Model, the Chi-square model and the Correlation Coefficient Model etc.

2.4.1 Laboratory analysis

Physical test

Physical parameters such as turbidity, electric conductivity, and pH were analyzed in order to find out the water quality status from a physical perspective.

Chemical test

Chemical parameters such as Total Dissolve Salt (TDS), hardness, nitrogen contents, Dissolved Oxygen (DO), Total Dissolved Oxygen (TDO) and Biological Oxygen Demand (BOD) were tested in the laboratory to certify the water quality status.

Microbial test

Biological parameters such as Total Coliform and Facial Coliform were analyzed in order to identify the water quality status from a microbial perspective.

Soil test and seed test

The soil samples were analyzed in the laboratory for the NPK (Nitrogen, Phosphorous and Potassium) presence in the sampled soils. The seeds were soaked in water for about six hours and the water was tested in the lab.

2.4.2 GIS environmental analysis

The base map, risk maps and zoning land use, location map of the existing industries (based on GPS data) were prepared by using GIS environmental tools. The secondary data, land use and land cover were analyzed using the GIS interpretation. GPS data regarding the position of the industries were entered into the GIS environment and presented in the base map.

2.4.3 Community perception analysis

Impacts on physical environment and its sensitive components

Physical environmental pollution is defined as adverse impacts on air, water, soil and noise due to the existing industries in the region. The qualitative information about the feelings, experiences, ideas and views of local individuals on the quality of air, water and soil due to the existing industrial activities were assessed using the Likert Model. The checklist for the KII is given in Annex 1.1. It was designed in such a way that the people's perceptions were classified into five classless: "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". The calculation of the assessment is given in Annex 7.

Local peoples' perceptions regarding the impacts of industrial activities on air, water, soil, and noise were assessed using correlation coefficient (r). The rational formula of the correlation coefficient is given below. The relationship between the impacts of such types of pollutions and distance from the industrial area was identified on the basis of two variables: level of impacts (X); and distances from the industrial region (Y). A detailed calculation calculated using the following relation is given in Annex 7. Here, 'n' is the number of places where the FGDs were carried out.

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

The impacts of air, water, soil and noise pollution on sensitive components due to industrial activities were assessed based on the checklist provided to the focus group discussions. According to the checklist, the sensitive components were water, soil, flora, fauna, socio-economic and health, and recreational values and tourism. The following hypotheses were set in order to test the impacts.

Null hypothesis (H0): Degree of impact of air pollution is independent of different sensitive components like water, soil, flora, fauna and health and also socio-economic and archaeological recreational values.

Null hypothesis (H0): Degree of impact of water pollution is independent of different sensitive components like flora, fauna, health, socio-economic, soil/land and archaeological recreational values.

Null hypothesis (H0): Degree of impact of land pollution is independent of different sensitive components like flora, fauna, health, water bodies, socio-economic and archaeological recreational values.

Null hypothesis (H0): Degree of impact of noise pollution is independent of different sensitive components like tourism, human health, socio-economic and archaeological recreational values.

These hypotheses were tested using the statistical tool the Chi-square test model. The calculation of the model is given in **Annex 7**.

Biological environment

The biological environment consists of vegetation and flora and fauna present in the region. The impacts on these biological components due to industrial activities were assessed on the basis of qualitative information about the feelings, perceptions, experiences of local individuals – and the checklist for this assessment is given in Annex 1.1. The assessments were carried out by using the Likert Model and the calculation during the assessment is given in Annex 7.

Socio-economic and health and architect and archaeological environment

The attitudes of the local people about the socio-economic impacts due to the industries were assessed using the Likert Model. The qualitative data or information obtained from the individuals was used in the assessment. The assessment was done on two aspects: adverse impacts on health and beneficial impacts on the economy due to the industries. The analysis of the assessment on both aspects was done using the Likert Model and this calculation is shown in Annex 7. Likewise the attitudes of the local respondents from the view point of archaeological significance due to the industries were analyzed using the Likert Model.

2.5 Zoning the land use and guidelines for development

The study area has been classified into different zones on the basis of several criteria like bio-physical characteristic of the study area, the local community's perception on the sustainable development of the region, sensitivity of the region due to carbon emission industries, government decisions related to the development of the Lumbini heritage etc. The guidelines for the development of the classified zones have been formulated based on the conservation and protection principles and approaches, findings of the study, other relevant replicable examples etc.

2.6 Broader consultation

The draft reports with the preliminary findings were shared in a broader consultation meeting that was held in Lumbini on 13 July, 2011. The comments and the suggestions are incorporated in the report. The comments were basically focused on the risk maps and zonings.

CHAPTER 3

Existing Baseline Description

3.1 Socio-economic and Bio-physical Status

3.1.1 Introduction

This chapter deals with socio-economic and bio-physical status of the study area. As stated above, the study area (LPZ) which is approximately 828 sq.km includes the Rupandehi and Kapilbastu districts in the western development region of Nepal. The coverage area of Rupandehi and Kapilbastu is approximately 552 sq.km (67 per cent of the total area of LPZ) and 276 sq.km (33 per cent of the total area of LPZ) respectively. There are 69 VDCs in the LPZ among which 44 VDCs lie in Rupandehi and 25 VDCs in Kapilbastu (Annex 5). The base map of the study area on a scale of 1:110,000 was developed (Figure 3.1). This base map shows the types of land use and land cover, terrain features and the existing industries located in the study area.

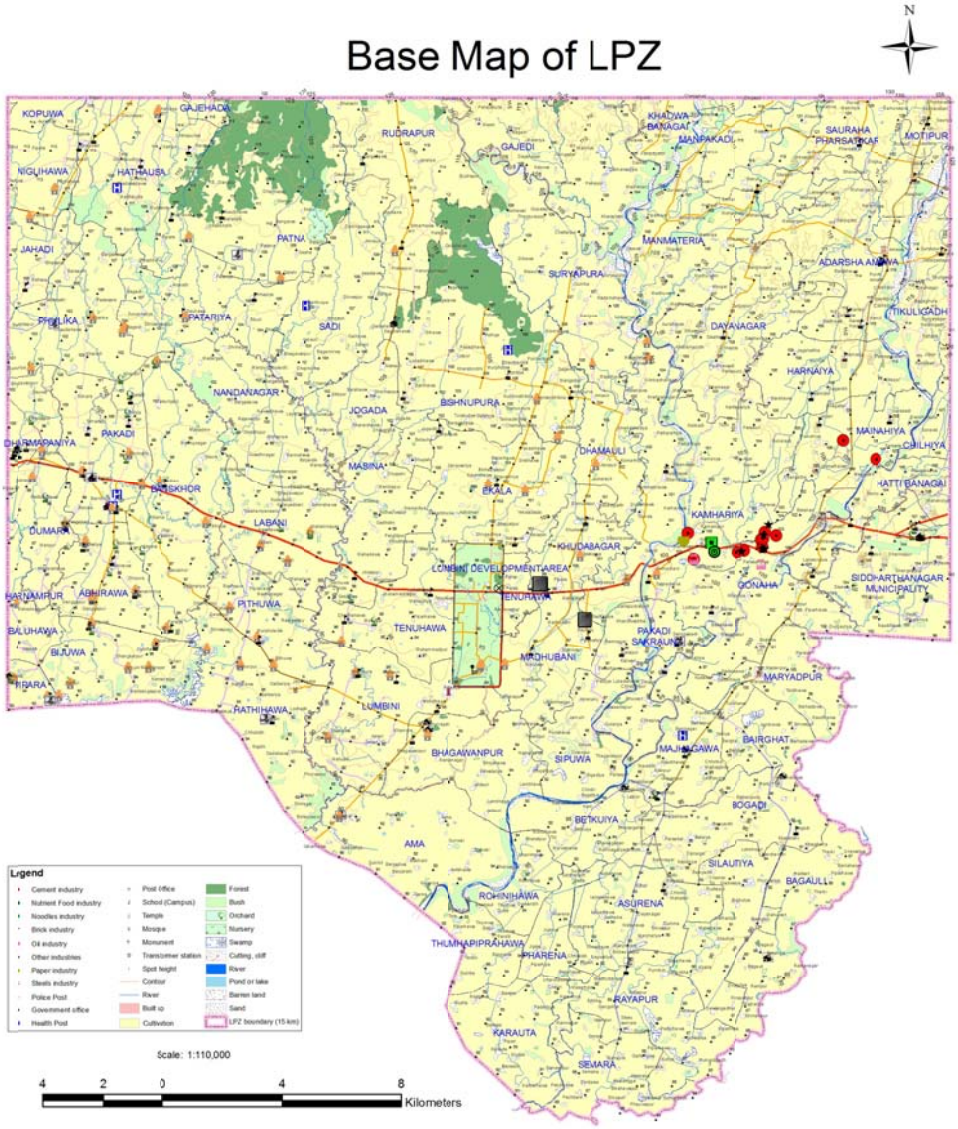

Figure 3.1: Base map of the study area

3.1.2 Socio-economic status

3.1.2.1 Population by caste and ethnic group

People living around the study area were fairly scattered. It was observed that settlement in the region tended to be concentrated along the Lumbini-Bhairawa Road. There was a total population of 57,164 in six sampled VDCs of the study area in 2001. The majority of the population in the region were Dalits (19 per cent), Yadav (16 per cent), Muslim (12 per cent) with a minor proportion comprising of a mosaic of ethnic groups such as Chhetri, Newar, Magar, Gurung and Kewat. Dalits were concentrated in Bisnupura (3,086), Kamhariya (2,156), Labani (1,989), Mudhabani (1,072), Lumbini (1,186) and Gonaha (1,412) VDCs, whereas Yadavs were distributed in Bishnupura (1,953), Madhubani (671) and Labani (1,133) VDCs. The majority of the population believed in Hinduism followed by Islam (Table 3.1).

Table 3.1: Population by caste and ethnic group

Ethnic Group	Ama	Bisnupura	Gonaha	Kamhariya	Labani	Madhuvani
Bahun	258	381	376	420	145	441
Dalit	1030	3086	1412	2156	1989	1072
Tharu	0	518	275	1750	65	409
Muslim	1479	1262	868	1188	1348	616
Magar	0	168	31	11	0	13
Yadav	1162	1953	2243	1759	1133	671
Chhetri	30	188	267	13	0	224
Kewat	750	196	656	1512	18	8
Lodha	2317	427	89	1635	0	541
Gurung	0	313	151	8	0	27
Kurmi	28	598	324	307	422	189
Newar	0	13	0	74	0	34
Mallah	37	62	762	670	0	72
Others	2256	2884	3384	1458	1333	1199
Total	9347	12049	10838	12961	6435	5516

Source: VDC Profile, 2009 and Field study, 2011

3.1.2.2 Demography, Literacy and Access to telephones and electricity

The population of the sampled VDC was projected for 2009 (Table 3.2). Table 3.2 reveals that the total number of households (11,246) with a maximum number of households (2,966) located in Kamhariya with population of 19,916 followed by households (2,414) in Bisnupura with a population of 15,323.The highest literacy rate was seen in Madhuvani with 46.5 per cent, followed by Kamariya (58.3 per cent). The literacy rate was high in Madhuvani because the people in the VDC were aware about the needs and importance of education. This VDC is adjacent to the Lumbini Heritage Site. The lowest literacy rate was found in Ama with 26.4 per cent, followed by Labani VDC with 26 per cent. The people in Ama VDC had very limited access to educational facilities. The VDC is far from the LWHS and on the border side to India. Social culture and beliefs are very traditional in Ama VDC. The sampled VDC had access to electricity and telephone services. The drinking water and sanitation status in Ama and Bishunpura VDCs was poor in comparison with other VDCs. The sanitation status was especially poor in the VDCs because of insufficient awareness and conventional beliefs. Likewise, telephone and electricity facilities were found in all VDCs.

Table 3. 2: Demography, literacy percentage and accesses to social services

Name of VDC's	Avg. H/H size	Total no. of H/H	Total population	Male	Female	Telephone	Electricity	Literacy
Ama	6.8	1747	11887	6266	5621	√	√	26.4
Bisnupura	6.35	2414	15323	8037	7286	√	√	32.8
Gonaha	7.25	1901	13783	7163	6619	√	√	31.3
Kamhariya	6.72	2966	19916	10167	9749	√	√	38.3
Labani	6.75	1170	7902	4095	3807	√	√	26.1
Madhuvani	6.69	1048	7015	3619	3395	√	√	46.5

Source: VDC Profile, 2009 and Field study, 2011

3.1.2.3 Land holdings and major crops

The region is predominantly an agriculture-based economy and agricultural land is the main asset of people in the study area. Land holding size determines economic well-being. The study revealed that 10 per cent of the people had no access to land, 10 per cent of the people had land holdings of less than five Kathas (0.17 Ha). Similarly, 40 per cent of the people had land holdings of two to three Bighas (1.4 ha to 2 Ha), 20 per cent of the people had holdings of three to 10 Bighas (2 Ha to 7 Ha), and the rest (20 per cent) owned comparatively the biggest segment of land i.e., 10 to 15 Bighas (7 Ha to 10 Ha). The major cultivated crops were rice and wheat. According to the local people, there was a lack of an irrigation facility. Only about 35 per cent of total agricultural land (720 sq-km) had irrigation facilities.

3.1.2.4 Commercial activities

Commercial activities such as shops selling household goods, cooked foods, medical supplies and small hotels providing accommodation around the industrial areas have been increasing day by day. It was observed that at the time of the study, about 80 to 90 shops have commenced economic activities and this figure shall increase in the future. According to the local people, the monthly income from these businesses varies from NRs 8000 to 18,000 and depends on the scale of consumption by the locals and industrial workers and the capacity of the shops. Therefore, the income of the local community around the industrial areas depends on industrial activities. People living around the industrial areas highlighted the need for better and more sustainable options for their livelihoods. The local community's engagement in tourism-based activities was found to be lacking.

3.1.3 Land use and Land Cover

Classification of the land use and land cover in the study area has been assessed by using the GIS interpretation on the topographical map. The types of land use and land cover with their corresponding areas are given in Table 3.3. About 87 per cent of the total area (83,085 Ha) was under cultivation. Likewise, the forest coverage in the region was not significant (about three per cent). Bush and grass coverage in the region accounted for four per cent of the total land (83,085 Ha). Furthermore, a considerable portion (about three per cent) of the region comprised of bare land.

Table 3.3: General features of the Land use and Land Cover Types of the study area

Land use type	Area		
	Ha	Sq km	Percent
Barren land	2369.87	23.7	2.8523
Built up	3.39	0.03	0.0041
Bush	3520.32	35.2	4.237
Cultivation	72017.28	720.17	86.679
Cutting, cliff	421.27	4.21	0.507
Forest	2345.34	23.45	2.8228
Nursery	153.94	1.54	0.1853

Orchid	231.15	2.31	0.2782
Pond or lake	166.7	1.67	0.2006
Sand	954.92	9.55	1.1493
Swamp	264.99	2.65	0.3189
Water body	635.59	6.36	0.765
Total area	83084.75	830.85	99.99

Source: Toposheets (DoS, 1995) and Field Survey, 2011

3.1.4 Biological Environmental Status

Historically, most of the farmland in Rupandehi's district was a mixture of grass land and different forest types. However, there has been a broad shift to intensive arable farming. Animals cannot find all their needs (food and nesting sites) supplied in areas dominated by only a few types of land use. Moreover, the farming has become much more intensive with increased use of fertilizer and pesticides.

3.1.4.1 Forest and vegetation composition

As mentioned above, only about three per cent of total land of the study area was covered by forest pockets. The study area was highly influenced by human settlement and cattle grazing which revealed less wild vegetation diversity. The forest landscape in general consisted of two types of forests in the districts of Rupandehi and Kapilbastu: natural forests and artificial forests (plantation). Common trees in the study area were: *Acacia catechu (*Khayer), *Adina cordifolia* (Haldu), *Albizzia lebbeck* (Seto Siris), *Albizzia procera* (Pink Siris), *Bombax ceiba* (Simal), *Dalbergia Sissoo* (Sisau), *Delonix regia* (Gulmohar), *Ficusbenghalensis* (Baar), *Ficus religiosa* (Peepal), *Grevillea robusta* (Kangio), *Jacranda momosifolia* (Jacreanda), *Magnifera indica* (Aanp) *Meliaazadirach* (Nim), *Melia persica* (Bakaino), *Pithocelbium dulce* (Jalebi), *Shorea robusta* (Sal), *Tamarindus indica* (Imli), *Tectona Grandis* (Teak), *Terminalia belerrica* (Barro) and *Terminalia chebula* (harro). The available forest area occurs on newly deposited alluvium, often in moist localities along the streams and rivers of the study area. A plantation forest is situated inside the Lumbini Garden, private land which is chiefly composed of Sissoo (*Darbergia sissoo*). Species like *Bombax ceiba* and *Shorea robusta* are legally protected by the Government of Nepal. As per the Forest Act Classification, the available LDT forest area falls under the government managed forest, though there are a few forest patches in the private land which are not officially registered as a private forest.

3.1.4.2 Floral Diversity

The natural vegetation plays an influential role in the socio-economic condition and lifestyle of local people. The local people are highly dependent on forests and forest-based non-timber forest products (NTFP) to fulfil their daily needs. Local plant resources were being used for different purposes including timber, firewood, medicine and food. The major timber yielding plants listed in the study are *Acacia catechu*, *Dalbergia Sisoo Anthocephalus chinensis, Eugeniaspp* etc. Beside these vegetations other species listed in the study, used for fodder, were *Aeschynomene indica, Alternanthera sessilis, Boehmeria platyphylla, Carex sp., Chrysopogon aciculatus, Saccharum spontaneum, Cynodon dactylon*. The Datura metel, *Eucalyptusspp* (Masala)., *Meliaazadirac* (Nim), *Terminalia belerrica* (Barro), *Terminalia chebula* (Harro) and *Syzugium operculata* (Jamun).etc. A detailed list of plants and their resource use pattern found in both Rupandehi and Kapilbastu districts is given in Annex 6.

3.1.4.3 Fauna Diversity

Wildlife:

The area affected by industrial activity mainly consists of agricultural land, patchy forest cover, grassland, some wetlands and rivers. However, the natural pristine forest area is very limited within the direct industrial area. The specific areas impacted by industrial development and activity are classified based on the existing land and vegetation cover. The forest is the prime habitat of wildlife but in the study area due to the lack of enough forest area, the habitat primarily used by the reported wild animals are mainly some patchy forest areas, bush, riverine belt, farmlands etc. Wildlife habitat conditions of the study area are described in detail in the forest and vegetation section of the report.

Mammals:

According to information supplied by the local people, the study area is home to a moderate population of wild mammals. The most common species are the: Common Mongoose, Blue Bull, Roof Rat, Rhesus Monkey, Hanuman Languor, Bat etc. Among these animals, the Nilgai or Blue Bull (Boselaphus tragocamelus) is one of the largest antelopes found in Asia. The LDT area provides a suitable habitat for the Blue bull. This species could be easily spotted during the visits. According to local people, the Blue Bull also raid and trample their farmland during night and day hours.

During the survey, a total of 12 mammalian species were reported by the local informants in the study area but actual observations of only monkeys, blue bulls and mongooses was possible. Rupandehi and Kapilbastu districts are potential Blue Bull habitats, but no conservation measures have been undertaken, hence the higher rate of decline in the population of the Blue Bull (*Subedi, 2001*). The decrease in the Blue Bull population might be due to the loss or destruction of habitat caused mainly by rapid industrial development, human interventions and rapid urbanization etc. For the establishment and construction of industries, generally large areas are occupied (e.g., 20 bighas – 13 Ha) by the Dynasties industry. During the course of industrial activity, waste is disposed directly into barren land and nearby rivers which creates pollution on both land and water. This ultimately affects the habitat of the Blue Bull. Therefore, it is necessary to identify Blue Bull habitats and their carrying capacity. Though different studies related to the Blue Bull suggest threats to the survival of the species, the Government of Nepal has yet to consider its status in its conservation category.

Of the 12 reported mammalian species, three species (Giant Flying Fox, Rhesus Macaque and Jungle Cat) are listed in CITES Appendix II, while other three (Red Fox, Bengal Fox and Common mongoose) are listed under CITES Appendix III and two (Hanuman Langoor and Common Leopard) in CITES Appendix I. IUCN has listed three species (Vulpes vulpes, Felis chaus, Pantthera pardu) under the category of lower risk and least concerned whereas Macaca mulatata, Semnopithecus entellus are listed as lower risk and near threatened species.

Beside these animals, cow, buffalo, goat are the domestic animals listed in the study area. None of the species found in the area are listed as a protected species by the Government of Nepal. The details of these animals are presented in Table 3.4. Likewise, about 21 mammalian species were recorded in Rupandehi district (Suwal, et al., 2001). The list of the species is given in Annex 9.

Table 3.4: Mammals of the Project Area Reported under Conservation Category

SN	Common Name	Scientific Name	Conservation Status		
			CITES Appendix	IUCN RedList	GON
1.	Giant Flying Fox	Pteropus giganteus	II	_	_
2.	Rhesus Macaque	Macaca mulatata	II	LR/nt	_
3.	Hanuman Langoor	Semnopithecus entellus	I	LR/nt	_
4.	Red Fox	Vulpes vulpes	III	LR/lc	_
5.	Golden Jackal	Canis aureus	_	_	_
6.	Bengal Fox	Vulpes bengalensis	III	_	_
7.	Common mongoose	Herpestes edwardsii	III	_	_
8.	Jungle Cat	Felis chaus	II	LR/lc	_
9.	Common Leopard	Pantthera pardus	I	LR/lc	_
8.	Spotted Deer	Axis axis	_	_	_
9.	Blue Bull	Boselaphus tragocamelus	_	_	_
10.	Three-Stripped Squirrel	Funambulus palmarum	_	_	_
11.	Roof Rat	Rattus rattus	_	_	_
12.	Rufous Tailed hare	Lepus nigricollis ruficaudata	_	_	_

Source: Field survey 2011

IUCN: LR/lc=Lower Risk/least concern, LR/nt=Lower Risk/near threatened, CITES=I-Listed in CITES Appendix I,II-Listed in CITES Appendix II, GON=P-Protected

Reptiles and Amphibians:

Information regarding the reptiles and amphibians in the area are limited. Limited survey works could not fully elucidate the numbers of species present and their habitat conditions. The information described in this section is based on the field observation, local people perception and secondary literature.

Habitat conditions on the riverine areas of Kapilbastu district are suitable for reptiles as the terrain has abundant shady stretches of land with leaves, litter and rotten logs. It also has farmland and grasslands which forms an ideal habitat for reptiles. Presently, the mobility range of all reptiles and amphibians is very small. These are sluggish animals that are easily hunted and killed by animal predators and humans. A total of 18 reptile and amphibian species were reported in the study area. Among the 18 reported species, two species (*Varanus flavescens* and *Python mourus molurus*) are legally protected by the Government of Nepal. Likewise, six species are listed in the CITES Appendix (One-Appendix II and Four- Appendix II). Two species (*Varanus flavescens* and *Python mourus molurus*) are listed under IUCN red list of which one species (*Python mourus molurus*) is at lower risk and near threatened. Another species, *Varanus flavescens* is categorized as lower risk and of least concern. Most of the reported species habitat is wetland followed by grassland, farmland and forest. The details of the reported species are given in Table 3.5. About 21 fauna species are recorded in Rupandehi district (Suwal et al., 2001) and are given in Annex 9.

Table 3.5: Reptiles and Amphibians Reported in the Study Area under Conservation Category

SN	Local Name	Scientific Name	Conservation Status		
			CITES Appendix	IUCN Red List	GoN
1	**Indian bull frog**	Rana Tigerina tigerina	II	_	_
2	**Marbled Toad**	Haplobatrachus tigerinus	II	_	_
3	**Asiatic rat snake**	Ptyas mucosa mucosa	II	_	_
4	**Russell's Viper**	Vipera russelli	_	_	_
5.	**Banded Krait**	Bungarus fasciatus	_	_	_
6.	**Binocellote Cobra**	Naja naja	II	_	_
7.	**Common Indian Krait**	Bungarus caeruleus	_	_	_
8.	**Bewngal monitor lizard**	Varanus bengalensis bengalensis	_	_	_
9.	**Brahminy skink**	Mabuya carinata	_	_	_
10.	**Brone grass skink**	Mabuya macularia	_	_	_
11.	**Wall Gecko**	Hemidactylus flaviviridis	_	_	_
12.	**Golden Monitor Lizard**	Varanus flavescens	I	LR/lc	P
13.	**Common Garden Lizard**	Calotes versicolor	_	_	_
14.	**Indian Roofed Turtle**	Kachuga tecta	_	_	_
15.	**Indian Burrowing Frog**	Tomopterna breviceps	_	_	_
16.	**Skittering Frog**	Rana cyanophlyctis	_	_	_
17.	**Indo Gangetic Flapshell Turtle**	Lissemys punctata andersoni	_	_	_
18.	**Asiatic Rock Python**	Python mourus molurus	I	LR/nt	P

Source: Field survey, 2011

Note: IUCN: LR/lc= Lower Risk & least concern, LR/nt=Lower Risk & near threatened, CITES=I-Listed in CITES Appendix I, II-Listed in CITES Appendix II, GON=P-Protected

Birds:

Birdlife International has declared Lumbini as an "Internationally important bird area" with a considerable diversity of bird life. Information related to birds was collected during the field observation, from secondary literature and by interviewing local people and this information is given in Table 3. 6. This area has the best known population of the globally threatened Sarus Crane in Nepal and is the only known site in the country where the species breeds regularly. They normally live in pairs and congregate during the non-breeding season (winter and spring season). Their movement is limited to a square kilometre during the nesting time. Hunting and the stealing of eggs and chicks is a direct threat to their survival.

A total of eight globally threatened birds are listed in the study area including the White-Rumped Vulture, Indian Spotted Eagle and the Aquila Hastata. The Slender-Billed Vulture, Cinereous Vulture

and Lesser Adjutant have also been recorded at the site and these are regularly seen in the region (Suwal, 2002). The Telar and Dano floodplains are recognized as important habitats for birdlife (Bhandari 1998). There are areas of tropical dry forests that are known to support significant populations of characteristic species of the Indo-Malayan Tropical Dry Zone biome (Bird Life International 2009).

Table 3.6: List of Birds in the Project Area under the Conservation Category

SN	Common Name	Scientific Name	IUCN Red List	GoN
1	Lesser Adjutant	Leptoptilos javanicus	VU	
2	Pallas's Fish-eagle	Haliaeetus leucoryphus	_	P
3	White-Rumped Vulture	Gyps bengalensis	CR	_
4	Slender-Billed Vulture	Gyps tenuirostris)	CR	_
5	Indian Spotted Eagle	Aquila hastate	VU	_
6	Sarus Crane	Grus antigone	VU	P
7	Bristled Grassbird	Chaetornis striata	_	_
8	White-throated Bushchat	Saxicola insignis	_	_

Source: Bird Life International, 2009: Important Bird Area fact sheet
Note IUCN: VU=Vulnerable, CR=Critically Endangered, P=Protected

Aquatic life:

Most of the people in the study area are dependent on wetland resources for their livelihoods. Wetlands found within the 15-km periphery area include lakes, village ponds, reservoirs, rain water ponds and paddy fields. During the monsoon, all the cultivated lands become wetlands with adequate water. A large mass of soil is usually excavated by the surrounding industries, mainly by brick factories, which has transformed the area into lowland which gets flooded with little rain. During the field survey, the local people highlighted the presence of some species in the region such as Suia (Gudusia chapra), Patara (Notopterus notopterus), Naini (Cirrhinus mrigula),Bam (Amphipnaus cuchia), Kauwa (Xenatodon Cancila), Garahi (C.punctatus), Mangoor (Clariusbatrachus) etc.

The local people said that the fish population had decreased in the Dano River in the last three to four years. As a result, local fishermen have to get involved in other economic activities in order to sustain a living. The fish habitat depends on the level of BOD in the water. The level of BOD has been assessed in this study (Chapter Six). The level of BOD needs to be monitored regularly in order to identify the situation of the aquatic habitat in the river system. Likewise, other threats to the site include unsustainable methods of harvesting fish, siltation, deposition of detritus from aquatic macrophutes, pollution from agricultural chemicals and invasive alien species such as *Richhornia crassipe* (DNPWC and IUCN, 2003).

3.2 Existing Industries

3.2.1 Introduction

This chapter deals with a description of the industries located in the study area (LPZ). It includes types, production capacities, products and by-products of the industries. The existing industries are located in the base map of the LPZ. The computation of green house emission especially CO2 emissions from the cement factory is also computed in this chapter.

3.2.2 The Industries in LPZ

Nearly 57 industries including Brick factories (30), Cement and Clinker production factories (11), Steels production factories (11), Noodles production (1), Paper production factories (1), Flour production factories (2) and others (10) are registered in the study area (Figure 3.2). The operation of brick factories is seasonal and this activity also varies its location as the availability of raw materials, such as clay, dictates the operational site. The establishment of industries at the site started from the fiscal year 2053/054 to the fiscal year (2067/068).

The Reliance Paper Mill is the oldest one (2053/054). The most recently established factories are Goinka Cement Factory (2067/068) - 9 Mangsir, 2067(Nov 25 2010) and Dynasty in 2011.

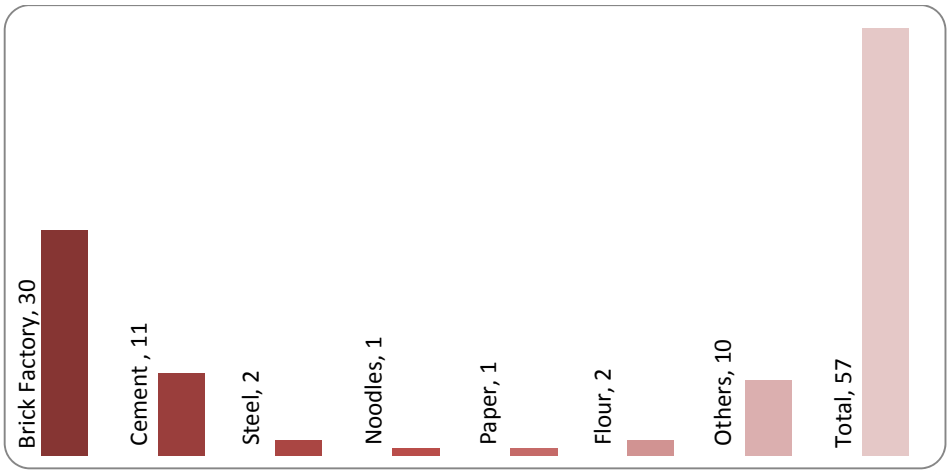

Figure 3.2: The existing factories located in the study area (LPZ)

Industries of the region are divided into following three categories according to their capacity in terms of production, employment, economic activities and impact intensity of these industries in environment and public health.

1) Major industries include cement, paper, steel and noodles factories.

2) Brick factories.

3) Other factories such as plywood, flour, oil, sacks, etc and these are represented in the table (Table 4.1).

The location of these industries is shown in Figures 3.3.and 3.4

Table 3.7: Classification of the industries based on their impacts

SN	Classes	Numbers of Industries	Possible Impact Areas	Remarks
1	Major Industries	15	Air Water Soil Sound Vegetation	This includes cement, aper mill, steel and noodles factories.
2.	Brick Industry	30	Air Soil Vegetation	The brick factories are seasonal and temporary.
3.	Other Factories	12	Air Sound	Plywood, flour mill, oil mill, sacks mill etc.

Source: Temporary Directory 2 (DoI, 2010) and Field Survey, 2011

Details about the actual information of the industries, including the number of employees and revenues was not available during the study period at the field level (as stated in the limitation).

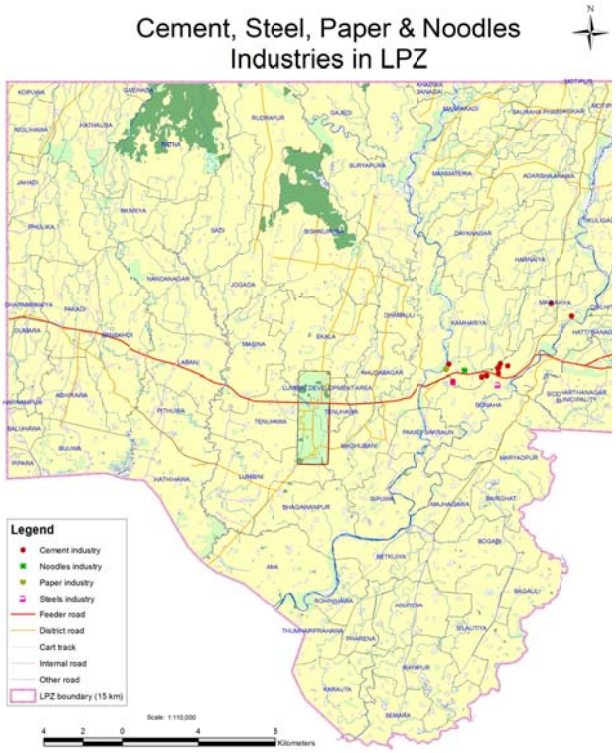

Figure 3.3: Cement, Steel, Paper and Noodles Industries in LPZ

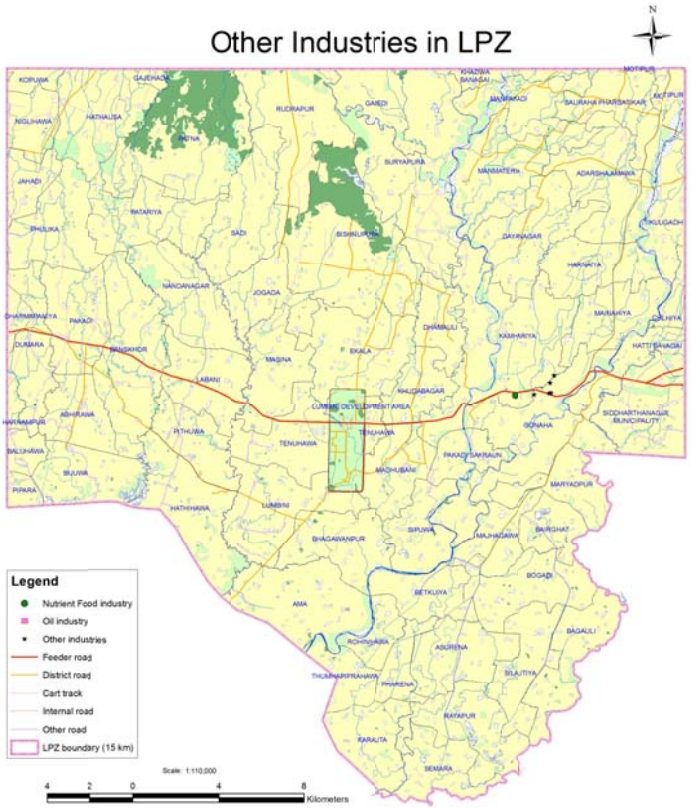

Figure 3.4: Location map of the existing industries in the study area

Of these major industries, almost all the industries were observed during the field visit except for the Bishal Cement Factory. The Bishal Cement Factory was under construction when the study was conducted. The distribution of 14 major industries in terms of their potential production capacity and current production are tabulated in Annex 6. The study shows that major industries have increased in the last ten years (Figure 3.5). The study also reveals that the cement industries produce about 4,200 metric tons of cement (including clinker) per day (Annex 6). It means that about 15 lakhs (33 thousand metric tons) of cement is produced annually in the region.

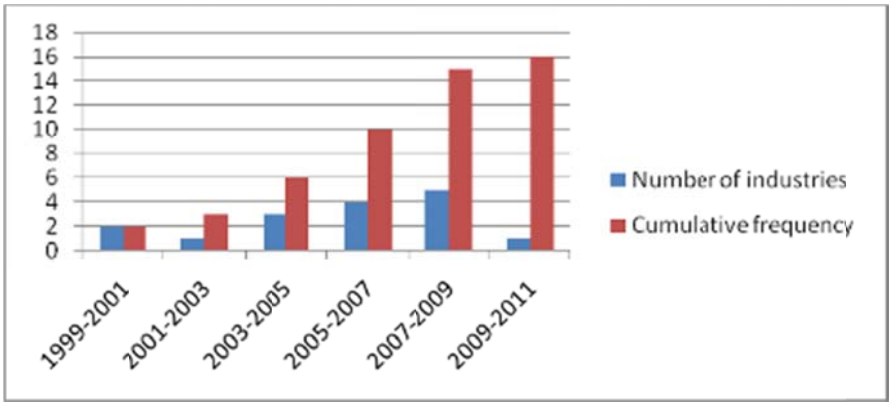

Figure 3.5: Cumulative of major Industries in LPZ

Source: Field Survey, 2011(the data is given in the Annex)

Of the 57 industries, 23 industries were visited during the field survey. These included major industries – 15 (11 cement industries, two steel industries, one paper industry and one noodle industry), bricks industries - two and six other industries (two flour industries, one plywood industry, one oil industry, and one casting industry). The list of the 23 industries is presented in Table 3.8.

According to decisions made by the Industrial Promotion Board (IPB) on 27 November 2009, carbon emitting industries are not permitted to operate in the LPZ, but these industries are also not allowed to be established within 800 metres from both sides of the Lumbini-Bhairawa Road. Yet, the new industries such as Goinka Cement Industry and Bishal Cement Industry are established within the LPZ (Table 3.8). Concerning the industries already existing within the area, it was decided that those industries can operate only if they respect the Environmental Protection Act. Industries which do not respect the Act will be relocated within two years.

Table 3.8: Location of the industries in distance from LPA and Lumbini-Bhairawa Road

SN	Name of Industry	Type	VDC	Production type	Distance from the boundary of LPA in km	Distance from L-B road in km	Current Production
1	Hira Brick Factory	Brick	Madhubani		3.01	0.998	
2	Ludian Brick Factory	Brick	Khudabagar		2.48	0.325	
3	Jagadamba Cement Pvt Ltd	Cement	Gonaha	Clinker-based	8.21	0.196	
4	Brija Cement Pvt Ltd	Cement	Kamahariya	Clinker-based	7.95	0.243	600 mt/day
5	Supreme Cement Pvt. Ltd.	Cement	Gonaha	Clinker and Cement	8.83	0.323	400 mt/day
6	Sidhartha Cement Pvt Ltd	Cement	Gonaha	Cement and Clinker (under process)	8.82	0.108	350 mt/day

7	Nepal Ambuja Cement Udhyog	Cement	Gonaha	Clinker-based	8.99	0.600	300mt/day
8	Reliance Cement Pvt. Ltd.	Cement	Kamahariya	Cement & Clinker	6.45	0.546	550 mt/day
9	Kailash Cement Pvt. Ltd.	Cement	Gonaha	Clinker-based	8.90	0.395	150 mt/day
10	Agni Cement Pvt. Ltd.	Cement	Gonaha	Clinker-based	9.35	0.570	300 mt/day
11	Dynasty Cement Pvt Ltd-2	Cement	Mainahiya	Clinker	13.24	2.429	500 mt/day
12	Goenka Cement Pvt. Ltd.	Cement	Kamahariya	Clinker-based	6.47	0.372	150 mt/day
13	Bishal Cement Pvt Ltd UCI	Cement	Mainahiya	Clinker-based	12.42	2.663	
14	Himalayan Snacks & Noodles	Noodles	Kamahariya	Noodles	7.14	0.170	10000 cartoon/day
15	Instant Meals Pvt. Ltd	Nutrient Food	Kamahariya	Nutrient Food	7.10	0.116	
16	Siddhartha Flour Mills Pvt Ltd	Other	Gonaha		8.90	0.085	
17	Jagadamba Synthetic Pvt. Ltd.	Other	Gonaha	PP Woven Sacks	8.11	0.230	900 mt/day
18	Shyam Plywood Pvt. Ltd	Other	Gonaha		8.93	0.506	
19	Siddartha Oil	Other	Gonaha		8.82	0.056	
20	Garima Kastigs	Other	Kamahariya		9.18	0.907	
21	Relience Paper Mills Pvt. Ltd.	Paper	Kamahariya	Craft paper	6.23	0.312	75 mt/year
22	Goenka Steels Pvt. Ltd.	Steels	Kamahariya	Iron rod	6.47	0.372	1250mt/month
23	Ambe Steels Pvt. Ltd.	Steels	Gonaha	Ms road angles channels	8.72	0.456	200 mt/day

Source: Field Survey, 2011

3.2.3 Industrial by-products status

3.2.3.1 Particulate matter

Sulphur dioxide is generated due to sulphur content in the production of coke. Likewise, oxides of nitrogen are generated during the combustion through oxidation of chemically bound nitrogen in the fuel and by thermal fixation of nitrogen in the combustion air.

Cement factories produce particulate matters due to the operation of crushers, hammer mills, raw mills, kilns and cement mills. The cement dust is alkaline with a size varying from 5 µm to250 µm (Chemical Technology and Pollution Control by Martin B. Hocking). The dust emissions occur during the process of handling the materials such as materials transfer (elevators and conveyor belts), the loading of raw materials, the packing of the cement, the unloading of cement bags, the transportation of vehicles, etc. The types of by-products produced by different types of industries located in the study area are tabulated in Table 3.9. The by-products include particulate matters and emissions.

Table 3.9: Particulate matter produced and emissions by the industries

Type	Major Wastes
Clinker-based Cement	Dust/smoke, Alkaline compound
Production of Clinker	Dust/CO_2/CO, sludge, SO2, NOx
Plywood	Dust/ CO_2/wooden dust
Noodles	Plastics, Ghee sludge, CO_2, Sludge
Steel	Sludge, CO_2,CO
Mustard Oil	Dust
Paper	Paper sludge
Nutrient Food	Dust

Source: Field Survey, 2011

Table 3.9 reveals that the clinker production from the raw material is comparatively rich in carbon emission polluters than cement production from the clinker. Furthermore, the particulate matters are sludge, dust, ghee sludge, alkaline compound etc. Quantitative data – including production amount and frequencies of the by-product waste produced by the existing industries – was not available during the field visit.

3.2.3.2 Emission of Green House Gases (GHGs)

Cement is an important construction material produced in most countries of the world. Carbon dioxide (CO2) is a by-product of a chemical conversion process used in the production of clinker, a component of cement, in which limestone-calcium carbonate (CaCO3) is converted to lime-calcium oxide (CaO). CO2 is emitted during clinker production and not during cement production (Michael et.al). The Intergovernmental Panel on Climate Change (IPCC) recommends using clinker data, rather than cement data to estimate CO2 emissions because CO2 is emitted during clinker production (not cement production). Moreover, revised IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines, 1996) provide a general approach to estimate CO2 emissions from clinker production in which the amount of clinker produced is multiplied by the clinker emission factor.

In this regard, IPCC guidelines provide a default value for the emission factor for calculating the CO_2 emissions from clinker production. The emission factor value is of 0.507 tons of CO_2/ton of clinker[2].

Out of 11 cement industries operating in the study area, few industries produce clinker. By using the emission factor, mentioned above, the CO2 emission from those factories are computed and given in Table 3.10.

[2]http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/3_1_Cement_Production.pdf
Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

Table 3.10: Emission of Carbon dioxide from clinker production industries in the study area

S.N	Cement Industries produced Clinker	Current Clinker Production (Mt/day)	CO2 emission (Mt/day)	Remarks
1	Dynasty industry Nepal	500	253.5	If it produces to its full capacity (700mt) the emission will be increased to 354.9 mt.
2	Supreme Cement	400	202.8	
3	Reliance Cement Mill	550	278.85	
4	Siddartha Cement	350	177.45	The factory was due to increase its production to about 700 mt clinker. If this target is achieved, it will increase the CO2 to 354.9 mt.
	Total	1800	912.6	

Source: Field survey, 2011

CHAPTER 4

Environmental Acts, Regulations, Policies and Guidelines

4.1 Introduction

The Government of Nepal has adopted various acts, regulations and guidelines to ensure the integration of development and conservation of the environment. During the course of this study, relevant legislative acts, regulations, policies and guidelines were thoroughly reviewed in order to understand the provisions made to integrate the development, along with environmental conservation. Furthermore, this chapter discusses the possible fragmentation of policies to draw the recommendations for proper execution of the policies for the conservation of the environment in the World Heritage Site of Lumbini.

4.2 Review of Acts, Regulations and Guidelines

Different acts that have provision for environmental protection are summarized as follows:

4.2.1 The Environment Protection Act (EPA) 1997 and Environment Protection Rule (EPR) 1997

The EPA deals with pollution control, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) and conservation of national heritage. It has a provision to stop emissions and discharging solid waste against standards. It also makes EIA mandatory for the establishment of certain polluting facilities including treatment plants and landfills for the management of hazardous waste. Any development project, before implementation, should pass through an environmental assessment, which may be either IEE or EIA depending upon the location, type and size of the project.

Section 7 in EPA, 1997 entitled the Prevention and Control of Pollution, states: “Nobody shall create pollution in such a manner as to cause significant adverse impacts on the environment or likely to be hazardous to public life and people’s health, or dispose or cause to be disposed sound, heat radioactive rays and wastes from any mechanical devices, industrial enterprises, or other places contrary to the prescribed standards.”

If it appears that anyone has carried out any act contrary to sub-section (1) and caused significant adverse impacts to the environment, the concerned agency may prescribe necessary terms in regard thereto or may prohibit the carrying out of such an act.

If it appears that the use of any types of substance, fuel tools or device has caused or is likely to cause significant adverse impacts on the environment, the Ministry of Environment may, by a notification in the *Nepal Gazette*, forbid the use of such substance, fuel, tools or device.

Sub Section 22 states, the manpower required for any industry shall have to be recruited from among Nepali citizens[i]

Rule 10 of EPR stipulates that all the proposals submitted for approval will have to produce a letter of recommendations from the affected parties, VDCs and municipalities on the proposal. However, the rule is silent on the status of the IEE/EIA if it is approved contrary to public and the affected VDCs and municipality opinion. However, the ministry can only grant its approval to implement the proposal if it does not cause significant adverse effects to the environment under rule 11.

Rule 12 of EPR stipulates that the proponent is obliged to follow the terms of conditions set by concerned agencies or the Ministry of Population and Environment in the approval letter during project implementation and operation. Rule 13 states that the concerned agency be responsible for project monitoring.

4.2.2 Ancient Monument Protection Act, 1956

This Act has the objective of protecting and conserving ancient monuments, temples, art and paintings which are older than 100 years. The Act empowers the government to declare any such

artefacts, temples, etc., under the conservation category by giving public notification. The Act stipulates that any such artefacts, temples etc., declared under the protection should not be disturbed or removed without the consent of the government.

This Act also provides authority to the chief archaeology officer to inspect as to whether or not the statue of a god or goddess that is being worshiped is kept properly and if it is found that it has not been kept properly, the officer has the power to order the concerned authorities to adequately preserve it.

Section 9 states that for the protection of shrines and temples: "The government of Nepal may make necessary arrangement to prevent misuse or any kind of ill treatment of places of archaeological importance or pilgrimage or temples which are under the supervision of the Government of Nepal. Anyone who is involved in any such kind of activities regarding any ancient monument or archaeological object would be liable to imprisonment of up to five years."

Section 17 states "The Government of Nepal can issue a notice declaring an area as preserved area and its sub-section one states that in the interest of research on archaeological objects if it is deemed proper to control or impose restriction on the act of researching and excavating such objects, the Government of Nepal may fix the boundaries of an area and declare it as a preserved area by issuing a notice to that effect."

But it fails to address any issues relating to pollution and industries creating pollution which render negative impacts on the surrounding environment i.e., biological, physical or socio-cultural and also fails to state how much distance should be maintained from the heritage site for the industries to operate.

4.2.3 Water Resource Act, 1992

Water Resource Act, 1992 of clauses 3, 7, 18, 20, 22 and 24 implies state ownership of any surface/ground water bodies of Nepal and stresses the utilization of water resources by any individual or organization without causing harm to others. It embodies that the Government of Nepal can fix, monitor and formulate regulations pertaining to water quality standards, pollution tolerance levels and development of water resources. It prohibits any action that may pollute water resources surpassing the threshold value. It has prioritized use of water resources in the successive order: drinking/ domestic use, irrigation, fishery, electricity, water transport, and recreation. It urges that utilization of resources should be carried out without causing any considerable damage to the environment such as soil erosion, floods, landslides and other similar natural hazards. The Act fails to address the licence mandatory for the extraction of water even from the land owner.

4.2.4 Industrial Enterprise Act, 1992 amended 2010

This Act makes an industrial licence mandatory for activities relating to defined public health and the environment. The Act gives priority to industries based on waste products and industry manufacturing pollution control devices. The provision for the Industrial Promotion Board is to direct industries to make arrangements for controlling environmental pollution.

The main objectives of the Industrial Act, 2010 is to ensure balanced industrial growth, backward linkage, protection and state support to industries, as well as to adopt the new environmental friendly technologies for the sustainable development of industries. Also, the new policy envisages creating more employment opportunities and reducing poverty through industrialization. It has also given emphasis to the use of local resources, raw materials and skills as well as encouraging women entrepreneurs. But in case of LPZ, a clear violation of this act can be seen as growing industries are creating pollution in the environment and also the local people, as well as women, are not given enough employment opportunities.

4.2.5 Solid Waste Management Act, 2011

This Act deals with provisions to manage solid waste and to mobilize resources and to minimize the adverse effect of solid waste on public health and the environment. The Act is the main legal body of the nation to address hazardous and non-hazardous industrial waste and municipal waste.

4.2.6 The Labour Act, 1991

This Act regulates the working environment and deals with occupational health and safety. It requires industry management to make arrangements to remove waste accumulated during production processes and prevent accumulation of dust, fume, vapour, and other impure materials, which adversely affect the health of the workers. It deals with the required management to provide protective clothing and devices to workers handling chemical substances and other hazardous and explosive substances.

The Labour Act, 1991 has also specified the rights and duties of labour and employers in the organized sector. The main functions of the Department of Labour are to implement policy and legislation on labour and assist the process of increasing production and productivity and also develop basic skills for labour employment. Its main tasks are to include the maintenance and stability of industrial sites, enforce provisions relating to minimum wages, safety and working conditions, welfare amenities, compensation and social security and develop human resources. It has a principal role of looking into labour relations and labour security issues. In the industries located in the study area, it was found that none of the measures related to the safety of the worker's health were enforced.

4.2.7 The Town Development Act, 1988

This Act empowers the Town Development Committee to regulate, control, or prohibit any act or activity that has an adverse impact on public health or the aesthetic of the town, or in any way that pollutes the environment.

4.2.8 The Local Self-Governance Act, 1999

The Local Self-Governance Act, 1999 empowers local bodies to implement measures for the conservation of soil, forest and other natural resources and implement environmental conservation activities. Sections 28 and 43 of the Act provide the Village Development Committee a legal mandate to formulate and implement programmes related to the protection of the environment and bio-diversity. Similarly, sections 189 and 201 of the Act provide that the District Development Committees is liable to formulate and implement the programmes related to the protection of the environment and give adequate priority to the protection of the environment during the formulation and implementation of the district level plan (s). It also has provision to make municipalities responsible for managing domestic solid waste. The Act does not require local governments to manage hazardous wastes, but empowers them to fine anyone up to Rs.15,000 for haphazard dumping of solid waste. This Act was also found to have been violated during the field visit in the study area, as there was haphazard development of industries without consideration for the environment. During the field visits, it was observed that the accepted measures such as plantation, drainage systems, etc., were not adopted to safeguard natural resources such as soil, air and water.

4.2.9 National Park and Wildlife Conservation Act, 1973

The National Parks and Wildlife Conservation Act, 1973 addresses the conservation of ecologically valuable areas and indigenous wildlife. The Act prohibits any movement of a person without written permission within the parks and the reserves. The Act further prohibits wildlife hunting, construction of houses and huts, damage to plants and animals etc., within the park and reserve, without the written permission of the authorized person. The Act has also listed 27 species of mammals, nine species of birds and three species of reptiles as protected wildlife species. Eight globally threatened bird species including the Sarus Crane and other wildlife are losing their natural habitat because of environmental degradation.

4.2.10 Aquatic Animals Protection Act (AAPA), 1961

This Act is one of the oldest acts in Nepal that recognizes the value of wetlands and aquatic animals. Under the Act, any party is punishable for introducing poisonous or explosive materials into a water source or destroying any dam, bridge or water system with the intent of catching or killing aquatic life. It also defines "private water" as a lake, pond, ditch, pool or reservoir that is on land used by a person who has been paying land tax to the government[ii].

4.2.11 Forest Act, 1993 and Forest Rules, 1995

The use of forestland for infrastructure projects is subject to forest law and regulation. Bridge projects need to comply with the provisions of forest law when it requires the use of forestland for construction.

The Act requires decision makers to take account of all forest values, including environmental services and biodiversity, not just the production of timber and other commodities. The Forest Act, 1993 (amendment, 1998) contains several provisions to ensure the development, conservation, management and sustainable use of forest resources, based on an approved work plan. It also recognizes the importance of forests in maintaining a healthy environment. Sections 68 of the Forest Act, 1993 empowers the government, in the case of no alternatives, to provide parts of any types of forest for the implementation of a national priority plan with assurance that it does not adversely affect the environment significantly. Section 49 of the Act prohibits reclaiming lands, setting fires, grazing, removing or damaging forest products, felling trees or plants, wildlife hunting and extracting boulders, sand and soil from the national forest without prior approval.

The Forest Rules, 1995 further elaborate legal measures for the conservation of forests and wildlife. Rule 65 of the Forest Regulation stipulates that in case the execution of any project having national priority in any forest area causes any loss or harm to any local individual or community, the proponent of the project itself shall bear the amount of compensation to be paid. Similarly the entire expenses required for the cutting and transporting of forest products in a forest area to be used by the approved project shall be borne by the proponent of the project.

4.2.12 National Environmental Impact Assessment Guidelines, 1993

In order to integrate environmental aspects in development projects and programs, the government developed the National EIA Guidelines (1993). The guidelines provide criteria for project screening and Environment Impact Assessment (EIA). This includes scoping, preparation of terms of reference for EIA, methods of EIA report, impact identification and prediction, impact mitigation measures, review of the draft EIA report, impact monitoring, evaluation of impact studies, impact auditing, community participation and schedules and annexes to IEE and EIA. Many of the guideline provisions are now included in the Environment Protection Act, 1997 and the Environment protection regulation, 1997. EIA in Nepal has now become legally mandatory.

4.2.13 Environmental Guidelines for Small Rural Infrastructure Planning, 2057

The directive is focused on the practical implementation of small rural infrastructure through the minimization of environmental impacts. This directive includes the simple methods of environmental management in the different phases of the project cycle. More emphasis is given to prevent rather than cure. So, the recommendations for the mitigation measures are provided only when it is necessary.

4.2.14 Industrial Policy 2067

The main objectives of the Industrial Policy, 2067 are: to ensure balanced industrial growth, backward linkage, protect and state support to industries, as well as to adopt the new environmental friendly technologies for the sustainable development of industries. Also the policy envisages creating more employment opportunities and reducing poverty through industrialization. It has also given emphasis to the use of local resources, raw materials and skills as well as encouraging women entrepreneurs.

However, the policy does not address the location of major industries that produce carbon emissions. Likewise, the policy also fails to explain the requirements to safeguard national and world heritage sites.

But in the case of LPZ, a clear violation of this policy can be seen as some industries are creating pollution as they are operate without pollution control measures. Also, local people as well as women are not given enough employment opportunities.

4.3 Interim Constitution of Nepal, (Second Amendment, 2007) Constitution of Kingdom of Nepal, 1990

The Interim Constitution of Nepal, (Second Amendment, 2007) is the supreme law of the country. Article 35 (5) of Interim Constitution proclaims that: “The State shall make necessary arrangements to maintain [a] clean environment. The State shall give priority to the protection of the environment and also to the prevention to its further damage due to physical development activities by increasing the awareness among the general public on the environmental cleanliness and the State shall also make arrangements for the special protection of the environment and the rare wildlife. Provision shall be

made for the protection of the forest, vegetation and biodiversity, their sustainable use and for equitable distribution of the benefit derived from them". Article 16 (1) proclaims that every person shall have the right to live in [a] clean environment. Article 19 (1) states that every citizen shall, subject to the laws in force, have the right to acquire, own, sell and otherwise dispose of the property. Article 19 (2) states that the State shall not, except in the public interest, acquire the property of any person, provided that this clause shall not be applicable on property acquired through illegal means. Article 19 (2) states that, compensation shall be provided for any property requisitioned, acquired or encumbered by the State in implementing scientific land reform program or in public interest in accordance with law. The compensation, basis thereof and operation procedure shall be as prescribed by law."
Likewise, the Constitution of Kingdom of Nepal 1990 gives priority for the protection of environment and it also highlights prevention of natural environment from further environmental damage due to physical developmental activities.

4.4 International Conventions

A number of legally-binding international instruments (conventions, treaties, protocols or agreements) have been adopted for the conservation of biological species and the natural environment. Nepal has also ratified or accessed a number of such instruments and the country has many obligations and commitments on the management of natural environment and biodiversity. As per the Nepal Treaty Act, 1991 [Section 9(1)], the provisions included in such international instruments are above the national laws.

Nepal is Party to the Convention on Biological Diversity (CBD, 1992); the Convention on the International Trade in Endangered Wild Fauna and Flora (CITES, 1973); the Convention on Wetlands of International Importance Especially the Waterfowl Habitat (Ramsar Convention, 1971); and the World Heritage Convention, which are all related to species conservation, international trade of species and their products, and conservation of wetlands, and natural and cultural heritage. The country as a whole is obliged to implement the Convention's provisions.

Nepal is also a signatory of the Convention (No. 169) concerning indigenous and tribal peoples in independent countries. Article 7 of this convention provides right to the indigenous and tribal people to decide their own priorities for the process of development. However for the national development plans and programmes, it mandates consultation with them in the formulation of the plans and programmes

UNESCO World Heritage Convention (WHC)

This convention observes the concept that cultural heritage and natural heritage are increasingly threatened with destruction, not only by the traditional causes of decay, but also by changing social and economic conditions which aggravate the situation even more. It recognizes that deterioration or disappearance of any item of cultural or natural heritage constitutes a harmful impoverishment of the heritage of all nations of the world.

Despite all of these protectionist policies, rules and regulations, 15 major carbon-emitting industries were still in operation in the Lumbini Protected Zone (LPZ), even after UNESCO inscribed this sacred place, the birthplace of the Lord Buddha, as a World Heritage Site. These industries began operations between 2001 and 2011 despite the decision by the UNESCO World Heritage Committee to inscribe Lumbini as a property with outstanding universal value onto the World Heritage List on December 6, 1997.

4.5 Implementation situation of policies by the industries

The industrial sector is one of the most dynamic sectors of the economy and plays an essential role in economic development for the alleviation of poverty. But the severity of some of the local impacts of industry and the high cost of industry remediation is becoming an increasingly sensitive issue. Regarding this issue, Lumbini is also not free from the pollution impact.

In this regard, many large environment polluting industries are being operated in Lumbini close to the World Heritage Site. This is mainly because the industries under Indian ownership capitalize on cheap

Nepali labour, water availability and proximity to the border. They also gain preferential access to existing infrastructure (i.e., electricity supplies and paved roads). The development of industry in this area is mostly motivated by economic benefits and social benefits are considered as secondary gains and have received less attention.

Industrial activities should comply with the regulatory norms for prevention and control of pollution. Alongside, it is also imperative to go beyond compliance through the adoption of clean technologies and improvement in management practices. Dedication and voluntary initiatives of industries for responsible care of the environment will help in building a partnership for pollution control. Realizing the role of rapid development and the industrialization process, which are adversely affecting the environment, the Government of Nepal has formulated several policies which all industries should comply with. In spite of these policies, the existing industries are haphazardly creating pollution and more new industries are being operated. Some drawbacks or possible breaching of the policies in the case of Lumbini are as follows:

Most of the factories operating in the Lumbini Road Industrial Corridor are clearly violating related regulations and guidelines for the protection of the environment. This has created an adverse impact on the environment, flora and fauna, local people and worker's health safety measures.

The Ancient Monument Protection Act, 1956 fails to address any other kind of pollution, such as industrial pollution, which creates havoc on the surrounding environment, i.e., biological, physical or socio-cultural. The Act also fails to designate the permitted distance towards heritage sites that industries can be operational.

Concerning the Nepal National Parks and Wildlife Conservation Act, 1973, eight globally threatened bird species including the Sarus Crane and other wildlife population are losing their natural habitat because of environmental impacts. Further verification study on this issue is needed.

The Water Resource Act, 1992 clearly prohibits any action that may pollute water resource surpassing the threshold value. It embodies that the Government of Nepal can fix, monitor and formulate regulations pertaining to water quality standards, pollution tolerance levels and the development of water resources. A clear violation of this law can be seen in the case of Lumbini. Factories are guilty of openly discharging waste liquid into the river Dano and its tributaries, therefore, they are making water unsuitable for domestic and recreational use and as a source of drinking water for wildlife.

Many facilities and concessions are provided by the government to attract investors to the industrial sector such as tax subsidies for industries which adopt pollution control measures and provide long-term benefits to employees. In spite of this provision, many industry operators have not complied with this policy which is a clear violation of the IA, 1997.

According to the Industrial Enterprise Act, 1997, Sub-section 22 states that manpower required for any industry should be Nepali citizens and that if any industries cannot be operated without a technician of a special category that is not available within Nepal, such a person may, with the approval of the Department of Labour, be appointed for up to five years. However, in the case of the Lumbini-Bhairawa corridor, most industries have more than 50 per cent of their workers – from officer level to labourers – recruited from India.

The Industrial Enterprise Act, 1992 has the power to impose a fine, cancel the registration, or close down an industrial operation if any industrial operation is found to be in violation of this Act. In spite of this policy, many industries at the study site were upgrading their production capacity.

The Labour Act 1991, also states regulations about worker's health safety measures, but in the industries visited during the field visit, no measures related to worker's health and safety were adopted. There also appeared to be a complete gap between industrial and labour administration as no coordination mechanism existed. There was also a major deficiency of skilled and trained manpower for the manufacturing industries.

In the case of Lumbini, there was a lack of coordination among responsible government agencies. According to the Environment Protection Act1997, it is the responsibility of the Ministry of Environment to accept or reject Environmental Impact Assessment applications submitted prior to the

establishment of a new industry. The main interest of the Ministry of Industry is to encourage the establishment of factories in the country to earn more revenue and support for economic development but it was found that environmental concerns are very little interest to the ministry .

From the relevant documents, it was also revealed that the EIA or the IEE document submitted by new industry applications did not contain detailed plans that address the likely impact on the health of workers and the local people and the environment arising from their operations. Nor did these documents describe how potential impacts will be monitored; the frequency of monitoring and reporting to the regulators and the local community; and mitigation strategies to resolve harmful impacts that may arise.

The Industrial Enterprise Act, 1992 should give more emphasis towards environmental protection along with the promotion of new industries. So, there should be clear policies considering the environment as well. Also there should be coordination between all the departments involved while establishing new industrial operations.

CHAPTER 5

Identification and Assessment of Environmental Impacts

5.1 Introduction

The Environmental Impact Assessment investigates the possible impacts, both adverse as well as beneficial, from the activities of factories operational in the study area. This chapter deals with the effects of these industries and deals with the primary impacts of industrial activities on air quality, water sources and soil quality in the location. The sectoral impacts, including socio-economic, cultural, health, physical and biological environments, are presented in this chapter. The impacts assessment was carried out by reviewing documentation, testing samples in the laboratory (soil and water) and analyzing qualitative information experienced by local communities.

5.2 Physical Environment

Primary impacts due to industrial activities focus on physical features such as air, water, and soil. As stated in the limitation of this study, getting scientific data and information to complete the impact assessments is a major challenge. However, the study tries as much as possible to show the primary impacts by assessing the primary information and data in terms of scientific analysis (laboratory analysis in the case of water and soils), reviewing the scientific literature, and also by evaluating the local community's perception about the industrial impacts.

5.2.1 Impacts on Air

Science-based discussions

Fugitive emissions from the cement industries were notably observed and were also felt by communities and tourists within the surrounding areas but the study team could not observe any specific fugitive emissions of particulates matter. This was because of the continuous rain during the field survey that washed away particles from the air. However, some factories such as Reliance Cement, Siddartha Cement, Supreme Cement, Bija Cement, Jagadamba (to some extent) produced fugitive emissions, especially in materials handling, crushing, transfer points of materials, packing of products and transportation. Most of the cement factories have not adopted the greenbelt and regular water sprinkling to reduce the impact of fugitive emissions. Exposure Limits to fugitive emissions are shown in the table below. The exposure limits for portland cement, gypsum, crystalline silica and calcium carbonate are given in Table 5.1. The emission emitted by the factories needs to be assessed by installing monitoring instruments in the region.

Table 5.1: Exposure limits for cement factory

S.N.	Chemicals	Mg/m^3
1	Portland Cement dust	10mg total dust/m3
2	Gypsum	10mg total dust/m3
3	Crystalline Silica	0.05mg reparable quartz/m3
4	Calcium carbonate	10m6 total dust/m3

Adopted from: EIA, 2008

Industrial impacts on air quality depend on the meteorological condition of the area when industries are in operational mode. Meteorological parameters determine dispersions, diffusion and transportation of particulate matter and emissions into the atmosphere. The meteorological parameters are wind velocity, temperature, humidity, rainfall, cloud cover, solar radiation, etc. Meteorological data is required for an analysis of air pollution impacts in the vicinity of the site. Importance of meteorological parameters is described in Table 5.2. However, this study was unable to analyze these parameters in order to determine the impact scale i.e., to what extent pollutants polluted the air (the constraints are described in the limitation). Further detailed study is required for an assessment of air quality.

Table 5.2: Importance of meteorological parameters concerning emission impacts on air quality.

Meteorological Parameters	Importance in the account of industrial impacts on air.
Wind speed	Determines the initial dispersion of air pollution.
Wind direction	Determine the downwind geometry.
Atmospheric stability condition	Determines plume spread associated with turbulent motions in the atmosphere.
Relative humidity	High humidity is associated with (I) Lowered visibility for water vapour plumes (ii) Possible acid mist formation in case of SO2 emissions.
Surface temperature	Influences stability conditions and extent of dispersion of pollutants.

Source: EIA, 2008

Likewise, an ambient air quality monitoring station is not located in and around the study area. Monitoring stations are needed at different distances from the source of the pollution (industrial zone) in order to detect air quality data to assess the degrees of industrial emission impacts on air. A model like the Gaussian Model can be used to predict the air quality and ground level concentration of suspended particulate matter by incorporating the pollution strengths and meteorological condition of the study area. It also requires detailed input data regarding industries such as the Vertical Shaft Brick Kiln (VSBK) stack data (vent height, vent diameter, particulate matter concentration, exist stack gas velocity, exist gas, ambient temperature, PM and emission load) and the details of cement mills stack data, etc.

People perception-based discussion

Industrial activities and their impacts on natural air were discussed with the local people in order to find the attitude of local people towards air pollution issues. For this, matrix questions containing seven statements (Annex 1) were given to local people, factory workers and students. The responses were analyzed by using Likert's Attitudinal Scale. The calculation of the analysis with the graphical presentation is given in Annex 7.2a. The result of the analysis shows that people are aware and have knowledge about air pollution due to existing industrial activities in the region.

Likewise, the relationship between the degree of air pollution and distance from industrial areas were analyzed by using correlation regression coefficient. In the field, it was noticed that the degree of air pollution differed according to the distances from the industrial area. So to measure this relationship, a correlation between the impact level and distances from the industrial area was calculated. Here the score for air pollution impact is obtained by using weights of three, two and one to the responses of high, medium and low respectively given by the respondents of FGD (Annex 1.2).The discussion shows that value of correlation coefficient is -0.402 which is negative. From this it can be concluded that there is a negative relationship between the impact of air pollution and distance from industrial area. This shows that people in the study area believed that the air pollution level is higher near the industrial area (Annex: 7.2b). The local communities made some conclusions which are given as follows: about three kilometres distance from the industrial areas, the air pollution provided the highest impact; from about three to eight kilometres distance it caused medium impacts in the region; and in from a distance of greater than eight kilometres from industrial areas, the impact was the lowest. The perception of local communities about the potential impact due to industrial emissions and pollutants is presented in Figure 5.1.

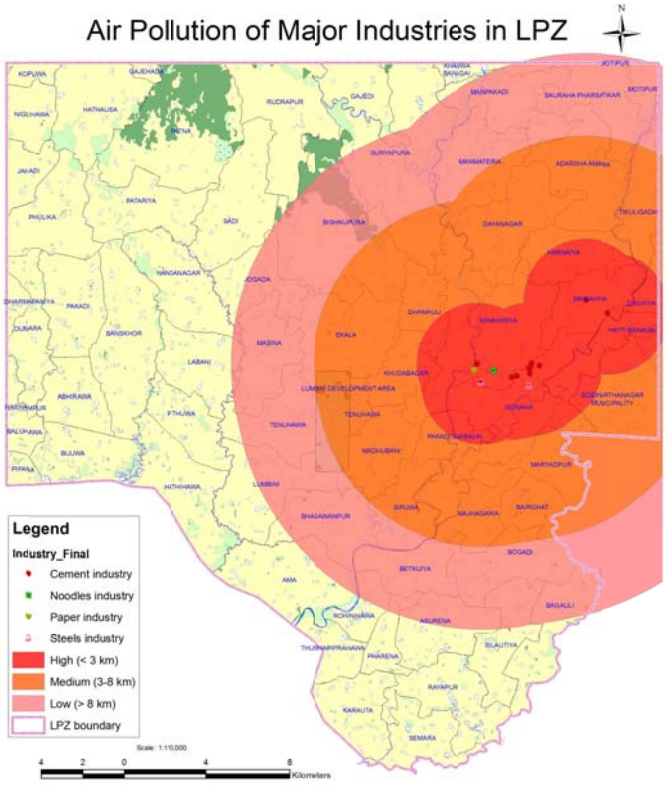

Figure 5.1: Air Pollution of major Industries in LPZ

5.2.2 Impacts on Water

Water quality assessment

As discussed in chapter two, water samples (ground water from water hand pumps and surface water from natural river and industrial drainage) were taken from the study area during the field visit. Water quality parameters such as dissolved oxygen (DO), pH, hardness, turbidity, total dissolved solids (TDS), phosphate, nitrate, biochemical oxygen demand (BOD), ammonia, electrical conductivity and coliform in water samples were tested in laboratory. Criteria for the selection of these parameters was based on the purpose of the water. The ground water parameters were selected to test the quality of water for drinking purposes, while surface water parameters were selected to test the pollution levels created by industries in the nearby water body. The parameters selected were not industry specific parameters but general parameters. The results obtained from the laboratory analysis are presented in Tables 5.3 and Table 5.4.

Table 5.3: Laboratory findings of the sampled ground water

Parameters	Findings				Unit	Desirable Limit
	H1	H2	H3	H4		
Dissolve Oxygen (Saturation)	80	6.3	4.5	7.5	%	>5
Total Coliform	10	240	19	0	MPN/100ml	0
Faecalcoliform	0	75	1	0	MPN/100ml	0
pH	7.9	8	7.5	7.7	-	6.5-8.5
Biological Oxygen Demand (BOD)	1.6	1.5	3.1	1.4	mg/L	3
Total Ammonia as N	0.1	0.05	1.7	0.1	mg/l	1.5

Nitrate (NO3)	0.05	0.02	0.2	0.03	mg/L	50
Phosphate (PO4)	0.07	0.06	0.06	0.1	mg/L	-
Turbidity	1	1	73	8	NTU	5
Total Dissolved Solid)TDS)	90	80	180	100	mg/L	500
Calcium Hardness as CaCO3	24	28	32	30	mg/L	-
Electrical Conductivity	550	500	1220	700	µS/cm	800
Water Quality Index	94	82	76	91		90-100: Excellent; 70-90: Good; 50-70: Medium; 25-50: Bad; 0-25: Very bad

Source: Field survey, 2011

Table 5.4: Laboratory findings of the sampled surface water

Parameters	**Findings**						**Unit**	**Desirable Limit**
	S1	**S2**	**S3**	**S4**	**S5**	**S6**		
Dissolve Oxygen (Saturation)	66	60	49	30	69	58	%	>5
Total Coliform	210	220	120	1100	460	93	MPN/100ml	0
Faecal coliform	43	63	43	460	150	64	MPN/100ml	0
pH	7.6	8	8	10.3	9.9	8.9	-	6.5-8.5
Biological Oxygen Demand (BOD)	2.9	2.8	3.7	6.6	2.1	4.1	mg/L	3
Total Ammonia as N	0.5	0.5	0.5	0.2	0.2	0.5	mg/l	1.5
Nitrate (NO3)	0.06	0.1	0.25	0.58	0.01	0.19	mg/L	50
Phosphate (PO4)	0.01	0.01	0.01	0.02	0.02	0.04	mg/L	-
Turbidity	260	259	319	100	259	213	NTU	5
Total Dissolved Solid)TDS)	40	30	40	220	40	50	mg/L	500
Calcium Hardness as CaCO3	46	51	27	28	32	36	mg/L	-
Electrical Conductivity	250	200	240	1230	280	330	µS/cm	800
Water Quality Index	71	67	63	45	62	62		90-100: Excellent; 70-90: Good; 50-70: Medium; 25-50: Bad; 0-25: Very bad

Source: Field survey, 2011

Water Quality Index: The water quality indexes of the sampled water are classified into three categories: a) excellent, b) good and c) bad as described in Tables 5.3 and 5.4. Regarding ground water, a total of four samples were collected. These samples were named from H1 to H4. The quality of sample H1 was excellent, while the three other samples: H2, H3 and H4 were found to be good. Similarly, six samples were collected from the surface water. These samples were named S1 to S6. In

the laboratory analysis, sample S1 was good quality. Similarly sample S2, S3, S5 and S6 were found to be medium quality, while sample S4 was a bad quality.

Dissolved oxygen (DO): Dissolved oxygen (DO) is a critical water quality parameter for characterizing the health of an aquatic system. It is a measurement of the oxygen dissolved in water which is available to sustain the life of fish and other aquatic life. The DO content of the water results from the photosynthetic and respiratory activities of the flora and fauna in the system and the mixing of atmospheric oxygen with water through wind and stream current action. Total dissolved gas concentrations in water should not exceed 110 per cent. Concentrations above this level can be harmful to aquatic life. Fish in water containing excessive dissolved gases may suffer from gas bubble disease however this is a very rare occurrence. The bubbles or emboli block the flow of blood through the blood vessels causing death. External bubbles (emphysema) can also occur and be seen on fins, skin and other tissues. Aquatic invertebrates are also affected by gas bubble disease but at levels higher than those lethal to fish. Adequate dissolved oxygen is necessary for good water quality. Oxygen is a necessary element to all forms of life. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. As it is lowered in concentration, the stress level intensifies. A level below 3 mg/l is stressful to most vertebrates and other forms of aquatic life. Tables 5.3 and table 5.4 reveal that dissolved oxygen level in the sample water were found to be: above 5 mg/l in all ground water samples (H1, H2, H3, & H4) and in all surface water samples (S1, S2, S3, S4, S5, S6).

Biochemical oxygen demand (BOD): This is a measure of the amount of oxygen consumed by the respiratory systems of microorganisms while feeding on decomposing organic material such as algae and other dead plants. Excessive nutrients (phosphates and nitrates) can cause algal blooms, and their eventual decomposition can cause massive fish fatalities if BOD drastically lowers dissolved oxygen levels. This demand occurs over some variable period of time depending on temperature, nutrient concentrations, and enzymes available to indigenous microbial populations. Total BOD is of more significance to food webs than to water quality. Dissolved oxygen depletion is most likely to become evident during the initial aquatic microbial population explosion in response to a large amount of organic material. If the microbial population deoxygenates the water, however, that lack of oxygen imposes a limit on population growth of aerobic aquatic microbial organisms resulting in a longer term food surplus and oxygen deficit. The biochemical oxygen demand should not be so great as to lower the dissolved oxygen to an unacceptable level (6.0 mg/l or less). Tables 5.3 and 5.4 reveal that BOD in the sample water was found to be less than 6 mg/l in all ground water samples (H1, H2, H3 and H4) and in all surface water samples (S1, S2 ,S3, S4, S5 and S6).

pH: The pH test measures the hydrogen ion concentration of water. It provides a gauge of the relative acid or alkaline nature of a sample. pH values between seven and eight are optimal for supporting a diverse aquatic ecosystem. A pH range between 6.5 and 8.5 is generally suitable. Tables 5.3 and 5.4 reveal that pH levels in the sample water was found to be within a desirable limit in all samples of ground water (H1, H2, H3 and H4) and also in the samples of surface water (S1, S2 and S3) but it was found to be above the desirable limit in the samples of surface water (S4, S5 and S6).

Turbidity: Turbidity is a measure of the light scattering properties of water. Suspended solids (including total dissolved solids) in water can reduce the transmission of light either through absorption or by scattering. High turbidity can have a negative impact on submerged aquatic vegetation. Tables 5.3 and 5.4 reveal that the turbidly of all the samples (ground and surface) were within the desirable limit.

Total solids: Total solids provide a measure of dissolved solids (from soluble rocks and soil) and suspended solids (silt, clay, plankton, etc.). Human activities can greatly increase these levels. Rapid changes in total solids levels are stressful to fishes.

Nutrients: The primary measures of nutrient loading, phosphates and nitrates are associated with many non-point pollution sources such as livestock manure and urine, failing septic systems and synthetic fertilizers. Excess nutrients can artificially stimulate plant growth resulting in algal blooms which speed up the aging process of aquatic systems. Nitrate levels in unpolluted water bodies should generally be below 1 mg/l. Phosphates in unpolluted water bodies should generally be below 0.1 mg/l. Tables 5.3 and 5.4 reveal that nitrate and phosphate levels in all of the water samples (ground and surface) were within the desirable limits.

Electrical conductivity: Electrical conductivity is the total concentration of inorganic ions (particularly sodium, chlorides, carbonates, magnesium, calcium, potassium and sulphates). Conductivity is often used as a measure of salinity. The conductivity level can directly affect the use of the water. For example, different types of plants have varying tolerance levels to salinity, as do different animals, which is important when considering the watering of stock.

Water Hardness: Total water hardness, expressed as calcium carbonate ($CaCO_3$) is the combined concentration of earth-alkali metals, predominantly magnesium (Mg^{2+}), calcium (Ca^{2+}) and some strontium (Sr^{2+}). The source of this hardness is limestone dissolved by water that is rich in carbon dioxide. Hardness levels range from <60 mg/L (soft) to >400mg/L (extremely hard). Water hardness can have an effect on the toxicity of certain heavy metals (chromium, copper, lead, nickel and zinc).

Ammonia: The ammonia level is not an immediate health relevance, however ammonia in water is an indicator of possible bacterial, sewage and animal waste pollution. It can also compromise disinfection efficiency, result in nitrite formation in distribution systems, cause the failure of filters for the removal of manganese and cause taste and odour problems. Tables 5.3 and 5.4 revealed that the ammonia levels in of all of the samples (ground and surface water) were within the desirable limit.

Coliform: Total coliform includes bacteria that is found in soil and water that has been influenced by surface water, and also in human or animal waste. Although total coliform can come from sources other than faecal matter, a positive total coliform sample should be considered as an indication of pollution. Faecal coliform bacteria indicates the likely presence of water-borne pathogenic (disease-causing) bacteria or viruses, including E.Coli. They are present in the intestinal tracts of all warm-blooded animals, including humans. Faecal coliform levels are measured in faecal colonies (FC) per 100 ml. Faecal coliform levels in freshwater should not exceed an average count of 100 colonies. Less than 50 FC is optimal. The health standard for drinking water is zero, for swimming 200 FC, and for partial body contacts (boating) 1,000 FC. Tables 5.3 and 5.4 reveal that growth of total coliform was observed in all the samples of surface water (S1, S2, S3, S4, S5, and S6) and it was also observed in the ground water samples (H1, H2 and H3) but not in the sample H4. Likewise, the results also showed that the growth of faecal coliform was observed in the ground water of samples H2 and H3 but not in the samples of H1 and H4. The faecal coliform was observed in the surface water of all the samples taken.

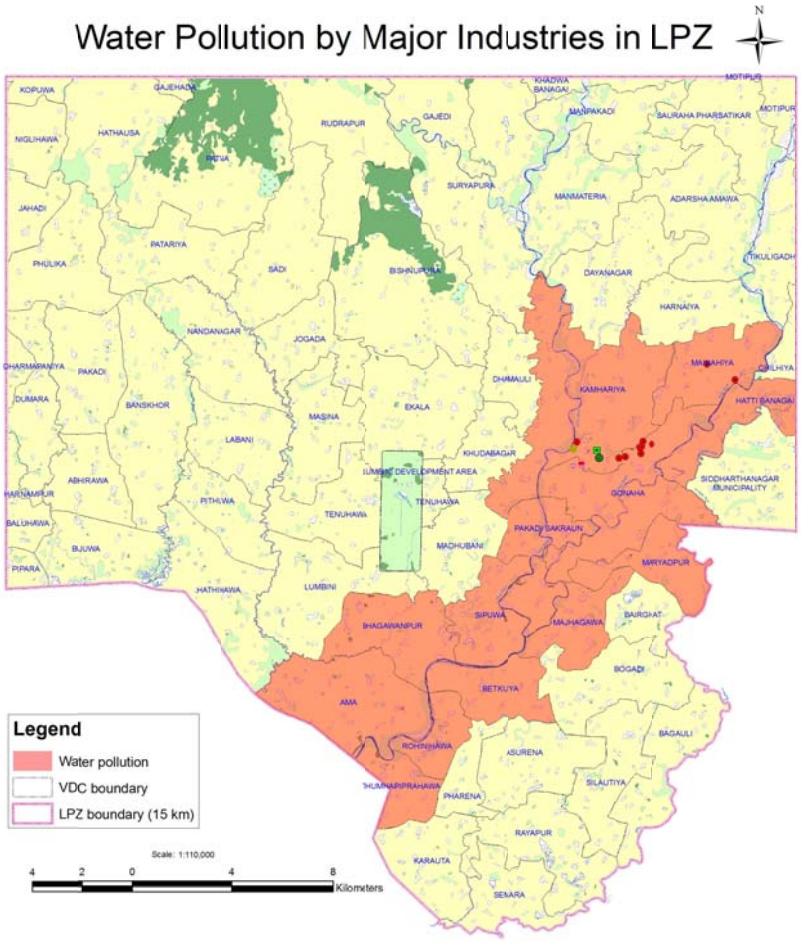

Figure 5.2: Water Pollution by Major Industries in LPZ

People perception-based discussion

In order to find the attitude of local people towards the water pollution issues, matrix questions containing 10 statements (Annex 1.1) was given to local people, factory workers and students. The obtained responses were analyzed by using Likert's Attitudinal Scale (Annex 7.4a). The calculation with the graphical presentation is given in Annex 7.4a. The results show that local people have sufficient awareness about water pollution.

Likewise, the degree of water pollution impact with respect to distance from industrial area was also discussed with the community during the field survey. In the field, it was noticed that the degree of water pollution differs from place to place. The relationship between the impact level and distances from the industrial area was assessed by using a correlation regression coefficient. The calculation of the analysis has been given in Annex 7.4b. Since the value of correlation coefficient is 0.45 (positive), it can be concluded that there is a positive relationship between the impact of water pollution and distance from the industrial area. This shows that the water pollution impact has been observed by the local communities in the downstream region from the industrial area even as the distance from the industrial area increases. The local communities confirmed an excessive withdrawal of ground water during the operation of the industries which has caused a drop in the level of water available in the region. The potential impacts of water pollution experienced by the local communities are presented in Figure 6.2.

5.2.3 Impacts on Soil

Laboratory analysis discussion

During the field visit, soils samples from sub soil to a 40-cm depth (on 4 July, 2011) were taken from two sampling points: crop lands and lands where industrial sludge was disposed. The results of the soil samples are presented in Table 5.5. Based on the soil samples taken during the field survey, it

was found that the soil was slightly alkaline; however, there was no toxicity in the soil. The soil was alkaline and the organic matters lower than the standard level. This revealed that that soil was affected by fugitive effluent due to the operations of the cement factories. For more detailed analysis, more soil samples need to be taken and analysed.

Table 5.5: Soil test results

Parameters	Soil Test Findings		Reference Range
	Sample 1	Sample 2	
pH(1:2.5% H2O)	7.7	7.7	
Total Nitrogen(N %)	0.12	0.11	Low (L): <0.1; Medium 0.1-0.2; High(H): >0.21
Available Phosphorous (P2O5) Kg/ha	30.25	24.75	Low(L): <30; MEDIUM: 31-55; High (H): >55
Available potassium (K2O) Kg/ha	384.0	369.6	Low (L): <110; Medium: 111-280; High (H): >280
Organic matter N)%	2.40	2.27	Low (L): <2.5; Medium: 2.6-5.0; High (H): >5.1

Sample 1: Reliance Paper and Cement Mill (within 100 metres of the mills); Sample 2: Semari, Back of the factory (within 1-km of the cement factory)

People perception-based discussion

The issue of industrial impacts on soil was discussed with the local communities. As per the local people's perception, most of the factories produced a significant amount of dust because the factories did not have dust collecting equipment. Dust generated by the cement manufacturing plants consists primarily of alkaline particulates from the raw and finished products. Furthermore, during the field visit, it was observed that Goinka Cement to some extent controlled their dust emissions. According to the locals, as a result of an accumulation of dust in the local environment, crop cultivation near the industrial areas decreased in comparison to the pre-industry era. Likewise, during the flowering periods, the photosynthesis and pollination processes were disturbed because of dust accumulation on plants and soil and the local people shared their experiences regarding this issue.

Qualitative information about the feelings, experiences, ideas and views of local individuals on the sensitization of soil pollution has been assessed by using Likert's Model. The calculation of the analysis with the graphical presentation is given in Annex 7. The result shows that the local people had knowledge about the soil-land pollution ration due to industrial activities in the region.

Further analysis regarding local people's perception about the soil impacts was carried out in the study. The degree of soil-land pollution potential and distance from industrial areas was specifically discussed. In the field, it was noticed that the degree of land pollution differed according to distances from the industrial area. So a correlation coefficient method was used to measure this correlation relationship between the impact level and distances from the industrial area. The score for land pollution potential was obtained by using weights of three, two and one and represents high, medium and low respectively given by the respondents of a Focus Group Discussion (Annex 1.1). From the calculation, it was obtained that the value of correlation coefficient was -0.68. This negative sign showed that there is a negative relationship between the impact of land pollution potential and distance from the industrial area. This revealed that land pollution potential is higher near the industrial area (Annex 7.6). The soil-land pollution due to the industries based on qualitative analysis is shown in Figure 5.3.

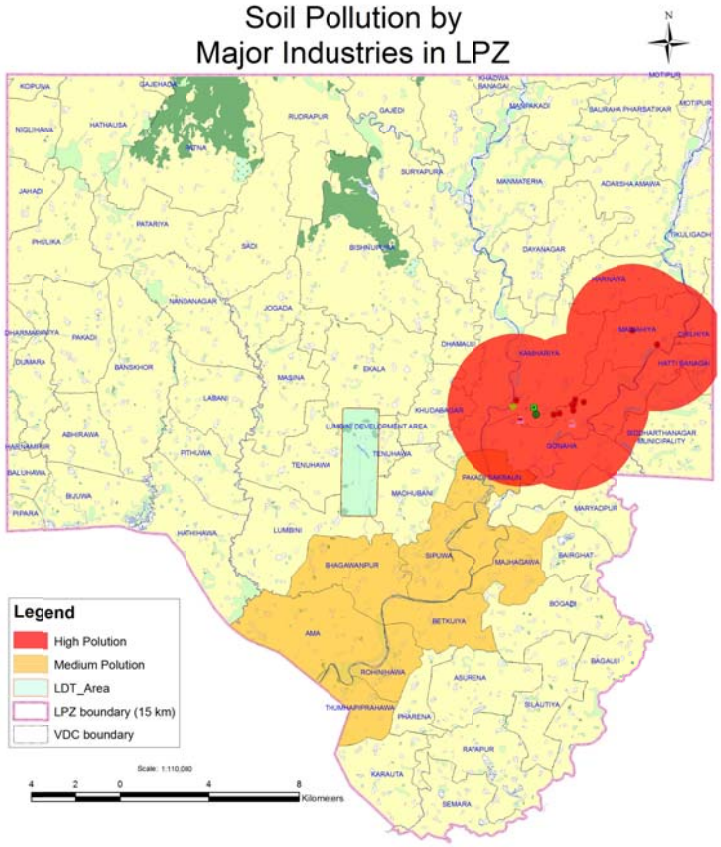

Figure 5.3: Soil pollution due to industrial activities buffered in GIS

5.2.4 Impacts of Noise

Noise level assessment

Cement manufacturing plants contain a number of heavy equipment such as fans, engines, generators, and cement grinding machinery. Adding to the severity of the noise pollution, cement plants in the study area are located adjacent to residential, institutional and education areas. The environmental disruption was also heightened by heavy vehicular traffic servicing the site, with up to 100 trucks a day causing traffic jams and excessive noise. Noise and vibration is greater from heavy truck traffic associated with quarry operations and the transport of raw materials and finished products. In this regard, the noise level measurement needs to be taken from noise receptors located outside the boundary of the cement factories. The permissible level of noise of a cement industry is recommended by The World Bank (1998). According to World Bank guidelines, appropriate noise levels for cement plants are given in Table 5.6. But the study has not accessed the noise levels data produced by the industries in the study area. Thus, noise level monitoring instrument needs to be installed for a detailed assessment of this issue.

Table 5.6: World Bank Guideline on Noise Level for Cement Plants

Receptor	Maximum Allowable (hourly measurement) in dB		Remarks
	Time (from 7am to 22pm)	(Time: From 22 pm to 7am)	
Residential, Institutional, Educational	55	45	
Industrial, Commercial	70	70	

Source: World Bank, 1998

People perception-based assessment

The assessment about the relationship between degrees of noise pollution with respect to distance from the industrial area was carried out in the field visit. In the field, it was noticed that the degree of noise pollution depends on the distance from the industrial area. So to measure this relationship, the correlation between the impact level and distances from the industrial area was assessed using correlation coefficient and the calculation is given in Annex 7.7b. According to the calculation, the score value for noise pollution potential is obtained by using weights of three, two and one to the responses of high, medium and low respectively given by the respondents of FGD (Annex 1.1).
Since the value of correlation coefficient is 0.125 which is nearly equal to zero, it can be concluded that there is no relationship between the impacts of noise pollution potential and distance from the industrial area (Annex 7.7b). This means that as the distance from the industrial site increases, the degree of the intensity of the noise decreases. The local people's perception about noise pollution due to the industrial activity is shown in Figure 5.4.

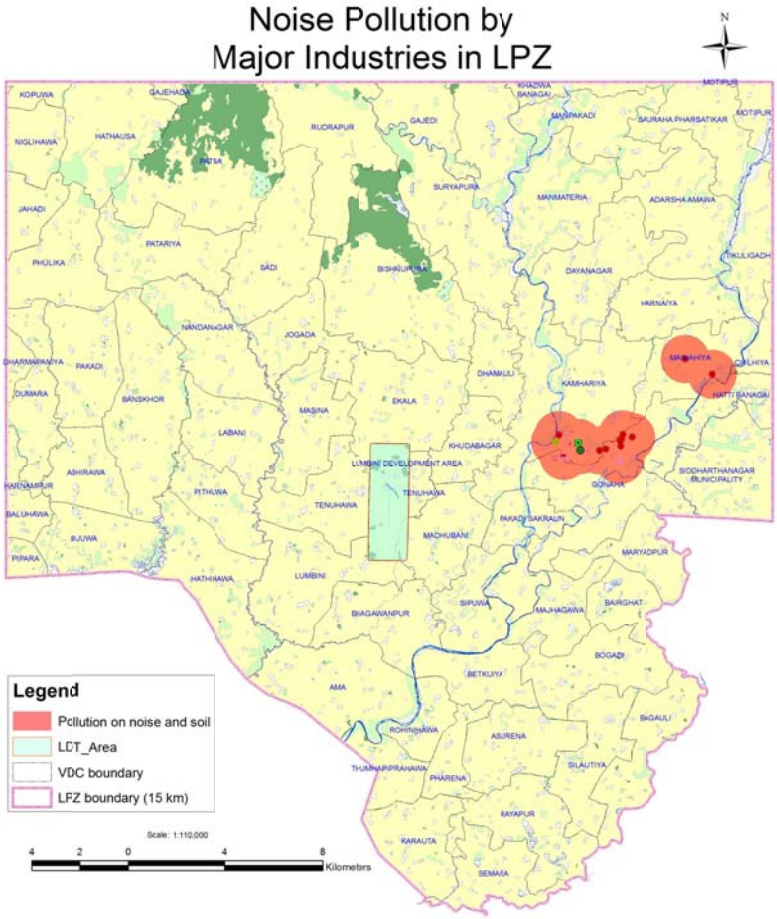

Figure 5.4: Noise pollution due to industrial activities buffered in GIS

In conclusion, air pollution levels were higher nearer the industrial area due to a lack of mitigation measures to control fugitive emissions produced by cement industries. According to the local community's perception, at a distance of about three kilometres distance from the industrial areas, the air pollution had the highest detrimental impact and from three to eight kilometres distance it caused a medium impact. This perception is required to be verified in further study activities. So far as water pollution is concerned, the growth of total colifom was observed in the samples of surface water and ground water. Water pollution was observed in surface runoff and in the sampled hand pumps. Furthermore, water pollution was experienced by the local communities in the downstream region from the industrial areas. The local people said that the water table decreased around the industrial areas because of excessive withdrawal of ground water during the operation of the industries. The soil

around the industrial site was found to be alkaline and the organic matter content in the soil was lower than the standard. The soil pollution assessment revealed that the soil around the industrial areas was affected by fugitive effluent due to the activities of the cement factories. As a result of an accumulation of dust in the local environment, crops cultivation near the industrial areas decreased in comparison to the pre-industry era in the region. Due to heavy truck traffic (about 100 trucks per day flows from/to industrial sites to transport materials) and due to quarry operations, excessive noise pollution and vibration was witnessed in the industrial areas. The noise level measurement needs to be taken by noise receptors located outside the boundary of the cement factories.

5.3 Socio-economic, Cultural and Health Environments

5.3.1 Socio-economic

As stated in the above sections, air, water, soil, and noise have been adversely affected due to industrial activities in the region. As a result, the consequences of such adverse impacts have also been observed in different sectors especially in socio-economic, culture and health. In this regard, the questionnaires regarding the industrial impacts on social, economic and cultural environment were provide to the local communities to determine their perception about the impacts. Furthermore, the qualitative information obtained from the local people was assessed using Likert's Attitudinal Model. The analytical result (calculation given in Annex 7.10a) shows that local people from the vicinity of the study area believe the emergence of industries helps economic development and assists in solving unemployment. Local communities have benefitted by improved road access, community forests, enhanced local service facilities such as water supplies, education and healthcare, etc. People were getting income opportunities because of the expansion of the local market of local commodities due to industrial activities in the region. According to the respondents, local people were attracted towards financial benefits offered by the industries. At the same time, the land use pattern has gradually changed from agricultural use to industrial activities as local people sell off their productive agricultural land. The study also showed that industrial development and expansion of the industrial area has been causing localized effects such as loss of private and community land, properties and resources of local residents, and disrupting patterns of communication, landholdings, social and economic systems and resource use.

Industrial pollution has also affected the religious and spiritual areas such as cremation ghats, spiritual bathing places, religious ritual places, etc. These impacts adversely affect the cultural, spiritual and religious practices of local communities and pilgrimages in the long run. Thus, socio-economic and cultural environmental issues and impacts were discussed during the field visits. Table 5.7 summarizes the socio-economic and cultural environmental issues and impacts and predicts the nature of impacts (adverse and beneficial) from existing industries to develop a clear monitoring plan.

Table 5.7: Socio-economic and cultural environmental issues and impacts

SN	Issues	Impact	Direct /Indirect impact	Extent	Duration	Magnitude
A.	**Adverse issues**					
1	**Population displacement, settlements (Expansion of earlier settlements, development of new settlements) and social impoverishment during the industrial development.**	Loss of private land and property.	D	L	LT	M
		Loss of agriculture production.	ID	L	MT	M
		Social impoverishment.	D	L	ST	M
		Population displacement.	D	L	LT	M
		Haphazard expansion of settlements.	ID	R	LT	M

3.	**Unplanned development for settlement and industries.**	Rapid growth of population, chaotic settlement and reduced quality of life.	D	R	LT	H
4.	**Influence on the social infrastructure and resources (Irrigation canals, water supply due to change in groundwater table), agricultural produce, educational, health services, road, by the industry.**	Damage to agricultural land.	ID	L	ST	M
		Reduction in the irrigation canal water discharges.	ID	L	ST	M
		Excessive extraction of groundwater by the industries.	ID	R	LT	H
		Impact on the health of the locals.	ID	L	ST	M
		Impact on the health of the students.	ID	L	ST	M
		Degradation of overall environment through smoke, dust.	ID	L	ST	M
		Traffic congestion, damage to the roads by heavy vehicles.	D	L	ST	M
5	**Dust raised by industries and vehicles.**	Impact on the health of locals, factory workers and on plants (Dust accumulation over the plant.)	ID	L	ST	M
6.	**Surface water pollution due to the direct discharge of effluents from industries into the river which affects the social utilities including irrigation canals.**	Restriction on the use of riverine areas for various local uses (bathing, washing, fishing cleaning, livestock feeding etc.)	ID	L	ST	M
		Limitation to the irrigation canal.	ID	L	ST	M
7	**Influence on occupational health, community health and accidental risks.**	Increase in air, water, noise and land pollution and its implication to community health.	ID	L	ST	M
		Increase in occupational health hazards of factory workers.	D	L	ST	H
		Increase in accidents (traffic, factory works) and implication on community health.	ID	L	ST	M
8.	**Employment opportunities.**	Increase in concentration of outside skilled and unskilled labour can have a negative impact such as drinking alcohol, gambling and illicit relationships.	D	R	ST	H
		Conflict between locals and outsiders.	ID	L	ST	M
9.	**Gender discrimination risk.**	Gender discrimination in employment.	ID	L	ST	M
10	**Damage to cultural/historical and**	Damage to heritage and religious sites by the	ID	R	LT	M

	religious sites.	industrial emissions.				
11.	**Influence on local culture and traditions.**	Erosion of local culture and traditions.	ID	L	ST	L
12.	**Affects on religious and spiritual traditions.**	Affects on cremation ghats, spiritual bathing places, religious ritual places, etc.	D	L	LT	H
B.	**Beneficial Issues.**					
1.	**Improved access facilities.**	Improved road access.	D	R	LT	H
2.	**Environmental enhancement benefits to local service facilities (Water supply, education, healthcare, community forests, etc.)**	Improvement in local service facilities especially in education.	ID	L	MT	M
3.	**Local employment opportunities.**	Local employment opportunities in labour.	D	S	ST	M
4.	**Local marketing/business opportunities.**	Development of market for local produce.				
		Development of tea stalls and restaurants business for local communities.	ID	R	ST	M
5.	**Local tourism opportunities.**	Increase in tourists to the area.	ID	R	ST	M
6.	**Subsidiary industrial opportunities.**	Development of new industrial skills among local communities.	ID	R	LT	M
7.	**Local government revenue opportunities.**	Increase in local government tax/revenue sources.	D	R	ST	H
8.	**Government service enhancement opportunities.**	Improvements in government services.	ID	L	LT	Lo
9.	**Land development opportunities.**	Alteration of land units to a better quality for development.	ID	S	LT	M

Note: Magnitude: High, Moderate and Low; Extent: Regional, Local, Site Specific; Duration: Long Term, Medium Term, Short Term; 4. D=Direct: ID= Indirect, S=Site specific=Local, R=Regional: ST=Short term, N=No Impact, MT=Medium Term, LT=Long Term; Lo=Low, M=Moderate, H=High

5.3.2 Health Environment

Potential matter that causes detrimental health consequences: Raw materials such as silica, gypsum, lime stone, clinker and the finished product like cement pose a major risk to health. There are a number of hazards inherent in the cement production process. Some examples for health sensitive factors are: exposure to dust and high temperatures; contact with allergic substances; and exposure to extreme noise. These mainly impact those working within the industry but they also have health hazards on local communities.

It was visually observed that local communities around a 1-km radius suffered the highest impacts in terms of health hazards due to dust pollution. However, air quality monitoring is required to find the actual level of pollution. Growing industries are degrading the overall environment of the surrounding areas by releasing smoke, dust and different solid waste and chemical particles. These kinds of activities have been adversely impacting the health of locals especially school children and factory workers. For example, Guruwani Mai Lower Secondary School, Parshahawa and Semari Secondary

School, Semari are at risk of air pollution caused by industrial activity, especially due to the Mayose Noodle factory. In addition to this, there have been detrimental impacts on health due to traffic congestion and heavy vehicular traffic on the Lumbini-Bhairawa Road. Most of the road network is encroached leading to traffic and transportation problems. The quantitative analysis regarding health impacts needs to be carried out by applying clinical tests and verification. Also, long-term health care facilities and rehabilitation centres are needed.

The detrimental consequences of industrial activity in the study area are listed below:

Eye Contact: Airborne dust can cause immediate or delayed irritation or inflammation. Eye contact with large amounts of clinker dust and dry cement powder can cause moderate eye irritation, chemical burns and blindness. Eye contact with large amounts of gypsum can cause moderate eye irritation, redness, and abrasions. Eye exposure to these substances requires immediate first aid and medical attention to prevent significant damage to the eye.

Skin Contact: Dust from clinker, gypsum and cement causes dry skin, discomfort, irritation, severe burns and dermatitis. Clinker dust and cement dust are capable of causing dermatitis through waterborne transmission. A symptom of skin affected by dermatitis is cracking. Irritant dermatitis is caused by the physical properties of clinker dust including alkalinity abrasion.

Inhalation (Acute): Breathing dust may cause nose throat or lung irritation, including choking, depending on the degree of exposure. Inhalation of high levels of dust can cause chemical burns to the nose, throat and lungs.

Inhalation (Chronic): Risk of injury depends on duration and level of exposure. This product contains crystalline silica. Prolonged or repeated inhalation of respiration crystalline silica from this product can cause silicosis, a seriously disabling and fatal lung disease.

In summary, temporarily economic activities, especially the expansion of the local market of local commodities due to the presence of existing industries in the region has increased. Unskilled labour from local communities has gained employment in the factories but the actual numbers of those in employment were not on record in all of the factories and these figures varied from time to time. So their income contributions through daily wages are too insignificant to survive (NRs. 150 per day). In the long run, industrial development and expansion of industrial activities will cause further disruption of communications, landholdings, social and economic systems and resource use.
Furthermore, water pollution in the river adversely impacts on the cultural, spiritual and religious practices of local communities and pilgrims. Eye irritation due to clinker dust and dry cement powder has been experienced by local communities. Likewise, dry skin, discomfort, irritation and severe burns caused skin problems across the region. As already mentioned, economic activities of some people has also increased in recent years but this comes at a price and at a cost to their health and available resources that are no longer sustainable to keep pace with the rapid industrial expansion. The impact on the health of the local people and the environment needs to be examined through further studies.

5.4 Biological Environment

5.4.1 Loss of Vegetation

The adverse consequences of industrial activities have caused a detrimental impact on vegetation cover. According to the local communities, dust particles generally accumulate over plant surfaces and as a result, the growth of the plant is suppressed leading to a decrease in the yield.
A detailed study of such issues is necessary to determine the actual impacts. Also, the dust – mainly from cement factories – covers the surrounding land which becomes unsuitable for farming. Likewise, water from the river disposed with industry produced effluent is used for irrigation which is unsuitable for cultivation (Sukha Dev. Yadav Kamariya VDC).

5.4.2 Loss of Wildlife and Habitats

In general, the forest is the main habitat of wild life. As stated in chapter three, the study area is predominated by agricultural lands (87 per cent) whereas the forest land is only about three per cent

of the total land area. So the affected area is not the prime habitat for most of the wildlife found in the area. However, it is being used as an occasional feeding ground.

Although the wildlife population is reported to be very low, what wildlife exists is disturbed during the industrial operation period due to the frequent movement of vehicles as well as pollution to the land, water resources, air quality and noise from industrial activity. Local people told investigators carrying out the field visit that vehicular flow and horn blowing in the area impacted on wildlife and bird species in the area. There is also a fear that people from outside of the community such as workers might engage in illegal hunting activities due to easy accessibility. The study area is also the prime habitat of some species such as the Blue Bull. The decrease in the Blue Bull population over the past two to four years might be due to the loss or destruction of their habitat through rapid industrial development, human interventions and rapid urbanization, etc. These impacts are presented in Table 5.8.

5.4.3 Loss of the Habitats of Rare/Endangered/Endemic wildlife

Reptilian species Ajingar (*Python molurus molurus)* and the Golden Monitor Lizard (*Varanus flavescens)* are two species legally protected by the Government of Nepal. The habitat of these has had adverse effects due to industrial development. The Lumbini area is also considered as one of the best places in the country to support the diverse population of globally threatened bird species, one of which is the Sarus Crane. It is also the only known site in the country where the species breeds regularly. Conversion of the wetlands into agricultural land and agricultural lands into manmade structures such as factories, roads, etc., is also one of the main reasons for the loss of the prime habitat for birds in the region.

Other globally threatened species such as the Lesser Adjustant is also affected by the degradation of the river quality. The aquatic fauna, the Sarus Crane and human dwellings adjacent to a local river are the most affected victims due to pollution created by industry (Suwal et.al, 2003). A total of eight globally threatened birds have been recorded at the site including the White-romped Vulture, the Indian Spotted Eagle, the Aquila hastate, the Slender-billed Vulture, the Cinereous Vulture and the Lesser Adjutant.

The Lumbini-Bhairawa Road and its connecting internal roads to factories in the Gonaha and Kamariya VDC, weave mainly through agricultural and patchy forested land that is home to local wildlife and its habitat. Wildlife and vegetation depletion may occur due to the industries' internal roads which are an easy access corridor to the people in the farmlands, riverine belt and forest which is the prime habitat sites of wildlife species. There has also been conversion of agricultural lands, forests, bushes, riparian zone, etc., into factories and other structures causing a habitat loss. The impacts will be indirect, low, local and long-term in nature.

Likewise, the attitude of the local people towards the impact of industrial pollution on the native flora and fauna was assessed using Likert's Attitudinal Model. The analytical result (the calculation given in Annex 7.8) shows that people do believe and know about the adverse impacts on the flora and fauna due to industrial activities in the region. Table 5.8 summarizes the biological environmental issues and impacts and predicts the nature of impacts (adverse and beneficial) of the existing industries to develop mitigation measures and a clear monitoring plan.

Table 5.8: Biological environmental issues and impacts

SN	Issues	Impact	Direct /Indirect impact	Extent	Duration	Magnitude
A.	Adverse issues					
1.	Loss and fragmentation of vegetation, bushes, riparian zone mainly through industrial development.	Loss of vegetation.	D	Lo	LT	M
2.	Loss of rare and endangered/endemic	(Need in-depth studies) Loss of rare and	D	Lo	LT	M

	plant species.	endangered/endemic plant species during industrial development.				
3.	Loss of community forests.	Loss of community forests.	NO community forest.			
4.	Influence of road and industries on farmlands, forests and vegetation.	Illegal harvesting of farmland, forests, riparian, vegetation by factory workers and/or locals.	ID	Lo	ST	M
5.	Influence of industrial activity (emission of dust, smoke, untreated effluents etc.,) on agricultural farmlands.	Decrease in production of agricultural products (As dust accumulates over plant surfaces and soil pollution).	ID	Lo	ST	M
6.	Loss of wildlife and wildlife habitats.	Loss of wildlife and its habitat.	D	S	LT	M
7.	Conversion of wetland, agricultural land, forest areas etc., into built structures for the development of factories.	Loss of habitats for water fowls, mammals, aquatic animals etc.	D	R	LT	H
7.	Loss of the habitats of rare/endangered/endemic wildlife (Mainly Sarus Crane, Blue Bull etc.)	Loss of the habitats of rare/endangered/endemic wildlife.	D	S	LT	L
8.	Influence of the internal roads of the industries and workers on the wildlife and its habitats.	Illegal poaching of the wildlife by factory workers and loss in wildlife habitat.	ID	L	ST	L
9.	Loss of aquatic life.	Loss of aquatic life due to waste discharge from industry.	ID	L	ST	M
10.	Loss of aquatic habitats.	Loss of aquatic habitat due to water pollution.	ID	S	ST	L
B.	Beneficial issues.					
1.	Improved vegetation cover due to the project -related afforestation programmes.	Improved vegetation cover due to the project (industrial development related afforestation programmes).	D	L	LT	M
2.	Awareness raising for wildlife conservation and management.	Awareness raising on the importance of wildlife and its management from project management activities and pressure from NGOs groups to the project.	ID	L	MT	M

Note: Magnitude: High (H), Moderate (M), Low (L); Extent: Regional ®, Local (Lo), Site Specific (S); Duration: Long Term (LT), Medium Term (MT), Short Term (ST)

5.5 Impact on archaeological remains of Lumbini

The industrial activities pose a threat to the World Heritage Site. Carbon emission from the existing industries is one of the potential threats to the heritage of the site. In this regard, a study conducted by UNEP RRC and AP Bangkok highlights major threats to the World Heritage Site. The study explains that growing levels of uncontrolled air, water and noise pollution from industrial and urban activities in and around Lumbini Protected Zone (LPZ) pose a great threat to the heritage. In addition, a thick and dense regional atmospheric haze, referred to as atmospheric brown clouds, that hovers over most of the Indo-Gangetic plains during the dry winter months, also covers the site. The ever growing air and water pollution are causing significant adverse impacts on the World Heritage Site, its tranquil

environment and public health in the area. Another major threat to this important archaeological site is the floods in the region. In addition, the Ashoka Pillar is impacted due to the presence of gypsum salt (Costantino, Meucci, 2011). A preliminary analytical report remarked that the monument of the Ashoka Pillar confirms the presence of some minerals on its surface and minerals usually produced by the cement industries (Costantino, Meucci, 2011). Other monuments are vulnerable to industrial pollution but these threats need to be identified with a detailed study. In this regard, the study conducted by C. Meucci, in March 28, 2011 highlighted that the operation of many industries has contributed to the threat of irreversible damage to the Ashoka Pillar.

Likewise, pilgrims are affected due to the frequent traffic jams along the Lumbini-Bhairawa Road. The road gets highly congested due to vehicles and as a result, pilgrims lose precious time during their visit to Lumbini. The air pollution caused by nearby factories also directly affects these pilgrims.

The Lumbini Development Trust is responsible for the protection of the outstanding universal value of the World Heritage Site. Lumbini, the birth place of the Lord Buddha is a sacred area as a centre of Buddhist pilgrimage. It is imperative that the sanctity of the place and the outstanding universal value of the property is preserved. Furthermore, a regional conservation approach (Kapilbastu, Rupendehi and Nawalparasi) for natural and cultural resources needs to be established and developed. The people in areas adjoining Lumbini have huge aspirations and economic development expectations by taking advantage of its location. Now it is the time to empower the local people for the integrated development of a multi-dimensional sector of the region with the participation of local communities.

CHAPTER 6

Environmental Impacts Mitigation, Monitoring and Management Plan

6.1 Introduction

This chapter presents the measures and actions proposed for augmenting the identified potential environmental impacts, both positive and negative, as well as proposing a set of mitigation measures to minimize or set off the potential adverse impacts. The operating industries should ensure that mitigation measures adopted in this section should be implemented during the operation of the industries.

The haphazard and unplanned growth of the industries may cause a loss of agricultural land, chaotic settlement and reduced quality of life. To control such adverse effects, careful planning and monitoring of industrial activities, a proper land use plan and industrial zoning is required.

The area most affected by industrial activity is mainly rural. Industries have provided employment opportunities mostly to non-locals, i.e., mainly Indian workers. Most of the people of the industrial areas are farmers and few are involved in micro-enterprises. Their main livelihood is based on agriculture and livestock. Farm land, grassland, river, shrub land, forest pockets and river flood plains are the common properties which provide a number of production and services to the local communities. The disadvantaged, poor and destitute people are dependent on these land resources and any effects to these common lands have direct and indirect implications on the livelihood of these people. Air dust, noise and water pollution are the main problems caused by industrial activities.

6.2 Mitigation measures

Customarily, the mitigation measures linked with the development of the industrial area should have an objective to address a clean environment and livelihood restoration of the affected people.

Focus group discussions in the industrial area revealed that the forestland, shrub land, grassland and river flood plain areas to be impacted by the industries provide direct services and production capabilities to the local people. The loss of this land is a community livelihood loss which could not and should not be overlooked in a rural society. The industries should take adequate pollution mitigation measures to abate the pollution due to their production activities.

6.2.1 Air Pollution Control Management

Greenbelts are an effective mode of control of air pollution in which green plants form a surface capable of absorbing air pollutants and forming a sink of pollutants. Leaves with their vast area in the tree crown, absorb pollutants on their surface thus effectively reducing the pollutant concentration in the ambient air. Often the absorbed pollutants are incorporated in the metabolic pathway and the air is purified. Plants grown to function as a pollution sink are collectively referred to as greenbelts.

An important aspect of a greenbelt is that the plants are living organisms with their varied tolerance limit towards air pollutants and a greenbelt is effective as a pollutant sink only within the tolerance limit of constituent plants. The greenbelt component on the road from Lumbini to Bhairawa should be able to be both absorbers of gases as well as of dust particles. The choice of plants for the road side should include shrubs of one to one-and-a-half metres in height and trees of three to five metres in height. Medium sized trees, alternating with shrubs are ideal for the absorption of particulates and gases.

Sensitive and tolerant plant species to cement dust: Tolerant and sensitive species should be planted in the area to absorb the cement dust. Sensitive plants that can control cement dust are listed below.

Sensitive Plants to cement dust: Zea mays, Syzgyium cumini, Triticum aestivum, calotropis procera, Dalbergia sisso andWithania somnifera.

Tolerant species-Poor Dust Collector: Erythrina indica, Cassia fistula, Poinciana regia, Sesbania sp, Azdirachta indica.

Tolerant species-Dust collector: Mangifera indica, Thespesia populnea longifolia, Ficus beglensis, Ficus infectoria, Ficus religiosa, tectona grandis, Shorea robusta, Terminalia arjuna, Nerium indicum and Thevetia neriifolia.

Tolerant species-Best Dust collector: *Pithecellobium ducle* and *Argyrea speciosa.*

Cyclone separators, bag filters and wet scrubbers can help control air pollutants. Some dust control equipment can be used at different points where dust is released (Table 6.1).

Table 6.1: Dust control equipment

Sources of Dust.	**Dust controls equipment.**
Crushing and Raw Materials Silos.	Cyclone Separator followed by reverse pulse jet type bag filter.
Raw Mill and blending silo.	Cyclone Separator followed by reverse pulse jet type bag filter.
Noduliser.	Reverse Pulse Jet Type Bag filter.
VSBK.	Cyclone separator and Wet Scrubber.
Clinker Crusher and cement mill feed hopper.	Cyclone Separator followed by reverse pulse jet type bag filter.
Cement mill.	Cyclone Separator followed by reverse pulse jet type bag filter.
Cement blending silo and packing section.	Reverse pulse jet type bag filter.

Source: Filed Survey, 2011

Likewise, the stacks should be attached to the air pollution control equipment to disperse the air pollutants to satisfactory levels. Recommendations to improve health and safety performance by controlling air pollution are given as follows:

In the short term: Engagement of operators in industry safety initiatives and forums in order to share knowledge and good practices so that these become the industry “norm”. The Cement Health and Safety Taskforce should be encouraged to develop and publish information on key hazards and their control and safe working practices. Publish safety data using common metrics to encourage comparison and benchmarking among companies.

In the medium-to-long-term: The industry should encourage the wider use of risk assessments in plant design, plant modification and for key operational activities. A few practices that can be adopted to reduce the pollution are as follows:

- Adopt best practices in emission control measures and promulgate their use.
- Air pollution control equipment needs to be installed to control dust emissions.
- Raw materials loading and unloading should be done in the covered area.
- Raw materials should be stored in a covered structure.
- All the conveyors need to be provided with a conveyer cover.
- The automatic bagging machine should be installed for packing.
- The sprinkling of water should be done along internal roads in the plant in order to control dust emissions.
- All the workers working inside the plant should be provided with disposable dust masks.
- The green belt should be developed around the plant to arrest the fugitive emissions.
- Bag filters should be cleaned regularly.

- Maintenance of air pollution control equipment needs to be done regularly.
- Dust removal efficiency of air pollution control equipment should be checked regularly.
- Adequate height needs to be attached to the air pollution control equipment to disperse the air pollutants to satisfactory levels.

6.2.2 Noise Control Management

The key measures for the noise management in industrial area are listed below:

The greenbelt proposed around the boundary of the plan will reduce the noise emitted by the various sources in the plant.

- The rotating machinery needs to be lubricated and provided with enclosures as far as possible to reduce noise transmission.
- Use of low noise components and equipments.
- Enclosure of equipment.
- Use of sound proofing materials in buildings.
- Use of banks, trees, walls and other physical barriers to reduce noise transmission.

6.2.3 Water Management

The key measures for the water management in industrial area are listed below:

- Rain water harvesting measures need to be adopted to recharge the aquifer.
- Introduce wastewater prevention measures in order to more effectively manage the treatment of effluent and improve the quality of water discharged from industry into the natural river flow.
- Wastewater sewer systems need to be covered by water pollution prevention measures.
- Effluent should be pre-treated in the factory to comply with stated minimum value restrictions and then mixed with pre-treated effluent from other factories in a main collection pipe that transports all pre-treated effluent to a joint wastewater treatment plant.

Table 6.2 describes the mitigation measures to be carried out to minimize the likely impacts of industrial pollution.

Table 6.2: Impact Mitigation Matrix

S.N	Activity	Likely Potential Negative Impacts	Suggested Mitigation Measures
Socio-economic Environment			
1	Loss of agricultural land due to haphazard development of industries.	Social inequalities, conflict and loss of agricultural production.	Careful planning and monitoring of industrial activities and encouragement to introduce modern agricultural activities on the available land.
2	Outside labour employment.	Social dispute; conflict between locals and outsiders, child labour issues.	Jobs should be given as a first priority to local people above 18 years of age.

3	Conflict between the local and outside workforce.	Erosion of local culture, law and order.	Regular ethical behavioural programme related to culture and traditions should be encouraged.
4	Social impoverishment.	Social disputes and child labour.	Employment priority to locals in the order of the affected VDC, affected districts, local people above 18 years of age.
5	Poor Sanitation and solid waste disposal in villages (Kamaraiya and Gonaha VDC).	Hazard to health of locals and factory workers.	Provide safe waste disposal, pit latrines and first aid health facilities and launch a community awareness programme for the locals.
6	Population displacement dislocation and resettlement.	Disturbances in social sentiment, reduction in quality of life of the affected people etc.	Proper resettlement programme including giving people job training opportunities to make them financially sustainable in the future.
7	Dust raised and blown by vehicles and industries.	Health hazards and interference of plant growth (dust accumulates over the plant).	Periodic health examinations of workers with treatment when needed and new health safety measures and strict monitoring of industrial activity. (Industries should adopt pollution control measures and those who fail should be ready to relocate).
8	Increase in vehicular movement.	Increase in accidents, road congestion, traffic jams, with and implication on community health.	Will place hoarding boards and traffic signs at critical points in traffic corridors or develop a alternative bypass road to decrease the traffic congestion.
9	Employment.	Gender discrimination in employment.	Gender should not be the reason for employment discrimination. Equal employment opportunities should be given to both male and females, with some percentage of jobs reserved for women.
	Beneficial Issues		
10	Industries may provide local employment opportunities.	Employment opportunities.	Local people should be given first priority for job opportunities in local industries.
12	Local government revenue opportunities.	Increase in local area revenue related to industrial operation.	No measure.
13	Improved access to social services and related local social service improvement.	Improved road access and related access to service facilities outside the industrial area.	Maintenance of the main access road should be provided.
14	Local tourism opportunities.	Increase in local tourism.	No measure.
Physical Environment			
	Adverse Issues		
1	Groundwater extraction excessive in the operation of industries.	Hazard of land subsidence.	Avoid excessive pumping and set recommended pumping rates after detailed investigation of recharging rate of aquifer, pumping rate and corresponding draw down rate of ground water table.

2	Noise and air pollution due to operation of industries.	Noise and air pollution.	Appropriate design of the system utilizing the latest technology and environmental-friendly solutions.
3	Discharge of waste water during the operation of industries.	Contamination of surface water body which may cause an impact on the health of the locals, obstruction on livestock feeding.	Select appropriate technology; ensure treatment and operating guidelines are sufficient to dispose of water safely with no risk to the health of humans and livestock.
4	Effluent discharge.	Loss of aquatic bio-diversity and fisheries in the receiving water.	Ensure that the effluent is safe enough to dispose in the natural system to safeguard both human, livestock and aquatic bio-diversity.
5	Treatment process or sludge disposal operation.	Odorous nuisance.	The proposed read bed treatment system is almost odourless; includes odour control measures; implement management and training programme; efficient operation systems. However a further detail study is required for the selection of the best suitable technology during the implementation time.
6	Discharges or effluent sites during normal operation.	Public health hazard in vicinity.	Select appropriate technology; ensure treatment and operating guidelines are sufficient to dispose of safely to a safe ground to safeguard the health of humans and livestock.
7	Waste water storage, reuse or disposal.	Soil, crop or ground water contamination heightening the risk of disease.	Inspect for compliance with operation plan and guidelines; ensure untreated waste water is not released or disposed.
8	Treatment and effluent discharge.	Reduction of tourists due to odour and other related nuisances.	Give special attention to real or perceived nuisance and aesthetic impacts when selecting sites.
9	Litter/ clandestine dumping.	Aesthetic degradation.	Provide complete refuse collection service.
10	Loading of refuse from stationary containers.	Dust nuisance.	Provide enclosures at the loading and unloading areas at the transfer station.
11	Unloading and loading operations at transfer stations.	Dust nuisance.	Provide enclosure to the loading and unloading areas the transfer station.
	Beneficial issues		
12	Land development opportunities.	Alteration of land units to a better quality for development which also increases the value of land.	Proper land use planning should be provided.
Biological Environment			
	Adverse issues		
1	Loss of vegetation due to Industrial activity.	Habitat alteration and Loss of forest vegetation or the wetland area by industrial activity labours.	Restoration of degraded site. As far as possible, the felling of trees/riverside areas plantations should be avoided. In case felling is required then such species should be planted as part of the compensatory forestation as per

			Department of Forest guidelines.
			Fuel wood should be strictly prohibited and also the outside workforce should be encouraged to live in the labour quarters where kerosene or lPG should be used for cooking.
2	Conversion of forested areas and agricultural land into built structures during the establishment of industries.	Loss of the wildlife and its habitat.	Regulate cutting of trees as well as use alternatives such as non-carbon emitting industries.
3	Operation of industries.	Noise and labours from the industries may cause disturbance to wild animals and their habitat.	Noise control devices should be installed. Careful planning, design and operation should be done so that there is a minimum impact on nearby areas. The industrial workforce should be instructed not to visit the forested areas.
4	Illegal poaching and hunting by outside labour force.	Loss of wildlife and its habitat.	Restrict such kind of activities. If anyone is found guilty of such activities, they should be punished or fired from their job.
5	Industrial activity and effect on internal roads.	Disturbance to waterfowls by industries and vehicular movement which may cause loss and avoidance of favourable habitat and also changes in feeding and breeding and patterns of wild life.	Noise control devices should be installed. Careful planning, design and operation should be done so that there is minimum impact on nearby areas. The industrial workforce should be instructed not to visit the forested areas.
6	Operation of industries and increase in vehicular traffic.	Noise from the industries and vehicles may cause disturbance to the wild animals and due to this they may avoid the most disturbed area and also changes in feeding and breeding patterns of wild life.	Careful planning, design and operation should be done so that there is minimum impact on the nearby areas. The industrial workforce should be instructed not to visit the forested or the riverside areas.
	Effluent discharge during the operation of industries.	Loss of aquatic biodiversity and fisheries in the receiving waters.	Inspect for compliance with operation plan and guidelines; Ensure that the effluent is safe enough to discharge to safeguard human, livestock and aquatic biodiversity.
	Beneficial issues		
8	Awareness development for the forest and agricultural land management and conservation.	Awareness raising on forest management and proper land use plan from the industries environment management plans and pressure from NGOs groups to the industries.	An awareness campaign should be organized from time to time targeting the local community, factory workers on forest and land use plan management and development.

9	Improved vegetation cover due to project related afforestation and awareness raising for wildlife conservation and management	Improved vegetation cover due to project related afforestation.	No measures.

Adopted from Field survey, 2011

6.3 Environmental Management Plan

Keeping in view various environmental issues associated with industrial activities, an Environmental Management Plan (EMP) including time frame and implementing responsibilities has been worked out. The detail of the EMP is given in Table 6.3.

Table 6. 3: Environmental Management Plan

SN	Activity	Mitigation Measure	Location	Timing of Action	Institutional Responsibility	
					Implementation	Supervision
	Socio-economic and Cultural impacts					
	Adverse Issues					
1	Unplanned development for industries and settlements	Regulate growth through proper land use plan and industrial zoning	Lumbini	-	Design consultant/DDC / IPB	DDC,LDT
2	Loss of agricultural land due to haphazard development of industries	Careful planning and monitoring of industrial activities and encouragement to adopt modern agricultural activities on available land	Kamariya and Gonaha VDC	-	Local farmers, businessmen and shopkeepers	DAO/DDC
3	Outside labour employment	Job priority should be given to local people above 18 years of age.	Existing Industries	During operation of Industries.	Industry owner.	LDT/DDC
4	Conflict between local and outside workforce	Regular ethical behavioural programme related to our culture and traditions should be encouraged.	Industrial area.	All throughout the year.	Industry owner.	
5	Social impoverishment	Employment priority to locals in the order of affected VDC, affected districts, local people over 18 years of age.	Existing Industries	During operation of Industries	Industry owner.	LDT/DDC
6	Poor Sanitation and solid waste disposal in villages (Kamaraiya and Gonaha VDC)	Provide safe waste disposal, pit latrines and first aid health facilities as well as launch community awareness	Lumbini and Rupendhi districts	All throughout the year.	Industry owner/LDT, DDC.	LDT/DDC

		programmes to the locals.				
7	Population displacement dislocation and resettlement.	Proper resettlement programme including job training and job opportunities to make them financially sustainable in the future.	Kamariya and Gonaha VDC.	-	Industry owner / DDC/IPB.	LDT/DDC
8	Dust raised and blown by vehicles and industries.	Periodic health examinations of workers with treatment when needed and adoption of health safety measures, plus strictly monitoring of industrial activities (Industries should adopt pollution control measures and those who fail should be ready to relocate).	Industrial area.	During operation of Industries.	Industry.	LDT/DDC
9	Increase in vehicular movement.	Place hoarding boards and traffic signs at the critical points in the traffic corridor or develop an alternative by-pass road to decrease traffic congestion.	Industrial area.	During operation of Industries.	Industry along with DDC/IPB.	DDC
10	Employment.	Gender should not be reason for employment discrimination. Equal opportunities should be given to both male and females in employment, with a percentage of jobs reserved for women.	Industrial area.	During operation of Industries.	Industry.	DDC/LDT
	Beneficial Issues					
11	Industries may provide local employment opportunities.	Local people should be given first priority for job opportunities in the industries.	Industrial area.	During operation of Industries.	Industry.	DDC/LDT
12	Local government revenue opportunities.	No measures.				

13	Improved access to social services and related local social service improvement.	Maintenance of the main access road should be provided.	Industrial area.			
14	Local tourism opportunities.	No measures.	Lumbini-Bhairawa road.	All throughout the year.	Priority to the local people.	DDC/LDT
	Physical Environment					
	Adverse Issues					
1	Groundwater extraction in an excessive rate for the operation of industries.	Avoid excessive pumping and set recommended pumping rates after a detailed investigation of the recharging rate of aquifer, pumping rate and corresponding draw down rate of ground water table.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT/IPB
2	Noise and air pollution due to operation of industries.	Appropriate design of the system utilizing latest technical and environment friendly solutions.	Industrial area.	During operation of Industries.	Operating industry/IPB.	DDC/LDT
3	Discharge of waste water during the operation of industries.	Select appropriate technology; ensure treatment and operating guidelines are sufficient to dispose of safely in order to safeguard the health of humans and livestock.	Industrial area.	During operation of Industries.	Operating industry/IPB.	DDC/LDT
4	Effluent discharge.	Ensure that the effluent is safe enough to dispose in a natural system to safeguard humans, livestock and aquatic bio-diversity.	Industrial area.	During operation of Industries.	Operating industry/IPB.	DDC/LDT
5	Treatment process or sludge disposal operation.	The proposed read bed treatment system is almost odourless; include odour control measures; implement management and training programmes; efficient operation systems.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT/ IPB

6	Discharges or effluent sites during normal operation.	Select appropriate technology; ensure treatment and operating guidelines are sufficient to dispose of it safely in order to safeguard the health of humans and livestock.	Industrial area.	During operation of Industries.	Operating industry /IPB.	DDC/LDT/
7	Waste water storage, reuse or disposal.	Inspect for compliance with operation plan and guidelines; ensure untreated waste water is not released or disposed.	Industrial area.	During operation of Industries.	IPB.	DDC/LDT/IPB
8	Treatment and effluent discharge.	Give special attention to real or perceived nuisance and aesthetic impacts during selecting sites.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT
9	Litter/ clandestine dumping.	Provide complete refuse collection service.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT
10	Loading of refuse from stationary containers.	Provide enclosure to the loading and unloading areas of the transfer station.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT
11	Unloading and loading operations at transfer station.	Provide enclosure to the loading and unloading areas of the transfer station.	Industrial area.	During operation of Industries.	Operating industry.	DDC/LDT
	Beneficial Issues					
12	Land development opportunities.	Proper planning land use should be provided.	Industrial area.	After the establishment of industry.	-	-
	Biological Environment					
	Adverse Issues					
1	Loss of vegetation and wetland areas due to Industrial activity.	Restoration of degraded site. As far as possible, the felling of trees or the removal of wetland vegetation should be avoided. In case of felling or removal is required then such species should be planted as part of the compensatory afforestation as per Department of Forest guidelines.	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	Operating industry /local people/farmers.	DFO/DDC/LDT

		Fuel wood should be strictly prohibited and also the outside workforce should be encouraged to live in labour quarters where kerosene or lPG is used for cooking.				
2	Conversion of forested area and agricultural land into built structures during the industry establishment.	Proper land use planning as well as the use of alternatives such as non-carbon emitting industries.	Industrial area (Gonaha and Kamariya VDC.	During operation of Industries.	Operating industry /local people/farmers.	DDC/LDT
3	Operation of industries.	Noise control devices should be installed. Careful planning, design and operation should be done so that there is minimum impact on the nearby areas. The industrial workforce should be instructed not to visit the forested areas.	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	Operating industry.	DDC/LDT
4	Illegal poaching and hunting by outside labour force.	Restrict such kind of activities, if anyone found doing such activities they should be punished or fired from their jobs.	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	Operating industry /local people/farmers.	DFO/ DDC
5	Operating industries and effect of the internal roads on the wildlife	Noise control device should be installed. Careful planning, design and operation should be done so that there is minimum impact on the nearby areas. The industrial workforce should be instructed not to visit the forested areas.	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	Operating industry.	DFO/ DDC
6	Operation of industries and increase in vehicular movement.	Careful planning, design and operation should be done so that there is minimum impact on the nearby areas. The industrial workforce should be instructed not	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	IPB/Operating industry	DDC

		to visit the forested areas.				
7	Effluent discharge during the operation of industries.	Inspect for compliance with operation plans and guidelines; Ensure that the effluent is safe enough to discharge to safeguard humans, livestock and aquatic biodiversity.	Industrial area (Gonaha and Kamariya VDC).	During operation of Industries.	IPB	DDC
	Beneficial Issues					
8	Awareness development for the forest and agricultural land management and conservation.	Awareness campaign should be organized from time to time for the local community, factory workers, and on forest and land use management and development.	Industrial area (Gonaha and Kamariya VDC).	-	Local people/NGOs /OI	Local people/DDC
9	Improved vegetation cover due to project related afforestation and awareness-raising for wildlife conservation and management.	No measure.	Industrial area (Gonaha and Kamariya VDC).	-	Local people/NGOs /OI.	DDC/LDT

Based on Field survey 2011

6.4 Responsible Authorities for Implementation

The Industrial Promotion Board (IPB), Lumbini Development Trust (LDT) and DDC have been entrusted with the responsibility for successfully implementing the EMP. The agencies, especially DDC and LDT, are responsible for development and maintenance of the environment. In this report, the Environmental Management Plan (EMP) has been prepared to set out environmental management requirements and to develop procedures to ensure that all mitigation measures and monitoring requirements are carried out effectively.

6.4.1 Statutory requirements

A number of statutory requirements and guidelines should be drawn up and observed to ensure the environmental management of industries, in addition to the conditions in this EMP.

6.4.2 Environmental Legislation

As stated above, tools such as EPA and EPR are the main legal tools in Nepal that legally dictate the environmental requirements that need to be fulfilled while executing development projects. The Ministry of Environment, Science and Technology (MoEST) is the lead agency which administers environmental matters, with an emphasis on environmental conservation and management through internalizing environmental assessments, pollution control and the prevention and conservation of natural heritage sites and compensation for environmental damages etc. However, there are several other policies, guidelines, acts and rules which relate to the construction and operation of industry and these should comply with all the provisions by involved parties. The relevant legislation, policies and

guidelines of the Government of Nepal are critically important and applicable to the operating industries that are briefly described in Chapter five.

6.4.3 Environmental Standards

There are few environmental standards endorsed by MoEST and other line agencies of GoN. Environmental quality standards of air, water and noise have been set up by the government. The threshold values are listed in Annex 11.

6.4.4 Institutional Requirements for Monitoring Industrial activity

The Ministry of Environment, Science and Technology (MoEST) is the main institution mandated to formulate and implement environmental policies, plans and programmes at the national level. It also has mandates for preparing and issuing environmental regulations and guidelines; development and enforcement of environmental standards; pollution control, commissioning environmental research and studies; and monitoring of programmes implemented by other agencies. The DDC has the main responsibility for the assessment of environmental impact and implementation of an environmental management plan at the district level. During the implementation of the plan in the district, the Industrial Promotion Board (IPB), LDT, and the District Technical Office (DTO) should assist the DDC.

As discussed above, the environmental management organizational structure has been proposed to implement EMP so that the adverse impacts due to the existing industries in the region can be reduced (Figure 7.1). Government ministries such as the MoEnv, MoI, Ministry of Federal Affairs, Parliamentary Affairs, Constituent Assembly and Culture (MoFAPACAC), and MLD are the key concerned ministries in the proposed structure. Likewise, other organizations such as IUCN Nepal, UNESCO etc., are the key concerned agencies for the conservation and protection of World Heritage Sites and their surrounding natural environment.

The roles of these agencies are as follows:

Ministry of Local Development (MLD): The concerned line ministry is responsible for review and final approval of study reports of EIA/IEE and for managing environmental monitoring. MLD has established an Environmental Management Section (EMS) which is mandated with the overall environmental responsibility of the Ministry. It implements an environmental assessment study through DDC.

Ministry of Industry: the ministry has the mandate for the promotion and development of industries through policy and legislation pollution.

Ministry of Federal Affairs, Parliamentary Affairs, Constituent Assembly and Culture (MoFAPACAC): The ministry has the mandate to protect and conserve national and World Heritage Sites and cultural values through its line department; the Department of Archaeology.

LDT: It has the responsibility to protect and develop Lumbini and the Trust is chaired by the Ministry of MoFAPACAC. The LDT needs to strengthen its capacity by establishing an environmental management section to address environmental issues at the LWHS.

Industrial Promotion Board (IPB): The IPB was formed under the chairmanship of the Minister for Industry in order to increase the pace of industrialization in the country; to formulate policy regarding industry and investment; and to coordinate between the central and implementing level.

District Development Committee (DDC): As stated above, DDC (Kapilbastu-Rupendehi) has the implementing role for commissioning EIA studies and carrying out mitigating works as well as environmental monitoring.

District Technical Office (DTO): DTO supports the IPB in planning and implementation, including supervision and monitoring of industrial works in the district.

UNESCO: The UN agency seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity. It also assists the government in safeguarding the Outstanding Universal Value of the World Heritage

Property. As already stated, Lumbini has been inscribed onto the World Heritage Site list and UNESCO has the mandate to promote and develop the site for the conservation of its cultural and religious values.

IUCN Nepal: IUCN Nepal plays a key role in the development and implementation of the governing tools in the line of conservation and protection of the natural environment and heritage values.

Existing industries or the proponent of industries responsible for industrial activities:

The DDC, LDT, IPB, DoA and MoEnv (EIA Section) as the executing agency (EA) should be responsible for implementing and monitoring the overall EMP in close consultation with concerned experts. In practice, the Project Implementing Party (i.e. the operating industry) will be the responsible party to implement EMP on behalf of the IPB. The factory operator will be responsible for implementing all mitigation measures during the operation period, especially to mitigate all environmental impacts associated with their operation activities.

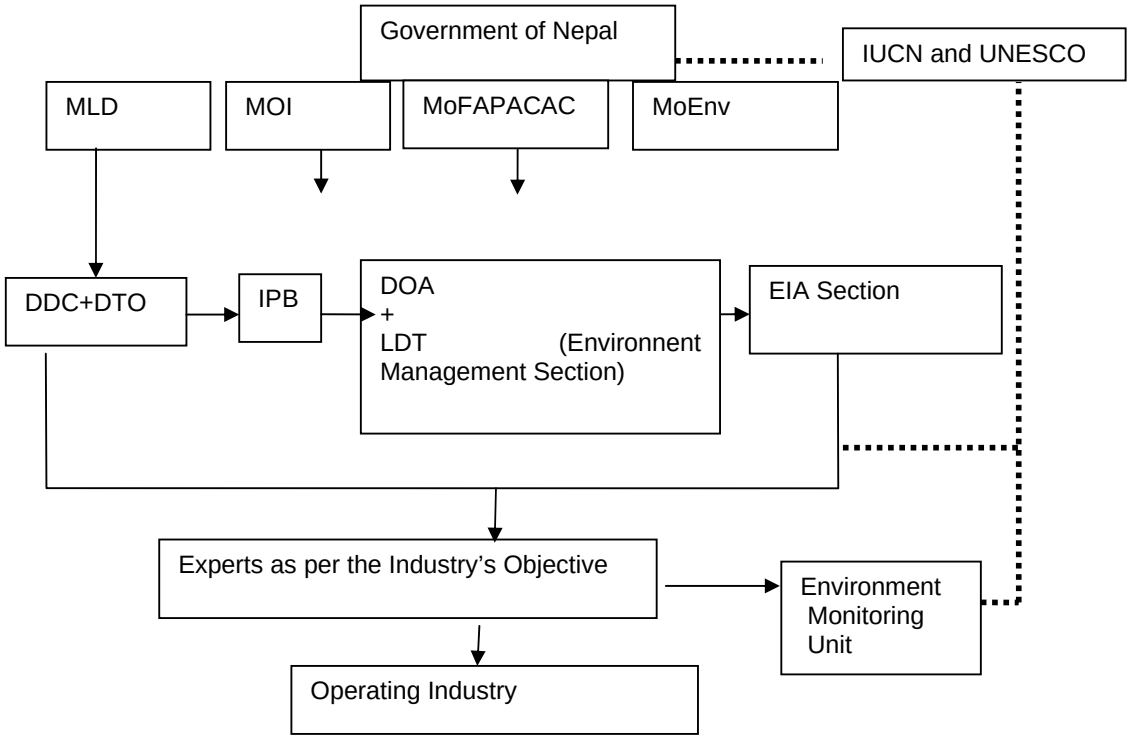

Figure 6.1: Environmental Management Organization Structure

6.5 Environmental Monitoring Plan

The Environmental Monitoring Plan addresses the responsibility of concerned parties to implement and supervises the monitoring report. In order to control the adverse impacts of industrial activities and maintain environmental quality, a framework for the Environmental Monitoring Plan has also been prepared. Environmental quality monitoring covers air and water quality, noise, vegetation, wildlife etc., and other environmental parameters. The monitoring plan aims to ensure no negative impact to the overall environmental quality. The Environmental Monitoring Plan is made by analyzing the issues with the help of the corresponding indicators. The issues and indicators were identified based on field visits and related study activities.

Furthermore, three types of monitoring are envisaged in the plan, namely: baseline monitoring, impact monitoring, and compliance monitoring. According to the EIA Guideline for Industry, the baseline monitoring plan for the respective industries in the region is already prepared before the industries

become operational. This study has not envisaged baseline monitoring since the aim of this study is to assess environmental impacts from the existing industries in the study area. Likewise, the Environmental Impact Monitoring Plan guides the actual level of impact in the field during the operation of the industries. The Environmental Impact Monitoring Plan has been tabulated (Table 6.4). Table 6.4 emphasizes issues, indicators, and monitoring methods, responsibility of the concerned agencies, and schedule of the monitoring.

The environmental compliance monitoring plan has also been proposed in the study (Annex 9). Compliance monitoring is necessary in order to ensure that the operators comply with the requirements as listed in the EMP. It consists of a compliance monitoring mechanism for environmental issues in the region. The compliance also covers verifiable indicators, methods, location, responsible agencies and time/frequency of compliance monitoring.

Table 6. 4: Framework for Impact Monitoring Plan

SN	Issues	Indicator	Methods	Individuals responsible	Frequency/Time	Place
	Socio-economic and cultural environment					
A.	**Adverse Issues**					
1	**Affect on the local people.**	Livelihood conditions and quality of life of the impacted communities/VDCs.	Interviews, observations and administrating structured questionnaire.	OI/ IPB.	Every year during industry operation.	All affected VDCs.
2	**Social services of the impacted VDCs.**	Pressure on transport services, water supply, irrigation facilities, education institutions, health institutions.	Interviews with commuters, water user groups, school teachers, health workers etc.	IPB/LDT/DDC	Every six month during industry operation.	All affected VDCs.
3	**Social infrastructure.**	Road conditions, bridges, agricultural fields etc.	Direct observations and discussion with local communities and parties.	DRO/LDT/DOA	Every six month during industry operation.	All affected VDCs.
4	**Community health.**	Number of airborne diseases, epidemic outbreaks, increase in STD,HIV/AIDs, accidents etc.	Records of diseases, direct observations, and discussion with local people.	DHO	Regularly.	All affected VDCs.
5	**Occupational health hazards.**	Diseases, injuries, accidents of factory workers.	Records of diseases, injuries and accidents.	OI/DDC	Every month.	All the workforce.
6	**Conflicts.**	Conflicts between locals and outside workforce.	Community consultations and record keeping.	Local people/OI	Every month.	Factory and its adjoining areas.

7	**Commodity prices.**	Prices of the commodities in the local area.	Records of commodity prices in the local markets.	DDC/ Local people	Every month.	Industrial area.
8	**Socio-economic development.**	Number of micro enterprises and ribbon settlement established along the Lumbini - Bhairawa Road alignment indicates the increased/decreased employment status and a trend of socio-economic development of local community.	Survey/Observations and discussion with industrialists, local people, banks etc.	IPB/VDCs, DDCs, LDT/Bank/Chamber of commerce etc.	Yearly.	Industrial area.
9	**Economic status of locals.**	Income levels in terms of standards of living of the local people can be simplified at the household level in order to ascertain the impact of tourism on the development of the Lumbini area, with a focus on increase in per capita income level among the local people.	Discussions with locals /sample surveys.	LDT/VDC/DDC/Local NGOs and CBOs.	Yearly.	Lumbini area.
10	**Tourism promotion.**	Hotel occupancy rate and visitor days of stay at different hotels/lodges in different seasons throughout the year will indicate the impact of visitors on the economy at the local tourism level.	Records of hotels/lodges/tourism records.	LDT/Hotels and lodges/Tourism office.	Yearly.	Lumbini area.

11	**Increase in local economy.**	Employment of local people.	Discussion with local people.	Factory owners.	Every three months.	Industrial area.
12	**Increase in burglary and hooliganism.**	Crime and socially undesirable activities.	Police records, consultation with communities.	Police, local people.	Monthly.	Industrial area.
13	**Culture and tradition.**	Shifts in cultural practices and traditions or cultural conflicts between locals and outsiders.	Direct observations and information from locals.	Local people/DDC/ LDT.	Monthly.	Industrial area.
	Beneficial issues					
14	**Environmental programmes.**	Environmental enhancement programmes.	Discussion with the beneficiary of the enhancement programmes.	DOI/Local people/lDT.	Yearly.	Industrial area.
	Physical Environment					
1	**Water quality.**	Test of important water quality parameters such as turbidity, dissolved oxygen content, pH, conductivity, temperature and key nutrients (nitrogen, phosphorous and potassium) in relation to assess potential water pollution in local water bodies.	Sample collection for laboratory testing for the parameters.	Industries, LDT ,IPB etc.	Once every three months routine test during operation of industries.	Industrial area.
2	**Ground water.**	Drop in ground water table faecal contamination in available water.	Sampling test for water quality indicators, detail hydrological study needed.	OI/DDC/IPB	Once every three months, routine test.	Industrial area.
3	**Pollution due to dust and smoke.**	Number of smoggy days due to dust and smoke pollution.	Measurement of air quality indicators.	IPB/DDC/LDT	Frequently during operation of factories.	Industrial area.
4	**Solid waste problem.**	Cases of solid/liquid waste disposal by the industries in the public area.	Observation.	LDT/industries staffs	Frequently during operation of factories.	Industrial area.

5	**Noise.**	Increase in noise pollution.	Direct observation and community discussions. Also the instrumental measurements of noise. Weighted averages (db) measured by noise level meters.	LDT/industries staff.	Frequently during operation of factories.	Industrial area.
	Biological Environment					
1	**Loss of Vegetation.**	Number of tree species cleared or impact on the vegetation due to other potential pollution.	Direct observations and records of clearance of species.	LDT/DFO	Frequently.	Industrial area.
2	**Ecology.**	Ecological status of forest and vegetation.	Direct observations and records of clearance of species.	LDT/DFO	Every six months.	Industrial area.
3	**Wildlife.**	Poaching of wildlife.	Community consultations and record keeping.	LDT/DFO	Every six months.	Industrial area.
4	**Waterfowls.**	Number of visiting long distant migrating waterfowls during winter seasons which is directly proportional to health and conservation status of local wetlands.	Site observation.	LDT/DFO	Yearly during on season.	Industrial area.
5	**Conservation status of wild animals.**	Higher number of bird and wildlife sightings will indicate better conservation status of local habitat condition.	Observation.	DFO	Frequently.	Industrial area.
6	**Fishery.**	Fish diversity and catch in unit time.	Fish sampling and discussion with local fisherman.	LDT/local people	Every six months.	Rivers and wetlands in the Industrial area.

Adopted from Field Survey, 2011

6.6 Environmental Auditing

In common terms, environmental auditing refers to a systematic, periodic, documented and objective review of project activities related to meeting environmental requirements. Generally the environmental impact auditing must be undertaken after industries have been operational for some time. But the environmental auditing needs to be done after all the proposed mitigation measures are implemented in the industrial area. In this regard, the framework sample has been proposed in the study for auditing for future use (Table 7.6). According to the Environmental Impact Assessment Guideline 1993, the environmental impact auditing assesses the actual environmental impacts, accuracy of prediction, effectiveness of environmental impact mitigation, enhancement measures and functioning of monitoring mechanisms.

6.6.1 Methodology for Auditing

The EIA report provides information on environmental impacts and the proposed mitigation measures that should be adopted by the industries, while the monitoring report gives a clear indication on non-compliance and problematic areas. Prior to the field study, the auditing team should inform all concerned industries about the auditing. Questionnaires, photo monitoring, reference materials, aerial photographs etc. can be used to generate necessary data required for auditing. The envisioned environmental auditing team should be comprised of an environmental expert experienced in EIA studies, monitoring and auditing who works as a team leader, accompanied by a sociologist and an ecologist. The approach is a scoping type audit which basically relies on documents and records starting from approved EIA documents, including the bi-monthly monitoring reports.

The National Environmental Impact Assessment Guidelines, 1993 (IUCN, 1994) has categorized the following different type of audits:

Decision point Audit: Examines the effectiveness of EIA as a decision making tool.

Implementation Audit: Ensures that the consent conditions have been met.

Performance Audit: Examines the effectiveness of project implementation and management.

Project Impact Audit: Examines environmental changes arising from project implementation.

Predictive Technique Audit: Examines the accuracy and utility of predictive techniques by comparing actual against predicted environmental effects.

EIA procedure Audit: Critically examines the methods and approaches adopted during the EIA study.

Implementation Audit: A performance audit and project impact audit has been proposed to be assessed in this study. The details of indicative parameters for environmental auditing are given in Table 6.5.

Table 6.5: Indicative Parameters for Environmental Auditing

SN	Parameter	Indicator	Location	Method	Sources
Socio-economic and cultural environment					
1.	**Employment to local people.**	Number of local people employed.	Kamariyaha and Gonaha VDCs (Main Industrial areas.)	Review of industrial records and interviews with local people.	Industrial records and local people.
2.	**Agricultural production.**	Amount of production of crops, fertilizers used.	Kamariyaha and Gonaha VDCs (Main Industrial areas.)	Consultation with farmers, comparison with previous year's yield.	Local people and farmers.

3.	**Economic activities.**	Number of local enterprises, shops, hotels, tea stalls etc.	Kamariyaha and Gonaha VDCs (Main Industrial areas.)	Field survey, consultation with local people, review of records of VDC.	VDC records, local people & field study.
4.	**Public health.**	Cases of air and waterborne diseases, communicable diseases.	Industrial area, school, health posts and hospitals.	Review of records and interviews.	Records of health posts & hospitals, students, & industrial expenses on health of workers.
5.	**Social disturbances.**	Cases of events.	Industrial area.	Record review and consultation with local people.	Police Records, VDC records.
6.	**Increase in local tourism.**	Number of tourist arrivals.	Lumbini.	Review of tourist arrival records.	Tourist arrival office.
Physical Environment					
1.	**Air quality.**	Particulate matters, SO_2, CO_2, NO_2, PbO_2 etc; Dust accumulated on roof, vegetation and surrounding area.	Industrial area, heritage sites and along access roads.	Measurement, laboratory analysis, and visual inspection.	Field study and EIA and monitoring reports.
2.	**Water quality.**	Surface and ground water quality (Temp, pH, turbidity, TSS, hardness, chloride, sodium, coli form, DO, BOD etc.)	Ground water and Tinau, Danow, Telar rivers and other local streams.	Water sampling and tests.	Field study and EIA and monitoring reports.
3.	**Noise.**	Noise level in the targeted area.	Industrial surrounding area, heritage site and along access roads.	Measurements from sound meter and also careful hearing.	Data analysis, hearing, and local people.
4.	**Dust.**	Dust accumulation over the plants, roof, houses etc.	Industrial area.	Field observation, consultation with local people.	Field study and local people.
5.	**Vibration of vehicles and industrial operation.**	Cracks in structures, complaints.	Settlements near the industrial site.	Interview and observation.	Local people.
Biological Environment					
1.	**Farmlands, wetlands, grassland, forest**	Conversion of the area by the factory-built structure, loss	Nearby forest areas.	Official records, consultation with local people.	DFO and local people.

	pockets.	of vegetation.			
2.	**Wildlife diversity.**	Frequency of mammals, birds, reptiles etc. in the area surrounding the industry site.	Vicinity of the industries.	Observation and interviews.	Local people.
3.	**Water fowls.**	Frequency of birds and waterfowls in the surrounding area.	Vicinity of industries and rivers.	Observation and interviews.	Local people.
4.	**Fisheries.**	Species of fish population and abundance.	Near the rivers (Dano, Tinau, Telar etc.) and local streams.	Interviews with fisherman and local people.	Fisherman and local people.

Based on Field Survey, 2011

CHAPTER 7

Proposed Zoning of LPZ for Environment Management

As mentioned earlier, the Lumbini Protected Zone (LPZ) is the region that covers a 15-km aerial distance from LPA (1 ml x 3 ml as stated in the Kenzo Tange Master Plan) and runs in a rectangular shape in the east, west, north and south. This chapter deals with the classification of the zones into different classes in order to conserve the natural environment of the zone and channel for the sustainable promotion of the livelihood of the local community in view of protecting Lumbini's heritage.

7.1 Guiding Approaches for Zoning the Lands

7.1.1 UNESCO's World Heritage Priority

According to the UNESCO World Heritage objective regarding conservation and management, the zoning is the important concept in environmental and development plans[3]. The guidelines emphasizes the needs of the legal set up around the World Heritage Site in order to protect monuments by protecting the historic core and a buffer zone. The heritage site includes an inner zone where human habitation is forbidden or its growth strictly controlled where no alteration other than conservation work is permitted through a proper management plan. The management plan should address these main elements: resource management and protection; human use including tourism; research and monitoring; and administration.

UNESCO in the Asia-Pacific region promotes the adoption of "Zoning and Environmental Management and Development Plans" (ZEMP). These plans provide a way to balance the conservation of the site with the need for economic development that will benefit the local communities through conservation work and the development of sustainable tourism. The plan provides for a way to balance the different needs of the different parties involved, both from the public and private sector, resulting in mutually-agreed upon objectives and policies. The implementation of the plan can then occur in conjunction with the work of other agencies and individuals, with a clear division of responsibility between every party involved. It also allows for heritage management to occur in relation to economic development plans. By balancing conservation, tourism and local economic needs, the plan allows for the sustainable socio-economic development of the area.

As stated, UNESCO's World Heritage priority within the environmental management and development plan, the study area is of a 15-km radius and rectangular in shape. This is in line with the Lumbini Project Area (LPA) which has been classified into different zones so that they meet the objectives of the LPA and the needs of the local communities.

7.1.2 IUCN Conservation Protection Category

According to the protected areas data base maintained by the IUCN category[4], the Lumbini World Heritage enacted both on the Category II (conservation of natural features – natural monument) and its protected landscape falls into Category V (landscape/seascape conservation and recreation-protected landscape/seascape). Category II (protected areas usually combine ecosystem protection with recreation, subject to zoning. Category V (protected areas are generally cultural landscapes or seascapes that have been altered by humans over hundreds or even thousands of years that rely on continuing intervention to maintain their qualities including biodiversity). Many category V protected areas contain permanent human settlements.

The guidelines for the conservation of IUCN Category V – protected areas include an historic heritage aim to show how protected areas under IUCN Category V should be planned and managed[5]. The guidelines for the management of cultural landscapes under World Heritage Sites (one of the coverage areas ascribed under IUCN Category V protected areas) mentioned twelve principles for the management of this kind of protected areas. Of these, principles stated as "economic activities

[3] http://www.unescobkk.org/index.php?id=2913

[4] IUCN. 1994.

[5] Phillips, 2002

(including the forms of industry and commerce) that do not need take place within the protected landscape should be located outside it". The guideline guides the criteria for determining the suitability of small-scale development and the acceptability of large-scale development in such protected areas.

The guideline emphasizes small-scale developments and large-scale developments in the protected area with specific criteria. These are as follows:

For small-scale developments:

Environmental Factors: Scale, design, materials, landscaping, off-setting benefits (e.g. the new wildlife habitat to benefit or not), location, technologies and resource consumption (is the scheme designed to minimize water, energy, waste, sewage, effluent, noise, light, low impact technologies?), green practices-biodegradable products; does it seek to minimize the use of private transport?

Social Factors: Relationship with the community, whether a scheme supports the local people; impact on cultural traditions – will the scheme support or undermine cultural traditions that identify the community's social space, circulation patterns; diversity – will the development activity support a diverse social community.

Economic Factors: Resource users – does the project support sustainable resource use in the area; employment – will the project employ local people and use local skills; produce – will the project make a demand of local goods and products; Servicing – will the scheme make reasonable demands on public services.

For large-scale developments:

Environmental Assessment: Monitoring operations and safeguards over pollution – where there should be an effective monitoring and compliance system.

Credible plans and secured funding for restoration and after-use treatment to remove the threat of pollution and or polluted water. Determine alternative ways of meeting needs.

Different type of schemes (e.g., energy conservation can be an alternative to new generating capacity; assess the different location or route outside the area if so argue for this alternative.

7.1.3 National Priority

The use of environmental assessment tools (IEE/EIA) has been mandatory throughout the Environment Protection Act 1997 (EPA) and Environment Protection Rules 1997 (EPR). A number of guidelines and manuals have been prepared for sectoral areas, particularly for the hydropower sector based on EPA (Winrock International, 2007).

The Tenth National Development Five-Year Plan emphasizes conservation of natural and cultural heritage (conservation and preservation of historical, cultural, religious and archaeological heritage and enhancing their practical utilization). Furthermore, the plan gives priority to the conservation of the World Heritage-Lumbini-Kapilbastu-Ramgram areas.

It emphasizes that World Heritage Sites and archaeological conservation areas should be protected by essentially maintaining standard measures ascribed to World Heritage Sites. In this regard, policies and programmes of action recommended for the sustainable development of Lumbini are as follows:

Increase opportunities in employment through protection of local skills and emphasis on the use of locally produced goods and services; offer a clean environment; services quality; and maintain strong and reliable safety and security measures.

Develop the infrastructure and partnerships between stakeholders; protect art, cultural and religious and heritage tourist activities; protect the environment and socio-culture values and provide economic benefits to the host community.

Instigate programmes that focus on alternative energy sources; employment generation and awareness raising activities and coordinate this action among all stakeholders; instigate a Lumbini

campaign during the birthday of Lord Buddha to increase visitor numbers from religious tourists; protect the uniqueness and religious tradition of Lumbini and its surroundings.

Enforce mandatory guidelines for the protection of areas around World Heritage Sites and other areas of archaeological importance; enforce legal protection of Buddhist literature and the museum.

Improve air and land transportation links from Kathmandu and Pokhara; construct a second international airport in the Lumbini area to make it a more direct destination; encourage the participation of all sectors in plan monitoring and evaluating activities; increase more services and facilities involving the participation of local people.

Encourage greater coordination between visitors, industry operators, communities, especially in regards to the environment; conduct regular auditing (management, environment and finance) reviews and feedback and keep the plan fresh and relevant (NPC, 2001).

The Ministry of Industry's Industrial Promotion Board (IPB) made the following directives in order to restrict industrial activities:

New carbon-emitting industries will be excluded from a designated area around the Lumbini World Heritage Property (LWHP). The designated area extends a 15-km aerial distance to north, east and west of the LPA boundaries (Master Plan Boundary), south to the Indian border and 800-metres on both sides of the road along the Lumbini-Bhairahawa Corridor.

Existing LPZ industries can operate only if they respect the Environment Protection Act (EPA). Industries not respecting the Act must relocate within two years and will be denied further increases in their capital, capacity, objectives and present levels of electricity consumption.

The Lumbini Development Trust (LDT) will be a member of the Environmental Review Committee overseeing approvals under the Act by non-carbon emitting enterprises to establishes operations in the Lumbini area and along the Bhairahawa-Lumbini Corridor up to the airport. This approval process will also apply to existing industries' requests for further increases in their capital, objectives and electricity consumption.

Registered, non-operating LPZ industries must observe the Act and instigate pollution control measures before operating. Non-performers will be relocated elsewhere promptly.

Moreover, the decision made by IPB include small manufacturing and service industries in the LPZ but excludes 28 types of large carbon-emitting industries (cement, leather, sugar, distillery, stone and concrete, brick and tiles, tobacco and animal slaughtering businesses).

7.1.4 Community-centred approach

People within the study area suggested that the zoning criteria should be guided as follows: The community be given the following priority for land use plans; livestock production; plantation; heritage conservation; water conservation; economic development; flood management; community development; employment; and livelihood promotion.

7.1.5 The Kenzo Tange Master Plan insight

The Kenzo Tange Master Plan emphasizes the protection and conservation of the World Heritage Lumbini. The Master Plan covers an area of 5ml x 5ml. It includes the Lumbini Project Area (1ml x 3ml) in an area of a rectangle shape running north to south and the restricted zone and buffer zone. The zonings in this study have been adopted within the objective of the master plan.

7.1.6 Study Findings

The study revealed that people within the study area believed that integration between archaeological sites and tourists with local people can be strengthened through adopting the following ideas:

- Determining the needs and potential opportunities of local people.
- Local communities expect cooperation from LDT for their needs.

- Local resources should be developed and priority should be given to local people in LDT.
- The role of local people should be increased in tourism development measures.
- Local needs should be integrated into tourism activities.

Likewise, people within the study area said that they are not against industrialization and development in the zone. Their only concern was about pollution caused by existing industries. They were in favour of some low-pollutant industries which provide a sufficient amount of employment opportunities for local people such as agro-based industries/cottage and tourism industries, cereal production industries and other non-carbon emission industries.

So far as the replicable model of the zoning in relation to World Heritage Conservation is concerned the most practicable zoning guidelines were developed for the protection of Angkor monuments on the World Heritage List in Cambodia and sustainable economic development[6]. The guidelines discuss the protection categories and demarcations in the Angkor region, along with brief indications of management regulations for each zone.

The LPZ includes 44 VDCs within Rupandehi and 25 VDCs within Kapilbastu districts. The issues of both tourism and sustainable economic development must be viewed within wider planning with the LPZ. The significance of the cultural heritage could potentially attract large numbers of visitors. The facilities and services required by the visitors would allow for the establishment of appropriate small industries and service providers. The feasibility of long-term profitable agro-businesses that are appropriate for the development of the regions needs to be looked into

7.2 Zoning Categorizations

Based on the above discussion about the guiding approaches, the LPZ has created five zoning classes which are shown in Table 7.1. The classified zones are as follows: Zone 1-Restricted Zone; Zone 2- Buffer Zone; Zone 3- Special Conservation and Management Zone; Zone 4-Community Resource Management Zone; and Zone 5-Ecological Economic Development Zone.

The zoning classes are also shown in Figure 7.1. The land use types and the land features of each zone are given in Annex 9. The classified zones aim to contribute to the significance of the cultural heritage that potentially attracts larger numbers of visitors. The facilities and services required by the visitors would allow for the establishment of appropriate small industries and service providers. The feasibility of long-term profitable agricultural-based businesses that are appropriate for the development of the regions needs to be assessed. In general, zoning can be a powerful tool for ensuring a good quality of life but it can also be dangerous if it is not well planned. (Matrin, et al.200).

Table 7.1: Zoning classes with their coverage areas

Zoning Classes	Proposed Zone	Area (Ha)
	Project area	785.61
Zone 1	Restricted	2870.82
zone 2	Buffer zone	7366.05
Zone 3	Special Conservation and Management zone	25548.98
Zone 4	Community Resource Management zone	22537.15
Zone 5	Ecological - Economic Development zone	23844.37
Total		82952.99

[6]http://www.autoriteapsara.org/en/apsara/about_apsara/legal_texts/decree3_text.html

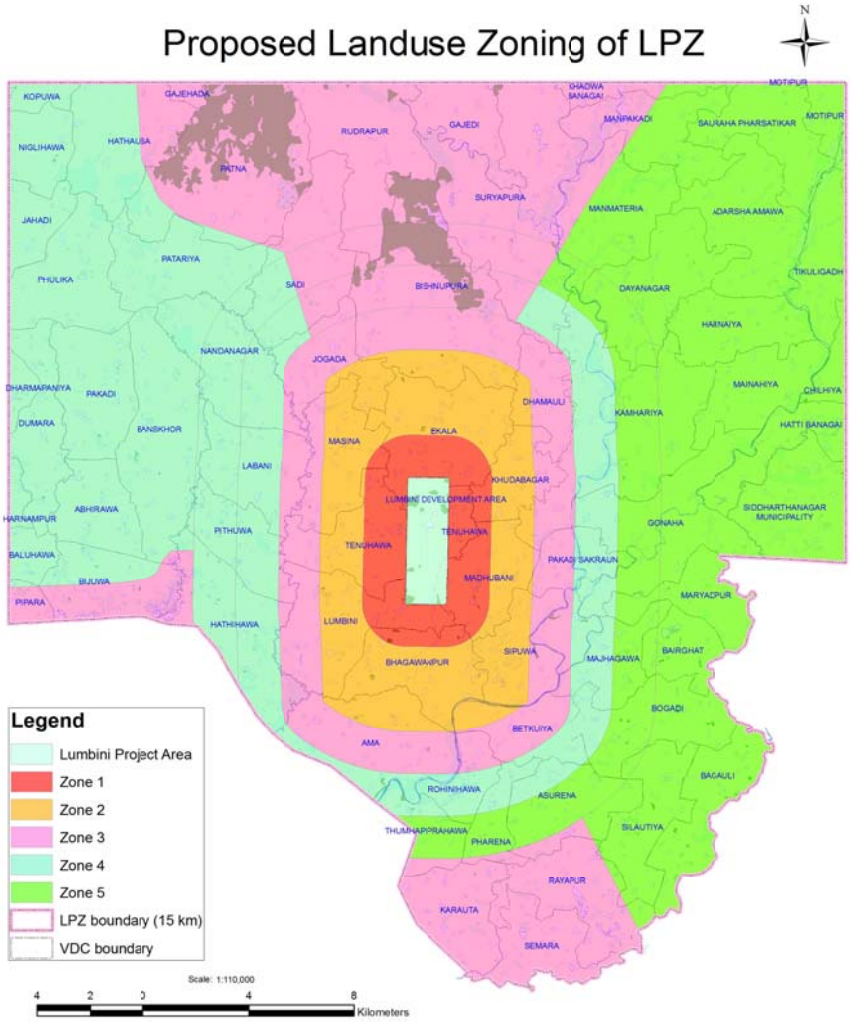

Figure 7.1: Proposed Land use maps into Five Zones

Zone 1: Restricted Zone

The proposed restricted zone has been extended from the restricted zone recommended by the Master Plan. The Kenzo Tenge Master Plan recommended that the restricted zone cover one mile east and one mile west from the boundary of LPA). Furthermore, the proposed restricted zone which aims to safeguard the LPA covers an area of 2871 Ha running around the boundary of the LPA with one mile from the boundary to the north, east, west, and south. This area deserves the highest level of protection. In the existing condition, this zone has been rapidly changing with public infrastructure and it raises concerns about threats to the LPA. It needs a control mechanism with by-laws and restricted principles for human intervention, except for conservation and research.

Zone 2: Buffer Zone

The characteristic of the buffer zone has been explained by different experts in different ways. For example, a report (Matrin, et al., 2008) stated that the Buffer Zone is intended to protect World Heritage Sites from negative influences. In other words, it represents a zone, that in itself is not of outstanding universal value, but that may influence a World Heritage Site. The importance of the environment for the object must be properly recognized to be able to define a suitable perimeter as well as required protective measures for the buffer zone.

The Buffer Zone mentioned in the Kenzo Tenge Master Plan covers two miles south and one mile east and west from the restricted zone of the Plan. The Buffer Zone in this report has been extended beyond the Buffer Zone recommended by the Master Plan. The coverage area of the proposed Buffer Zone is about 7366 Ha of lands that run two miles north and south and one mile east and west from the boundary of the restricted zone. Local communities can enhance their livelihoods in view of conservation of the Buffer Zone.

Zone 3: Special Conservation and Management Zone

This zone is proposed to undertake special conservation of the natural resources in view of keeping the sustainable habitat of flora and fauna. According to the land features of this zone, it is rich in forest resources, bush coverage, swamp lands and water body with low-lying lands (wetlands and ponds such as the Karbalahiya tal and Kebataliyatal wetlands). Such land features help maintain and promote the habitat of fauna and flora. The zone covers an area of 25549 Ha. It runs one mile distance from the boundary of the Buffer Zone to the east, west and south. Likewise, it also runs towards the north by covering the existing natural forest lands and major lakes located in the region. Furthermore, some patches of lands in the west and south near to the Nepal-Indo border sites are also covered by this zone.

Zone 4: Community Resource Management Zone (focus on conservation area)

This zone is proposed to empower the local community by promoting agricultural-based activities such as cereal food production cash crops promotion, etc. The zone covers about 22537 Ha of land. Agriculture-based tourism development is the priority of the local people in this zone.

Zone 5: Ecological-Economic Development Zone

Since the zone has enough access to development facilities such as road access mostly along the Lumbni-Bhairawa Road, as well as communication access and market promotion access, the zone is proposed for the promotion of greenery economic development. Major river basins such as the Tinau and Dano pass through this zone. The Lumbini-Bhairawa Road linked to Sidharthanagar Municipality lies in this zone. The zone is also rich in habitat for flora and fauna that can be can be conserved for tourism development and biodiversity conservation. Community-based forest activities need to be developed to help achieve this tourism goal. Small cottage industries to precede agriculture production with a mandatory of IEE can be developed in the zone. The zone covers about 23844 Ha.

7.3 The Lumbini Protected Zone Guidelines

Article 1: Introduction, Name and Objective of Guideline

Introduction: Lumbini was inscribed onto the World Heritage List in 1997 in recognition of the site bearing a unique testimony of Lumbini as the birthplace of the Lord Buddha. A rapid development of industrial activities in the LPZ poses a threat to the archaeological values, local community health, socio-cultural beliefs and ecological habitat. In this regard, the Industrial Promotion Board (IPB) decided some key decisions in view of controlling these threats in the region. The key decisions are: 1) an area of 15 km – vector radius (this area is termed as the Lumbini Protected Zone-LPZ) from the Northern Eastern and Western boundaries of the present project area as designated in the Kenzo Tange Master Plan and South up to the Indian boarder and 800-metres on both sides of the road along the Lumbini-Bhairahawa corridor will be off-limits to the establishment of new industries except for those which are not carbon-emitting; 2) Industries already existing within this area can operate only if they respect the Environment Protection Act (EPA). Industries which do not respect the Act will be further discussed in order to relocate them within two years. Provision will be made to avoid further increase of capital, capacity and objectives of those industries and to prevent them from exceeding their present level of electricity consumption; 3) Industries already registered but at present not operating within the LPZ need to take pollution control measures as per the EPA before operating and those which do not meet the requirements will be relocated in other parts within a given time frame.

Keeping these considerations, this guideline helps to guide any future infrastructural and industrial developments within the region in view of maintaining diversity of landscape or habitat of associated species and eco-systems.

Name and Objectives of Guideline

"Guidelines for Lumbini Protected Zone Environment Management" is the name of this guideline

Objectives of the Guideline

To guide any future infrastructural and industrial development within the region and integrate local community development and values of the habitat of the ecosystem into the conservation and protection of the heritage of Lumbini.

Article II: Categorizes the LPZ for Cultural and Archaeological Protection and sustainable development of the region

The region has been established into five zoning classes

Zone 1: Restricted Zone.

Zone 2: Buffer Zone.

Zone 3: Special Conservation and Management Zone.

Zone 4: Community Resource Management Zone.

Zone 5: Ecological-Economic Development Zone.

Article III:

Zone 1: Restricted Zone

The proposed restricted zone has been extended beyond the restricted zone recommended by the Master Plan (Kenzo Tenge Master Plan recommended a restricted zone that covers one mile east and one mile west from the boundary of the LPA). Furthermore, the proposed restricted zone which acts as a safeguard for the LPA covers an area of 2871 Ha running around the boundary of LPA with one mile from the boundary to the north, east, west, and south. It deserves the highest level of protection. In the existing condition, this zone has been rapidly changing with public infrastructure projects and concerns that represent threats to the LPA. It needs a control mechanism with by-laws and restricted principles for human intervention, except for conservation and research.

Article IV:

Zone 2: Buffer Zone

The characteristic of the buffer zone has been explained by different experts in different ways. For example, a report (Matrin, et al,. 2008) stated that the Buffer Zone is intended to protect World Heritage Sites from negative influences. In other words, it represents a zone, that in itself is not of outstanding universal value, but that may influence a World Heritage Site. The importance of the environment for the object must be properly recognized to be able to define a suitable perimeter as well as required protective measures for the Buffer zone. The Buffer Zone mentioned in the Kenzo Tenge Master Plan covers two miles south and one mile east and west from the restricted zone of the Plan. The Buffer Zone in this report has been extended beyond the Buffer Zone recommended by the Master Plan. The coverage area of the proposed Buffer Zone is about 7366 Ha of land that runs two miles north and south and one mile east and west from the boundary of the restricted zone. The local community can enhance their livelihoods in view of keeping the conservation of the Buffer Zone.

Article V:

Zone 3: Special Conservation and Management Zone

This zone is proposed to undertake special conservation of the natural resources in view of keeping a sustainable habitat of flora and fauna. This land is rich in forest resources, bush coverage, swamp lands and water body with low-lying lands (wetlands and ponds such as the Karbalahiya Tal (Lake) and Kebataliyatal wetlands). Such land features help maintain and promote the habitat of fauna and flora. The zone covers an area of 25549 Ha land. It runs a one mile distance from the boundary of the Buffer Zone to the east, west and south. Likewise, it also runs towards the north by covering existing

natural forest land and major lakes in the region. Furthermore, some patches of land in the west and south near to the Nepal-Indo boarder sites are also covered by this zone.

Article VI:

Zone 4: Community Resource Management zone (focus on conservation area)

This zone is proposed to empower the local community by promoting agricultural-based activities such as cereal food production cash crops promotion, etc. The zone covers about 22537 Ha of land. Agriculture-based tourism development is the priority of the local people in this zone.

Article VII:

Zone 5: Ecological-economic Development Zone

This zone is proposed for the promotion of "greenery" economic development as it has sufficient access to development facilities such as roads, mostly along the Lumbni-Bhairawa Road, communication access and market promotion access. Major river basins such as the Tinau and Dano pass through this zone. The Lumbini-Bhairawa Road linked to Sidharthanagar Municipality lies in this zone. The zone is also rich in habitat for flora and fauna that can be can be conserved for tourism development and biodiversity conservation. For this aim, there is a need to develop community-based forest activities. Small cottage industries to precede agriculture production with a mandatory of IEE can be developed in this zone which covers about 23844 Ha of land.

Article VIII: Categories of Industrial Activities (based on the IPB decision)

The following industrial activities are categorized based on the IPB recommendation:

Class A: All carbon-emitting industries and other industries named below are not prescribed in the zone: Cement Factory; Leather Processing Industry; Sugar Mill; Paper Industry; Distillery Industry; Crosser Industry, Brick Industry; Tobacco Industry; Plastic Industry; Metal Foundry/ Melting Industry; Chemical Fertilizer Industry; Rolling Mill; Chemical goods production /Processing Industry; Soap Industry (Chimney system); Rubber production /Processing Industry; Animal Fodder Industry; Bone Mill; Mineral Industry; L.P. Gas filling \Production Industry; Aluminium and Iron Processing Industry; Paint (Distemper) Industry; Lubricant Industry; Foam\Sponge Industry; Battery Industry; Dying of Clothes Industry; Lime Production Industry; Meat Processing Industry; and Medicine Industry.

Class B: The industries which need to be financed up to NRs. Ten lakh (One million) only for machine use and not to be used as carbon-emitting energy sources such as coal, fire wood, paddy dust, wooden etc., are permitted in some of the zones of the region through IEE/EIA approval. These are: Rice, Flour and Oil Mill (except Beaten Rice Mill); Grill Industry; Repair Workshops; Packaging Industry; Saw-Mill, Wooden Furniture Industry; Bakery, Chocolate and Biscuit Industry; Water Processing Industry; Readymade Aluminium Production Industry; Herbal Medicine Industry; Products of processed leather Industry; Press, Printing Industry; Dairy Industry; and Photo processed Industry.
Class C: The industries as listed below are permitted in some of the zones of the region by IEE approval: Cottage Industry; Tourism Industry; Training Institute (Industry); Consultancy Industry; Poultry/Animal Farm Industry (Except hen and pig livestock); Candle, Incense Sticks (Agarbatti) Industry; Contracting industry (Thekkpatta Udhyog); Ice-cream Industry; Solar/Bio-Gas Energy Industry; Agriculture and Forest-Based Industry (Except Milk Processing);. Industry which do not need an energy source; Cold-Store Industry; Hospital, Nursing Home, Human Health Care Centre; Software Production Industry; and Film Production Industry

Article IX: Development of Zone in view of protecting Cultural and Archaeological Activities

Objectives: Development of the zones in connection with the archaeological and cultural activities for the better protection of the environment through the following measures:

Protection of cultural and archaeological values of all the zones (Zones 1, 2, 3, 4 and 5) shall be undertaken, if necessary.

Procedures for the review and approval of development and conservation projects in the region shall be established prior to the onset of development projects.

Any new projects prior to their establishment shall be reviewed by an evaluation of their impacts on the environment.

Integration of an archaeological study of the zones concerned shall be done in any assessment of the environmental impact.

Emergency archaeological excavations shall be carried out if necessary prior to the commencement of development work.

An inventory of detailed archaeological records in the region should be set up prior to the establishment of any project.

An inventory of archaeological sites based on the GIS in the region should be created.

Create criteria and a programme for the designation of protected cultural landscapes and guidelines and policies for the management of those landscapes in order to make provision for archaeological research and educational activities.

Employ local people in order to maintain the protected zone.

Draw up a plan for conserving the local traditions of the region.

Zones 1 and Zone 2:

Identify the archaeological sites and preserve these through protection measures.

Prohibit development around the archaeological sites with the exception of development that is essential for the protection and enhancement of the sites.

Provide training to the local community about conservation of archaeological assets and traditional values.

Article X: Development of the Zones in view of reducing Air Pollution and Energy Consumption

Mitigation Measures: The following guidelines have been drawn up to ensure an air-pollution free environment in the region:

An air-pollution free area in the region should be developed. In order to achieve this aim, an awareness programme should be conducted about the inter-relationship between the importance of World Heritage Sites and bio-physical impacts and air pollution. This can be achieved by developing a concrete action plan at the implementation level in all protected zones (zones 1, 2, 3, 4 and 5).
Maintain air quality control as per the national standard of the Government of Nepal in all protected zones (zones 1, 2, 3, 4 and 5).

Air and sound polluting vehicles in all protected zones (zones 1, 2, 3, 4 and 5) shall be prohibited especially in zones one and two and in the LPA too. For this, green stickers should be provided as per the “In-Use Emission Standard” set by the Government of Nepal.

Promote electric vehicles in all the zones especially in zones one and two and in the LPA as well.

Adopt short-term and long-term strategies to control air pollution caused by existing industries in the region.

Adopt the “Polluter Pays Principle” (PPP) to control air quality in the region.

Monitor air polluting industries and sources by the concerned authority regularly and then share that information in a public forum.

Widen the Lumbini-Bhairahawa Road and make a greenery belt on both sites of the road from Siddarthnagar Airport to the Lumbini heritage sites.

Promote environmental-friendly transportation means such as public walkways and cycling paths in zone one and even in the LPA.

Promote renewal energy for domestic uses in zones one and zone two.

Promote renewal energy technology in all the protected zones (zones 1, 2, 3, 4 and 5).

Encourage solid waste management reuse by providing processing approaches.

Prohibit the use of horns in zones one and two and around the dense settlements along the Lumbini-Bhairahawa Road.

Adopt sound controls measures for existing industries in the region.

Article XI: Water Management

Mitigation measures: The following actions/guidelines have been drawn up regarding water management in the region:

Prohibit polluted water discharge into the river directly in all the protected zones (zones 1, 2, 3, 4 and 5).

Promote water ecosystem by maintaining the water quality of the surface and ground water. For this, a water quality monitoring examination is required regularly in all zones of the region.

Manage faecal sludge by adopting safety tanks and proper management practices.

Conduct a community-based watershed/lake management programme in zones three, four and five.

Adopt rain water harvesting technologies especially in the existing industries so that the rate of ground water consumption can be reduced.

Develop an irrigation facility in order to increase agricultural productivity especially in zones three and four.

Article XII: Industry and Commerce

Permission: The following guidelines are recommended regarding industrial and commercial activities:
Prohibit carbon-emitting industries and other industries listed in Class A (given in the Article VIII) in all the protected zones (zones 1, 2, 3, 4 and 5). For example, ban carbon emission industries (avoid the industries that produce a 30 ton/day carbon emission).
Monitor all the existing industries so that they are compelled to follow IEE and EIA guidelines with pollution control mitigation measures. If they do not adopt the guidelines and pollution control measures, the licence (official and authorized document permitting industrial production) should be withdrawn by the Government of Nepal.

Prohibit legal provisions to scale up the capacity of existing industries especially cement and bricks industries located in the region.

Existing industries should not be allowed to increase the production of clinker in the region. The production of clinker from raw materials of cement production is one of main sources of GHGs emissions, especially CO2 emissions.

Reduce traffic jams due to loaded trucks parking on the Lumbini-Bhairahwa Road. To combat this traffic congestion issue, industrial operators should develop their own parking spaces within industrial sites.

Stop construction activities underway to produce cement and bricks.

Shift the existing carbon emitting industries, including clinker-based cement industries, from the region within a certain period (of around ten-years.) To achieve this, carry out a study at the government level to recommend a transfer of existing industries from the region. The scope of the study should include key activities such as an assessment of compensation means, an assessment of the alternatives (move the industries from the region or convert their capital into tourism industry activities in zones four and five) and assess with recommendations alternative destinations to move the industries.

Permit industrial activities of Class B in zones four and zone five by adopting IEE and EIA guidelines.

Prohibit any industrial and commercial activities in zone one with the exception of some small-scale activates given in Class C. Of these activities given in Class A, small-scale activities such as tourism promotion training institutes, consultancy work related to tourism promotion and the educational sector should only be permitted for local communities.

Encourage local communities to set up craft and industrial industries including Class C in the zones two, three, four and five and the Class B industries in zones four and five.

Carry out a scientific study to identify specification of the type and nature of industries that could help maintain a sustainable environment and promote the local community and attract Lumbini Heritage visitors to the region.

Article XIII Conservation and Management of Cultural and Archaeological assets

Zoning guidelines for the sustainable development of local communities and conservation of the LPZ are discussed below:

All protected cultural and heritage sites (zones one to five).

Establish procedures for the review and approval of development projects in the LPZ.

Ensure that the projects are accompanied by an evaluation of their impacts on the environment, include an alternative project and ensure this is planned so as to minimize adverse effects (EIA/IEE).

Incorporate an archaeological study of the zones concerned in any assessment of the environmental impact.

Undertake, if necessary, emergency archaeological excavations before development work starts.

Ban carbon emissions industries (avoid the industries that produce 30-ton/day carbon emissions.)

CHAPTER 8

Conclusion and Recommendations

8.1 Conclusion

The Lumbini World Heritage Site (LWHS) is a destination for both pilgrims and visitors from Nepal and the rest of the world. The fertile farmland around the LWHS is a good habitat of abundant flora and fauna but this scenario changes rapidly as we enter the industrial zone. The 15-km area in terms of aerial distance (the landscape is termed as the Lumbini Protected Zone-LPZ) from the northern, eastern and western boundaries of the Lumbini Project Area (LPA-1ml x 3ml is designated in the Kenzo Tange Master Plan) and south up to the Indian border. The rapid and uncontrolled growth of carbon emission industries within the LPZ is threatening the master plan area of 5ml x 5ml, including the Lumbini World Heritage Site. A rapid development of industrial activities in the LPZ threatens archaeological values, the local community's health, socio-cultural beliefs and the ecological habitat.

The Rupandehi District administration has not yet designated any specific area as an industrial zone and as a result, the construction and operation of industries can be described as haphazard. The economically positive impact from industrial operations varies from Nepalese Rupees (NRs) 8,000-12,000 /month for about 80-100 families. The cost of land near the industrial area has increased in the last 10 years as industrial activity and the related transportation sector have increased their activities quite substantially.

There has been clear violation of laws by industrial operators and this breach of legislation has had significant adverse consequences on the bio-diversity, water resources, air quality, land use and condition of the environment and the health of the local people. Air pollution levels are higher near the industrial area due to a lack of mitigation measures to control fugitive emissions produced by cement industries.

The growth of total colifom was observed in the samples of both surface and ground water. The local community expressed the view that the water table has decreased around the industrial areas because of excessive extraction of ground water for the operation of industrial activities. The soil around the industries is alkaline and the organic matters content in the soil was recorded as lower than standard acceptable levels. The soil pollution assessment showed that soil around the industrial area was contaminated by fugitive effluent due to cement production. As a result of the accumulation of dust in the local environment, crop cultivation near the industrial areas decreased in comparison to the pre-industry era in the region. Heavy truck traffic (about 100 trucks per day servicing the industrial site) has caused excessive noise pollution and vibration in these industrial areas.

Furthermore, water pollution in the river adversely impacts the cultural, spiritual and religious practices of local communities and pilgrims. Eye irritation due to clinker dust and dry cement powder has been experienced by the local communities. Likewise, dry skin, discomfort, irritation and severe burns have caused skin problems in the region. Economic activities and associated financial returns for a small number people has increased in this area in recent years but this has been at a cost to the health of many and precious natural resources. The health impact due to industrial activities needs to be examined for further clarification about the industrial impacts on the local environment.

Wildlife and vegetation depletion may occur due to the industries internal roads which could be an easy access corridor to the people in the farmlands, riverine belt and forest which is the prime habitat sites of the wildlife species. There is also a change underway related to agricultural land, forests, bushes and riparian zone as these once pristine areas are turned into land sites for factories and other commercial and private structures causing habitat loss. Adverse pollution on monuments and the World Heritage Site and traffic jams experienced by the pilgrims were observed during the study.

The short and long-term strategies for the reduction of the industrial impact has been identified from an assessment of the study. The short-term strategies are concerned with the adoption of mitigation measures to reduce the impacts. Likewise, the long-term strategy is linked with the shifting of the carbon emitting industries from the LPZ. Mitigation measures have been developed to address the identified adverse impacts. Measures to control air pollution caused by the cement industries are

needed in order to combat soil pollution and land degradation caused by cement dust. Environmental monitoring and management plans, along with an environmental auditing system, have been prepared to minimize the adverse impacts of industrial activities.

The study concluded that the area affected by industrial activities is mainly rural. The major industries have provided employment opportunities mostly to non-locals but the official records of the employment were not available during the study. Most of the people in the industrial area are farmers and few were involved in micro-enterprises. Their main livelihood is based on subsistent-level agriculture and livestock. Farm land, grassland, rivers, shrub land, forest pockets and river flood plains are the common properties which provide a number of production and services to the local communities. The disadvantaged and poor people are dependent on these land resources and any adverse cost on these common lands has direct and indirect implications on the livelihood of these people. A lack of adopted mitigation measures, guided by EIA and IEE, has enabled a detrimental climate of air, noise and water pollution to permeate the LPZ, especially around the industrial sites. The study also concluded that the integration of the development of LPA and community livelihoods is the main approach in view of keeping sustainable environmental development in the region. Similarly, the zoning system of the LPZ has been prepared with detailed guidelines by dividing the area in five different zones.

8.2 Recommendations

This is a preliminary environmental study to identify the possible adverse impacts from the establishment of industries around the LWHS. The study tried to cover different aspects of environmental, socio-economic and cultural issues associated with the LWHS. Some of the issues in the report could not be verified by data due to insufficient field study feedback/investigation and some technical limitations. Therefore, a further comprehensive study on the different aspects of the environment in this area is strongly recommended to assess the actual impacts in and around the LWHS. This additional study should also focus on visitors to the LWHS (both local and international) and the consequences of industrial activities on this aspect. Such a study should also suggest a sustainable solution to the current environmental problems being experienced at the industrial sites and the surrounding vicinity.

Based on the results obtained from the analysis and assessment, the region has been classified into different zones. The guidelines for the sustainable development of the classified zones are given in the study. Based on the preliminary study and proposed guidelines, the following recommendations are made for further evaluation of the local environmental condition and finalization of the guidelines to make it more practical and useful for the protection of the LWHS and the sustainable development of the region.

Research level: The following study areas need to be addressed:

- Water table analysis in the Dano and Tinau sub-watersheds.
- Industrial impact on air quality by establishing a monitoring station and using numerical modelling.
- Soil analysis around the industries, upstream and downstream.
- Pilot research on biodiversity sensitiveness especially the fauna habitat in the LPZ.
- Health impact analysis at the community level.
- Scientific demarcation for developing a long-term ecological-economy development that must cover the Great Lumbini Programme.
- Exact population, habitat condition, threats to make the conservation management plan for the existing population of wildlife in the Lumbini area.

Advocacy level: The following activities should be addressed:

- Strong and practical policy for the industrial location and relocation in the region and linking the policies with the Great Lumbini Programme.

- The LDT should carry out the work (project area, restricted area and buffer area) as guided by the Kenzo Master Plan and the zoning guidelines.

- An industrial operational system should be monitored with a team as per industrial guidelines. The team should be represented from the LDT, MoEnv, DoI, FNCCI, concerned agencies and technical experts as per the types of industries.

Operational Level: The following activities should be undertaken immediately:

- The LDT needs to start coordination with communities around, up and downstream of the industries.

- The LDT needs to develop inter-coordination with the LDA.

- Immediate development governing tools needs to be developed to address development in the restricted and buffer zones.

- The Government of Nepal should provide alternative income generation activities by promoting tourism activities, such as an awareness of culture and Lumbini's rich cultural heritage, livelihoods and the importance of local resources at the community level.

Policy Level: The Department of Archaeology has a central responsibility for the conservation of heritage sites throughout the country. But within this line of conservation, many other governmental agencies also have their own specific responsibilities, so it is a matter of concern to all stakeholders to act expertly and fulfil their duties related to compliance monitoring. With this in mind, the following measures should be undertaken/or adhered to:

- The roles, responsibility and authority of different organizations in the field of the environment should be clearly defined and incorporated into laws and policies.

- Industries within the LPZ or in the other heritage sites around Lumbini need to undergo a full EIA with final approval from the Ministry of Environment, Department of Archaeology, Ministry of Culture, UNESCO (for World Heritage sites) and relevant stakeholders.

- During the field visit the entrepreneur and even the Industrial Promotion Board members had no knowledge of the environmental conditions and consequences of the industry at the site selected. Hence, they ended up investing and giving permission to open industries in extremely environmentally sensitive sites, thinking only about the income. So, there is an obvious knowledge gap in the IPB related to the environment and to remedy this – a separate Department of Environment, with trained manpower, for monitoring industrial activities and all related policies should be created.

- Depending on the location specificity, an industry may have to provide more elaborate pollution control equipment to meet more stringent standards than those permissible in order to avoid adverse impacts caused by extreme site sensitivity.

- The role of the MoEST itself needs to be more clearly defined including the task of environmental inspectors.

- Environmental friendly mainly non-carbon emitting industries should only be allowed to be established in the region by minimizing the environmental impact through regularizing the IEE/EIA process.

- The policy of industrial locations needs to take into account environmental considerations such as zoning, provision of buffer zones, use of industrial districts with centralized waste treatment

facilities as part of the infrastructure; compatibility of industries within an industrial district; and dispersal of industries to reduce pollution stress.

- Awareness programs should be conducted to sensitize community people through sensitization campaigns, workshops etc.

- The problems faced by the locals due to pollution need to be addressed in an integrated way at the local level.

- The “polluter pays principle” should be followed with a reasonable financial levy to discourage other people from activities that cause pollution, and all the possible mitigation measures should be adopted and compiled by governmental policies.

- The management of the environment needs to be broad and public awareness is necessary to take into account ecological considerations in the decision-making process

- Different experts such as civil and chemical engineers, economists and ecologists should be operational within one organization and they should work together on the development of proper environmental management policies.

- Cooperation between inter and intra-ministries should be made more effective among the Ministry of Culture, the Ministry of Industry and the Ministry of Environment.

- Close involvement of local people in the development activities of Lumbini at all levels of project formulation, implementation, operation and maintenance is necessary. The implementation area should be according to the zoning plan. This will mobilize entire local communities for sustainable development activities complying with all the rules and regulations resulting into an integrated and desired mode of development of the entire areas.

Note: Some of the valuable comments and suggestions of the reviewers of the report could not be incorporated due to the limitation of this preliminary study. These comments should be considered in the further detailed comprehensive environmental study.

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ANNEXES

Annex 1: Field Survey Checklist

Annex 1.1: Checklist Individual

Environmental Impact Assessment in LPZ[7]
(Community people, factory worker, student etc.)

Date:	Survey No.:
Place/ Site:	Name:
Sex:	Age:
Occupation	Distance from Core area of Lumbini heritage…….km

A five category scale will be used to indicate how much the respondent agrees or disagrees with the statement and the environmental issues that were predicted.
(Rating Scale : Strongly disagree=1, Disagree=2, No opinion= 3, Agree=4, strongly agree=5)

S. No	General perception about environmental issues(Do you think that……?)	Strongly disagree (1)	Disagree (2)	No opinion (3)	Agree (4)	Strongly agree(5)
1.	Industries are responsible for environmental pollution					
2.	Industrial pollution has affected the Heritage site					
3.	Industrial pollution has affected the Tourism					
4.	Industries has followed all the rules regulations of GON before establishing this industry					
5.	Breaching of environmental Law during the construction and operation of industries					
6.	Growing industries has solved the unemployment problem to some extent					
7.	Monthly income generated from Carbon emission industries in average					
8.	Monthly income generated from non-Carbon emission industries (alternative sources)					

Specific Assessment

S. No.	Physical environment	Strongly disagree (1)	Disagree (2)	No opinion (3)	Agree (4)	Strongly agree(5)

[7] LPZ: Lumbini Protected Area: the Study area

A	Water pollution has caused					
1.	Depletion/degradation of available water supply					
2.	Deterioration/depletion of surface water quality					
3.	Deterioration/depletion of ground water quality					
4.	Negative Impact on the health of the locals					
5.	Negative Impact on the wildlife					
6.	Negative Impact on the vegetation					
7.	Negative impact on soil quality					
8.	Negative impact on livestock					
9	Amenity losses					
10	Recreational value of the area					
B.	Air pollution has caused problems on					
1.	Heritage site					
2.	The Health of the locals including schools children					
3.	the Health of the factory workers					
4.	the Vegetation/flora					
5.	The animal/fauna					
6.	The Soils/land					
7	Recreational value of the area					
C.	Noise pollution has caused problem on					

1.	Amenity losses					
2.	Irritation and loss of concentration					
3.	Health related problem					
4.	Tourism					
D.	Solid waste has impacted on					
1.	Sanitation and drainage					
2.	Water bodies					
3.	Air quality					
4.	Human health					
5.	Recreational value					
Biological environment						
D.	Flora and Fauna					
1.	Negative Impact on wildlife and its habitat					
2.	Negative Impact on vegetation					
3.	Negative impacts on livestock					
Socio-culture Environment						
E.	Socioeconomic and cultural environment					
1.	Growing industries has caused rapid urban population growth					
2.	Increased commercial activities in the area					
3.	Increase the options of livelihoods for the locals					

2.	Negative Impact on the agricultural activity					
3.	Raised the economic condition of locals					
4.	Solved the unemployment problem to some extent					
6.	Negative Impact on the socio cultural environment					
7.	Negative impact on tourism					
8.	Land degradation					
9.	Decrease in recreational value					

Note: Strongly disagree=1, Disagree=2, No opinion= 3, Agree=4, strongly agree=5

Annex 1.2 Checklists for Focus Group Discussion

Environmental Impact Assessment in LPZ[8]
(FGD includes authorized agencies and key individuals, local community, farmers…:

Discuss focusing on:
Historic land use and occupancy
……

Archaeological and culturally important sites
……
Cultural significance
……
Tourism potential and benefits
……

A general description of the community in terms of
Population and its distribution, Demographic profile (age, sex, caste/ethnicity, labour force etc)
……
Community characteristics in terms of literacy, poverty, employment and major occupation etc
……
Existing infrastructure and services (roads, school, hospital, water and sanitation, parks, drainage and other community buildings etc)
……
Stage of information and communication (tele-communication, television, cables, emails, internet etc)
……
Livelihood assets and options (productive land, forest area, wetland, marginal land agriculture, business, livestock raising etc.)
……

[8] LPZ: Lumbini Protected Area: the Study area-15 km aerial distance from LMPB(Lumbini Project Area-1mlx3ml)

Employment opportunities and commercial activities in the area (has it increased because of industrial establishment, tourism, heritage area???)
………
Increase the options and living standard
…….
Issues like conflict, cohesiveness due to increased industrial activity
………..
Does the community have any specific concerns about the environment? Specifically ask about water and air pollution and other hazards, and recent changes to environmental conditions and sources of those changes.
……..

4. Discuss on general information about Industries:
Established since:
Types of waste discharge systems
Type of pollution caused
Opportunities they provide…

---

5. Discussion on,
Community perception on industrial establishment and its impact on their community
…….
Community perception on impact of industrial activity on the heritage site
…….
Is there any conflict ongoing between community vs. industry and community vs. heritage conservation, if so then, please explain in detail
…….

6. Discuss on the impact caused by effluents and solid waste from the industry on
Sanitation and drainage problem:…………………………………………….
Water quality (ground/surface water) :……………………………………………
Existing water bodies like rivers that could be potentially affected by pollution and floods ………………………………………………………………………………………
Air quality and its related health hazards :…………………………………………………
Flora and fauna existing in the area:…………………………………………………….
Wetland vegetation:,,,
Sources of water for agriculture, impact on agriculture land/soil and agriculture production:………………………………………………………………………
Source of water for Livestock, impact on livestock health and livestock production:…………………………………………………………………………
Household water sources, impact on human health:……………………………………………………………………

7. Impact of industrial establishment on wildlife and its habitat (birds, including waterfowl and non-waterfowl species, mammals)

8. Discuss on the community perception on present condition of the study area and the proposed improvement programs that could be done for improvement of the area:

Location	Description	Existing condition	Proposed improvement

9. Discuss on;
General attitude of people towards industry (rating the response 1- 5)
(See below the rating tool)

Whether the existing industries has followed the rules regulations of GON before establishing this industry
Whether the industries has breached environmental Law during the construction and operation of industries
Whether the industries has caused impact on: land use changes since last 15 years (forest-agriculture-urban including industrial purpose/development activities)
Monthly income generated from Carbon emission industries in average
Monthly income generated from non-Carbon emission industries (alternative of the existing Carbon emission industries)
About alternatives of existing industries for local livelihood promotion
Local people perception about the re-location of the existing industries away from the protected zone

10. Specifically discuss about how the environment of the area has changed in the past ten years, noting changes to agriculture land, forests, pasture, supplies of raw materials, access and availability of water and pasture land, rainfall.:……

11. Does the group see the location of the community as one that is safe from pollution and natural hazards? If 'No" then state its causes……?.....
……..
Environmental Impact Assessment of Industrial Development around Lumbini

Checklists for focus group discussions, authorized agencies and key individuals (KII)
Specific to Zoning perspectives and mitigating measures assessment:

(Preparation of Zoning Plans and Guidelines identifies the sites for sitting industrial activities permitted or prohibited. The preparation of zoning will be based on environmental considerations. The environmental parameters and conditions will be evaluated and quantified and the suitability of sites will be determined based on their sensitivity to air, water and land).
People perceptions on: Whether the schemes (small and large development projects) fit the objectives of the protected area and meet the requirements of sustainability practices.

For small scale development
Environmental Factor: Scale, Design, Materials, Landscaping, Off-setting benefits (e.g. new wildlife habitat be benefited or not), Location, Technologies and resource consumption (is the industry designed to use minimum of resources-water, energy, waste, sewage, effluent, noise, light? Low impact technologies), Green practices-biodegradable products, seek to minimize use of private transport?.
Social Factors: Relationship with community-whether an industrial activity supports the local people; Impact on cultural traditions –will the industrial plan support or undermine cultural traditions that identify the community-social space, circulation patterns?; Diversity-will the development activity support a diverse social community ?
Economic Factors: Resource users-does the project support sustainable resource use in the area?; Employment-will the industrial activity employ local people and use local skills? Producers: will the project make a demand of local goods and products; Servicing: will the industrial plan make reasonable demands on public services.
For Large Scale Development
Environmental Assessment: Monitoring operations and safeguards over Pollution-where there should be an effective monitoring and compliance system; Credible plans and secured funding for restoration and after-use treatment to remove the threat of polluted land or water
Determine an alternative way of meeting the needs: different type of scheme(e.g. energy conservation can be an alternative to new generating capacity; assess the different location or route outside the area if so argue for this alternative;
Discussions on the zoning and management of the protected areas (Perception of protection categories, demarcation, indication of management, zoning indication and classes)
Talk about indicators for zoning the type of development and industrial activities permitted or prohibited in the protected zone

Indicators	Specific Measures	Indicators Groupings (General)	Remarks

How to integrate archaeological and visitor interest with local people interest and needs?
What type of industries are allowed to operate and where they could be established and Why?
What are the zoning criteria in order to protect the site and meets the needs of the local people?
What are the popular/famous/public places around the boundary of the protected zone (on the perimeter sites-15 km)?
How many types of possible zoning classes that need to be classified in the protected area? Please mention the guidance of each zone. May be: monuments sites, cultural landscape, socio-economic and cultural development, preserve the areas as tourist attraction
Are there any development projects working with the community and what do they do?
Primary Impacts: Potential Air Pollution

Category	Pollution cover in terms of distance (Km)	Degrees of impacts on Sensitive components (H/M/L)							Remarks
		Water body	Soil /land	Flora	Fauna	Health	Socio-economic	Archaeological, recreational values	
A1									
A2									
A3									

Primary Impacts: Water Pollution Potential

Category	Pollution cover in terms of distance (Km)	Degrees of impacts on sectoral components (H/M/L)						Remarks
		Flora	Fauna	Health	Socio-economic	Archaeological, recreational values	Soil/ land	
W1								
W2								
W3								

Primary Impacts: Potential Land Pollution

Category	Pollution cover in terms of distance (Km)	Degrees of impacts on sectoral components (H/M/L)						Remarks
		Flora	Fauna	Health	Socio-economic	Archaeological, recreational values	Water bodies	
L1								
L2								
L3								

Coverage distance: whose impact is not likely to exceed …….km

Primary Impacts: Potential Noise Pollution

Category	Pollution cover in terms of distance (Km)	Degrees of impacts on sectoral components (H/M/L)				Remarks
		Tourism	Human Health	Socio-economic	Archaeological, recreational values	

L1						
L2						
L3						

Coverage distance: whose impact is not likely to exceed …….km

How would the group (LDT members/Govt. officers etc.) describe a good future for the Locality they reside in as well as Lumbini' the world famous heritage site"? (Prompt for types of work, tourism, types of housing, access to water, electricity, roads, education and health status and changes to the environment.)
What suggestions do all the group members make as to how environmental issues in the area should be addressed? Describe in detail: The way out methods or suggestions for related environmental problems that are identified?

Annex 1.3: Industry's Owner Discussion Checklist

Environmental Impact Assessment in LPZ
Checklist/Questionnaire for the Industry Owner/Employee

Date:	Survey No.:
Name/Position of respondent:	Place/ Site:
Established Date:	Current activity:
Industry's name:	Aerial distance to Lumbini (MPB)[9]…….km
Type of ownership:	Manufacturing Product:

Could you please give the followings:

Objective:……..

Production Capital:…….

Production Capacity:…….

Current Production Rate: ……..
Could you please explain about your problems regarding this industry and its consequences?

Did you need to relocate settlement during establishment of this industry?

Yes..…….. b) No…….

What is the source of water that is used for the operation /production in the industry?
……..
How much is the electricity used per month for the operation?
……

Are the entire employees working here locals? State the approximate no. of employees with income rate.

S. N.	Description (Number of persons engaged)	Male	Female	Total	Income Rate
	Local				
	Seasonal and temporary employees				
	Non Nepali workers				

Did you conduct EIA/IEE or any other related study prior to the establishment of this industry?
Yes…….. b) No……..
If "Yes" then which one?

[9] MPB: Master Plan Boundary

Are you aware about any policies related to environment protection in the protected zone-world heritage area?
Yes b) No
If "Yes" then why? Please specify…….
If "No" then also why? Please specify…….

Do you think the establishment is adversely affecting heritage site at any scale?
Yes ……. b) No…….
If "Yes" could you please mention few major adverse effect at heritage site?
……..
Please indicate, which types and what are the quantities of waste produced by this industry?

S. No.	Types of Waste	Quantity(specify unit & period)

Did you increase your production capacity since the establishment period?
Yes…….. b) No…….
If 'yes" do you think it has also increased the production of waste? (Specify the amount and types)
…….

Do you think this industry has caused any environmental pollution?
Yes……. b) No……..
If 'Yes" then, what kind of pollution and in which sector is its impact?

S. No.	Possible Impacts on:	Yes/No	Remarks
	Water		
	Air		
	Land		
	Biodiversity (Flora and fauna)		
	Socio-culture		
	Economic		
	Health (community people, factory workers, wild and domestic animals and other concerned)		
	Tourism		
	Heritage site		

Have you adopted any waste disposal methods?
Yes…….. b) No…….

If 'Yes" then, what are the methods you adopted for waste disposal?

If No, why…….
Do you follow the waste management principles i.e. recycle, reuse, reduce?
Yes…….. b) No…….

If "Yes" then, please specify……

What are the approaches to reduce pollutant emissions?

(Preventive techniques-changes fuels to electric power, sanitation land fields for solid waste disposal, changes in design & operating practices; Effluent dispersal-building taller smokestack, ; and Effluent cleaning-adding pollution control devices)

……..

……

Do the factories have adopted any other protection measures like :
For the workers health safety: Yes or No
For environment around the industry: Yes or No
For conservation of heritage site: Yes or No

……

Do you have any suggestion to prevent the prevailing pollution problems?

……..

……

Do you feel that it is necessary to relocate the industry (which is causing environment degradation of the heritage site) from protected Zone?
Yes…….. b) No……

If yes, are you ready to remove the industry from protected zone?
Yes…….. b) No……

If 'Yes" then, what needs to be done by the government for the relocation?

……..

……

If 'No" what is your recommendation concerning this issue?

……..

……..

Annex 2: Field Work Plan for EIA Lumbini

June 26-July 4, 2011											
SN	Activities	Day									Remarks
		26th -Jun	27th-Jun	28th -Jun	29th -Jun	30th-Jun	1st -Jul	2nd-Jul	3rd -Jul	4th -Jul	
1	Kathmandu-Bhairawa										
2	Consultation with LDT Authorized person										Remark 1
3	Consultation with Lumbini Institute Alliance										Remark 2
4	Consultation with government authorities at district level-Rupandehi-Kapilbastu and Industries association										Remark 3
5	Transect walk and Visit to Industries										Remark 4
6	Focus Group Discussion										Remark 5
7	Meeting for KII (Key Informant Interview)										Remark 6
8	Sampling the samples-water and soil										Remark 7
8	Field closing meeting with LDT										
9	Return to Kathmandu										

Notes:

Remark 1: Briefing about the field visit and finalizing the field schedule for stakeholder meetings, visit to industries, transect walk, group discussion, meeting with local government and industry association.... as per the situation of the field for the field work;

Remark 2: A brief discussion about the study including field works and talk about the environmental issues in brief

Remark 3: A brief discussion about the study including field works and talk about the environmental issues in brief as per the checklists

Remark 4: Locate the industries locating in study area using GPS and consult with authorized person for the discussion about the issues as per the checklist (Checklist for Industry)
Remark 5: Discussion with communities including vdc level stakeholders at VDC -Gonaha and Kamhariya as per the checklist (Checklist for FGD & zoning); other location will be taken based on the situation and the discussion
Remark 6: LDT persons, Lumbini Alliance, Leaders, School, Management person, local experts, local key person
Remark 7: The identified samples points will be redefined as per the field situation. The identified sample points are: 1. samples Surface water: a) Tributary of Dano River-upstream nearby Barewa; b) Mid-stream at Confluence of the tributary & Dano River near by Reliance Cement-Harnampur; c) at Dano River-downstream nearby Gandi; 2. Samples for Ground water: a) ground water from Gandi or Sundi, b) Mahadiaya, c) Tenuhawa - Ramawapur; 3. Sample for soils will be decided in the field
Remark 8: Specific discussion about zoning

Annex3: List of Participants in the FGD

०६४

मिति २०६८/३/१८
समय: ५:४० बजे
स्थान: गोनहा-6 गुरुवानिया

क्र.सं.	नाम	ठेगाना	पद/संस्था	हस्ताक्षर
१	जनुन हरिजन	गोनहा-6 गुरुवानिया	"	[illegible]
२	साधु यादव	गोनहा-६	"	[illegible]
३	गुरुदेव सहनी	गोनहा-६	"	गुरुदेवसहनी
४	हेरीप्रसाद पाल	गोनहा 6	"	[illegible]
५	बैजनाथ पाल	गोनहा-६	"	बैजनाथ
६	सीता खनाल	गोनहा ६	"	सीता
७	ताराबति हरिजन	" ६	"	ताराबति
८	अकाली पाल	" ६	"	अप
९	सान्दा पाल	" "	"	सन्धा
१०	बासमति पाल	" "	"	बासमति
११	सरास्वति पाल	" "	"	सरस्वति
१२	सुनिता हरिजन	" "	"	सुनिता
१३	टिका यादव	" "	"	टिका
१४	प्रभा पाल	" "	"	प्रभा
१५	दुर्गेस यादव	" "	"	[illegible]
१६	सन्जु पाल	" "	"	Sanju Kumari Pal.
१७	मन्जु पाल	" "	"	Anju Pal
१८	अन्जुत पाल	" "	"	[illegible]
१९	तमेश्वर यादव	" "	"	तमेसर यादव
२०	सुर्याम यादव	" "	"	[illegible]

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बैठक

मिति- २०६८/०३/१६

समय- १० बजे

स्थान - मोतीझारी निम्न मा० विद्यालय, लबनी)

उपस्थिति

क्र.सं.	नाम	ठेगाना	संघ/संस्था	हस्ताक्षर
१-	हकीकुल्लाह मु०	लबनी १	अलीशिफा शैक्षिक तथा वातावरण विकास केन्द्र	[illegible]
२-	फुलचन्द कोरी	बिछुवा ४-	सरसफाई सदस्य	फु[illegible]
३-	रामेश्वर कलवार	लबनी-१	सरसफाई सदस्य	[illegible]
४)	कन्हैया पासी	लबनी-५		कन्है[illegible]
५-	चन्द्रभान कोरी	लबनी-१		चन्[illegible]
६-	पशुपति चौधरी	बिछुवा-८		पशु[illegible]
७-	अब्दुल समद मु०	लबनी-३		[illegible]
८-	शिवप्रसाद गुप्ता	बसहर-४		शिव[illegible]
९-	हरिप्रसाद पन्डेय	लबनी-१		[illegible]
१०-	तौलन प्रसाद जयसवल	लबनी-१	ने.स.पा, केन्द्रीय सदस्य	[illegible]
११-	त्रिलोकी पासी	लबनी-५		त्रिलोकी पासी
१२	मो॰ हसन मु॰	लबनी-५		हसन

— सहभागीहरुको नामावली —

ठेगाना - गाविस - ९ कालीदह

स्थान - कालीदह चोक

मिति २०६८/०३/१६

१. अब्दुल सलाम शेख - ९ - कालीदह
२. मंजुर अली - ९ ,,
३. तेज प्रताप यादव - ९ - ,,
४. राजाराम यादव ९ ,,
५. राम लखन यादव ९ ,,
६. रमाई यादव - ९ ,,
७. इलियास अहमद ,, ,,
८. मोहम्मद ईम्रान अहमद ,,
१०. अब्दुल कलाम शेख - ९ कालीदह

(४)

क्र.सं नाम ठेगाना संघ/संस्था हस्ताक्षर

१३. रामरेखावरण(करन) विहुवा-६ कृषि

14. Kishan Chettri " -2 "

15 राम त्रिलोकीपासी गोबिया लबनी वार्ड नं० ५ सुलेमान (कानन)

16 Bobby nath yadav, प्रभुनाथ यादव गा०सं० विहुवा-८ सहकारिता

17 रामचन्द्र क्षेत्री विहुवा-१ कृषि

18 ओम प्रकाश पाण्डेय डुमरा-२ (शिक्षक)

१९ मोहम्मद हसन गोबिया लबनी वार्ड नं० ५ सामाजिक

२० रामखेलावानपासी । लवनी वर्ड ना०६ कटपासी

२१- हरि प्रसाद पाण्डेय गाविस० लवनी वार्ड नं०१

२२- अब्दुल समद मुसलमान

२३- रामेश्वर कलवार लवनी-१ सरसफाई(सदस्य) - रामेश्वर

२४- अब्दुल हेरा डाफाली लवनी २-श्री हेल्थ पोस्ट

२५- रामप्रसाद यादव

२६ शिव प्रसाद गुप्ता बांसखोर शिक्षा

२६. श्रीकान्तपासी सीसानीया-५

(3)

बैठक

२०३८/२/१६

समय - ८ बजे

स्थान: प्रकटेश्वर महादेव मन्दिर गोनहा-८ बुड्वा

क्र.स.	नाम	ठेगाना	हस्ताक्षर
१	गुनीलाल लोधा	गोनहा-८, बुड्वा	
२	गंगा राम यादव	” ”	गंगाराम यादव
३	राधेश्याम यादव	” ”	[signature]
४	चेतलाल	गोनहा-६ सेमरहवा	
५	संतराम भार	” ”	संतराम
६	औतार चौबे	गोनहा-८ बुड्वा	[signature]
७	बुद्धिसागर यादव	कन्हैयापुर ६ सोनहरी	
८	गौरी शंकर आर्य	गोनहा-८, बुड्वा	
९	भोलाई यादव	” ”	भोलाई
१०	राधिका लोधी	गोनहा-६ हिमराज नगर	राजेश
१२	गिरि यादव	”	
१३	सदानन्द पाल	” ८- बुड्वा	सदानन्द पाल
१४	शिताई यादव	” ”	शिताई

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बैठक

समय - ८ बजे

मिति - २०६८/३/ (28 June 2011)

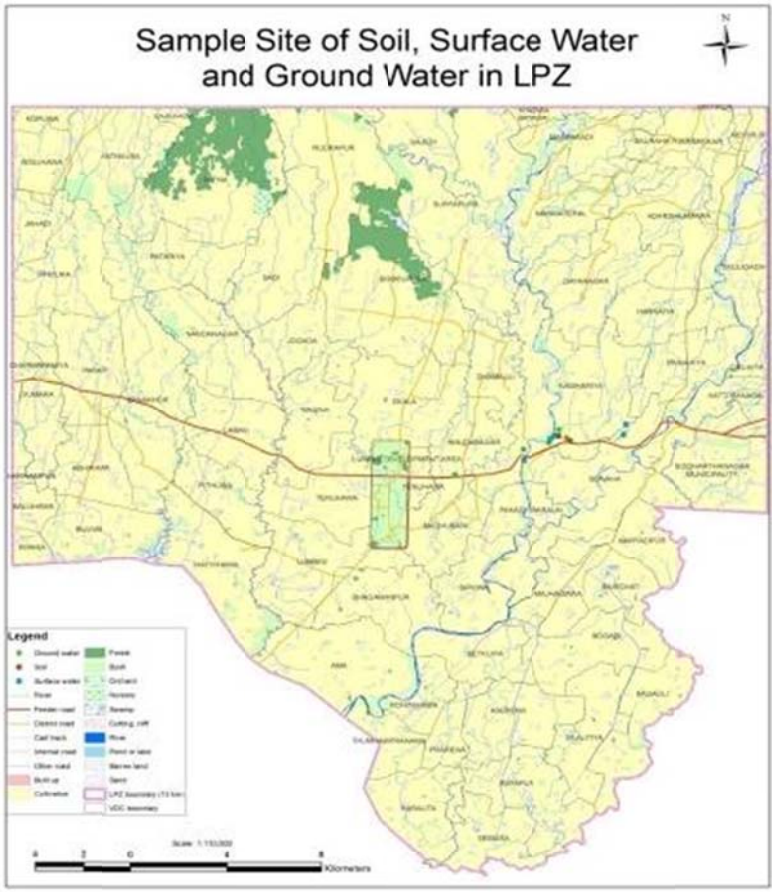
स्थान: मधुवनी मा० वि० मधुवनी, [illegible]

उपस्थिति

क्र.सं.	नाम	ठेगाना	हस्ताक्षर
१	सुग्रीव प्रसाद यादव	मधुवनी-३	[signature]
२	प्रभु नारायण चौधरी	,,	[signature]
३	श्याम बहादुर [illegible]	[illegible]	[signature]
४	रोशन गिरी	सिराहा	[signature]
५	विष्णु मल्लाह	[illegible]	विष्णु प्र. मल्लाह
६	विनोद यादव	,,	Binod yadav
७	सहाबुद्दीन शुक्र	,,	
८	दुर्गा उपाध्याय	नेका प्रतिनिधि	[signature]
९	दीपक पौडेल	आयुष्टिल	[signature]
१०	कला अधिकारी	,,	
११	प्रल्हाद यादव	,,	[signature]

(९)

Annex 4: Sampling Site of Water (hand pump and surface) and Soil Samples



Annex 5: List of VDCs with Land use and Land cover types

	Land use type Area in Hectare													
SN	VDC Name	Barren land	Built up	Bush	Cultivation	Cutting, cliff	Forest	Nursery	Orchard	Pond or lake	Sand	Swamp	Water body	Grand Total
1	ABHIRAWA	32.69		2.10	897.83				4.55	2.57			3.76	943.50
2	ADARSHA AMAWA	44.71	0.13	71.32	1613.74				0.58	1.94	39.55		9.68	1781.66
3	AMA	57.30		76.92	1658.74	7.91	9.35		11.40	5.98	41.56		25.91	1895.06
4	ANANDABAN				10.12						34.61		4.22	48.95
5	ASURENA	44.27		16.25	1201.63				5.17	2.28		7.08		1276.68
6	BAGAULI	37.06		40.85	1117.85	30.99	7.89		7.00	0.63	26.59		30.64	1299.50
7	BAIRGHAT	22.04		11.99	596.19	4.05	4.00		0.75	0.77	4.00	21.10	4.83	669.73
8	BALUHAWA	9.13		1.82	313.18				2.41	1.65			1.37	329.55
9	BANSKHOR	49.76		59.47	2038.57		2.14		13.16	5.27		4.83	7.06	2180.27
10	BETKUIYA	27.12		4.07	875.81					1.15	17.20		13.02	938.38
11	BHAGAWANPUR	53.85		10.33	1224.51		9.15		2.64	2.34	7.46	3.25	20.07	1333.60
12	BIJUWA	27.44		116.03	998.08		4.29	0.29	1.93	6.10		64.09	10.71	1228.97
13	BISHNUPURA	72.22		14.33	2340.47		824.30	37.77		5.90		27.25		3322.24
14	BOGADI	58.69		7.55	1311.57	3.71	8.36		1.93	1.73	3.67		3.81	1401.02
15	CHILHIYA	4.35		6.68	249.28	7.18	1.64				6.00	0.69	6.17	282.01
16	DAYANAGAR	66.07		15.37	1551.12	21.27		1.77	0.92	4.80	9.08		8.77	1679.16
17	DHAMAULI	31.30		1.69	724.58			5.78						763.35
18	DHARMAPANIYA	4.03			204.62				2.55	2.31				213.50
19	DUMARA	28.42		20.7	1002.8		0.69		8.97	6.34			7.61	1075.62

				1	9									
20	EKALA	57.90		15.49	1718.74		4.38	5.76		4.54			0.34	1807.15
21	GAJEDI	13.57		50.77	767.21		0.07			0.26	22.25		14.07	868.18
22	GAJEHADA	3.39			100.16		3.18			0.24				106.96
23	GONAHA	65.60	0.13	68.78	1934.07	25.51	0.32		6.10	1.03	40.92	3.49	43.62	2189.58
24	HARNAIYA	24.45	0.13	25.68	1041.18	4.52			8.20	2.32	13.97		7.36	1127.81
25	HARNAMPUR	0.15		15.13	146.71					0.50				162.49
26	HATHAUSA	36.06	0.34	204.31	1418.54		19.85		0.73	0.51				1680.34
27	HATHIHAWA	31.57		163.12	1462.48	20.25	2.65		9.80	5.76		38.69	13.85	1748.18
28	HATTI BANAGAI	28.37	0.45	45.01	705.91	17.28	0.06		6.29		34.01	2.20	18.09	857.66
29	JAHADI	8.84	0.05	4.84	559.42				3.79	1.53				578.47
30	JOGADA	35.43		10.37	991.44	17.42		4.02		1.72			5.07	1065.48
31	KAMHARIYA	99.47		161.67	2772.10	10.77	4.77	3.15	2.63	1.38	65.04		49.35	3170.33
32	KARAUTA	53.20		13.60	1050.48	7.27			5.99	2.51	0.60	2.13		1135.76
33	KHADWA BANAGAI	8.19		23.27	300.16						17.15		5.02	353.79
34	KHUDABAGAR	31.20		2.44	740.24			3.17		0.52			1.19	778.75
35	KOPUWA	3.30		3.24	237.00					0.40				243.94
36	LABANI	36.20		7.03	1171.90	15.29			6.89	6.76			8.56	1252.64
37	LUMBINI	45.93		6.17	1578.30	26.81	1.81	0.35	7.67	7.86		1.48	11.39	1687.78
38	LUMBINI DEVELOPMENT AREA	12.05	0.68	693.47	13.93		56.18			6.11			3.19	785.61
39	MADHUBANI	34.22		21.70	966.11	1.31	1.02		10.37	4.56			2.67	1041.96
40	MAINAHIYA	37.33	0.14	36.9	1012.3	4.00			2.15	3.39	11.1		12.92	1120.39

				4	5						8			
41	MAJHAGAWA	48.75		24.65	722.95	1.66		0.86	3.43	2.64	8.66		10.73	824.33
42	MANMATERIA	53.84		160.50	1321.61			6.44		1.16	68.39	3.00	20.36	1635.29
43	MANPAKADI	45.40		150.15	1123.11			0.07	1.99	0.72	55.85		13.58	1390.87
44	MARYADPUR	26.88	0.05	20.49	826.89	20.79			1.72	2.34	2.22		10.57	911.95
45	MASINA	27.54		19.26	1126.81	24.93		3.86	2.47	4.54			8.74	1218.14
46	MOTIPUR	12.84		1.66	289.13						41.59		2.96	348.18
47	NANDANAGAR	36.65		97.56	1328.85	26.18			5.55	2.53			12.30	1509.62
48	NIGLIHAWA	15.02	0.10	23.01	655.11		1.72		0.18	0.09				695.24
49	PAKADI	47.47		11.69	1255.69		1.10	0.59	3.38	6.31			3.98	1330.21
50	PAKADI SAKRAUN	43.26		60.26	855.18	12.54	6.98		0.14	1.10	34.12		39.08	1052.66
51	PATARIYA	35.88	0.09	51.84	1415.92	1.88			3.30	1.59			2.10	1512.59
52	PATNA	31.20	0.09	87.56	1618.59		1276.73	69.72	3.10	0.45				3087.43
53	PHARENA	21.00			504.75	0.93			5.14	2.55				534.37
54	PHULIKA	33.10	0.09	37.64	1369.90			0.69	6.38	1.86				1449.66
55	PIPARA	9.66		11.02	200.59				5.48	1.12				227.87
56	PITHUWA	19.27		40.68	870.42	14.79	1.73		3.39	8.34			9.57	968.19
57	RAYAPUR	60.11		22.19	1307.47	10.90	0.30		9.58	2.91	7.59	41.42	4.12	1466.59
58	ROHINIHAWA	24.08		20.45	476.08				6.09	0.93	19.02	5.77	12.80	565.23
59	RUDRAPUR	11.26		57.78	1813.69		31.25			0.76	2.31		2.93	1919.98

60	SADI	24.06	0.06	6.19	1733.97	10.68	2.09	0.19	3.64	0.26			1.12	1782.27
61	SAURAHA PHARSATIKAR	34.15	0.15	52.57	1118.32				1.09	2.45	39.61		8.26	1256.57
62	SEMARA	37.14		14.36	870.62	42.26				0.14	15.63	12.97	16.08	1009.20
63	SIDDHARTHANAGAR MUNICIPALITY	56.78	0.60	114.86	1282.12	5.37	1.78	2.11	6.12	2.78	17.73		5.37	1495.61
64	SILAUTIYA	49.89		9.09	1087.59		3.19		11.21	3.09				1164.07
65	SIPUWA	35.34		45.40	855.96	0.84	5.77		1.06	3.07	10.27	8.01	24.16	989.88
66	SURYAPURA	89.12		252.43	2722.86		43.12	5.76		2.58	118.95	17.53	40.45	3292.80
67	TENUHAWA	51.87	0.09	7.66	1372.60	12.82	0.01	1.59	3.97	4.18			6.36	1461.16
68	THUMHAPIPRAHAWA	26.88		25.25	551.55	3.00	3.46		8.18	2.34	4.33		6.76	631.77
69	TIKULIGADH	24.60	0.03	43.57	723.51	3.37				0.22	113.84		16.27	925.43
	Grand Total	2369.90	3.39	3520	72021	418.47	2345.34	153.94	231.17	166.	954.	264.99	632.97	83083.16

Annex 6: Distribution of Major Industries by Name, Types and Production in the Study Area (till the date of field visit)

Name	Type	Capacity	Current Product rate	Types of Waste	No. of employee	Waste disposal methods	Recycle practice	Suggestions	Established Year
1. Nepal Ambuja Cement	Clinker based cement	100mt/day	300mt/day (2066)	Dust/smoke	45	Dispose backyard within the boundary	Dust is reused	Government should monitor make policies and should give alternatives	2003(2060)
2. Dynasty industry Nepal	Producing clinker for cement factory	700 mt/day	500 mt/day	CO_2, dust	150	Disposes inside the boundary of fact	Dust is reused	Government should monitor make policies and should give alternatives	2008((2065)
3. Supreme Cement	Cement + clinker production	200 mt/day	400 mt/day (2006)	Dust, smoke	150	Within boundary of factory	Dust is reused	Government should monitor make policies and should give alternatives	2003(2060)
4. Siddhartha Cement	Cement	750 mt/day	350 mt/day	Dust, smoke sludge	200	Dust collector is used	Dust is reused	Government should monitor make policies and should give compensation	2003(2060)
5. Kailash Cement Factory	Cement from clinker	75 mt/day	150 mt/day	Dust, smoke			Dust is reused	Government should monitor make policies and should give alternatives	2006(2063)
6. Agni	Cement	300	300 mt/day	Dust,	50	Collect	Dust	Governme	2008(206

Cement Pvt. Ltd.	from clinker	mt/day		smoke noise		the dust and dispose at safe place	is reused	nt should monitor make policies and should give compensation	5)
7. Brij Cement	Cement production	200 mt/day	600 mt/day (now increased)	Dust, CO_2, CO, waste water		Different control measures are used	Dust and water are reused	Government should monitor make policies and should give alternatives	2001(2058)
8. Reliance Cement Mill	Clinker based cement from 2062 and production of clinker from 2066	250 mt/day	550 mt/day (2066)	Dust, CO, ash, waste water	75-100	Effluents are collected on constructed pond	Dust is reused	Government should monitor make policies and should give compensation	2005(2062)
9. Jagadamba Cement Pvt, Ltd.	Cement from clinker	500 mt/day	900 mt/day	Dust, ash, CO_2, bleaching power	300		Gypsum is reused	Government should monitor make policies and should give alternatives	2000(2057)
10. Goinka Cement Pvt. Ltd.	Cement from clinker	400 mt/day	150 mt/day	Dust, CO_2		Dust collector is used	Reused Gypsum	Government should monitor make policies and should give compensation	2010(2067)
11. Goinka Steels	Iron rod, TmT, Rolled product bar	300mt/day	1250mt/month	CO2, dusts, slag (silica, calcium oxide, magnesium oxide, and	250	Reused the iron wastes materials		Government should monitor make policies and should give compensation	2008(2065)

				aluminium and iron oxides), sludge					
12. Ambe Steels	Steel product/rod	200 mt/day	200 mt/day	Sludge, smoke CO_2, CO	300	Sludge-underground and pollution control device are used	No	Government should monitor make policies and should give compensation	2008(2065)
13. Reliance Paper Mill	Production of paper		75 mt/year	Waste paper sludge				Government should monitor make policies and should give alternatives	2004(2061)
14. Himalayan snacks and noodles – Mayos Noodles	Noodles production	10000 cartoon/day	10000 cartoon/day	Platics/CO_2 Ghee, sludge	100	Disposes inside the boundary of fact	Ghee is reused by soap factory	Government should monitor make policies and should give compensation	2007(2064)

Source: Field Survey, 2011

Annex 7: Statistical Calculation of the Qualitative Information Discussed with the Local People

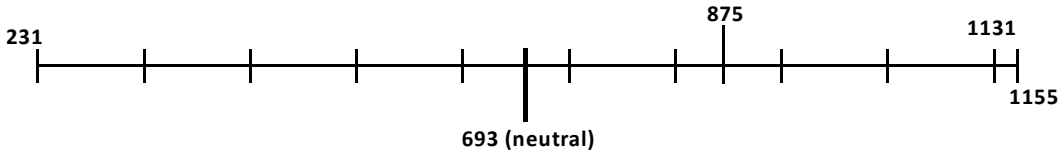
Annex- 7.1
Impact of air pollution on different sensitive components

	Water	Soil/Land	Flora	Fauna	Health	Soc-Eco	Arch	
High	2	2	3	3	3	0	2	15
Medium	2	2	2	3	3	5	3	20
Low	3	3	2	1	1	2	2	14
	7	7	7	7	7	7	7	49

Source: Field survey 2011

Null Hypothesis H_o: Degree of impact of air is independent of components.
Test Statistics is χ^2
Calculated $\chi^2 = 7.5769$
Level of Significance (α) = 5 per cent
Degrees of freedom = (7 – 1) (2 – 1) = 6
Tabulated $\chi^2 = 12.59$
Decision: calculated χ^2 < tabulated χ^2
H_o is accepted.
Conclusion: Degree of air pollution is equal for all types of sensitive components (water body, soil/land, flora, fauna, health, socio-economic, archaeological recreational values)

Annex- 7.2a
Rating scale
Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5
Total number of statements given to respondents = 7
So, Minimum score=strongly disagree in all 7 statements
=1*7=7
Maximum score=strongly agree in all 7 statements
=5*7=35
So, range of score for a respondent=7 to 35
No of respondents=33
So, total range =7*33 to 35*33=231 to 1155
Individual Score from 33 respondents :35, 28, 29, 24, 9, 34, 29, 35, 28, 27, 35, 14, 28, 29, 17,26, 30, 28, 27, 28, 27, 33, 16, 28, 16, 25, 25, 26, 31, 26, 22, 26, 34
Total observed Score: 875
Range: 7*33 ——————— 35*33
231 ——————— 1155
Graphical Presentation



Result: The observed score of 875 is much higher than neutral. So it can be concluded that people have experienced air pollution.

Annex- 7.2b
Relationship between impact of pollution and distances from industrial area
Relationship between impact of air pollution and distances from industrial area

VDC's	High(3)	Medium(2)	Low(1)	Total score	
Gonaha–9	4	3	0	18	
Vishnupura	1	2	4	11	
Madhubanil	1	4	2	13	
Labani	1	5	1	14	
Gonaha–7	4	2	2	18	

Ama	0	3	4	10	
Lumbini institute	3	2	2	15	

Source: Field survey 2011
Here, Weights for 1 unit of high = 3 , Weights for 1 unit of medium = 2, Weights for 1 unit of low = 1

Calculation of Co-relation coefficient between Impact of Air pollution and Distance from Industrial Area

VDC's	X (Impact Level)	Y (Distance from Industrial Area)	XY	X^2	Y^2
Gonaha–9	18	3	54	324	9
Vishnupura	11	12	132	121	144
Madhubanil	13	8	104	169	64
Labani	14	25	350	216	526
Gonaha–7	18	1	18	324	1
Ama	10	11	110	100	121
Lumbini institute	15	10	150	225	100
Total	99	70	918	1479	1064

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

$$= \frac{7\times 918 - 99\times 70}{\sqrt{7\times 1479 - 99^2}\sqrt{7\times 1064 - (70)^2}}$$

$$= -0.402$$

Result
Since correlation coefficient is negative so it can be conclude that there is negative relationship between Impact of Air pollution and Distance from Industrial Area. That's mean air pollution is high near the industrial area.

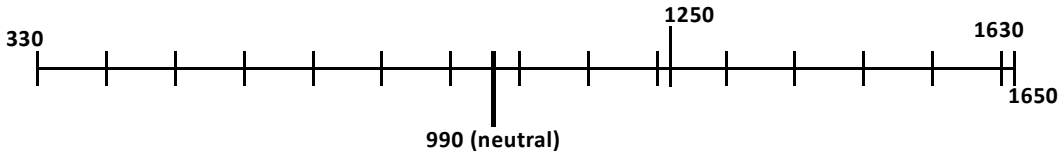
Annex- 7.3
Impact of water pollution on different sensitive components

	Flora	Fauna	Health	Soc-Eco	Arch	Soil	
High	3	4	2	4	4	4	21
Medium	2	1	5	2	2	1	13
Low	2	2	0	1	1	2	8
	7	7	7	7	7	7	42

Source: Field survey 2011
Null hypothesis H_o: Intensity of impact of water pollution is independent of components.
Or, Degree of water pollution impact is equal to all sensitive components.
Test Statistics – chi-square (χ^2)
Calculated $\chi^2 = 7.5554$
Level of significance (α) = 5 per cent
Degrees of freedom = (6 – 1) (2 – 1) = 5
So, tabulated χ^2 at 5 per cent level for 5 degree of freedom = 11.07
Decision: calculated χ^2 < tabulated χ^2
So H_o is accepted.
Conclusion: Degree of water pollution is equal for all types of sensitive components (soil/land, flora, fauna, health, socio-economic, archaeological recreational values)

Annex- 7.4a
Analysis on attitude of respondents towards water pollution issues
Likert attitudinal model
Rating scale
Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5

Total number of statements given to respondents = 10
So, Minimum score=strongly disagree in all 10 statements
=1*10=10
Maximum score=strongly agree in all 10 statements
=5*10=50
So, range of score for a respondent=10 to 50
No of respondents=33
So, total range =10*33 to 50*33=330 to 1650
Individual Score from 33 respondents : 45, 38, 41, 41, 39, 33, 38, 39, 24, 34, 23, 44, 30, 36, 37, 39, 44, 43, 31, 35, 33, 23, 50, 33, 41, 50, 35, 46, 28, 36, 40, 36, 50
Total observed Score: 1235
Range: 10*33——————————— 50*33
330 ——————————— 1650
Graphical Presentation



Result: Observed score 1250 is higher than neutral value 990 which indicates that the people have sufficient amount of awareness towards water pollution.

Annex- 7.4b
Relationship between impact of water pollution and distances from industrial area

VDC's	High(3)	Medium(2)	Low(1)	Total score	
Gonaha–9	4	2	0	16	
Vishnupura	1	1	4	9	
Madhubanil	3	3	0	15	
Labani	1	1	4	9	
Gonaha–7	5	1	0	17	
Ama	3	3	0	15	
Lumbini institute	4	2	0	16	

Source: Field Survey 2011

Calculation of Co-relation coefficient between Impact of Water pollution and Distance from Industrial Area

VDC's	X (Impact Level)	Y (Distance from Industrial Area)	XY	X^2	Y^2
Gonaha–9	16	17	272	256	289
Vishnupura	9	12	108	81	144
Madhubanil	15	25	375	225	625
Labani	9	10	90	81	100
Gonaha–7	17	17	289	289	289
Ama	15	27	405	225	729
Lumbini institute	16	10	160	256	100
Total	97	118	1699	1413	2276

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

$$= \frac{7\times 1699 - 97\times 118}{\sqrt{7\times 1413 - 97^2}\sqrt{7\times 2276 - 118^2}}$$

= 0.45

Result

Since correlation coefficient is positive so it can be conclude that there is positive relationship between Impact of water pollution and Distance from Industrial Area. That's mean water pollution is increases as the increment of distance from industrial area. Excessive withdrawal of ground water during the operation of the industries causes decreases of ground water table/resources. The community around the industries experienced that people get water when hand pipe bores till 60-70 feet deep for fresh water, but the water was obtained from 30-40 feet deep before the industries. To very such experience, the ground water table should be assessed which was the limitation of this study. There are not adopted any measures to recharge the ground water.

Annex- 7.5

Impact of land pollution on different sensitive components

	Flora	Fauna	Health	Soc-Eco	Arch	Water bodies	
High	2	2	1	1	4	2	12
Medium	4	2	3	5	2	3	19
Low	1	3	3	1	1	2	11
	7	7	7	7	7	7	42

Source: Field survey 2011

Null hypothesis H_o: Intensity of impact of land pollution is independent of components.
Or Degree of land pollution impact is equal to all sensitive components.
Test statistics = χ^2
Calculated $\chi^2 = 6.3072$
Level of significance (α) = 5 per cent
Degrees of freedom = (6 – 1) (2 – 1) = 5
So, tabulated χ^2 at 5 per cent level for degree of freedom = 11.07
Decision: calculated χ^2 < tabulated χ^2
So, H_o is accepted.
Conclusion: Degree of land pollution is equal for all types of sensitive components (Water bodies, flora, fauna, health, socio-economic, archaeological recreational values).

Annex-7.6

Relationship between impact of land pollution and distances from industrial area

VDC's	High(3)	Medium(2)	Low(1)	Total score	
Gonaha–9	2	3	0	12	
Vishnupura	0	4	2	10	
Madhubanil	0	3	3	9	
Labani	1	3	2	11	
Gonaha–7	6	0	0	18	
Ama	0	3	3	9	
Lumbini institute	3	2	1	14	

Source: Field Survey 2011

Calculation of Co-relation coefficient between Impact of Land pollution potential and Distance from Industrial Area

VDC's	X (Impact Level)	Y (Distance from Industrial Area)	XY	X^2	Y^2
Lumbini Institute	14	10	140	196	100
Ama	9	9	81	81	81
Gonaha–7	18	2	36	324	4
Labani	11	8	88	121	64
Madhubani	9	11	99	81	121
Vishnupura	10	8	80	100	64
Gonaha–9	12	8	96	144	64
Total	83	56	620	1047	498

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

$$= \frac{7\times 620 - 83\times 56}{\sqrt{7\times 1047 - 83^2}\sqrt{7\times 498 - 56^2}}$$

= – 0.68

Result

Since correlation coefficient is negative so it can be conclude that there is negative relationship between Impact of land pollution potential and Distance from Industrial Area. That's mean land pollution potential is high near the industrial area.

Annex- 7.7a

Impact of noise pollution on different sensitive components

	Tourism	Human health	Soc-Eco	Arch	
High	2	2	0	1	5
Medium	3	3	2	4	12
Low	2	2	5	2	11
	7	7	7	7	28

Source: Field survey 2011

Null Hypothesis H_o: Degree of noise pollution impact is independent of components [tourism/human health/ social/economic/archaeological recreational values]

Or, Degree of noise pollution impact is equal to all components

Test statistics = χ^2 (chi-square)

Calculated χ^2 = 5.3144

Level of significance (α) = 5 per cent

Degrees of freedom = (4 – 1)(2 – 1) = 3

Tabulated χ^2 at 5 per cent level for 3 degrees of freedom is 7.82

Decision: Calculated χ^2 < tab. χ^2

So, H_o is accepted.

Conclusion: Degree of noise pollution is equal for all types of sensitive components (tourism, human health, socio-economic, archaeological recreational values)

Annex- 7.7b

Relationship between impact of noise pollution and distances from industrial area

VDC's	High(3)	Medium(2)	Low(1)	Total score	
Gonaha–9	2	2	0	10	
Vishnupura	0	0	4	4	
Madhubanil	0	3	1	7	
Labani	0	3	1	7	
Gonaha–7	1	3	0	9	
Ama	0	0	4	4	
Lumbini institute	2	1	1	9	

Source: Field Survey 2011

Calculation of Co-relation coefficient between Impact of Noise pollution and Distance from Industrial Area

VDC's	X (Impact Level)	Y (Distance from Industrial Area)	XY	X^2	Y^2
Lumbini Institute	9	10	90	81	100
Ama	4	1	4	16	1
Gonaha–7	9	6	54	81	36
Labani	7	5	35	49	25
Madhubani	7	2	14	49	4
Vishnupura	4	8	32	16	64
Gonaha–9	10	2	20	100	4

Total	50	34	249	392	234

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

$$= \frac{7\times 249 - 50\times 34}{\sqrt{7\times 392 - 50^2}\sqrt{7\times 234 - 34^2}}$$

= 0.125

Result

Since correlation coefficient is nearly equal to 0 so it can be conclude that there is no relationship between Impact of noise pollution and Distance from Industrial Area.

Annex- 7.8

People attitudinal analysis towards impact of pollution on flora and fauna

Likert attitudinal model

Rating scale

Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5

Total number of statements given to respondents = 3

So, Minimum score=strongly disagree in all 3 statements

=1*3=3

Maximum score=strongly agree in all 3 statements

=5*3=15

So, range of score for a respondent=3 to 15

No of respondents=32

So, total range =3*32 to 15*32 = 96 to 480

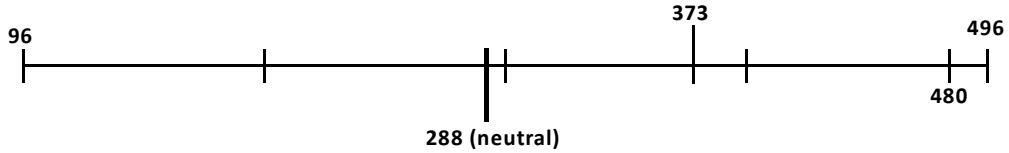
Individual Score from 32 respondents :: 15, 12, 12, 12, 12, 12, 13, 13, 9, 12, 3, 15, 9, 10, 12, 12, 12, 12, 8, 10, 10, 12, 15, 13, 12, 15, 11, 15, 7, 11, 12, 15

Total observed Score: 373

Range: 3*32 ——————— 15*32

96 ——————— 480

Graphical Presentation



Result: Observed score 373 is much more above than the neutral value 288 and nearly equal to highest value of continuum 480. So it can be concluded that people have observed about the negative impact of pollution on flora and fauna.

Annex- 7.9

Analysis on attitude of respondents towards solid waste issues

Likert attitudinal model

Rating scale

Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5

Total number of statements given to respondents = 5

So, Minimum score=strongly disagree in all 5 statements

=1*5=5

Maximum score=strongly agree in all 5 statements

=5*5=25

So, range of score for a respondent=5 to 25

No of respondents=34

So, total range =5*34 to 25*34=170 to 850

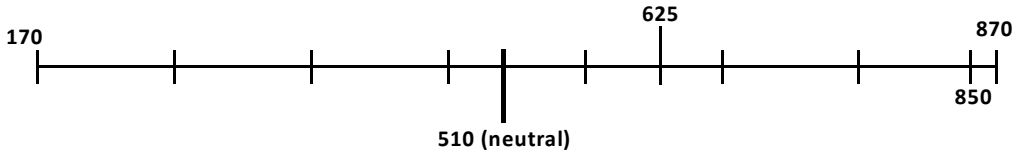
Individual Score from 34 respondents : 23, 19, 20, 21, 8, 23, 16, 25, 16, 17, 25, 17, 20, 17, 17, 19, 19, 18, 18, 16, 17, 21, 21, 19, 20, 17, 17, 20, 19, 19, 21, 18, 22

Total observed Score: 625

Range: 5*34 ——————— 25*34

170 ——————— 850

Graphical Presentation



Result: Observed score 625 is above neutral score 510. So it can be concluded that people have some knowledge about the negative impact of solid waste.

Annex-7.10

Analysis on attitude of respondents towards socio- economic & cultural environment (positive statements)

Likert attitudinal model

Rating scale

Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5

Total number of positive statements given to respondents = 6

So, Minimum score=strongly disagree in all 6 statements

=1*6=6

Maximum score=strongly agree in all 4 statements

=5*6=30

So, range of score for a respondent = 6 to 30

No of respondents=32

So, total range =6*32 to 30*32=192 to 960

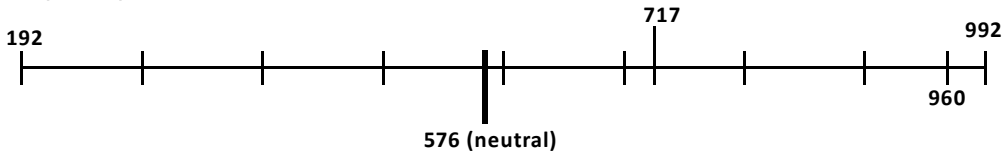
Individual Score from 32 respondents : 27, 25, 26, 19, 22, 25, 27, 19, 21, 18, 25, 24, 26, 18, 26, 21, 27, 23, 25, 23, 15, 19, 22, 25, 21, 23, 12, 24, 21, 18, 24, 26

Total observed score = 717

Range = 6 × 32 – 30 × 32

= 192 – 960

Graphical presentation



Result: The observed score 717 is much more than neutral score 576 so it can be concluded that people do believe that growing industries help in economic activities and helps in solving unemployment problem.

Annex- 7.11

Analysis on attitude of respondents towards socio- cultural environment (negative statements)

Likert attitudinal model

Rating scale

Strongly disagree=1, disagree=2, neutral=3, agree=4, strongly agree=5

Total number of negative statements given to respondents = 4

So, Minimum score=strongly disagree in all 4 statements

=1*4=4

Maximum score=strongly agree in all 4 statements

=5*4=20

So, range of score for a respondent = 4 to 20

No of respondents=32

So, total range =4*32 to 20*32=132 to 640

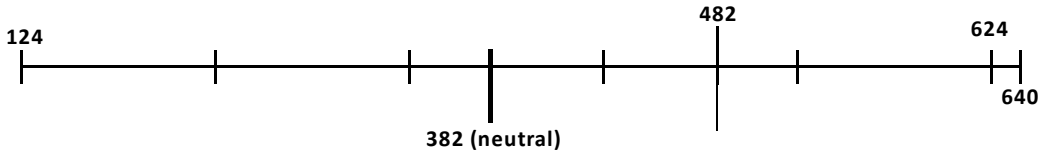
Individual Score from 32 respondents : 15, 14, 15, 15, 16, 18, 15, 15, 13, 14, 11, 17, 13, 13, 14, 15, 17, 13, 14, 14, 14, 8, 20, 16, 15, 20, 16, 18, 10, 18, 16, 20

Total observed score = 482

Range = 4 × 32 – 20 × 32

= 124 – 640

Graphic presentation:



Result: Observed score 482 is higher than neutral score 382 so it can be concluded that people have negative perception on industry towards socio, cultural environment, tourism, land quality and recreational value.

Annex- 7.12

Attitude of people towards industry

In order to measure attitude of people towards industries, seven different rating statements were given to respondents which are categorized into strongly disagree, disagree, neutral, agree and strongly agree and the weights of -2, -1, 0, 1, and 2 respectively. Then the observed frequencies were as follows. Results are analyzed by using Guttmann's attitudinal scale.

$1 + 0 + 1 + 1 + 0 + 0 + 2 \Rightarrow 5$

$0 + 1 + 1 - 2 + 1 + 1 + 1 \Rightarrow 3$

$-2 - 2 + 0 - 2 + 1 + 1 + 2 \Rightarrow -2$

$0 + 1 + 1 - 1 + 1 + 1 + 1 \Rightarrow 4$

$0 + 0 + 2 + 1 + 2 + 2 + 0 \Rightarrow 7$

$1 - 1 + 1 - 1 + 2 + 2 + 2 \Rightarrow 6$

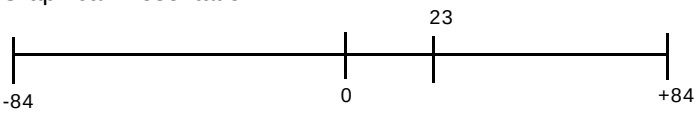
Observed score = 23

Total range

-14×6 _____ $+ 14 \times 6$

$= -84$ _____0_____ $+ 84$

Graphical Presentation



Result: Attitude towards industry is slightly positive.

Annex 8: List of Flora and Fauna available in the Districts of the Study Area

List of Floras and their Uses

Species	Uses (values)
Acacia catechu	Timber
Anthocephalus chinensis	Timber
Achryanthes aspera	Medicinal
Aeschynomene indica	Fodder
Ageratum houstonianum	Poisonous to livestock
Alisma Plantato-aquatica	Unknown
Alternanthera sessilis	Fodder, Medicinal, vegetable
Arundo donax	Construction
Azolla imbricate	Green manure
Bambusa sp.	building material
Baleria cristata	Aesthetic value
Boehmeria Platyphylla	Timber Medicinal, flowers edible
Caesulia axillaries	Fodder
Callicarpa macrophylla	Medicinal
Calotropis gigantean	Medicinal, fibers(seeds) for making pillow
Carex sp.	Fodder
Careya arborea	Medicinal
Cassia fistula	Medicinal, avenue tree
Cassia occidentalis	Medicinal
Centella asiatica	Medicinal , vegetable , fodder
Centipeda minima	Medicinal
Centranthera nepalensis	Unknown
Ceratophyllum demersum	Medicinal ,fish food
Ceratopteris thalictroides	Potherb
Chara spp.	Unknown
Chromalaeno odorata	Medicinal ,fuel ,ornamental flowers
Chrysopogon aciculatus	Fodder ,soil binder ,baskets making
Cleome viscose	Medicinal ,seed edible
Colebrookea appositifolia	Medicinal , used for ripening the bananas
Colocasia esculenta	Corms Edible
Commelina diffusa	Fodder
Croton bonplandianum	Unknown
Cymbopogon martini	Fodder, oil yielding grass
Cynodon dactylon	Fodder, religious plant
Cyperus distans	Fodder
Cyperus halpan	Fodder
Cyperus iria	Fodder, medicinal
Dactyloctenium aegyptium	Fodder
Dalbergia sissoo	Fodder, timber, medicinal
Datura metel	Medicinal
Delonix regia	Avenue tree, fuel
Desmodium triflorum	Soil binder ,medicinal
Dichanthium annulatum	Fodder
Dysophylla auriculata	Fodder
Echinochloa colona	Fodder, grains edible
Echinochloa crus-galli	Fodder, grains edible
Eclipta prostrate	Fodder, medicinal, vegetable
Eichhornia crassoper	Fertilizer , biogas , raw material for paper
Eleocharis dulcis	Fodder
Enydra fluctuans	Pot herb , blood purifier
Equisetum debile	Medicinal
Eucalyptus spp.	Medicinal ,timber ,fuel , oil source
Eulaliopsia binnata	Fodder

Evolvulus nummularius	Soil binder
Ficus resmosa	Fodder
Filmbristylis dichotoma	Fodder
Filmbristylis miliacea	Fodder
Fissendocarpa linifolia	Medicinal
Flocospa scandens	Fodder
Gonostegia pentandra	Fodder
Haldina cardofolia	Timber
Hedyotis corymbosa	Medicinal
Hemarthria compressa	Fodder
Hydrilla verticillata	Fish food , oxygenator
Hydrocotyle sibthorpioides	Medicinal
Hygrophilla auriculata	Medicinal
Hygrohiza aristata	Medicinal ,fodder
Imperata cylindrical	Fodder, soil binder ,medicinal, flood
Ipomoea aquatic	Vegetable , medicinal
Impoea carnea spp.	Medicinal ,poisonous to livestock ,hedge
Isachne globosa	Fodder
Juncus spp.	Unknown
Justicia procumbens	Unknown
Justicia quinqueongularis	Flower attractive
Kyllinga brevifolia	Fodder
Lagesstromia parviflora	Flowers attractive
Lantana camera	Ornament ,hedge , medicinal
Leersia hexandra	Fodder
Lemna perpusisilla	Fish food
Lipocapha chinensis	Fodder
Lindernia anagallis	Unknown
Lindernia antipoda	Unknown
Lindernia pusilla	Unknown
Ludwidgia adscendens	Medicinal , flower attractive
Ludwidgia actovalvis	Medicinal , flower attractive
Ludwidgia perennis	Medicinal
Mallotus philipipensis	Fodder, medicinal, dye
Marsilea Quadrifoliata	Unknown
Monochoria hastate	Potherb
Monochoria Vaginalis	Potherb
Murdannia nudiflora	Medicinal
Najas graminia	Fish food
Nelumbo nucifera	Rhizomes edible, attractive plant
Nymphaea nouchali	Aesthetic value
Nymphoides hydrophyllum	Aesthetic value
Oenanthe javanica	Medicinal
Oplismenus burmannil	Fodder
Oryza rufipogon	Seed edible and religious
Ottelia alismoides	Unknown
Panicum repens	Fodder
Parthenium hysterophorus	Medicinal , allelopathic plant
Paspalidium puntatum	Fodder
Paspalum distichum	Fodder
Paspalum scrubiculatum	Fodder
Phragmites karka	Hedge , thatching and basket weaving
Phyllanthus urinaria	Medicinal ,piscicide
Phyllanthus virgatus	Medicinal
Pistia stratiotes	Potherb
Pogostemon benghalense	Medicinal
Polygonum barbatum	Piscicide
Polygonum hydropiper	Piscicide

Polygonum glabrum	Piscicide
Polygonum lapathipholium	Piscicide
Potamogeton crispus	Fish food
Potamogeton nodosus	Fish food
Potamogeton pectinatus	Fish food
Pterocarpus marsupium	Timber ,fuel
Pycreus flavidus	Fodder
Pycreus sanguinolentus	Fodder
Ranunculus sceleratus	seed taken as pickle ,plants consumed
Rotala indica	Unknown
Rotala rotundifolia	Unknown
Rottboellia	Fodder
Rumex dentatus	Vegetable
Saccharum spontaneum	Fodder , soil binder , thatching
Scciolepis indica	Fodder
Sagittaria guayanensis	Medicinal
Sarothra japonica	Unknown
Schleichera oleosa	Timber ,fuel , fruit edible
Schoenoplectus juncoides	Fodder
Schoenoplectus mucronatus	Fodder
Semicarpus anacardium	Poisonous
Setaria pumilia	Fodder
Smithia sensetiva	Fodder
Sphenoclea zeylanica	Plants edible
Spilanthes acmella	Flower (heads) edible
Spirodela polyrhiza	Green manure , fish food
Sporobolus indicus	Fodder ,raw material for basket
Syzgium cumini	Fruit edible ,Fodder
Terminalia alata	Timber ,Medicinal
Themeda arundinacea	Thatching material
Thevetia peruviana	Medicinal , aesthetic value
Tonningia axillaris	Fodder ,medicinal
Trapa bispinosa	Fruit edible
Trewia nudiflora	Fodder , fuel
Tridax procumbens	Fodder ,medicinal
Triumfetta rhomboidea	Fiber
Typha angustifolia	Raw material for weaving mats and roofing
Typha eliphantania	Raw material for weaving mats and roofing
urena lobata	Bark fiber used as cord , flower attractive
Utricularia aurea	Insectivorous plant
Vallisneria spiralis	Fish food
Veronica anagallis-aquatica	Unknown
Vetiveria zizanioides	Soil binder , essential oil yielding plant
Vitex negundo	Medicinal ,Hedge
Woodfordia fruticosa	Medicinal ,aesthetic value
Xanthium strumarium	Medicinal
Ziziphus nummularia	Fruit edible

Source: IUCN, 1993-1996

List of Birds

SN	Birds Name	SN	Birds Name	SN	Birds Name
1.	Little Grebe	71	Pied Harrier	141	Greater racket tail drongo
2.	Great Crested Greb	72	Marsh Harrier	142	Grey Headed Myna

3.	Great Cormorant	73	Red thighed Falconet	143	Brahminy Myna
4.	Little Cormorant	74	Peregrine Falcon	144	Pied Myna
5.	Lesser whistling duck	75	Merlin	145	Common Myna
6.	Common teal	76	Eurasian Kestrel	146	Bank Myna
7.	Cotton teal	77	Barn Owl	147	Jungle Myna
8.	Eurasian Wigeon	78	Forest Eagle Owl	148	Indian Treepie
9.	Ruddy Shelduck	79	Great Horned Owl	149	Small Coucal
10.	Cinnamon Bittern	80	Jungle Owlet	150	Large Coucal
11.	Yellow Bittern	81	Spotted Owlet	151	Jungle Crow
12.	Gray Heron	82	Brown Hawk Owl	152	House Crow
13.	Purple Heron	83	Black Patridge	153	Lesser Wood Shrike
14.	Little Green heron	84	Kalij Pheasant	154	Large Cuckoo Shrike
15.	Pond heron	85	Red Jungle Fowl	155	Golden Fronted Leaf bird
16.	Night heron	86	Bengal Green Pigeon	156	Iora
17.	Cattle Egret	87	Blue Rock Pigeonl	157	Blue throat
18.	Large Egret	88	Eurasian Collared Dove	158	Scarlet Minivet
19.	Intermediate Egret	89	Rufous turtle Dove	159	Small Minivet
20.	Little egret	90	Red turtle Dove	160	Red Vented Bulbul
21.	Painted Stork	91	Spotted Dove	161	Red Whiskered Bulbul
22.	Open-billed Stork	92	Rose ringed Parakeet	162	Large Grey Babbler
23.	Wooly necked stork	93	Plum headed Parakeet	163	Jungle Babbler
24.	Black Stork	94	Pied crested Cuckoo	164	Red Breasted Flycatcher
25.	Lesser adjutant Stork	95	Common Hawk Cuckoo	165	Slaty Blue Flycatcher

26.	Demoiselle Crane	96	Indian Cuckoo	166	White Throated F. F.
27.	Sarus Crane	97	Koel Cuckoo	167	White Breasted FF
28.	White Ibis	98	Sirkeer Cuckoo	168	Brook's flycatcher
29.	Black Ibis	99	Dark Roller	169	Gray Headed Flycatcher
30.	Eurasian Spoonbill	100	Indian roller	170	Zitting Cisticola
31.	Brown Crake	101	Hoopoe	171	Oriental White Eye
32.	White breasted Waterhen	102	Pied Kingfisher	172	Rufous Prinia
33.	Indian Gallinule	103	Eurasian Kingfisher	173	Jungle Prinia
34.	Water cock	104	Stork-billed Kingfisher	174	Gray Capped Prinia
35.	Coot	105	White breasted Kingfisher	175	Plain Prinia
36.	Pheasant tailed Jacana	106	Chestnu headed Beeeater	176	Ashy Prinia
37.	Bronze winged Jacana	107	Blue tailed Bee eate	177	Tailor bird
38.	Red wattled Lapwing	108	Green Bee eater	178	Hodgson'a Prinia
39.	Yellow wattled Lapwing	109	Gray Hornbill	179	Smoky leaf Warbler
40.	Gray headed Lapwing	110	Lineated Barbet	180	Paddy field Warbler
41.	River Lapwing	111	Crimson breasted Barbet	181	Blyth's warbler
42.	Greenshank	112	Wry neck	182	Plain Leaf Warbler
43.	Green Sandpiper	113	Gray crowned pigmy woodpecker	183	Dusky Leaf Warbler
44.	Common sandpiper	114	Lesser Golden backed woodpecker	184	Yellow Rumped Leaf Warbler
45.	Little Ringed Plover	115	Fulvous breasted pied woodpecker	185	Large Crowned Leaf Warbler
46.	Little Stint	116	Indian Pitta	186	Black Redstart
47.	Common Snipe	117	Bush lark	187	Slaty Backed Forktail

48.	Pintail Snipe	118	Rufous tailed finch lark	188	Robin Dayal
49.	Eurasian Thicknee	119	Sand lark	189	Plumbeous Red Start
50.	Black Shouldered Kite	120	Crested Lark	190	Collard Bushchat
51.	Honey Kite	121	Oriental Skylark	191	Pied Buschat
52.	Dark Kite	122	Red Breasted Pipit	192	Indian Robin
53.	Brahminy Kite	123	Richard's Pipit	193	Dark Throated Thrush
54.	Goshawk	124	Olive Backed Pipit	194	Orange Headed Ground Thrush
55.	Sparrow Hawk	125	White Browed Wagtail	195	Gray Tit
56.	Besra	126	Pied Wagtail	196	Chestnut Bellied Nuthach
57.	Shikra	127	Citrine Wagtail	197	Thickbilled Flowerpecker
58.	White eyed Hawk	128	Yellow Wagtail	198	Purple sunbird
59.	Crested Serpent eagle	129	Grey Wagtail	199	House Sparrow
60.	Changeable Hawk Eagle	130	Bay Backed shrike	200	Tree Sparrow
61.	Bonellis eagle	131	Black headed Shrike	201	Yellow-throated Sparrow
62.	Short toed Eagle	132	Grey Backed Shrike	202	Baya Weaver
63.	Lesser Spotted Eagle	133	Brown shrike	203	Black breasted Weaver
64.	Steppe Eagle	134	Golden Oriole	204	Red Munia
65.	Osprey	135	Black Headed Oriole	205	Black headed Munia
66.	Cinereous Vulture	136	White bellied Drongo	206	Indian Silverbill
67.	Long billed Vulture	137	Hair Crested Drongo	207	Scaly breasted Munia
68.	White backed Vulture	138	Black Drongo	208	Crested bunting

69.	Egyptian Vulture	139	Little Bronzed Drongo	209	Red Rumped Swallow
70.	Hen Harrier	140	Lesser racket tail drongo	210	Barn Swallow

Source: Source: IUCN, 1993-1996

List of Mammals

Common Name	Scientific Name
Giant Flying Fox	Pteropus giganteus
Rhesus Macaque	Macaca mulatata
Hanuman Langoor	Semnopithecus entellus
Red Fox	Vulpes vulpes
Golden Jackal	Canis aureus
Bengal Fox	Vulpes bengalensis
Common mongoose	Herpestes edwardsii
Jungle Cat	Felis chaus
Common Leopard	Pantthera pardus
Spotted Deer	Axis axis
Blue Bull	Boselaphus tragocamelus
Three-Stripped Squirrel	Funambulus palmarum
Five striped Squirrel	F.Pennantail
Roof Rat	Rattus rattus
Rufous Tailed hare	Lepus nigricollis ruficaudata
Grey Musk Shrew	Suncus murinus
Smooth Coated Otter	Lutragale perpicillata
Large Indian Civet	Veverricula indica
Small Indian Civet	Viverra zibela
Wild Boar	Sus scrofa
Indian Porcupine	Hystrix indica

Source: Suwal et al, 2001

List of Herpeto fauna

Local Name	Scientific Name	Habitat	Location
Indian bull frog	Rana Tigerina tigerina	WL/FL	LDT
Marbled Toad	Haplobatrachus tigerinus	WL/FL	LDT
Indian Burrowing Frog	Tomopterna breviceps	FL/WL	LDT
-	Rana crassa	WL/FL	LDT
Black Spined Toad	Bufo melanostictus	WL/FL	LDT
Skittering Frog	Rana cyanophlyctis	WL/FL	LDT
Russells Viper	Vipera russelli	GL	LDT
-	Mabuya dissimilis		LDT
Banded Krait	Bungarus fasciatus	GL/FO	LDT
Binocellote Cobra	Naja naja	GL/FL	LDT
Common Indian Krait	Bungarus caeruleus	GL/FO	LDT
Bengal Monitor Lizard	Varanus bengalensis bengalensis	WL/GL	Jignihawa, LDT
Brahminy skink	Mabuya carinata	FL	LDT

Bronze grass skink	Mabuya macularia	FL	LDT
Wall Gecko	Hemidactylus flaviviridis	Residential building	Common
Common Garden Lizard	Calotes versicolor	FL	Common
Indian Roofed Turtel	Kachuga tecta	WL	LDT
Asiatic rat snake	Ptyas mucosa mucosa	GL/WL/FL	LDT
Asiatic Rock Python	Python mourus molurus	GL/WL	LDT
Indo-Gangetic Flapshell Turtle	Lissemys punctata andersoni	WL	LDT
Buff –Striped Keelback	Amphiesma stolata	GL/FL/WL	LDT

Source: Suwal et al, 2001

Annex 9: Compliance Monitoring Plan

SN	Issues	Verifiable Indicator	Verification methods	Individuals responsible	Frequency/ Time	Place
1	Integration of local peoples environmental concerns	Incorporation of EIA/EMP recommendation	Observations and interviews by administrating structured questionnaire	IPB/OI	Every year during industries operation	All affected VDCs
2	Social services of the impacted VDCs	EIA conditions approval for compliance	Interviews with commuters, water user groups, school teachers, health workers etc.	IPB/LDT/DDC/OI	Every six month during industries operation	All affected VDCs
3	Compliance to Occupational health and safety matters	Health and safety regulations, first aid and medical arrangements, contingency plan, number and type of safety equipments such as mask, helmet, glove, safety belt	Spot checks at work sites, photos, accident records, interviews	IPB /LDT/DDC/OI	Throughout operation activities	All affected VDCs
4	Measures to protect water bodies from pollution	Visual observation, observation of open defecation and waste disposal around water sources in the industrial sites; parameters like pH, hardness, DO etc.	Site inspection, test site-selected samples of water at laboratory, records of diseases, direct observations, and discussion with local people	IPB /LDT/DDC/OI		All affected VDCs
5	Compliance to environmental protection measures, including pollution prevention, water and soil management, waste management, sensitive habitats and critical sites, protection of fauna and flora	Arrangement specified in the code of practice and in manuals relating to environmental protection; records and observations on pollution, waste management, spoil deposit.	Site inspection, discussion with consultants, and local people. Quantifying site-specific impacts, photos, laboratory tests where required. Existing patrol, control and enforcement mechanisms, enforcement records, air and noise quality measurement, water quality test	IPB/LDT/DDC	Every months	Factory and its adjoining areas
6	Air and noise, water pollution, public health and accident risks	Air, water and noise pollution measurements, health and safety regulations, first aid and medical arrangements, contingency plan, safety awareness programme	Laboratory test of site-selected samples, point source noise data, spot checks at camps and work sites, photos, accident records from traffic police; training records and material, road signs	IPB/LDT/DDC	Every three months	Factory and its adjoining areas

7	Measures to protect environment from air & noise pollution	Dust level and noise level at factory sites, major settlements and sensitive spots like health centres and schools	Observation of good adopted mitigation measures practices and discussion with residents and workers	LDT/DDC/OI	Every month	Industrial area
8	Economic status of Locals	Income level in terms of standards of living of local people can be simplified at household level in relation to ascertain impact of tourism in developed Lumbini area on increase in per capita income level among the local people	Discussions with locals /sample survey	LDT/VDC/DDC/Local NGOs and CBOs	By yearly	Lumbini area
9	Increase in Local economy	Employment of local people and Incorporation of EIA/EMP recommendation	Discussion with local people	Factory owner	Every three month	Industrial area
10	environmental programs	Environmental enhancement programs	Discussion with the beneficiary of the enhancement programs	Local NGOs/LDT	Yearly	industrial area
11	Restoration, rehabilitation, reconstruction of all infrastructure services disrupted or damaged by the industrial activities	Continued services by the facilities and functional public life	Site observation, VDC/DDC records, public consultation meetings, photos	LDT/DDC	Every three month	Lumbini area
12	Use of local labour, particularly vulnerable groups and women	Provision which obligate the holder to observe certain quotas for employing local labour, specially vulnerable groups and women, use of child labour	Records that facilitates and coordinates the process for local people's employment, interviews	LDT/DDC	During the entire period where labour work is contracted	industrial area
13	Pollution due to dust and smoke	Number of smoggy days due to dust and smoke pollution	measurement of air quality indicators	LDT/DDC/OI	Frequently during operation of factories	Industrial area
14	Solid waste problem	Cases of solid/liquid waste disposal by the industries in the public area and Incorporation of EIA/EMP recommendation	Observation	LDT/industries staffs	Frequently during operation of factories	Industrial area
15	Awareness and on-the-job training to locally employed labourer	Training programmed for skill development, occupational safety and environmental protection	Training records, check training programme reports, assess feedback from participants	NGOS/LDT/DDC	Every Six Month	Industrial area

16	Adequate technical and environmental supervision	Adequate number of technicians regularly at the industrial site	Check number and type of technicians available at site; Skill of work carried out; Discussion	NGOS/LDT/ DDC/IPB	Every three month	Industrial area
17	Measures to protect environment from air & noise pollution	events of hunting and killing of wildlife/fishes ,use of firewood or fossil fuel by factory workers, dust, smoke, noise from factories and vehicles	Inspection, interview with local people	OI/LDT/DD C/IPB	All throughout the year	Industrial area
18	Ecology	Ecological status of forest and vegetation and Incorporation of EIA/EMP recommendation	Direct observations and records of clearance of species	LDT/DFO	Every six month	industrial area
19	Wildlife	Poaching of wildlife and Incorporation of EIA/EMP recommendation	Community consultations and record keepings	LDT/DFO	Every six month	industrial area
20	Waterfowls	Incorporation of EIA/EMP recommendation and number of visiting long distant migrating waterfowls during winter seasons which is directly proportional to health and conservation status of local wetlands	Site observation	LDT/DFO	Yearly during on season	Rivers /wetlands of Industrial area
21	Conservation status of wild animals	Incorporation of EIA/EMP recommendation	Observation	DFO	Frequently	Industrial area
22	Fishery	Fish diversity and catch in unit time and Incorporation of EIA/EMP recommendation	Fish sampling and discussion with local fisherman	DDC/LDT	Every six month	Rivers /wetlands of Industrial area

Based on field Survey, 2011

Annex 10: Land use Types of the Zoning Classes (Land use type Area in Hectare)

Activities Performed	Barren land	Built up	Bush	Cultivation	Cutting, cliff	Forest	Nursery	Orchard	Pond or lake	Sand	Swamp	Water body	Grand Total
Project area	12	1	693	14		56			6			3	786
Restricted	100	0	14	2715	4	8	3	9	4			13	2871
Buffer zone	256		91	6865	7	10	16	18	27	26	11	39	7366
Special conservation & management zone	630	0	990	20641	181	2217	118	50	30	316	214	217	25603
Community resource management zone	587	0	923	20497	69	22	3	90	63	129	11	149	22541
Ecological & Economic development zone	785	2	809	21290	157	32	15	64	37	485	29	212	23916
Grand Total	2370	3	3520	72021	418	2345	154	231	167	955	265	633	83083

Source: Field Study, 2011 and Topographic Map, 1996

Annex 11: The Threshold Values of Environmental Quality Standards

Tolerance Limits for Industrial Effluents to be discharged into Surface Waters

Parameters	Tolerance Limit
Total Suspended Solids, mg/L	30-200
Particle size of total suspended particles	Shall pass 850-micron Sieve
pH	5.5 to 9.0
Temperature	Shall not exceed 40^{o}C in any section of the stream within 15 meters down-stream from the effluent outlet
Biochemical oxygen demand (BOD) for 5 days at 20 degree C, mg/L	30-100
Oils and grease, mg/L	10
Phenolic compounds, mg/L	1
Cynides (CN), mg/L	0.2
Sulphides (S)	2
Insecticides	Absent
Total residual chlorine, mg/L	1
Fluorides (F) mg/L	2
Arsenic (As) mg/L	0.2
Cadmium (Cd) mg/L	2
Hexavalent chromium (Cr) mg/L	0.1
Copper (Cu) mg/L	3
Lead (Pb) mg/L	0.1
Mercury (Hg) mg/L	0.01
Nickel (Ni) mg/L	3
Selenium (Se) mg/L	0.05
Zinc (Zn) mg/L mg/L	5
Ammonical nitrogen mg/L	50
Chemical Oxygen Demand mg/L	250
Silver mg/L	0.1

Source: Ministry of Environment, Science and Technology (2006)

Tolerance Limits for Industrial Effluents to be discharged into Public Swears

Parameters	Tolerance Limit
Total Suspended solids, mg/L	600
pH	5.5 to 9.0
Temperature	45
Biochemical oxygen demand (BOD) for 5 days at 20 degree C, mg/L	400
Oils and grease, mg/L	50
Phenolic compounds, mg/L	10
Cynides (CN), mg/L	2
Sulphides (S4)	2
Chlorides	1000
Insecticides	Absent
Sulphates ($^{So}_{4}$)	500
Fluorides (F)	10
Arsenic (As) mg/L	1
Cadmium (Cd) mg/L	2
Total dissolved solids	2
Copper (Cu) mg/L	3
Lead (Pb) mg/L	0.1
Mercury (Hg) mg/L	0.01
Nickel (Ni) mg/L	3
Selenium (Se) mg/L	0.05
Zinc (Zn) mg/L mg/L	5
Ammonical nitrogen mg/L	50

Chemical Oxygen Demand mg/L	1000
Silver mg/L	0.1
Total Dissolved Solids, mg/L	2100
Mineral Oils, mg/L	10
Inhibition of nitrification test at 200ml/l	<50%

Source: Ministry of Environment, Science and Technology (2006)

National Ambient Air Quality Standards for Nepal

Parameters	Units	Averaging Time	Concentration in Ambient Air (maximum)	Test Methods
TSP (Total Suspended Particulates	g/m^3	Annual 24-hours*	- 230	High Volume Sampling
PM10	g/m^3	Annual 24-hours*	- 120	Low Volume Sample
Sulphur Dioxide	g/m^3	Annual 24-hours**	50 70	Diffusive sampling on weekly average
Nitrogen Dioxide	g/m^3	Annual 24-hours**	40 80	To be determined 2005
Carbon Monoxide	g/m^3	8 hours** 15 minute	10,000 100,000	To be determined 2005 Indicative sampling
Lead	g/m^3	Annual 24-hours*	0.5 -	Atomic observation spectrometry and PM10 samples**
Benzene	g/m^3	Annual 24-hours*	20***** -	Diffusive sampling on weekly average

Source: Ministry of Environment, Science and Technology (2006)

*Note: 24 hourly values shall be met 95% of the time in a year.18 days per calendar standard may be exceeded but not on two consecutive days.

**Note: 24 hourly standards for No2 and So2 and 8 hours standard for CO are not controlled before MoPE has recommended appropriate test methodologies. This will be by 2005

***Note: Control by spot sampling at roadside locations: Minimum one sample per over 15 minutes during peak traffic hours, i.e. in the period 8am-10am or 3pm-6pm of workday. This test method will be re-evaluated by 2005

****Note: if representatives can be proven, yearly averages can be calculated from samples from selected weekdays from each month of the year.

*****Note: To be revaluated by 2005.

Annex 12: Field Photographs

Photo1. Discussion with Venerable Vivekananda about the LPZ in Lumbini Institution

Photo 2. Discussion with members of Udyog Banijya Sangh (Bhairawa) and journalist about LPZ

Photo3: Focus group discussion in Madhubani VDC

Photo 4. Interview with school teacher (Madhuvani Madhyamic Bidhyala)

Photo 5: FGD with villagers of Semrahana, Gonaha VDC (Prakateshor Mahadev Temple)

Photo 6: Smoke from Himalayan Instant Noodles Pvt. Ltd (Near Semari Secondary School and just at a distance of 200 metres from the highway)

Photo 7. Smoke Stack of Brick Factory (Due to heavy rainfall the factory was closed during the field visit)

Photo 8. FGD at Bithua-1, Rajapur

Photo 9: FGD at Kurvundi, Kapilvastu

Photo 10: DynastyII Factory at Maainaya -1, Gonaha VDC (Occupies more than 20 Bigha of land)

Photo11: Solidwaste problem in Kamariya VDC.

Photo 12: Disposal of factory wastages nearby farmlands (Reliance paper and cement factories)

Photo 13: Disposal of factory wastages in nearby river, Dano

Photo 14: Taking sample on the bank of the Dano river (It was raining heavily earlier night)

Photo 15: Disposal of factory wastages in nearby river

Photo 16: Taking Water Sample

Photo17: Release of reliance paper factory effluent directly into local people's farmlands

Photo 21: Sarus Crane in the farmlands near the factories

Photo 18: Factories in the Kamariya VDC and inundation nearby farmlands due to the removal of soil by factories and lack of proper drainage

Photo 22: Taking ground water sample from hand pump

Photo 19: Traffic congestion due to the heavy vehicles used by the factories along the Bhairawa-Lumbini Road

Photo 24: A local villager showing his flooded farmland mainly caused by establishing the industry without proper drainage in Gonaha VDC

20: Taking Soil sample in the Farmland of Kamariya VDC

Photo 29: Focus group discussion on Kamariya VDC