His Majesty's Government of Nepal
Ministry of Population and Environment
Singh Durbar, Kathmandu

Final Report
on
Preparation of Hazardous Waste Inventory

July, 2004

Submitted By: -
DEVS Consult Nepal (P) Ltd.
Anam Nagar, Kathmandu
Phone: - 4-219267
P.O. Box:19630

Acknowledgement

At the very outset, DEVS Consult Nepal (P.) Ltd. would like to extend our sincere acknowledgement to the Ministry of Environment and Population (MoPE) for assigning the task of "Preparation of Hazardous Waste Inventory".

Our sincere gratitude to Mr. Dilip Khatiwada, Mechanical Engineer, MoPE, for his cooperation and guidances during the completion of the study.

We would also like to thank Mr. Suman Sharma, Chemist, MoPE and all other individuals for their kind cooperation, participation and valuable information during the entire work process.

The study team also deserves special thanks without whose effort this study task would not have been possible.

July 2004.

Manjul K. Manandhar
Prativa Tuladhar
DEVS Consult Nepal (P.) Ltd.
Anam Nagar, Kathmandu

Table of Content

List of Tables

Glossary

AIC	Agriculture Input Corporation
BHC	Benzene Hexachloride
BOD	Biological Oxygen Demand
CBS	Central Bureau of Statistics
CDB	Cotton Development Board
CFC	Chlorofluro Carbon
COD	Chemical Oxygen Demand
COWI	Canadian International Consulting Agency
DDT	Dichloro Diphenyl Trichloroethyne
DOA	Department of Agriculture
DOC	Department of Custom
DOI	Department of Industries
EPA	Environment Protection Act
EPR	Environment Protection Rule
ESPS	Environment Sector Programme Support
MoF	Ministry of Finance
MoPE	Ministry of Population and Environment
MT	Metric Ton
NBSM	Nepal Bureau of Standards and Measurement
PCB	Polychlorinated Biphenyl
PCC	Pollution Control Certificate
PIC	Prior Informed Consent
POP	Persistent Organic Pollutants
SoE	State of the Environment
TCDF	Tetra Chlorodifuran
TDS	Total Dissolved Substance
TEQ	Toxic Equivalent Quantity
TSS	Total Suspended Substance
UNIDO	United National Industrial Development Programme

Preparation of Hazardous Waste Inventory, 2004

Executive Summary

Introduction

Urbanization and industrial development in Nepal have caused many environmental problems, such as water pollution, air pollution, noise pollution and solid waste. In addition, a wide range of industrial, commercial, agriculture and even domestic activities have also generated a number of hazardous wastes whose improper management causes grave environmental and health problems.

Till present, Nepal have not developed any legislation to control and manage wastes that fall under the hazardous category. For developing such legislation, Nepal needs to first identify the sources of hazardous wastes and quantify them accordingly. Such an Inventory preparation is the first step towards this effort and the main objective of this study. In addition, Nepal is also a signatory of the Basel Convention on the control of Trans-boundary Movement of Hazardous Waste and their disposal. Hence, this issue demands close attention as it is legally binding for Nepal to prepare such an Inventory.

Hazardous Waste Inventory

In this study, the Basel definition of Hazardous Waste has been assumed valid for Nepal since Nepal has still to develop its own list of Hazardous substances. This study categories broadly the Hazardous substances according to its source of generation. Hazardous wastes that have known and identifiable sources, such as certain industries are placed under "Specific Sources" and those having various other unidentifiable sources are placed under " Non- specific Sources".

It is evident that the quantity of hazardous wastes produced from industrial sectors (or Specific sources) outweigh the non-specific sources of generation. This study have identified 15 of such specific sources as the major sources of hazardous waste generation for Nepal, and carried out the quantification and qualification of wastes generated from such sectors. The selection of these industries were based on the study

published by IUCN on the most pollution causing industries in Nepal. The Chapter 4 of this study categorically quantifies the nature of hazardous wastes generated by these industries / sectors.

On the non-specific sources, the study identified the certain sectors that are considered non-specific by Thailand's study and these substances were collected the quantified .

The data collected in this study is the result of investigation at various polluting industries, published reports and literatures. The data from the Department of Customs were also helpful in quantifying various chemicals that have been imported into Nepal. The DoC have developed an International Coding system and a database of all its imported/exported items. This database could be developed into a Hazardous Substance Inventory which could be used to monitor and track those sectors that deal with such substances.

Limitation

This study does not claim to be a comprehensive study since it was carried out within a short period. However, the Inventory data gives a general broad view of the quantities of Hazardous Wastes within the country and also identifies the respective sectors. It is thought that the information contained in this study would be helpful to take necessary steps towards developing legislation for hazardous wastes and also for developing a country strategy for handling and managing such wastes.

Chapter 1 : General Introduction

1.1 Introduction

Rapid industrial development has generated substantial amounts of hazardous wastes. These 'new' types of wastes have aggravated the waste disposal problems, which are already quite serious among most Asian cities. Nepal is facing increasingly the environmental and health problems caused by improper management of hazardous wastes. The main environmental impact issues associated with the inappropriate disposal of hazardous wastes, relates to the potential impact on surface water, groundwater. Hazardous wastes also pollute ambient air.

Hazardous wastes are generated from a wide range of industrial, commercial, agriculture and even domestic activities. It may be in the form of solid, liquid, sludge or gaseous materials. Most of the hazardous wastes are derived from mining, metallurgical, chemical, refining, electroplating and other operations. Environmental pollution may be created due to their improper handling, transportation, control, treatment and disposal of hazardous wastes.
Hazardous wastes cause immediate, short-term public health problems as well as long-term environmental pollution. Their impacts can be disastrous as they could affect the whole life and food cycle and hence, human health and the ecological system.

It is therefore necessary to work out proper disposal and storage methods so as to eliminate the possibility of contamination from one ecological medium to another. Proper control of hazardous wastes does cost money, but experiences in a number of developed countries suggest that cleaning up the "Sins of Past" is much more expensive in the long run. Hence, it is important that all developing countries institute controls over hazardous wastes to avoid such excessive remedial costs subsequently.

On the part of government administration, it is essential to provide guidance to the industry in handling these hazardous wastes and substances. Legislative efforts and strict regulative enforcement are vital for the safe management and disposal of these wastes and substances. On the part of industry, hazardous waste management is indispensable from the viewpoint of not only the social responsibility of business corporations but also from the necessity to comply ISO 14000 standards that will effect their competitiveness in global market.

Nepal has yet to carry out systematic or completed survey on the sources and quantities of hazardous wastes. As per the Environmental Protection Act/Regulations 1997 hazardous waste management strategy is to be formulated in Nepal. In a hazardous waste management strategy, hazardous waste inventory drafts general outlines, as well as on how, by whom and the type of hazardous wastes are being used. The first step of preparing such as strategy includes identifying and quantifying the hazardous substances/wastes and their problems and then formulating waste management procedures and control mechanism, and establishing common technologies and a proper classification of hazardous wastes.

1.2 Study Objectives:

The main objective of this study is to prepare an Inventory, that is, identification and quantification of hazardous substances/wastes generated, collected, transported, stored, handled, processed and disposed in Nepal and also provide import and export data on it.

1.3 Scope of Study :

The following are the specific scope of this study:

- To review the Basel Convention, other relevant Conventions such as Rotterdam and Stockholm and identify and interpret the hazardous wastes and substances.
- To identify and quantify the hazardous wastes and substances which are generated, collected, transported, stored, handled, processed and disposed in Nepal.
- To identify and qualify the hazardous wastes and substances which are exported / imported in Nepal.
- To review and evaluate the existing hazardous wastes inventory reports in Nepal, if available.
- To consult and gain information with other Governmental and non-Governmental organizations, private firms and industries which are directly or indirectly related with hazardous wastes and substances.
- To visit industries and have direct consultations with concerned entrepreneurs if found necessary.
- To conduct a workshop inviting specialists in the area of hazardous wastes and

substances management for the discussion on the draft report, and amend the final report as per the advice of the participants.

- To categorize the prepared hazardous wastes and substances lists in the form of origin, and disposal system.
- To submit the Final Inventory Reports to the MoPE.

1.4 Inventory preparation need for Nepal :

The preparation of Inventory of Hazardous Waste is needed in the Nepalese context for the following reasons:

- The present state of the Hazardous waste generation and its management not documented in Nepal's context.
- To submit necessary documentation under the Basel Convention on Nepal's status.
- To assist in the formulation of necessary rules, regulation and legislation for the reporting of Hazardous waste and its management within Nepal.
- To develop a Guideline to workout proper management of wastes so as to minimize and /or eliminate the possibility adverse effects to human and natural environment.
- Identification of physical state of Hazardous wastes also helps to design low cost methodology for recycling.

1.5 Methodology

For conducting the Inventory study, the following methodology has been adopted as three phase plan development.

Phase I: Preparation and planning

It consists of the collection, meeting and review of relevant literature to hazardous waste like :

(a) Study reports, related publications and documents about hazardous waste

(b) Selection of main sources of hazardous waste generation field.

Phase II: Field work / Office work

It consists of

(a) visiting selected industries and quantification of waste generation.

(b) collecting information and data from sources, e.g. from:

i) Ministry of Environment and Population

ii) Ministry of Finance

iii) Department of Industry

iv) Department of Customs

v) Environment Sector Program Support

vi) Department of Drug Administration

vii) Kathmandu Municipality (Environment Department)

viii) NGOs & INGO

Phase III : Report Preparation:

It consists of the activities like data compilation, formation, brainstorming and preparation of field report and get the comments on it.

The Final Report was the outcome of compilation of all the data and information and the comments and issues raised in the Presentation program held.

Chapter 2 Policy and Legislation related to Hazardous Waste

In this Chapter, the present legal situation regarding Environment and Hazardous Waste management in Nepal is discussed.

2.1 Status of hazardous wastes management in Nepal

Proper management of hazardous waste is very rare in Nepal because of lack of regulations and limited technical knowledge and weak institutions. Most generators of hazardous wastes, such as industries and health care facilities dispose it in a haphazard manner. A few have treatment facilities but most of them are not functioning properly.

Nepal does not have one specific agency to look after hazardous waste management. MOPE has overall responsibility for environmental protection, while the Ministry of Industry, Commerce and Supply is responsible for regulating and promoting industries. Likewise MOH is responsible for managing hospitals and protecting public health and the MOAC is responsible for regulating pesticides. In 1992, Environmental Protection Council (EPC) was established under the chairmanship of Rt. Hon. Prime Minister. In 1995, MOPE was established as the main institution responsible for environmental protection and improvement. MOI and its four departments, Department of Industry, Department of Cottage and Small Industries, Department of Mines and Geology and Nepal Bureau of Standard and Metrology have very few staffs trained on environmental management. The Pesticide Registration office in the DOA is responsible for monitoring the import, storage, sale and the use of pesticides in Nepal. Although, the municipalities are responsible for managing solid wastes and controlling pollution, most of them do not have the capacity or resources to perform these tasks.

The environmentally sound management of hazardous wastes is sought to be regulated through various provisions of EPA, 1997. Specific standards, authorization for management and handling requirements of environmentally sound management of hazardous wastes are not yet in place. There is provision for appointment of Environmental Inspectors in the EPA for effective monitoring and enforcement of regulations. Institutional arrangement and supporting infrastructure like environmental laboratories is not in place. There have been sporadic studies on pollution assessment, monitoring and surveys carried out with the support of expert agencies from Nepal and abroad for database purpose. There is no separate manpower appointed or allocated exclusively for the purpose of environmentally sound management of hazardous wastes. There is provision of establishing Environment Protection Authority in the EPA, 1997 but it is not constituted yet.

Recyclable hazardous wastes such as lead-acid batteries, non-ferrous metallic scrap, waste or used oil are going to India for recycling, which is not allowed by Basel convention. MOPE does not permit import or export of hazardous wastes.

Biomedical wastes are covered under the Basel convention. There is no facility for environmentally sound management of these wastes except some hospitals have installed incinerators without any norms. Kathmandu Metropolitan City is planning to set up an incinerator for the management of hospitals waste. For this purpose MOPE has already approved the EIA document. Infrastructure facilities and technical manpower at the Custom Department are not adequate for the control of trans-boundary movement of hazardous wastes.

2.2 Government policy on management of hazardous wastes

Nepal Treaties Act, 1991 states that the provision of any treaty that Nepal had ratified shall prevail as the law of Nepal. In the absence of specific acts and regulations to address specific matters, Nepal Treaties Act 1991 becomes incomplete. The constitution of Kingdom of Nepal, 1990 provided for the establishment of a " Natural Resources and Environment Committee" in the House of Representatives. Government has powers to regulate the waste and waste management but in the absence of itemized details of the provisions in rules and backup guidelines, the EPA and EPR are as good as non-existent.

Nepal so far does not have any policies or regulations specifically dealing with hazardous waste. Some ad hoc policies, for example, the Cabinet decision to ban production of plastic bags thinner than 20 micron, addresses only the waste management part of plastic bags. It probably was not considered that with thicker bags, more dioxins would be released.

In the absence on National Waste Act and Rules, the provisions of Basel convention pursuant to paragraph 1 sub-paragraph (a), (b) and (c) of Article 4 could not be enforced through national legislation. Existing SWMRMA, 1987, has some general provision to cover the provision of the Article 4 under paragraph 2, sub-paragraphs (a) and (b) other paragraphs and sub-paragraphs of the article could not be enforced under the provision of the existing act. SWMRMA, 1987, for the first time defines" Hazardous Waste", refers to their categorization and prohibits their storage, dumping or improper disposal at any public or private places. Some of the regulations, which address the issue of hazardous waste and chemicals, are discussed below.

2.3 Solid Waste Management & Resource Mobilization Act, 1987

This act was formulated for the management of solid waste. It created the Solid Waste Management and Resource Mobilization Center (SWMRMC) and gave it the responsibility for managing solid waste, including the categorization and management of hazardous waste, in the Kathmandu valley. Although this first attempt to regulate waste management was very good, currently it is not functioning because municipalities have taken over the responsibility for managing solid waste and the role of SWMRMC has decreased significantly.

2.4 Industrial Enterprises Act, 1991

This Act, which was promulgated, to promote and regulate industrial development in Nepal has listed some industries an "industries affecting safety, public health and environment" and made special provisions for their establishment. The Act, however, does not address the issue of industrial pollution. No references have been made to compliance of environmental standards by industries or monitoring of environmental impacts.

2.5 Labor Act, 1991

The Labor Act, which is administrated by the Ministry of Labor is the main regulation regulating the working environment. Chapter 5 of this Act deals with occupational health and safety. Section 27 of chapter 5 requires the management to make certain arrangements such as the removal of waste accumulated during production process and prevention of accumulation of dust, fume, vapor, and other impure materials, which would adversely effect health of workers, Section 28 and 29 require management to provide clothing and devices to workers handling chemical substances and other hazardous and explosive substances.

In order to prevent accidents. Section 30 of the Act requires proprietor to make arrangements for fire safety equipment and emergency equipment while Section 31 requires the placement of study fences around hazardous machines and equipment operated by energy.

2.6 Environment Protection Act (EPA), 1997 & Environmental Protection Rules (EPR), 1997

The EPA and EPR were formulated to reduce adverse impacts on the environment and ensure the proper use of natural resources for environmental conservation. The Act is the first attempt by the government to deal specifically with environmental issues.

The Article 9 of the convention related to Article 6, 7 and 8 is not covered in the existing EPA and EPR. However, the Act and Rules empower the authorities to control and management of the waste in very broad terms and lack of itemized provisions for the wastes related to Basel convention. Specific standards, authorization for management and handling and requirements of environmentally sound management of hazardous wastes are not put in place.

Article 13 of the convention relating to the information transmission to the parties of convention and the Secretariat by the designated competent authorities or the focal point pursuant to Article 5 is ineffective. The reason behind is the lack of national legislation covering the provision of Basel convention and support national organization for waste management at various levels with mandates to generate database and their updated to the requirement of the Basel convention.

The Act and the Regulations specify development projects for which Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) and necessary and also specifies the procedures to be followed for these activities. According to the Regulations, EIA is necessary for the following activities related to hazardous wastes:

- Import of over 10 tons of registered pesticides
- Marketing, storage and disposal of over 1 ton of registered pesticides
- Use of over 1 ton of pesticide in one area
- Establishment of pesticide formulating plant
- Establishment of certain industries including the following:

  Chemicals (capacity of over 100 tons/day),

  Leather tanning (capacity of over 100 pieces/day),

  Mechanical workshop (spread over an area of more than 3 ha),

  Fertilizer,

  Lubricating oil,

  Petrochemicals, Cement,

  Asbestos,

  Establishment of hospital/nursing home with over 25 beds

  Establishment of facilities, including treatment plant, recycling plant, storage and

  Landfill for management of hazardous waste.

  Disposal management of any hazardous chemicals with lethal dose of 50

  Incineration or recycling of hazardous wastes requiring over one hectare of land and

  Energy.

  Landfill of over 1,000 MT per year of municipal waste

  Domestic waste transfer station or recovery area spread on an area of over 3 hectares.

Although the EPA and EPR have been in effect, they have not been effectively implemented because MOPE has not yet issued sufficient environment standards and it does not have the manpower to implement the Regulations. Furthermore, the government has yet to develop more specific regulations for water quality, solid waste management and hazardous waste management. The Act does not define hazardous waste or provide provisions for its management.

2.7 Pesticides Act, 1992 and Pesticides Regulations, 1994

HMG/N has gazetted the Pesticide Act, 1992 and the Pesticides Rules, 1994. All pesticides are registered and regulated under the Pesticides Act and the Pesticides Rules. The Act regulates the import, manufacture, sale transport, distribution, production, marketing and use of pesticides in Nepal with a view to prevent risk to human health and the environment. The Act calls for the formulation of a Pesticides Committee, under the Chairmanship of Secretary to the MOAC, to formulate and implement national policy for pesticides.

According to the Act, a Pesticide Regulation Agency will be established to register appropriate pesticides, issue certificates and develop guidelines for its proper use. There will be restriction on the import, export, production, marketing and use of unlisted pesticides and a license will be required for the formulation, marketing and professional use of listed pesticides. Section 13 of the Act allows HMG to appoint Pesticide Inspectors. According to Section 18 of the Regulations, the Inspectors will have the authority to enter any house, vehicle or factory premises and seize any imported or being sold contrary to the provision of the Act and Regulations.

2.8 Local Self-Governance Act, 1999

According to the local Self-Governance Act 1999, municipalities are responsible for managing domestic solid waste. Municipalities are also supposed to preserve water bodies such as lakes and rivers and assist in controlling water, air and noise pollution. The Act does not require the local governments to manage hazardous waste, but empowers them to fine anyone up to Rs. 15,000 for haphazard dumping of solid waste.

2.9 Related institutions in the control of hazardous wastes

At present the national and other related institutions involved in governmental control on hazardous chemicals are;

- Ministry of Population and Environment
- Ministry of Agriculture and Co-operatives
- Sectoral Ministries and Departments
- National Committee on Man and Biosphere, 1974
- National Resources Conservation Commission 1980s

- Environment and Resource Conservation Division in the National Planning Commission, 1987
- Council for Conservation of Natural and Cultural Resources, 1990.
- Environment Protection Council, 1992 chaired by Rt. Hon. the Prime Minister
- Municipalities
- Nepal Electricity Authority

2.10 Action to be taken for the effective management of hazardous wastes

Nepal has given due importance to conserve its natural resources and environment as a whole and have signed various international conventions regarding environment protection and management where conventions related to hazardous wastes and chemicals are few of them. As a signatory of the Basel convention, Nepal has a legal obligation to meet the provisions enshrined in the Articles and Annexes of Basel convention. In the current scenario, without adequate legal and institutional measures, it is not possible to meet the requirements of Basel convention. Henceforth, following legal and institutional measures are proposed as priority actions.

Chapter 3 Hazardous Waste Generation in Nepal

This Chapter identified the sectors that generate substances that are categorized as Hazardous Waste under the Basel Categorization. The sectors are classified under the Specific and Non-Specific sources.

3.1 Hazardous Waste Identification

Wastes are defined as materials that are no longer suitable for their intended purpose. This includes materials that are waste products of a procedure, old outdated products that have not been used or new products purchased in excess.

Hazardous wastes are solid, liquid or gaseous wastes with one or more of the characteristics listed below.

1. **Corrosive**: Any substance with a pH less than 2 or greater than or equal to 12.5. A corrosive waste with no other waste characteristic may be neutralized to a pH between 6 and 9 and sewered (Log date and Volume). Examples would include 5% nitric acid or an alkali such as sodium hydroxide.
2. **Ignitable**: Any substance having a flash point less than 140°F (60°C), or any ignitable gas, or an oxidizer. Aqueous wastes containing 24% or less of an alcohol are not considered to be hazardous wastes. See the precautions on treatment in the introduction. Examples would include paint thinner, acetone, and potassium or ammonium dichromate.
3. **Reactive**: Any unstable substance that can undergo rapid violent change, reacts violently with water, or is a sulfide or cyanide bearing material. Examples would include sodium or potassium cyanide.
4. **TCLP** listed waste. A liquid mixture containing any of listed substances at or above the TCLP concentrations. If a solution contains a TCLP substance that is less than the Hazardous Waste regulatory limits but higher than the limits of the Municipal Sewer Code, it must be disposed of as a hazardous waste. Examples of a TCLP substance are silver, chromium or lead.
5. **Acutely Hazardous**: Any material that has been found to be fatal to humans in low doses, or has an oral LD50 (rat) of less than 50 mg/kg, an inhalation LD50 (rat) or less than 2 mg/l, or a dermal LD50 (rabbit) of less than 200 mg/kg. Acutely hazardous

wastes are found in Annex I of Basel Convention. Examples would include potassium cyanide.

6. It is a **toxic** waste. Any material listed in Annex I of Basel Convention. Examples would include formaldehyde.
7. It is a **listed** waste from non-specific sources. Any material listed in Annex I of Basel Convention

3.2 Hazardous Waste Classification

Regarding the above characteristic features of the Hazardous Wastes generated from different sources, it can be categorized into the following two types on the basis of their sources:

A. Specific Sources
B. Non Specific Sources

A. Specific Sources

Hazardous chemicals which are generated from definite or known sources are under this category.

B. Non Specific Sources

The chemicals that have various sources and are hazardous once they are released into the environment are under this category. Therefore they are termed as hazardous substances from non-specific sources.

Some of the sectors that fall under each of these two categories are listed in the following list:

A. Specific Sources

1. Wood Preservative Industries
2. Paint and Adhesive Industries
3. Plastic Industries
4. Fertilizer Industries
5. Pesticides and Insecticides Industries
6. Lubricants Industries
7. Steel and Surface Finishing Industries
8. Lead producing Industries
9. Aluminum Industries
10. Zinc Industries

11. Clinical / Hospital Sources
12. Textile Industries
13. Wool Dying and washing Industries
14. Laundry and Dry Cleaners
15. Laboratories
16. Leather and Tanning Industries
17. Pulp & Paper Industries
18. Batteries Industries
19. Pharmaceutical
20. Photographic Processing Chemicals

A. Non - Specific Sources

1. Household uses
2. Personal care
3. Painting
4. Others

The following table illustrates the Material Consumptions and Hazardous Wastes generation from Specific and Non-specific sources:

Table: 3.1. :Typical Material Consumptions and Hazardous Wastes Generation from Specific and Non-specific Sources

Hazardous Waste Sources	Material Consumptions	Hazardous Wastes
A. Specific Sources		
Wood Preservative Industries	Cresote or Chlorophenol	Dioxin, PCDD, creosote, PAHs (Polycyclic Aromatic Hydrocarbon)
Paint Industries	Ethanol, Methanol, Aluminum, PbO, Organic solvents, Compounds of heavy metals, Additives, Alkaline Resins	Heavy metals, PCB, Organic solvents
Plastic Industries	Ethene, Chloroethene, Phenol ,Methanol, Carboxylic Acid, PCB	Dioxin, Amylonitrite, Vinyl Chloride, Amalymide, Phenol, Chlorine, PCB
Fertilizers Industries	NPK, Phosphatic Nitrate, Potassium Ammonium, Urea	Chromium
Pesticides & Insecticides	DDT, BHC, Malathene, Bromine, Lead arsenate, Calcium arsenate, Endosulfans,	Chlorine, Arsenic, PCDD, PCDF, All remaining Pesticides

Hazardous Waste Sources	Material Consumptions	Hazardous Wastes
	Chlorinated Organic compounds, Organic Phosphates	
Lubricant Industries	Petrol, Ethanol, Tetraethyl Lead	Lead
Steel Industries	Carbon, nickel, iron, chromium	Nickel, Chromium, Zinc
Health Care	Radioactive materials, Organic compounds,	Mercury, Infectious waste, Radioactive materials
Dry Cleaner	CFCs as solvent, organic solvent	CFC, organic solvents
Leather Industries	Sodium Sulphide, Chromium Sulphate, Lime	Chromium, chlorine
Pulp & Paper Industries	Chlorine, Sodium Hydroxide, Lime, Talc, Rosine, H_2O_2, Gum, HCl, Sodium Silicates	Dioxine, Chlorine, Arsenic
Batteries Industries	Lead, Sulphuric Acid, Compounds of Heavy Metals	Lead, Acid, Heavy Metals
Surface Finishing Industries	Zinc, Gold, Nickel, Chromium	Zinc, Gold, Nickel, Chromium
Dying Industries	Bromine, and Pigments, dyes	Pigments, Heavy metal dyes
Photographic Processing	Silver Bromide, Gold, Hypo solution	Silver, Hypo solution
Vegetable Ghee	Nickel, Hydrogen, Sodium hydroxide	Nickel, chlorine, Sodium Hydroxide
Soap Industries	NaCl, Na_2CO_3, Oil and fats, Sodium silicate, colors, carboxylic acid	Sodium hydroxide, color, and acids
B. Non - Specific Sources		
Household uses	Insecticides, Cleansing agent, Bleaching powder	Chlorine, different organic compounds
Personal care	Pharmaceutical Products, dyes, organic solvents, perfumes, antiseptic	Date expired medicine, dye, residue
Painting	Organic solvents, compounds of heavy metal	Remainder paints
Others	Glue, ink, batteries	Date expired and residue of glue, ink and batteries

Type of Industries generating Hazardous Wastes relating to Nepal are listed below:

- Leather Tanning Industry
- Textile Industry
- Pulp and Paper Industry
- Wool Dying / Carpet Industry
- Soap and Detergent Industry
- Pharmaceutical Industry
- Pesticide Industry
- Lubricant Oil
- Paint Industry
- Rubber Industry
- Plastic Industry
- Foam Industry
- Surface Finishing Industry
- Mining Industries
- Batteries Industry
- Sugar Mill
- Photographic Processing
- Vegetable ghee and Oil
- Dairy Mill
- Hospital /Clinical
- Dry Cleaner

The Industries have been categorized according to those generating :

1. **Heavy Metals**
2. **Organic Compounds**

Table: 3.2. : Industries Categorized according to Type of Waste generation

1. Heavy Metals	2. Organic Compounds
Leather Industry Iron / Galvanizing Industry Metal Processing Industry Electrical Appliances Industry Mining Industries Leather Industry Oil and Ghee Industry Rubber Industry	Paint Industry Plastic Industry Dry cleaning Surface Finishing Glue and Adhesive

3.3 Sectors and Industries Identified for Inventory Preparation

The types of Industries and sectors selected for making the Inventory of Hazardous Waste in Nepal are listed below.

The reasons for selection of these sectors and industries are:

- Industry selected were labeled as "most pollution causing industries". (DoI, Class A)
- Raw materials used in the industries are itself hazardous.
- The raw materials consumption are very large in amount.
- Waste generation is in large scale and contains various types of highly hazardous substances.

Selected Sectors and Industries for Preparation of Inventory of Hazardous Wastes in Nepal :

1. Textile Industry
2. Wool dyeing and Carpet Industry
3. Tanning and Leather Industry
4. Pulp & paper Industry
5. Paint and Adhesive Industry
6. Lubricant Waste generations
7. Batteries Industry
8. Tyre waste generation
9. Soap and Detergent Industry
10. Vegetable Oil and Ghee Industry
11. Medical /Hospital Wastes
12. Pharmaceutical Industries
13. Pesticide & Insecticide waste generation
14. Surface Finishing Waste generation
15. PCB Stockpile
16. Other Non-Specific Sources

Chapter 4 Hazardous Waste Inventory : Sector Wise

In the following Chapter, the Inventory of Hazardous Waste generated from different sectors that are identified above are categorically presented. The hazardous wastes generated have been accumulated to quantify in an annual generation unit for each sector.

A. Industry Specific Hazardous Waste generation

1. Textile Industry Sector

The textile industry is one of the major industry of the Nepal. Till 2004, the total number of industries registered with the DOI is 169. According to DOI statistics, the annual production of cotton production of cotton textile is 1700000m and synthetic textile is 13167000m.

In the textile industry a number of chemicals are used in the dying and washing processes which is also released in its waste water, creating a major environmental concern. The types of pollutants associated with various dyes generally used for textile are given below:

Table: 4.1.1 :Typical Characteristics of Dyes Used in Textile Dyeing Operations

Dye Class	Description	Method	Typically Applied to	Typical Fixation (%)	Typical Pollutants Associated with Various Dyes
Direct	water -soluble, anionic compounds; can be applied directly to cellulosics without mordants (or metals like chromium and copper)	Exhaust/ Beck/ Continuous	cotton, rayon other cellulosics	70-95	color; salt; unfixed dye; cationic fixing agents; surfactant; defoamer; leveling and retarding agents; finish; diluents
Disperse	not water-soluble	High temperature exhaust Continuous	polyester, acetate, other synthetics	80-92	color; organic acids; carriers; leveling agents; phosphates; defoamers; lubricants; dispersants; delustrants; diluents
Reactive	water-soluble, anionic compounds; largest dye class	Exhaust/ Beck Cold pad batch/ Continuous	cotton, other cellulosics, wool	60-90	color; salt; alkali; unfixed dye; surfactants; defoamer; diluents; finish

Dye Class	Description	Method	Typically Applied to	Typical Fixation (%)	Typical Pollutants Associated with Various Dyes
Sulfur	organic compounds containing sulfur or sodium sulfide	Continuous	cotton, other cellulosics	60-70	color; alkali; oxidizing agent; reducing agent; unfixed dye
Vat	oldest dyes; more chemically complex; water-insoluble	Exhaust/ Package/ Continuous	cotton, other cellulosics	80-95	color; alkali; oxidizing agents; reducing agents

Source: Best management practices for Pollution prevention in textile industries, USEPA

The major chemicals and dyes used for cotton textile and synthetics textile for washing and dying processes are given below. The consumption in Kg per ton of the products for respective chemicals and dyes are also shown.

Table :4.1.2. Chemicals & Dyes Consumption For Cotton textile

S.N	Chemicals/Dyes	Consumption Kg per ton of product
1.	Sodium Hydroxide	300.0
2.	Sodium Chloride	20.0
3.	Sodium Carbonate	8.0
4.	Sodium Sulphide	4.0
5.	Sodium Hypochlorite	3.6
6.	Sodium thiosulphate	2.5
7.	Sodium Acetate	6.5
8.	Sodium Nitrite	3.5
9.	Sodium Perborate	7.0
10.	Hydrochloric acid	9.0
11.	Urea	1.0
12.	Acetic Acid	1.0
13.	Wetting Agent	8.0
14.	Detergent	14.0
15.	Enzymes	6.5
16.	Starch	80.0
17.	Sodium Hydrosulphide	2.0
18.	Reactive Dyes	2.0
19.	Sulfur Dyes	3.0
20.	Vat Dyes	8.0
21.	Napthol Dye	15.0

Source: ESPS, 2003

Table: 4.1.3 :Chemicals & Dyes For synthetic textile

S. N.	Raw Materials	Consumption Kg per ton of product
1.	Caustic Soda	80.0
2.	Acetic acid	33.0
3.	Soda Ash	48.6
4.	Liquid soap	130.0
5.	Birta scouring agent	18.0
6.	Oxalic acid	48.0
7.	HCl	21.0
8.	Levocal WS	40.0
9.	Levelcell FTS	13.5
10.	Ammonium Sulphate	32.0
11.	Sodium Sulphide	5.0
12.	Common Salt	165.0
13.	Hexameta Phosphate	1.6
14.	Hydrogen Peroxide	2.7
15.	Zystab	3.76

Source: ESPS, 2003

Hazardous Waste generation

For the textile industry, the hazardous wastewater, generated in the washing and dying process is the largest waste stream. It is estimated that for every ton of textile produced 270 tons of waste water is generated from washing and dying processes. This large volumes of waste contains chemicals from preparation and continues dying, alkaline waste from preparation and bathing of dying , containing large amounts of acid, alkali and salts.

The effluent characteristic is shown below:

Table: 4.1. 4: Characteristics of Textile Effluents collectively from all processes within the Industry

Parameter	mg/l
COD	22135.1
Oil and Grease	18.5
Chromium	0.8
TDS	82002.0
TSS	4951.2
Sulphide	685.3
Chloride	2162.5
Colour	1708.7

Source: ESPS, 2003

The DoI data for 2002/3, shows around production of 1700 th. m of cotton textile and 13167 th. m. of synthetic textile.

Table: 4.1.5: Total Annual Production

Textile Annual Production *	
Category	Quantity (m)
Cotton Textile	1700000.00
Synthetic Textile	13167000.00
Total	**14867000.00**
	(4955.7 T)

Source : DoI, 2002

The table shows the total hazardous waste generated from the textile industry sector of Nepal.

Table: 4.1.6 : Hazardous Waste Generation from Textile Industries

Waste Generation			
Category	Generation *		Quantity
Waste water	1338.0	m^3/Ton	1338.00 T
Chromium	1.07	mg/lit	1.07 T
Sulphide		mg/lit	916.95 T
Chloride	2162.5	mg/lit	2893.50 T
Oil & Grease	18.5	mg/lit	24.75 T
Colors	1713	mg/lit	2286.30 T

** Source: ESPS, 2003*

Chromium, Sulphide, Chloride, Oil & Grease and colors from the effluents of a Textile Industry fall in the hazardous substances. Hence their presence in the effluents has been quantified.

2. Wool Dying and Carpet Washing Industry Sector

Natural woolen carpets are one of Nepal major export items. The data for 200 shows an annual consumption of wool for dying used in making carpets is 11000 T and the annual carpet produced is 25,00,000 m^2.

The total number of registered wool dying & carpet washing industries in Nepal is 108.

In the process of wool dying and carpet washing, a large quantity of chemicals and dyes are used . For dying of woolen yarn 1:2 metal complex dyes are most commonly used. The consumption of these dyes varies according to the shade of the color, ranging from 0.1 to 1.0% on the basis of weight of the yarn. The most common and popular shades consumes about 0.2% in average. On the basis of this figure, it is estimated at about 200 MT of dyes are consumed annually in the carpet sectors.

Dyes and chemicals:

A large quantity of chemicals is also used for wool dying and carpet washing. Dyes and chemicals are used in dyeing of woolen yarn.

The most commonly used dyestuff is:

1:2 metal complex dye

Consumption of dyes varies according to the shade of the color ranging from 0.1 –1.0 % on the basis of weight of the yarn (key factor for dyes), most common and popular shades consume around 0.2 % in average.

Taking this figure as the average consumption figure, it can be estimated that about 200 metric ton of dyes are consumed every year in the carpet sector.

The commonly used chemicals in yarn dyeing are:

acetic /formic acid,
ammonium sulphate,
sodium sulphate,
common salt / Glauber salt etc.

The commonly used chemicals in carpet washing are:

sulfuric acid,
caustic soda,
bleaching powder,
acetic acid,
household detergent,
softener etc.

Table: 4.2.1 :Dyes and Chemical Consumptions

Process	Dyes/Chemicals used	Consumption of Chemicals		
Wool Yarn Dying	1:2 metal complex dyes	0.1 - 0.25	0.175	% of wt
	Acetic acid	0.5 - 1.0	0.75	% of wt
	Sodium sulfate/ Glauber Salt	5.0 - 10.0	7.5	% of wt
	Lyogen SMK	0.1 - 0.3	0.2	% of wt
	Scouring agent		0.5	% of wt
Carpet washing	Sulfuric acid		280	gm/m^2
	Caustic soda		100	gm/m^2
	Bleaching powder		40	gm/m^2
	Detergent		4	gm/m^2
	Acetic acid		5	gm/m^2
	G.I. Paste (softener)		45	gm/m^2

Source: ESPS, 2001

Hazardous Waste Effluent generation:

Table : 4.2.2 : Nature of effluents

Process	Type of waste	Quantity of waste (on the basis of unit production)	Total annual waste
Dyeing	Water effluent	30 liter/kg	318,000 m^3
Washing	Water effluent	300 liter/ sq. meter	750,000 m^3

Source: ESPS, 2001

Table : 4.2.3 : Characteristics of Effluent

Parameter	Unit	Dyeing effluent		Washing effluent	
		Range	Mid value	Range	Mid value
COD	mg /L	500-2800	1650	200-1400	800
BOD	mg /L	130-790	460	10-800	405
PH		4.0-5.5	4.75	1.4-6.0	3.7
TSS	mg /L	20-150	8.5	100-1000	550
Oil and grease	mg /L	10-80	45	10-100	55
Temperature	^{0} C	60-85	72	10-20	15
Total Chromium	mg /L	0.02-0.24		0.01-0.02	

Source: ESPS, 2001

The above Table shows that the contamination level of Chromium in Dying Effluent and Washing Effluent varies. On the basis of this, total Chromium containing in the Dying Effluent and Washing Effluent is 429 kg and 150 kg respectively for annual production 11000 T wool and 2500000 m^2 of Carpet.

The table below shows the total hazardous waste generated from the Wool Dying and Carpet Washing Industries sector of Nepal.

Table: 4.2.4 :Hazardous Waste Generation from Wool Dying and Carpet Washing Industries

Total Annual Production *		Total Waste Generation			
Category	Quantity	Category	Generation **		Quantity
Wool Dying	11000.00 (T)	Effluent	30	lit/kg	330000.00
		Chromium	0.13	mg/l	0.0429
		COD	1650	mg/l	544.5
		Oil & Grease	45	mg/l	14.85
Carpet Washing	2500000.00 (m2)	Effluent	300	lit/m2	750000.00
		COD	800	mg/l	600
		Oil & Grease	55	mg/l	41.25
		Chromium	0.015	mg/l	0.0115

* Based on Industrial Statistics, Dept. of Industries, 2002/03

** ESPS, 2001

3. Leather and Tanning Industry Sector

Leather and Tanning Industry is also one of the industries generating Hazardous Waste in its effluents. During various production processes hazardous chemicals, dyes, pigments and acids are used. Certain proportions of these chemicals are wasted in its effluents.

There are 15 tanning industries in Nepal producing a total of 292378m^2 leather. (DOI, 2003)

The basic raw materials and chemicals required for the production are tabulated below.

Table: 4.3.1: Raw Material Consumption for production of 100 sq. ft. of leather

Description	Wet Blue	Crust	Finished
wetting agents	1.0		
Preservatives/Bactericide	0.5		
Sodium Sulphide	2.50		
Hydrated lime	8.0		
Ammonium sulphate	2.0		
Bate	1.0		
Salt	9.0		
Sulphuric Acid	2.0		
Basic chrome sulphate	9.0	2.0	
Sodium bisulphate	1.2	0.5	
hydrochloric acid conc.	0.8		
Hypo solution	0.5		
Liquid detergent	0.8		
Sodium carbonate	0.8		
Sodium formate	1.0	1.0	
Formic acid	0.5	0.2	
Syntan		5.0	
Sodium sulphate		1.5	
Dyes		1.0	1.0
Falliquors		6.0	
Pigment		1.0	0.6
Binder		1.0	1.0
Wax			
Pentrater			0.2

Description	Wet Blue	Crust	Finished
Ammonia Liquid			0.2
Lacquor			1.0
Thinner			2.0
Auxiliaries			0.5

Source: DOI, Norms, 2058

Hazardous Waste generation

Solid and liquid waste contaminated with hazardous waste are generated mainly from pre-tanning and tanning operation and very little from post tanning.

The following table projects the nature of hazardous waste and amount.

Table :4.3.2 : Quantity of solid waste

Process	Type of waste	Quantity of waste (%)
Pre-tanning	Trimming Pulped hair, Lime Fleshing	12 7-23
Tanning	Chrome containing organic matter Chrome split waste Trimming + shavings	 11.5 10
Post tanning	Buffing dust	0.2
Finishing	Finished trimmings	3.2

Source: The conversion of solid tannery waste into saleable by-products by K. T. W. Alexander, UNIDO consultant

Table: 4.3.3 : Quantity of effluents

Process	Quantity of waste, m^3 / T hides
Pretanning	18.0
Tanning	1.0
Post tanning	7.0
Other (mechanical operation, floor washing etc.)	25.0
Total*	50
Total**	60-70

Source: Effluent Control in Leather Tanning Industry SI/NEP/88/801, by Karel Kubec, Leather Expert & Srdjan Selanec, Tannery Effluent Treatment Expert

* Worldwide practice ** In case of Nepalese tanneries

Table: 4.3.4 :Economic Valuation of Waste

Unit process	Waste stream	Waste	Waste kg/ton hide processing	Annual processing (Ton/yr)	Total chemical (T)
Beam house	Unhairing liquor (buff)	Sodium sulphide	11	1200	13.200
	Unhairing liquor (goat)	Sodium sulphide	32	200	6.400
		Lime	27	1400	8.400
Tanning	Chrome tanning	Tanning waste liquor containing basic chromium sulphate	24	1400	26.,600

Source: ESPS, 2001

Table: 4.3.5 :Total Annual Production

Total Annual Produced	
Category	**Quantity Produced (m^2)**
Tanned Leather *	292378.00
(3184000 sq. ft.)	
Total	**292378.00**

* Based on Industry Productions (Dept. of Industries)

Main hazaradous waste generation process is chrome tanning. During this process chromium sulphate is used in high volume.3.45Kg of chromium is generated during production of 292378 m^2 of leather.

The table below shows the total hazardous waste generated from the Leather and Tannery Industries sector of Nepal.

Table :4.3.6 : Hazardous Waste Generation from Leather and Tannery Industries

Total Waste Generation		
Sources	**kg/Ton hide ****	**Quantity**
Effluent	75	328925 T
Sulphide	17.64	77.36 T
Chromium	3.45	15.13 T
Thinner	20	87.71 T

** ESPS, Baseline Study of Leather Tanning Industries, Dec., 2001

4. Pulp and Paper Industries

The exact number of industries in operation in the Pulp and Paper sector is 6 (registered in Department of Industry). Five has already started its production and one is under construction.

Total annual production of various kinds of paper is quantified as 22852 T.

Table: 4.4.1 :Total Annual Production (2001)

Type of Paper	Quantity T
Newsprint Writing/Printing Color Paper Cover board	17200
Kraft Paper	4092
Media Paper	1560
Total	**22852**

Source: ESPS, 2004

Chemicals Used:

Large quantities of chemicals are used in paper mills for pulping and bleaching process.

Chemicals used for pulping are Sodium Hydroxide and Sodium Sulphite. The chemicals used in bleaching are Hypo chlorite prepared from Lime and liquid Chlorine.

The Chemicals used for neutralization and washing purposes are Hydrochloric acid, Sodium silicate, household detergent, softener etc.

Caustic Soda
Sodium Sulphite
Chlorine
Lime
Hydrogen Peroxide
Rosin, Alum
Talc, Gum (starch)
Defamers
HCl
Sodium Silicates

Hazardous Waste generation

The majority of wastes from screening washing units discharged with their effluent directly or indirectly into surface water only after simple pretreatment.

Table: 4.4.2 :Percentage of Waste Generation T/year

Type of wastes	Writing/Printing (1)	Writing/Printing (2)	Media	Kraft
- Lignin - Fines - Ash - Silica - Chemicals	65 %	56 %	42 %	42 %

Source: ESPS, 2004

Table: 4.4.3 :Chemical Consumption & Waste Generation for bleached & unbleached paper T / year (1999 - 2000)

Process	Chemicals	Writing/ Printing (1)	Writing/ Printing (2)	Kraft Paper	Media Paper	Total	Total Waste Generated (T/Yr)
Cooking	Caustic Soda	3800	181	290		4271	2693.16
	Sodium Sulphite	300	1838	48		2186	1244.44
Bleaching	Chlorine	1050	1029			2079	1258.74
	Lime	880	1200			2080	1244.00
	Hydrogen Peroxide	45				45	29.25
Papermaking	Rosin	85	63	14	16	178	103.13
	Alum	860	700	206	125	1891	1090.02
	Talc	600	625			1225	740.00
	Gum (starch)				25	25	10.5
	Defamers			0.20		0.200	0.084
	HCl	80				80	52.00
	Silicates		88			80	49.28

Source: ESPS, 2004

Main hazardous waste generation is during pulping process. Under this process, various

chemicals are used which are itself hazardous, also their by-products are hazardous. One of the typical hazardous chemical produced during Chlorine bleaching is Dioxin.

All of the chemicals used are not consumed during the processes and some are discharged in its effluent which are termed as hazardous waste. From small and large scale paper industries, waste generation is 457040 T per year including 20 m^3/T waste water.

Table: 4.4.4 :Annual Production.

Total Annual Production *	
Category	**Quantity (T)**
Writing/Printing (1)	12000.00
Writing/Printing (2)	5200.00
Kraft Paper	4092.00
Media Paper	1560.00
Total	**22852.00**

* Based on Pulp & Paper Industries of Nepal, Baseline Study Report, ESPS, 2004

The table below shows the total hazardous waste generated from the Paper and Pulp Industries sector of Nepal

Table: 4.4.5 :Waste Generation from Paper and Pulp Industries

Total Waste Generation			
Category	**Generation ***		**Quantity**
Effluent	20.00	m^3/Ton	457040.00 m^3
Caustic Soda	915	mg/lit	418.2 T
Sodium Sulphite	750	mg/lit	342.7 T
Chlorine	3512	mg/lit	1605.1 T
Hydrogen Peroxide	2100	mg/lit	959.8 T
Resin	550	mg/lit	251.4 T
Alum	750	mg/lit	342.7 T
Hydrochloric Acid	430	mg/lit	196.5 T
Silicates	550	mg/lit	251.4 T
Dioxin		TEQ mg	31.99

* Based on Pulp & Paper Industries of Nepal, Baseline Study Report, ESPS, 2004

5. Paint and Adhesive Industry

Paint and adhesive Industries are such sectors where excessive amounts of hazardous organic solvents, heavy metals and other materials are used.

There are total 16 small and big paint industries operating in Nepal.

For various types of paint production, different types of raw materials are required. These raw materials also signify the contamination of effluent with hazardous substances.

Table: 4.5.1 :Raw Materials Required for Production of 2392.5T.

	Cement Paint	Enamels	Plastic emulsion	Primer	Varnish	Aluminium Paint	Others
Titanium dioxide	2.5	70	17				12
White cement	250						
extenders	210		100	86			42
Additives	37.50	17	41	11			2
Alkaline Resin		490		94	13.50		46
organic solvents		122		169	6.50		18
Emulsions			42				
Red Oxide				90			
Aluminum						2	
Medium						8	

Source: DOI, Rregistered Industries, 2003

Hazardous Waste Generation

The table below shows the total hazardous waste generated from the Paint Industries sector of Nepal.

Table: 4.5.2 :Annual Consumption

Total Annual Consumed	
Category	**Quantity**
Asian Paints *	2392.00 T
Johnson & Nicholson *	3671.00 T
Yeti Paints *	1835.50 T
Pashupati Paints *	2569.70 T
Other Manufacturers*	917.75 T
Total Domestic Production	**11385.95 T**
Foreign Imports **	1205.65 T
Total Consumed	**12591.60 T**

* Based on Industry Productions (Dept. of Industries)

** Based on the Total Annual Imports (Source: Dept. of Customs, 2003)

Table: 4.5.3 :Hazardous Waste Generation from Paint Industries

Total Waste Generation		
Generation Mode	**Percentage +**	**Quantity**
a. Spillage during usage	5.00%	629.58 T
b. Discarded after use / unused dried	8.00%	1007.32 T
c. Production Waste at Industries	5.00%	629.58 T
d. Demolition	0.50%	62.95 T
Total		**2329.45 T**

+ The percentage mentioned are assumptions based on discussion with vendors and users.

The table below shows the total hazardous waste generated from the Lubricant Oil Industries sector of Nepal.

Table: 4.6.4 : Total Hazardous Waste Generation

Total Waste Generation		
Generation Mode	**Percentage +**	**Quantity**
a. Spillage during usage	0.30 %	30.77 T
b. Production Waste at Industries	5.00 %	512.85 T
c. Demolition at Auto Workshops	90.00 %	9231.38 T
Total		**9775.01 T**

+ The percentage mentioned are assumptions based on discussion with venders and users.

7. Battery Industry

Used batteries are also source of hazardous waste because they contain heavy metals. There are 5 dry cell industries are running successfully. Three lead cell industries situated in Biratnagar, Hetauda and Butwal. The total production volume of these five companies equals 240-280 Tones of lead yearly . These companies are manufacturing their own batteries based on imported lead alloy for the battery grids, lead oxide for the lead oxide pasta on the grids.

The total production of dry cell from 5 industries is 225 T per year. The raw materials consumption per 1000 dry cell batteries are tabulated below.

Table: 4.7.1 :Raw materials Consumption

Raw materials	Quantity (Kg)
Carbon black	2.90
E.M.D	7.40
N.D.D. IND	17.10
AMM. chloride	7.16
Zinc choloride	8.13
Mercuric cholride	0.014
Gum karya	0.129
Zinc oxide	0.42
Asphalt	2.57
Carbon Rod	1030.00
Tissue paper	0.043
Kraft paper	3.84
Grey board 300 gm	2.16
Mill Board 300gm	2.16
Level metal jacket	1030.00
Brass/Steel cap	136.7
Plastic top	82.00
Glue	15.00
Zinc calot	1217.4
Wheat flour	4.13
Corn starch	19.28
H..P.Wax	40.51

Source : DOI, 2003

On the basis of application of lead cell in various sectors, total estimated consumption of batteries is 3042 tones/yr and scrap quantities is 3042 T/yr .

Calculated based on the assumption that batteries for motor cycles, cars, tempos, mini busses and other vehicles contain approximately 85% lead while batteries for other purposes contain approximately 60% lead.

Table: 4.7.2 :Estimated current and future consumption and scrap generation for lead acid batteries in Nepal

Application	Estimated consumption (tons batteries)		Estimated scrap quantity (Tons batteries)	
	1998	2008	1998	2008
Automobile sector,	1770		1240	2075
Traction sector, total -Electrical vehicles -Other purposes	155-190 155-190 1	800-1070 800-1070 1	1-50 0-50 1	1-930 0-930 1
Stationary sector, total -Solar energy systems -Other purposes	80-95 37-39 41-56	225-320 170-240 56-81	20-30 3-5 16-26	110-190 90-160 21-31
Total	2005-2055	3535-3900	1260-1320	2185-3195

Source: COWI, 2001

The total consumption of dry cell batteries has been estimated to be 4.5 million per year. The total amount of dry cells disposed of per year is about 225T. In addition, about 10 T/Yr are generated from the factories in the country , now total hazardous waste generation is 325T/Yr. (SOE Nepal Report, 2001)

Table: 4.7.3 :Total Annual Consumption

Total Annual Consumed	
Category	**Quantity**
Lead Acid Battery	3042.00 T
Dry Cell Battery	
Production	225.00 T
Imported	62350.00 T
Total	**65617.00 T**

* Based on Industry Productions (Dept. of Industries)

The table below shows the total hazardous waste generated from the Battery Industries sector of Nepal.

Table: 4.7.4 : Hazardous Waste Generation from Battery Industries

Total Waste Generation		
Sources	**Percentage**	**Quantity**
a. Discarded after use	100.00%	65617.00 T
b. Production Waste at Industries	5.00%	24.25 T
Total		**65642.25T**

** Based on the Total Annual Imports (Source: Dept. of Customs, 2003)

8. Automobile Tyre

There is only one tyre producing industry registered in Nepal, which is Gorkhali Tyre Industry.

Yearly raw materials required for Gorkhali Tyre Industry is listed below:

Table: 4.8.1 : Raw materials required for Tyre Production

Raw Materials	Quantity MT
Rubber (natural, synthetic and reclaimed rubber)	3120
Carbon black	1330
Nylon Cord	500
Rubber Chemical	970
Steel bead wire	250
Other chemicals	50

Source : Company Registration Data, DOI

Hazardous Waste generation

The total number of vehicles increased from 75,141 in 1990 to 207,579 in 1998. Two wheelers (motor cycles) accounted for the largest share, followed by light vehicles such as cars, jeeps, and vans. In 1998, the largest number of vehicles was registered in the Bagmati zone, which includes Kathmandu, making up about 57% of the total vehicles registered in Nepal.

Along with the increasing rate of vehicles, the waste generation has also increased. The annual increase in the number of vehicles is 17 % for Nepal (SOE Nepal Report, 2001).

Table: 4.8.2 : Total Consumption

Type of Production	Domestic Production	Imported
Automobile Tyres	122000	75680
Bus & Truck Tyres		68272
Motor Cycle Tyres	20000	29530
Bicycle Tyres	400000	673845
Others	29327	
Total	**2556.64 T**	

There is dynamic equilibrium established between used tyre rate and resoling tyre.

Hence 100 % Hazardous waste is generated from 2556.64 T of consumed tyre.

9. Soap and Detergent Industry

Soap and Detergent industry is also considered as one of the polluting sectors. Out of 26 industries only 23 are registered in the VAT office and can be considered that they are in operation currently.

The annual production of different types of soap and detergent is 31529.85 T.

Besides caustics and silicates, the industry uses oils and fatty acids of different kinds and composition as raw material. In addition, sodium chloride, acetic acid, potassium hydroxide, calcium, magnesium and zinc chemicals are also used. For the preparation of soap, different processes carried out generates various types of wastes.

On the basis of different production capacity from different soap industries, hazardous waste generation also vary.

Hazardous Waste Generation

The wastes produced from different processes for production of 15 tons of soap are as follows:

Table: 4.9.1 : Wastes produced from different processes for production of 15 tons of Soap

S.N	Process	Type of waste	Quantity of waste, %	Remarks
1.	Raw Material Preparation	Oil and Chemical spills	0.012	Washed out as effluent
2.	Saponification	Spent Lye with chemical like Caustic Soda, Salts, soap, unsaponified fatty acid etc.	19.2	Most quantity can be reused after Settling and Bleaching
3.	Mixing	Fillers and Additives	0.032	Washed as effluent
4.	Filtering and intermediate storing	Soap	0.35	Reused in previous process
5.	Vacuum Spray Drying	Soap	0.47	Reused in previous process
6.	Extrusion	Soap	0.16	Reused in previous process
7.	Cutting	Soap	4.45	Reused in previous process
8.	Stamping and Packing	Soap	2	Reused in previous process

Source: ESPS, 2004

Table: 4.9.2 :Total Annual Production

Total Annual Production *	
Category	**Quantity (T)**
Soap and Detergent	31529.85
Total	**31529.85**

* Based on Industrial Statistics, Dept. of Industries, 2002/03

The table below shows the total hazardous waste generated from the Soap and detergent Industries sector of Nepal.

Table: 4.9.3 : Hazardous Waste Generation from Soap Industries

Total Waste Generation	
Category	**Quantity**
Effluent	6053.73 T
Oil & Chemicals	0.01 T
Caustic Soda	113.00 T
Additives	0.01 T

Calculation Based on ESPS 2004

10. Vegetable Oil And Ghee Industry

Vegetable ghee and oil industry is also a pollution-prone industry. There are 16 medium and large scale industries operating at present and most of the industries are located in and around Biratnagar and Birgung areas. The medium and large scale units produce vegetable ghee and refined oil as the main products. Total annual production from this sector is estimated to be 115000T.

A majority of raw materials are imported from India and other countries, such materials are:

(a) Palm oil (Acquired from Malaysia)
(b) Soybean oil (from India, Brazil and other countries)
(c) Chemicals like Nickel catalyst, bleaching earth, caustic soda, sulfuric acid (very small quantities) and other chemicals and detergents primarily from India.

In general, the consumption of raw materials depicts the following trends per ton of oil or ghee produced.

a)	Electricity-	145-150 kWh
b)	Raw oil-	1.02 tones (soya or palm)
c)	Sesame oil-	30-70 kg
d)	Rice husk-	0.65-0.8 tones
e)	Caustic soda-	1.5501.7 kg
f)	Phosphoric acid-	0.9-1.1 kg
g)	Bleaching earth and/or activated carbon-	1.4-1.6 kg
h)	Common salt-	
i)	Furnace or fuel oil + Diesel oil-	0.7-0.85 ltr.
j)	Coal-	0.3-0.4 kg
k)	Nickel catalyst-	6.25 kg

Source:ESPS, 2001

Hazardous Waste generation

Effluents characteristic of the 4 industries surveyed by ESPS are shown below. This indicates the presence of hazardous and harmful pollutants in effluents.

Table: 4.10.1 : Characteristic of Effluent from 4 different Vegetable Oil Industries

Parameters	Industry			
	1	2	3	4
pH	7.34	7.72	6.11	6.8
TSS mg/L	230	150	275	630
TDS mg/L	4400	2500	2700	880
COD mg 0_2/L	1237	571	475	1520
Oil & Grease mg/L	895	481	579	532
Cr mg/L	<0.01	0.01	<0.01	0.03
Ni mg/L	0.02	0.03	0.33	<0.01
Mn mg/L	0.04	0.16	0.30	0.01
Cu mg/L	0.14	0.02	0.03	0.03
Zn mg/L	0.51	0.03	0.05	0.06

Source: ESPS, 2001

Table: 4.10.2 : Annual Waste generated from 115000 T of Production

Waste Type	Production Rate	Total Quantity
Filter Cloth	0.25 kg / MT of Product	2.87 T
Soap Stock	200 kg / 10 MT of Product	2.3 T
Spent Bleached Earth	100 kg / 10 MT of Product	11.5 T
Exhaust Catalyst	10 kg / 10 MT of Product	115.0 T

Source :Registered in DoI

The table below shows the total hazardous waste generated from the Vegetable ghee and Oil Industries sector of Nepal.

Table: 4.10.3 :Hazardous Waste Generation from Vegetable Ghee and Oil Industries

Total Annual Production *		Total Waste Generation	
Category	**Quantity (T)**	**Category**	**Quantity**
Vegetable Ghee & Oil	115000	Sludge Waste	131.68 T
		Spent Bleach	11.5 T
		Nickel Catalyst	115 T
Total	**115000 T**		

* Based on Industrial Statistics, Dept. of Industries, 2002/03

11. Hospital and Medical Wastes

Hospital and Medical waste stands as a great source of hazardous wastes. Total number of hospital and medical centers are 129 in Nepal. According to the Kathmandu Municipality survey on medical waste management, it was reported that 20% hazardous waste generated from Hospital/Medical are in total municipal waste.

B. Tuladhar (1999) estimated that a total of 6,521 hospital bends in Nepal generally approximately 500T of hazardous waste per year. Waste generated per patient per day is 1.72 Kg. and 26 % of these wastes are hazardous wastes.

Over 60 health institution in the capital produce 1300 Kg. of hazardous waste every day. In total waste generation has characteristics of 82.2% non-infectious, 14.16% infectious and 3.64% sharp type of wastes.

Waste generation from this field is directly thrown out into municipal waste. Wastes like amputied body parts, foetues, clotted blood, date expired medicines and needles must be managed carefully and treated with caution.

Among annual 500T hazardous waste containing 395.30T Infectious and 101.55T sharp.

Table: 4.11.1 :Total annual hazardous waste generated from Hospital and Medical sector.

Hazardous waste type	Total quantity (T/yr)
Infectious	395.30
Diagnostic Medicine, Left over medicine, Sharp objects	101.55

12. Pharmaceuticals

There are 37 number of pharmaceuticals industries that are registered with the Department of Drugs Management in Nepal.

Considering high volume of production species from each pharmaceuticals and computing imported quantity of medicinal products, the total annual production of tablet/capsule is estimated to be 181335 kg. and liquid syrup 14000000 kg.

Since, the pharmaceutical industries in Nepal all import the required chemicals in required amounts, especially from India, and does not produce its own chemicals, the waste generated are: production processes, discarded due to quality rejection, rejected due to date expiry and spillage/destruction during handling, which is of small quantity.

Table: 4.12.1 :Total Annual Consumption of Medicines

Total Annual Consumed	
Category	**Quantity (T)**
Production Capacity	
Tablet / Capsules	181.335
Syrups	14000.0
Total	**14181.335**

* Based on Industry Productions (Dept. of Industries)

** Based on the Total Annual Imports (Source: Dept. of Customs, 2003)

The table below shows the total hazardous waste generated from the Pharmaceutical Industries sector of Nepal.

Table: 4.12.2 : Hazardous Waste Generation from Pharmaceutical Industries

Total Waste Generation		
Generation Mode	**Percentage +**	**Quantity (T)**
a. Production Waste at Industries	2.00%	283.626
b. Discarded due to Quality Rejections	0.50%	70.906
c. Rejected due to Date Expiry	1.00%	141.81
d. Spillage & Destruction	1.50%	212.72
Total		**709.066**

+ The percentage mentioned are assumptions based on discussion Industry Production Managers

13. Pesticides and Insecticides

Pesticides are substances that kill or otherwise control an unwanted organism. There are persistent pesticides which are not degraded by chemical and biology activity. They are bio-accumulative, that is, they are retained within the body of the organism which ingests them. Insecticides, fungicides, herbicides, all are under pesticides. These chemical pesticides share the common toxic property. Hence, obsolete pesticides or pesticide containers can be classified as hazardous waste.

Altogether an estimated 250 types of pesticides are used in Nepal. Among them, according to a survey conducted in 1995, the most commonly used pesticides in Nepal were BHC, Aldrin and Endosulfan (SOE, 2001). The average agricultural use of pesticide was 0.17 Kg./Ha in 1986 (CBS1998) and 0.142 Kg/Ha in 1995 (Palikhe, 1999). All these pesticides are organochlorides and organophosphates.

The largest stockpile is located in Agriculture Input Corporation (AIC) at Amelekhgunj. It is estimated that 50.9 Tons of obsolete pesticides are stored in a warehouse of AIC. 14.47 MT organic phosphates, orgnochlorines and organomercury are stored at AIC, Nepalgunj and other places. At CBD, 3.71 MT pesticides is stored. 44 cylinders of methylbromide are stored at Kathmandu.

Table: 4.13.1 : Stockpile Pesticides in various sites in Nepal

Site Name	Organic phosphates	Organochlorine	Organomercury	Methyl Bromide	Total in metric Tons
AIC, Amlekhgunj	8.10	35.40	7.40		50.90
Nepalgunj & others	12.93	1.54			14.47
Khumaltar	3.88	0.16	0.73		4.76
Cotton Development Board, (CDB)	3.71				3.71
Khumaltar Birtipur				22 Cylinders 21 Cylinders	
Total	28.62	37.10	8.13	43	73.84

Source: Anonymous, 1992; PPD, 2000; Ento.Div. 2002

Similarly, 2 MT of Aldrin dust including some organophosphate chemicals and mercury are stored at AIC. Organochlorine and Organomercury pesticides stored at AIC warehouse are listed below:

Table: 4.13.2 :Organochlorine and Organomercury pesticides stored at AIC warehouse in Nepal

Pesticide Name	Quantity
Endrin	1200 lit
Aldrin Dust	2.0 ton
DDT Dust	3.22 ton
Lindane Granules	0.625 ton
Chlordane Dust	1.35 ton
BHC Dust	6.8 ton
2, 4-D Wettable Powder	1.0 ton
Unidentified including OC Pesticides	22.5 ton
Organomercury	7.58 ton

Source: ADB TA 2808 & AIC

Table: 4.13.3 :Stored pesticides at AIC warehouse in Nepal

Pesticide Name	No. of Containers	Quantity
Endrin liquid (Lit)	19 drums	1200 Lit
Organomercury	47 drums	7.4 ton
DDT dust	16 drums	3.2 ton
Lindane granules	3 drums	0.5 ton
BHC dust	25 drums	6.8 ton
Chlordane dust	5 drums	1.2 ton
2, 4-D Wettable Powder	4 drums	1 ton
Unidentified including OC Pesticides	108 drums	22.5 ton

Source: ADB TA 2808 - NEP

Total annual imported pesticides is 21678128 Kg and waste generated 975515.76 Kg from sources during production, rejected due to date expiry, spillage and destruction and decomposed.

Table: 4.13.4 : Total Annual Imported Pesticides

Total Annual Imported **	
Category	**Quantity**
Malathion, BHP, MEC Formulation	10707.34 T
Anti Mosquito coils	4844.64 T
Fungicides	12.70 T
Herbicides	632.60 T
Disinfectants	15.06 T
Rodenticides	4477.60 T
Others	988.16 T
Total	**21678.12 T**

** Based on the Total Annual Imports (Source: Dept. of Customs, 2003)

The table below shows the total hazardous waste generated from the Pesticide Consumption sector of Nepal.

Table : 4.13.5 : Hazardous Waste Generation from Pesticide Consumption

Total Waste Generation		
Generation Mode	**Percentage +**	**Quantity**
a. Rejected due to Date Expiry	0.50%	108.39 T
b. Spillage & Destruction	5.00%	1083.90 T
Total		**1734.25 T**

+ The percentage mentioned are assumptions based on discussion with venders and users.

Currently, about 67 T of hazardous obsolete pesticides are stockpile in unsafe conditions at various location within the country (DOA 2000). In Kathmandu, 6 MT are stored unsafely in the Southern outskirts of Patan. According to a survey conducted in 1995, 38% of pesticides are buried, while 25% threw then in open dumps, 17.5% gave them to friends, 10.8% reused them and 8.3% threw into waste containers. Similarly, the pesticide containers were disposed in the following manner.

Throw	46%
Burn	26%
Buried	18%
Reuse	10%

(Source : SOE 2001)

This above data and table shows mismanagement of pesticide waste is a major spreading source of hazardous waste . this is due to the lack of knowledge of impact of hazardous pesticides.

14. PCB Stockpile

The well known acronym PCBs (Poly Chlorinated Biphenyls) stands for a group of industrial organochlorine chemicals that became a major environmental concern. Although not pesticides, they are used in a variety of applications because of their certain other properties. Like many other organochlorines, they are very persistent in the environment and they bioaccumulate in living systems. As a result of careless disposal practices, they have became a major environmental contaminant in many areas.

All PCBs are practically soluble in fatty or oily substances and are excellent electrical insulators. As a result of these properties, they were used extensively as the coolant fluids in power transformers, capacitors, de-inking solvents for recycling newsprint, as heat transfer fluids in machinery, and as water proofing agents.

Liquid PCB is mainly used in electrical transformers. As these electrical units are gradually decommissioned, their PCB content usually is stored in order to prevent further contamination of the environment in some locales. PCBs are destroyed by incineration.

Previously, PCB containing transformers were often just dumped in to landfills, and their PCB content was allowed to leak into the ground. In summary, PCBs were released into the environment during their production, their storage and their disposal.

Approximately 2000 liters of PCB wastes are accumulated in Nepal, according to the study by NBSM, 2001.

Transformer Oil imported for the year 2001 was 59477.6 Kg (DOC, 2001).

The exact content of PCBs in imported Transformer Oil could not be confirmed but the data quoted in the Country Case Study, 2000, PCB concentration is 1.2 mg per Kg of Transformer oil. Hence the total PCB in 59477.6 Kg of transformer oil is estimated to be 7.13 Kg.

However, it could not be confirmed whether imported Transformer Oil, at present, contains 1.2 mg PCB/Kg or not.

15. Surface Finishing Sector

Gold Plating Sector : Mercury Waste Generation from Gold Plating Industries

Because Mercury is the only heavy metal that is a liquid at room temperature, it is widely used as a fluid in medical thermometers, in fluorescent light bulbs and objects were plated (surface finishing) with gold or silver by rubbing them with an amalgam of mercury and the precious metal, an then heating the object off the mercury . Mercury is the most volatile of all metals and its vapor is highly toxic.

In the context of Nepal, gold amalgam is used in Patan area, where traditional business of plating idols with gold is undertaken without any precautions from its toxic effect. There is consumption of One Kg. mercury per 1 Tola Gold for about one feet idol, as reported by the gold plating craftsmen. 100 % mercury is evaporated out after the completion of this process.

Mercury is imported from India, by local vendors, according to craftsmen and Cottage Industry in Patan Area.

Table :4.15.1 : Total Hazardous Waste generation from Gold-plating industries

Consumption of Materials *		Total Waste Generation		
Category	**Quantity**	**Category**	**Generation**	**Quantity**
Gold	0.1368 T	Mercury Evaporated after process	100 %	12.00 T
Mercury (@ 1 kg per idol)	12.00 T			
Gold Plated Idols produced	12000 No.			

* Based on Industrial Statistics, Dept. of Industries, 2002/03

Galvanizing Sector :

The total quantity of galvanized production (e.g. CGI Sheets, wires and pipes)in Nepal is 140026 T.

The galvanizing process also uses various chemicals, thinners for cleaning, paints and Zinc metal for zinc-galvanizing. For a production of 100 kg of GI Sheets, 7.11 Kg of Zinc is consumed. The hazardous waste generated is given in the Table 4.15.3.

Table: 4.15.2 :Required Raw Materials For 100 Kg Production

Type Of Production	Raw Materials	Quantity
G.I Pipe, G.I Wire, & G.I Sheets	H. R Sheet	93.7 Kg
	Zinc	8.87 Kg
	Other Chemicals	1.41 Kg

Source: DoI, Norms 2058

Table: 4.15.3 :Total Production of Galvanized Products

Total Annual Consumption*		
Category		**Quantity (T)**
G. I. Sheets, Pipes, Wire	Production*	140026.00
	Imported**	188312.52
Total		**328338.52**

* Based on Industrial Statistics, Dept. of Industries, 2002/03

**Based on Department of Custom, 2003

The table below shows the total hazardous waste generated from the Galvanizing sector of Nepal.

Table: 4.15.4 :Hazardous Waste Generation from Galvanizing Sector

Total Waste Generation		
Generation Mode	**Percentage**	**Quantity**
a. Production Waste Zinc and other hazardous wastes	4.00 %	5601.56 T
b. Discarded after used / Damage and other wastes	50 %	94156.2 T
Total		**99757.76 T**

B. Non - Specific Sources Quantification

Listed below are the substances from Non-Specific Sources and listed as Hazardous Wastes, with quantities imported as per the Department of Customs 2003 data.

	Quantity
Tetrachloroethylene	39.49 L
Trichloroethylene	294.38 L
Methylene Chloride	8117.26 L
1,1,1 - trichloroethane	662.73 L
Carbon tetrachloride	347.74 L
Cresols	1960.34 L
Toluene	238268.07 L
Methyl ethyl ketone	471.55 L
Carbon disulfide	45.28 L
Benezene	15963.06 L
Acetone	22586.00 L
Methyl isobutylketone	2750.69 L
Cyclo hexanane	81.19 L
Methylene Chloride	3596.65 L
Tetrachloroethylene	50.83 L

Electroplating
Aluminium, Tin, Zinc
Sulphuric Acid
Cyanide

Chemical Industry
Pentachloro-phenol
Tetra or penta or hexachlorobenzene
Tri or tetrachlorophenol
Chlorinated Aciphatic Hydrocarbon
Tetra-penta-hexa Chlorobeneze

Tri-Tetra, penta chlorophenol

Wood Preserving Process
Chlorophenolic Chemicals
Cresol formulations
Pentachlorophenol
Arsenic
Chromium

Petroleum Refinery
Primary Sludge
Emulsified Secondary Sludge

List of Major imported hazardous chemicals as per the Data compiled by Dept. of Customs for the year 2003:

Types of Hazardous chemicals	Quantity (T)
Chlorine	2508.00
Sodium hydroxide	15987.95
Bleaching Powder	346.54
Acids	634.16
Vinylacetate	16.00
Hexene oil	150.49
Methyl alcohol	128.97
Organic solvents	148.55
Lead	77.07
Zinc oxide	0.56
Lead Oxide	380.67
Zinc sulphate	1.50
Chromium sulphate	28.60
Formaldehyde	742.61
Chloroform	329.79

Source : DOC, 2003

Chapter 5 : Basel Convention

This Chapter discusses the Basel Convention, its objective, general obligation, and classification of wastes.

5.1 Basel Convention

The Basel Convention, an international agreement on transboundary movement and disposal of hazardous wastes, is the most effective instrument against such garbage imperialism. The Basel Ban (1995) puts a stop to the export of hazardous wastes to developing countries for final disposal and recycling.

The need for it to be ratified and effectively implemented at ports and customs is thus an urgent requirement. The impressive industrial productivity that characterizes the so–called developed world comes at a price that are reluctant to pay : hazardous wastes that are expensive and dangerous to dispose or recycle.

Most of the countries receiving the waste are tragically ill equipped to process or dispose of it. Efforts to extract recyclable or potentially valuable elements from the waste attract the poorest of people working in uncontrolled and exploitative circumstances. Lack of the most basic regulations leaves the workers vulnerable to poisoning and disease.

So while waste traders make money from dumping hazardous wastes, the health of people and the environments in less-industrialized countries are sacrificed to this poisonous trade.

The overall goal of the Convention is to protect human health and the environment against the adverse effects which may result from the generation, transboundary movements and management of hazardous wastes.

The main objectives of this Convention are:

- A control system for the trans-boundary movement of wastes aiming at the reduction of trans-boundary movement of wastes; and
- The environmentally sound management of wastes aiming at the reduction of the quantity of wastes to a minimum.

Nepal is a signatory of the Basel Convention and thus Nepal needs to obey the commitments stipulated in the Convention. However at present Nepal does not have the preliminary data on the Inventory of Hazardous Waste in the Country and how they are managed. Thus the first step would be to prepare the Inventory of the Hazardous Wastes for which this study has been designed.

5.2 General Obligations of Basel Convention

(a) Ensure that the generation of hazardous wastes and other wastes within it is reduced to a minimum, taking into account social, technological and economic aspects;

(b) Ensure the availability of adequate disposal facilities, for the environmentally sound management of hazardous wastes and other wastes, that shall be located, to the extent possible, within it, whatever the place of their disposal;

(c) Ensure that persons involved in the management of hazardous wastes or other wastes within it take such steps as are necessary to prevent pollution due to hazardous wastes and other wastes arising from such management and, if such pollution occurs, to minimize the consequences thereof for human health and the environment;

(d) Ensure that the trans-boundary movement of hazardous wastes and other wastes is reduced to the minimum consistent with the environmentally sound and efficient management of such wastes, and is conducted in a manner which will protect human health and the environment against the adverse effects which may result from such movement;

(e) Not allow the export of hazardous wastes or other wastes to a State or group of States belonging to an economic and/or political integration organization that are Parties, particularly developing countries, which have prohibited by their legislation all imports, or if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner, according to criteria to be decided on by the Parties at their first meeting.

(f) Require that information about a proposed trans-boundary movement of hazardous wastes and other wastes be provided to the States concerned, according to Annex

V A, to state clearly the effects of the proposed movement on human health and the environment;

(g) Prevent the import of hazardous wastes and other wastes if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner;

(h) Co-operate in activities with other Parties and interested organizations, directly and through the Secretariat, including the dissemination of information on the trans-boundary movement of hazardous wastes and other wastes, in order to improve the environmentally sound management of such wastes and to achieve the prevention of illegal traffic.

5.3 Waste classification according to Basel Convention

Categories:

1. **Annex I** a list of 45 categories of wastes which are themselves divided into:
   - Wastes streams (e.g: clinical wastes, waste mineral oil, PCBs, etc.);
   - Wastes having as constituents certain enumerated substances

   (e.g: copper compounds, arsenic, cadmium, lead, organic cyanides, halogenated organic solvent, etc.).

2. **Annex III** lists 13 classes of hazardous characteristics numbered H3 to H33

Annex I

Waste streams List of wastes (Y list)

Y1 Clinical wastes from medical care in hospitals, medical centers and clinics

Y2 Wastes from the production and preparation of pharmaceutical products

Y3 Waste pharmaceuticals, drugs and medicines

Y4 Wastes from the production, formulation and use of biocides and phytopharmaceuticals

Y5 Wastes from the manufacture, formulation and use of wood preserving chemicals

Y6 Wastes from the production, formulation and use of organic solvents

Y7 Wastes from heat treatment and tempering operations containing cyanides

Y8 Waste mineral oils unfit for their originally intended use

Y9 Waste oils/water, hydrocarbons/water mixtures, emulsions

Y10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybromated biphenyls (PBBs)

Y11 Waste tarry residues arising from refining, distillation and any pyrolytic treatment

Y12 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish

Y13 Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives

Y14 Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known

Y15 Wastes of an explosive nature not subject to other legislation

Y16 Wastes from production, formulation and use of photographic chemicals and processing materials

Y17 Wastes resulting from surface treatment of metals and plastics

Y18 Residues arising from industrial waste disposal operations

Wastes having as constituents:

Y19 Metal carbonyls

Y20 Beryllium; Beryllium compounds

Y21 Hexavalent chromium compounds

Y22 Copper compounds

Y23 Zinc compounds

Y24 Arsenic; arsenic compounds

Y25 Selenium; selenium compounds

Y26 Cadmium; cadmium compounds

Y27 Antimony; antimony compounds

Y28 Tellurium; tellurium compounds

Y29 Mercury; mercury compounds

Y30 Thallium; thallium compounds

Y31 Lead; lead compounds

Y32 Inorganic fluorine compounds excluding calcium fluoride

Y33 Inorganic cyanides

Y34 Acidic solutions or acids in solid form

Y35 Basic solutions or bases in solid form

Y36 Asbestos (dust and fibers)

Y37 Organic phosphorus compounds

Y38 Organic cyanides

Y39 Phenols; phenol compounds including chlorophenols

Y40 Ethers

Y41 Halogenated organic solvents

Y42 Organic solvents excluding halogenated solvents

Y43 Any congenor of polychlorinated dibenzo-furan

Y44 Any congenor of polychlorinated dibenzo-p-dioxin

Y45 Organohalogen compounds other than substances referred to in this Annex (e.g. Y39, Y41, Y42, Y43, Y44)

Annex III Hazard criteria (H codes) List of Hazardous Characteristics

H3 Explosive

H3 Flammable liquids

H4.1 Flammable solids

H4.2 Substances or wastes liable to spontaneous combustion

H4.3 Substances or wastes which, in contact with water emit flammable gases

H5.1 Oxidizing

H5.2 Organic Peroxides

H6.1 Poisonous (Acute)

H6.2 Infectious substances

H8 Corrosives

H30 Liberation of toxic gases in contact with air or water

H31 Toxic (Delayed or chronic)

H32 Ecotoxic

H33 Capable, by means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

Chapter 6 : Conclusion and Recommendations

This report on Hazardous Waste Inventory for Nepal has identified and quantified the hazardous waste generated from specific and non-specific sources. The present study has thus identified the sectors of high quantity of hazardous waste generated in the Nepalese context.

This report has prepared the Inventory of Hazardous Wastes based on the Basel Convention's definition and categorization, since Nepal has not yet categories this own list. It is expected that Nepal's obligation as a signatory of Basel Convention is expected to be fulfilled as a result of this Inventory preparation.

Even though the problem of Trans-boundary movement of Hazardous Wastes is not a major problem in Nepal's context, the management of wastes seems to be a major area lacking for proper disposal without rendering health impacts and negative environmental impacts.

It is recommended that Nepal needs to monitor the emission of hazardous wastes by the industries that are identified in our study and make such industries abide by the rules and regulations of Environmental Protection of Nepal.

The following are the recommendations to be carried out for better management of Hazardous Waste in the Nepalese context :

1. Establishment of Hazardous Waste Database:

In the Nepalese context, the availability of reliable data is a major problem. For the management of any sector, its adequate and reliable data is a prerequisite. For the management of Hazardous Waste, there is an urgent need to establish a Database that records the type of hazardous waste that are being used in Nepal, their sources of import and quantity used in each sector.

This database could be developed by the MOPE in collaboration with the Department of Coustoms, since the DoC has already developed a computerized database system for all its items imported in Nepal. This DoC's database will be immensely helpful for the establishing of Hazardous Waste Database.

2. Developing a Tracking Mechanism

A mechanism to track the generation, use and disposal of hazardous wastes by sectors who are using them, especially the industries of specific sources need to be developed. The hazardous waste database would help to identify the users and this mechanism would make possible the concerned industries/ sectors responsible to periodically report their consumption, use and hazardous waste generated. It is recommended that MOPE, DoC and DoI should collectively work in establishing such a mechanism.

3. Developing Hazardous Waste Management Legislation and Manual

There is an urgent need to develop a legislation for all the users and handlers of Hazardous substances to follow rule and regulation for transporting, storing, disposal and use. This legislation should ensure that people and environment that come into contact with these substances are safe guarded against their toxic effects. The Manual should educate concerned people on safe handing of these substances. The MOPE should take the initiative to develop the legislation an the manual.

4. Establishment of Safe Disposal Facility

It is important that MOPE, in collaboration with other Environmental agencies, establish a prototype integrated hazardous waste management facility. This facility should demonstrate a small-scale safe disposal methods. For instance, a physical landfill site facility or an improved incinerator.

5. Others

- Generating public awareness about health impact of hazardous waste is very important. Public awareness about hazardous waste management or handling needs to be raised through public media, posters, drama, school education programs and so on. The local elite, political leaders, social activities and NGOS should be involved in public awareness programs about hazardous waste.

- The ongoing practice of direct discharge of domestic sewage and industrial waste contaminate with hazardous substances into rivers is one of the main cause of pollution. To solve this problem a practical, reliable and cheaper method of treating effluent before being passed into the river should be sought, biological waste water treatment would be one of the best alternatives. Such treatment plants should be planned to treat the majority industrial and domestic waste.

- Because of the poor monitoring system of hazardous waste generated sector, programs aimed at mitigating the deteriorating conditions of the environment have not been successful. Existing monitoring systems in government organizations tracking activities in the right direction and with an output orientation need to be made more defective, this can be achieved with dedication and commitment.

REFERENCE:

1. Colin Baird, Environmental Chemistry , University of Western Ontario, 1995

3. Basel convention on the control of Trans-boundary movement of Hazardous wastes and their Disposal and Protocol on liability and compensation for Damage Resulting from Trans-boundary Movements of Hazardous Wastes and Their Disposal, United Nation Environment Protection, UNEP

4. Politics in Poison, Nepal Forum of Environmental Journalist, 2060, Kathmandu

5. Nepal: State of the Environment (SOE), 2001, United Nations Environment Programme, UNEP.

6. Country Case Studies on Persistent Organic Pollutants (POPs) March 2000, United Nations Environment Programme, UNEP.

7. Strengthening of Environmental Administration and Management at the Local Level – Nepal (SEAM-N), A Reference Guide for Self-Monitoring System in Dharan-Biratnagar Industrial Corridor, March 2004.

8. Foreign Trade Statistics, Fiscal year, 2057/058, His Majesty's Government Ministry of Finance, Department of Customs, Statistics Section

9. List of Hazardous Chemicals, 2061, Prepared by Department of Customs Laboratory Section, Kathmandu.

10. Material Consumption Norms Part I & Part II, Ministry of Industry, Commerce and Supplies, Department of Industries, Tripureshwor, Kathmandu. 2060.

11. Drug Bulletin of Nepal (DBN), 2004 His Majesty's Government Ministry of Health Department of Drug Administration.

12. Annual Imported and Exported Statistics Fiscal year 2059/060, Customs Department, Statistics Section, 2060

13. Pulp & Paper Industries of Nepal , Baseline Study Report, Environment Sector Programme Support April 2004

14. Soap Industries of Nepal , Baseline Study Report, Environment Sector Programme Support, June 2004

15. Baseline Study of Leather Tanning Industries, Environment Sector Programme Support, December 2001

16. Textile Industries of Nepal, Baseline Study Report, Environment Sector Programme Support, May 2003

17. Vegetable Oil and Ghee Sector, Baseline Study Report, Environment Sector Programme Support, December 2001

18. Baseline Study of Wool Processing Industries, Baseline Study Report, Environment Sector Programme Support, December 2001

19. Anonymous 1992, Registration, regulation and use of pesticide in Nepal. First draft - terminal report prepared by ANZDEC Ltd.

20. Plant Protection Directorate, 2002. Bali Samrachan Karyakramko Parichaya, Upalabdhi ra Sanchlan Karyabidhi. Plant Protection Directorate. Pesticide Registration Office, Harihar Bhavan, Lalitpur.

21. COWI, 2001, Study on environmentally benign handling, disposal and recycling of used lead-acid batteries in Nepal. COWI / DANIDA.

22. Trankler J. 2002. Hazardous Waste Management Technology (Revised), AIT, Thailand.

23. Entomology Division, 2002. Annual Technical Report 1994/1995. Entomology Division, Nepal Agriculture Research Council, Khumaltar, Nepal.

24. Adhikari, J.R. and Pokhrel, N.P., Government Policy on Management of Hazardous Substances, in Implementation of Stockholm Convention on Persistent Organic Pollutants (POPs) Enabling Activities in Nepal, Proceedings of Inception Workshop, 2004, MoPE, UNIDO.

Presentation Discussion

A presentation of the Draft Final Report was organized on July 12, 2004 at the premises of the MoPE with an objective to present the contents of the report and gather comments and suggestions for the improvement on the Draft final Report.

It was observed that this Inventory, prepared within a short period of time, does not assume to be comprehensive and the data in exact figures. However, the Inventory identifies and quantifies the most prominent sectors that generate Hazardous waste in Nepal . The Inventory was prepared based on secondary data from published sources and some fields verifications ware also carried out.

During the presentation, it was suggested that some additional sectors like Rubber Product Industry , Foam Producing Industry, some unidentified hazardous materials at various Hydro-power plants, should also be included in the Inventory. As stated in the Report, this Inventory was based on the sectors that were labeled as the "most pollution causing" industries. The Industries stated above and some other sectors, could not be included in the Inventory because of their comparatively small contribution and also because of the limited tine and resources available in preparing this report . However, it is suggested that the above sectors and other chemical-using sectors be included while performing similar studies in the future .

The issues related to POPs, including PCBs were also discussed with interest. The participants pointed out that Nepal has the inventory of most of the obsolete pesticides. The PCB is also quantified to a certain extent but efforts are underway to exactly determine the PCB contents in the Transformer Oils used within Nepal.

The participants of the presentation also observed that the overall content of the Inventory presented in the Report was of satisfactory nature and also a positive step towards creating a much needed, national level database. The participants also agreed on the Conclusions drawn at the end of the report.

The list of participants are attached in the Annex overleaf.

Annex :

List of Participants at Draft Final Report Presentation at MoPE. (July 13, 2004)

	Name	Affiliation
1.	Mr. Dilip Khatiwada	Ministry of Population and Environment
2.	Mr. Narendra Pokharel	POPs / Ministry of Population and Environment
3.	Mr. Gaurav Dahal	Ministry of Population and Environment
4.	Mr. Purushotam Kunwar	Ministry of Population and Environment
5.	Mr. Surya Man Shakya	Solid Waste Management & Resource Mobilization Center
6.	Mr. Bhupendra Devkota	POPs / Ministry of Population and Environment
7.	Mr. Jaya Ram Adhikari	POPs / Ministry of Population and Environment
8.	Ms. Nira Pradhan	EIA / Ministry of Population and Environment
9.	Mr. Suman Sharma	EIA / Ministry of Population and Environment
10.	Mr. Rajendra Pd. Ghimire	EIA / Ministry of Population and Environment
11.	Mr. Durba N. Manandhar	POPs / Ministry of Population and Environment
12.	Mr. Durga Pd. Koirala	Environment Sector Programme Support
13.	Mr. Deepak Adhikari	Environment Sector Programme Support
14.	Ms. Sarita Paudel	Environment Sector Programme Support
15.	Ms. Rashmi Rana	Nepal Health Research Council