Final Report

on

Development of Profile of Toxic Waste Products in Nepal

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Table of Contents

List of Tables

1.0 Introduction

1.1 Inventory/Profile development of toxic wastes

Toxic wastes are produced by various activities and phenomena particularly in the industrial/commercial sector and the inventory/profile development of toxic wastes can be taken as an essential step towards reduction and eventual elimination of such releases in to various environmental compartments. But development of such profiles at national/regional levels is a meticulous task requiring diligent efforts and the knowledge on various processes involved, to work out quantitative expressions of different releases.

1.2 National legislation and control mechanism in toxic waste management

The formulation of an appropriate environmental quality standard, and the design and operation of industrial and waste management establishment in Nepalese context has always been a challenging and difficult task, and as such, it has never been taken seriously by policy makers.

Thus, till date Nepal does not have any specific policy or legislation which deals with handling and management of hazardous/toxic waste products. The consequence of this is that so far, there is:

- No definition and categorization of toxic wastes as such and their origins.
- No identified mandatory institution specific enough to handle and manage toxic waste products effectively.
- No systematic database on industrial production-volumes; input volumes; waste-volumes of toxic substances; and types / contents of toxic chemicals contained in the waste volumes; etc.
- No control in all types of waste releases / emissions (gasses, liquids and solids) from activities like industrial; business / commercial; municipal / domestic; etc.

For the purpose of this study, a waste is taken as any solid, liquid or contained gaseous substances which is being discarded or disposed of by burning or incineration or other means such as, recycling, or simply dumping in nearby open places including waterways; and toxic wastes as wastes containing chemicals (natural and synthetic) which are acutely harmful to health and the environment even at low concentration levels.

1.3 Toxic Waste Products, their Origins and Release Vectors

Toxic wastes/toxic waste products that are ultimately disposed in to the environment and which are of concern to health and environment can be of inorganic and organic nature. The inorganic pollutants include among others, heavy metals such as As, Pb, Cd, Cr, Hg, Se, or their compounds; metal carbonyls, cyanides, etc whereas, organic pollutants are diverse and of various types and some are grouped together separately, chief among them are: Volatile Organic Compounds (VOCs,) consisting of chlorinated alkenes (carbon tetrachloride, dichloromethane, dichloroethane / trichloroethane etc.); chlorinated ethenes (vinyl chloride and others), aromatic hydrocarbons (benzene, toluene, xylene); Poly-cyclic Aromatic Hydro-carbons (PAHs) consisting of Anthracene, Naphthalene, Benzo (a) pyrene etc; and Persistent Organic Pollutants (POPs).

The origin of toxic waste can be both natural such as, volcanoes, wildfires and other natural processes as well as anthropogenic such as, industrial, commercial, municipal, domestic and service sector activities. The release vectors include: air, water, soil, utility products and residues left such as in recycling and combustion processes.

1.4 Literature review of toxic waste product

International and national literature reviewed and studied include among others: UNEP chemicals; case studies conducted by developed countries, particularly from northern hemisphere on production of hazardous/toxic chemicals and toxic waste products; UNEP proceedings of workshops/programs conducted at various places; environmental international conventions to which Nepal is a party such as, Stockholm Convention on POPs etc.

On the national front, the sources of data/information reviewed and studied include: Industrial statistics published by DOI, FNCCI, CBS, Trade statistics, etc and available reports on studies carried out by individuals, institutions (e.g. DANIDA) etc on hazardous/toxic chemicals / wastes released by various pollution sources.

A brief review of current literature indicates that among the groups of toxic chemicals, the world attention seems to be focused more on POPs, for release reduction and eventual elimination from the environment. The identified POPs targeted for this are: aldrin, dieldrin, endrin, DDT, hexachlorobenzene, chlordane, heptachlor, mirex, toxaphene, PCBs, dioxins and furans. Out of these 12, the first nine are mainly organo-chlorine pesticides, extensively used in agriculture, but recently most of them are banned in many countries including Nepal from production and use. PCBs and hexachlorobenzene are mostly used in industry and utility products. Dioxins and furans are unintentional byproducts in a large number of chemical, biological and thermal processes.

There can be two main reasons behind this elimination target. One is that the risks posed by POPs to human health and the environment are becoming of increasing concern in many countries and the other is that they are ubiquitously present across the world far from places of origins.

The widespread distribution of POPs across the world can be attributed to the following reasons:

POPs resist degradation due to chemical, biological and photolytic processes and are characterized by low solubility in water and high solubility in lipid resulting in to bio-accumulation in fatty tissues of living organisms (cause for sustained low level exposure to humans through diet). POPs persist in the environment for a longer time, its half-life ranges from a few days to several years and are semi-volatile, favorable conditions for trans-boundary movements to longer distances.

In Nepal, studies/activities carried out on toxic wastes released by industrial and domestic sectors are few and far between. Moreover, because of virtual absence of effective legal

measures taken to control waste releases as said earlier, measurements and documentation of waste releases kept by industries for instance, are either not available or even if available, they are far from being accurate or even adequate. Results of systematic investigation/time series data are hardly available. Whatever data/information is available, they are related to short term project works carried out at different times to fulfill different objectives, thus compatibility of data between studies on the same subject mater have not been observed to be meaningful for inventory or profile development in quantitative manner (see later sections).

1.5 About the study and its limitations

The main theme behind this study is about the development of national profile of toxic waste products and from what has been said above regarding definition, origin and release vectors, the list of toxic wastes and toxic waste products linked to the study can be extensive and beyond its intended scope.

Thus, the study has focused more on certain groups of toxic substances such as, heavy metals and POPs (Dioxin/Furan) as applicable, if it is found possible to give quantitative expression for them.

Moreover, profile development primarily from secondary data, demands the availability of some kind of direct or indirect international as well as country data sources, from which qualitative and quantitative data on release volumes of identified toxic waste products may be derived at national or regional levels. However, as said earlier, country data is largely lacking at the moment for the development of such a profile. But keeping in view of the national requirements, particularly in meeting national obligations under international conventions in which Nepal is a party, attempts have been made to develop a profile which best represents the national/regional scenario under the circumstances even if in a limited scale, consistent with available study resources.

1.6 About Dioxin and Furan (D/F)

As environmental contaminants, D/F have been detected in most of the global eco-systems and unlike other POPs, it has never been intentionally produced or served any useful purpose but share the undesirable properties of other POPs in adversely affecting health and the environment.

1.6.1 Some characteristics of D/F

The chemical name of D/F is: Polychlorinated dibenzo-p-dioxin (PCDD) and Polychlorinated dibenzofurans (PCDF). They are tricyclic aromatic compounds the hydrogen atoms of which may be replaced by up to eight chlorine atoms.

Congeners

It has been found that PCDD can posses up to 75 possible congeners and similarly PCDF can have 135 possible congeners, a total of 210, all of which have been identified in emissions from thermal and industrial processes. In environmental matrices such as, soil, sediment, air, plant and animal, PCDD/PCDF is found as mixtures of individual congeners.

Toxicity

It has been recognized that Chlorine substituted at positions: 2,3,7,8 in dioxin molecule namely, 2,3,7,8 – tetrachlorodibenzo – p – dioxin as the most toxic of all dioxin compounds and consequently, International Agency for Research on Cancer (IARC) classified it as a group 1 compound meaning carcinogenic to humans (1997), based mainly on studies of cases involving accidental occupational heavy exposures and studies on animals.

To measure the toxicity of PCDD/PCDF, terms like Toxic Equivalent (TEQ) and Toxicity Equivalency Factor (TEF) have been established. Since there are a number of PCDD/PCDF congeners with chlorine substitutions at various positions and exhibiting varying degrees of toxicity (WHO established 17 congeners each assigned with a particular TEF), the combined

toxicity of mixtures of these materials is evaluated as a single number called the toxic equivalent. To determine TEQ of a mixture, the amount of each of the toxic members of the family is multiplied by a weighting factor relative to the most toxic member: 2,3,7,8 TCDD. The weighting factor is called a Toxic Equivalency Factor.

1.6.2 Risks to Human Health

As said in earlier sections, PCDD/PCDF transcend geographical and eco-boundaries and exist throughout Global Environments for instance, soils, sediments, plants, and food chains; and all living beings including human are exposed to these chemicals particularly through fatty foods and breast milks. Health effects of course, depend upon various factors such as, levels of exposure, time of exposure, and frequency of exposure.

1.6.2.1 Health Effects

PCDD/PCDF exhibit health effects similar to those shown by chlorinated organic chemicals (c/o other POPs). Dioxin exposures are associated with increased risks of severe skin lesions, altered liver functions and lipid metabolism, general weakness with severe weight losses, changes in activity of various liver enzymes, depressions etc.

1.6.3 Tolerable Daily Intake (TDI)

TDI is the amount of intake per kg of body weight per day of a chemical judged not to give rise to manifestation of adverse effects to health even if such an amount is taken for an entire lifetime.

In May, 1998, WHO evaluated the risks which dioxin may cause to health and established TDI of 10 pg (pico gram) TCDD per kg of body weight. Later with new evidence in neurological development cum endoctrine system, WHO agreed to set TDI of 1 to 4 pg/kg of body weight? This value is almost at background level and is indicative of the fact that dioxin elimination or exposure to the lowest possible level is the ultimate target.

2.0 Study objectives/scope of study

Objectives are:

To document and finalize a step-wise procedure to assess profile of toxic waste products of different origins in Nepalese context.

To field apply the finalized procedure to develop a profile of toxic waste products.

Scope of the study:

To limit the field work to five districts, namely, Kathmandu Lalitpur, Bhaktapur, Morang and Sunsari.

3.0 Main Elements in Step-wise Profile Development Procedure

Sources producing toxic wastes can be varied and diverse in nature such as, point sources, diffuse sources, hotspots etc. and most often they are linked together giving rise to overlaps of toxic releases (double counting). To avoid just this kind of confusion, a protocol of inventory assembly has been provided (UNEP toolkit), applicable for dioxin quantification in particular, in waste releases. The protocol, however provides standardized formats for each procedure in profile development and insists that all source categories and sub-categories together with dioxin emissions in each vector should be taken in to account, and where possible quantified to fit the country profile in question in to the protocol, so that the results so obtained can be compared with similar results done elsewhere. This means that the task is huge for a small study like the present one, given the state of waste management in Nepal. Thus, this study focused only on a few categories of manufacturing establishments in the industry sector, which are thought to be polluting (toxic waste producing) in the country context.

3.1 Identification of source categories producing toxic wastes

So the first step carried out in the profile development is to classify the available toxic waste producing industries (targeted), big or small in to similar groups (types). The industries selected for the study are:

- Textile industry
- Tanning and leather
- Pulp and paper
- Paints
- Cement
- Bricks
- Metal production (ferrous/non-ferrous from scraps)
- Miscellaneous (Dry cleaning, Lead acid Batteries)

3.2 Quantification of toxic waste releases in each source category (type of industry)

This task involved establishing sub-categories, according to scale or technology differences, (wherever applicable) within each industry type, so that emissions from each subcategory, can be estimated from the activity rate for that sub-category in a particular environmental compartment. The summation of activity rates of sub-categories within the main category will then give waste quantity released by the main source category.

Here it should be noted that basically there can be two ways of waste release quantification from any one type of industry cited. The first one can be: release quantifications in various environmental compartments such as, volume of gaseous or stack emission in to the air (e.g. N m3 / hour), waste water effluents from a particular industrial process / processes mixing with the surrounding water bodies, solid waste/residues releases etc.; the second can be the quantification of a particular toxic chemical (toxic metal for example) or a group of chemical taken together as toxic such as dioxin, calculated or measured from emission in a particular waste release vector such as, air, water or residue, knowing the volume or the quantity of the releases.

3.3 Assessing activity rates (or waste releases) regional/national

The activity rates or waste releases of a particular type or pollutant obtained for a particular source category are then summed up for the whole region or the nation by knowing the total number of such main source categories in the region or the nation.

3.4 Development of profile of the toxic waste products in Nepal or the district

The profile development (district-wise or national) is completed by putting together all discharges of various types obtained for the district or the nation from all sources considered.

4.0 Methodology

Profile development of the toxic waste products has been attempted by the use of data/information gathered from the secondary sources as well as by the use of data/information obtained from questionnaire survey works.

4.1 Data generation from secondary sources

4.1.1 Data compilation / classification of identified industrial establishments

The first activity in this regard has been to prepare a list of manufacturing establishments with indicators as available in each of the study district. The general criteria followed while grouping the establishments in to a particular type are:

- That they belong to one of the eight industry types (main category as well as subcategory, if available) listed earlier (section 3.1).
- They are believed to produce toxic waste products judging from their activity statistics.
- The scales of operation are expected to lie between medium to large as defined by HMG rules (this is subject to availability / and or applicability of the data).

- They are believed to be in operation now.

In many instances, the particulars given in the secondary information are such that it is difficult to work out the exact type of activity carried out by each type of industry and the annual production volumes are most often not stated.

Again, most industries cited above involve complex sets of operation during various stages of product manufacturing. So, within the main category, sub-categories are usually classified according to the nature of process and the product involved.

4.1.1.1 Nepal Standard Industrial Classification (NSIC)

Industries in Nepal have been classified according to Nepal Standard Industrial Classification (NSIC), in which, specific numerical is allocated to a broadly categorized industrial establishment. For industries which are of concern in this study, the primary numbers allocated are as follows:

17 for the manufacture of textiles; 18 for wearing apparels; 19 for tanning/leather processing; 21 for pulp/paper; 24 to the manufacture of chemicals and chemical products; 26 to other non-metallic mineral products; 27 to basic metals; 28 to fabricated metal products etc.

Within each primary number, sub-numbers are given, for instance, sub-numbers for textiles are: 171 (spinning, weaving, and finishing of textiles); 172 (manufacture of other textiles); and 173 (manufacture of knitted fabrics etc.). Under each sub-number, class numbers (NSIC) are given, such as, 1711 (preparation and spinning of textiles fibers & weaving of textiles); 1712 (Finishing of textiles) etc. Similarly, under 172 and 173, there are several other classes of textile industry whose NSICs are 1721 (manufacture of made-up textile articles, except apparel) etc.1730 (manufacture of knitted and crocheted fabrics and articles) depending upon the availability of industries under these classes (reference: CBS, eighth census volumes of manufacturing establishments: directory, district-wise, national, 2001-2002).

Similarly, sub-categories / classes under each sub-category are given NSICs as available for each of the main category of establishment cited above.

Thus while preparing district-wise lists of industries together with indicators such as, number of establishments under each category/sub-category, activity types, production volumes etc, secondary sources, particularly CBS classification system is followed first wherever appropriate. For toxic profile development, however, relevant data / information given in CBS published volumes are to be supplemented from other sources.

So the list drawn at this stage can at best be tentative one (with many data gaps), which has to be sorted out by actual survey works, if at all it is possible.

4.1.1.2 District-wise list of industries with indicators

The prepared list with indicator summary is given below.

Table -1 District-wise industries with indicators

District : **Kathmandu**

S.N	Main category of establishment	Number of establishment	Indicators
1	Textile mills	37	Cotton/synthetic yarns, spinning weaving, dyeing, finishing etc. Annual production volume : unknown
2	Tanning and Leather Processing	None	None
3	Pulp and Paper mill	4	Includes Nepali Kagaj, others, not known
4	Paints Manufacturing	3	Details not available
5	Cement	None	None
6	Bricks	3	To be investigated
7	Metal Casting	11	Includes Iron/steel and Aluminum, copper, brass, Zinc etc
8	Miscellaneous		
	Lead Acid Battery	None	None
	Dry cleaning	unknown	To be investigated

District : **Lalitpur**

S.N.	Main category of establishments	Number of establishment	Indicators
1	Textile	27	Cotton/synthetic yarns, spinning weaving, dyeing, finishing etc. Annual production volume : unknown
2	Tanning and Leather Processing	None	None
3	Pulp and Paper mill	None	None
4	Paints Manufacturing	None	None
5	Cement	None	None
6	Bricks	30	To be investigated
7	Metal Casting	14	To be investigated
8	Miscellaneous Lead Acid Battery	None Unknown	To be investigaed

District : **Bhaktapur**

S.N.	Main category of establishments	Number of establishment	Indicators
1	Textile	15	Cotton/synthetic yarns, spinning weaving, dyeing, finishing etc. Annual production volume : unknown
2	Tanning and Leather Processing	None	None
3	Pulp and Paper mill	4	To be investigated
4	Paints Manufacturing	3	To be investigated
5	Cement	None	None
6	Bricks	35	To be investigated
7	Metal Casting	none	none
8	Miscellaneous Lead Acid Battery Dry Cleaning	None Unknown	To be investigated To be investigated

District : **Sunsari**

S.N.	Main category of establishments	Number of establishment	Indicators
1	Textile	11	Cotton/synthetic yarns, spinning weaving, dyeing, finishing etc. Annual production volume : unknown
2	Tanning and Leather Processing	2	To be investigated
3	Pulp and Paper mill	3	To be investigated
4	Paints Manufacturing	None	None
5	Cement	None	None
6	Bricks	25	To be investigated
7	Metal Casting	8	To be investigated
8	Miscellaneous		
	Lead Acid Battery	None	To be investigated
	Dry Cleaning	Unknown	To be investigated

District : **Morang**

S.N.	Main category of establishments	Number of establishment	Indicators
1	Textile	13	Cotton/synthetic yarns, spinning weaving, dyeing, finishing etc. Annual production volume : unknown
2	Tanning and Leather Processing	2	To be investigated
3	Pulp and Paper mill	6	To be investigated
4	Paints Manufacturing	None	None
5	Cement	1	To be investigated
6	Bricks	18	To be investigated
7	Metal Casting	8	To be investigated
8	Miscellaneous		
	Lead Acid Battery	1	To be investigated
	Dry Cleaning	Unknown	To be investigated

The above district-wise lists indicate that information given in the last column is inadequate in the sense that there is a degree of uncertainty regarding the activity statistics of the group of industries given in the column 3 against each main category. The column 3 figures are tentatively drawn from available literature/document keeping in view of the general criteria developed for the purpose (section, 4.1.1).

4.1.2 Toxic waste products generation from main category / sub-category sources

Data / information on the types of waste, pollutant contents and the release vectors can be characterized by the manufacturing processes involved from raw material treatment to product formation for each main category of industry, its scale of production as well as the state of art technology used for environmental pollution control measures undertaken by the industry. Thus in the following sections, some features of main category industrial establishments (manufacturing) relevant to the study are given

4.1.3 Manufacturing processes, probable toxic chemicals involved and waste streams

It is a recognized fact that consumer goods manufacturing establishments, particularly those based on the use of synthetic organic chemicals as input materials, are regarded as among the primary sources responsible for producing toxic chemicals in their waste streams. There are numerous synthetic organic chemicals available in the market having a wide spectrum of useful properties (physical/chemical), most of which get entry in to the consumer goods manufacturing processes. Some such names (chemicals) having useful properties relevant in the study context, are: bleaching agents, biocides/fungicide, dyes, pigments inclusive of structurally attached toxic heavy metals like Cd, Hg, Pb, Ni, Cr, As etc., preservatives, flame retardants, fixing agents, foaming/defaming agents, finishing agents, plasticizer, softener, stabilizer, surfactants, degreaser, anti-creasing, anti-wrinkling, anti-shrinking, and hosts of others. After the processes are complete, the unused chemicals (sometimes new chemicals, favorably formed under process conditions, such as, dioxin/furan), which are mostly toxic, get released in to various waste streams.

Most manufacturing establishments identified for the profile development (section 3.1) use several such synthetic organic chemicals at one stage or another during the product formation. This is also the reason for their selection in the profile development.

In the following section, relevant data/information on manufacturing processes, probable toxic waste chemicals involved and the waste streams for each of the main category industry is given.

4.1.3.1 Textile Mills

As said in earlier section, for purpose of toxic profile development, textile manufacturing processes have been limited as far as possible to:

NSIC 1711 Preparation, weaving, and finishing of textile fibers, weaving of textiles and

NSIC 1712 Finishing of textiles.

Thus, the number of establishments given for textile in the table-1 for all districts is largely from the above two NSICs and hundreds of other industries with various NSIC numbers under textile manufacturing sector which bear little relevance to this study, such as, manufacture of made-up textiles, carpets, rugs, ropes, twins, jute/jute products, etc have been excluded in this inventory preparation.

The probable toxic/ chemicals that may be present in the effluents are: PCP (salts), TEPA, TRIS, PBB, Cd, Ni, Pb, and Cr.

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams of textile mills are tabulated below.

Table-2 Textile process and waste stream

Process	Agents commonly used, of environmental concern (toxic)	Waste Streams Solid / gas /wastewater
Washing /Scouring	Detergents (Alkylphenol ethoxylates Nonylphenol ethoxylates Alkyl benzene sulphonates); Anti-static compounds; wetting/complexing/ foaming agents; lubricants;	Un-used /excess chemicals in wastewater streams.
Sizing / desizing	Acrylates,Polyvinylalcohol Carboxymethylcellulose	Un-used/unfixed chemicals in wastewater
Bleaching	Sodium chlorite/Sodium hypochlorite	Un-used/unfixed chemicals in wastewater
Dyeing/Printing	Dyes: Reactive, VAT, Acid, Base, Direct, Disperse, Sulphur, Pigments, Metal complex	Organics and inorganics (Cu, Cr, Cd, Co) in wastewater stream
Pigments	Organic or inorganic colouring agents (e.g. Zinc Chromate)	Un-used chemicals in the wastewater
Finishing	Flame retardants, Wrinkle resistant, biocides/preservatives etc	Un-used chemicals in the wastewater

4.1.3.2 Tanning and Leather Processing

The relevant NSIC is 1911 (Tanning and dressing of leather).

The secondary data collected reveals that there are only 9 operating tanning plants in operation in Nepal. CBS lists 2 each in Morang and Sunsari, a total of 4 and none in other study districts. From the point of view hazardous waste generation, tanning/leather plants are placed under heavily polluting industries.

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table -3 Tanning process and waste stream

Processes	**Agents commonly used, of environmental concern (toxic, etc)**	**Waste Streams Solid / gas/ wastewater**
Pre-tanning: soaking/washing, liming/unhairing, fleshing, splitting, pickling of raw hides/skins	bactericide, soda ash, wetting agent, lime/sodium sulfide,	Dirts, dung,/ alkaline wastewater;
Chrome tanning: to stabilize collogen structure of hide/skin to bind chromium in leather to impart a special feel (wet blue)	Basic chromium sulphate, Masking agent (sodium formate), some fungicide (preservative),	Shavings contaminated with chromium /unused and unfixed chemicals (chromium) in wastewater
Post-tanning: mechanical/chemical operation whereby, wet blue is changed to crust	Synthetic tanning (syntan for retanning); dyes; oils, formic acid (for dye fixation),	Un-used/unfixed chemicals/dues in wastewater
Finishing: gives final appearance to the leather	Pigments/dyes, binding agent, plasticizer, glazing agent, solvents	Unfixed/excess dyes, chemicals, amines, lacquer, thinner etc in wastewater stream

4.1.3.3 Pulp and Paper Mills

Reports indicate that there are 5 medium to large scale paper mills operating in Nepal, 2 of them are in Morang district.

NSIC numbers allocated to pulp and paper mills and allied industries have been limited as far as possible to the following:

NSIC 2101 for manufacture of pulp and paper; and paperboard.

NSIC 2102 for manufacture of corrugated paper and paperboard

NSIC 2103 for manufacture of other articles paper and paperboard.

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table-4 Pulp process and waste stream

Processes	Agents commonly used, of environmental concern (toxic, etc)	Waste Streams Solid / gas/ wastewater
Raw material preparation (straws/kans/grass/bagasse): Cutting to size, depithing bagasse, dedusting, cleaning, washing, screening		Under-sized rejects, pith, dusts, fibers.
Pulping: involves cooking (the raw materials in digesters with chemicals in specified temperature and pressure by	Sodium hydroxide, sodium sulfide	Solid wastse; emissions of gases; Black liquor, containing leached materials (organics includes lignin) and also may

steam), blowing, washing, screening, thickening etc		contain toxic substances associated with raw materials, such as heavy metals, pesticides, etc
Bleaching: involves making the pulp clean and then bleaching	Elemental chlorine/hypochlorite solutions	Waste stream contains unused chemicals and also may contain dioxin like toxic chemicals formed during pulp making/bleaching processes
Paper making: involves blending (furnish), mechanical mixing with chemicals to produce pulp/paper of desired quality.	Rosin, alum, talk etc., dyes/pigments, flame retardants, finishing agents, whitening agent.	Waste stream contains unused chemicals and also may contain toxic chemicals.

4.1.3.4 Paints

Available reports indicate that there are 11 medium and large scale and 4 small scale paint industries operating in Nepal.

In the study districts, paint industry locations are: Morang NSIC 2422, none; Sunsari, i) Rain bow ink ii) Pashupati paints; Lalitpur NSIC 2422 none; Bhaktapur NSIC 2422, i) Awal Rangai Udyog ii) Johnson and Nicholson; Kathmandu NSIC 2422, i) Reliance paints ii) Rukmani chemicals

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table-5 Paint process and waste stream

Processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
Cement-based paints: Raw materials weighing. Milling the charges in series of ball mills; matching the shades with cards; Adjusting the shades; discharged for finishing and packing	First charge: pigments and extenders; Second charge: cement/hydrated lime Third charge: Additives	Dusts and gasses emissions
Water-based paints: Raw materials processing in thickener to form gel; charged to twin shaft machine; dispersion attainment; shading as required; consistency attainment; filtered; packed	Additives; extenders, dispersive agents,; emulsifiers; stainers;	The process wastewater from washings the interior of machines, contaminated with various kinds of chemicals including residual pigments/coloring matters, solvents etc.
Oil-based (enamel) Raw materials charged in ball mills; dispersed; stabilized; solvent washed; final adjustment; packing	Agents for dispersion, stabilizing; pigments; extenders; stainers; resins solvents;	Emission of Volatile organic compounds (VOCs) in to the air of the production halls, as used in various processes.

4.1.3.5 Cement productions

The available reports indicate that at the present time there are only 4 medium to large scales cement (clinkerization based) industries operating in the country. They are: Hetauda Cment (Makanwanpur district), Udaypur cement (Udaypur district), Maruti cement (Sirah), and Butawal

cement (Rupandehi).There are many more industries based upon grinding of clinker brought from outside the country. For toxic waste profile development, the later is excluded.

CBS directory lists NSIC 2694 National cement p.Ltd, (Morang); none in Sunsari, Lalitpur, Baktapur, and Kathmandu.

Some available data/information on main production processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table-6 Cement process and waste stream

Processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
Raw materials mining (drilling, blasting etc); crushing; raw mill grinding; homogenization; clinkerization; clinker grinding; cement storing/packing.		Mainly stack emissions of dusts and gasses including toxic ones.

4.1.3.6 Production of Bricks

The bricks industry is placed under NSIC 2693 (manufacture of structural non-refractory clay, bricks in this case). The CBS directory under NSIC 2693 lists bricks producing units in the 5 study districts as Morang 18; Sunsari 25; Bhaktapur 35, Lalitpur 30; and Kathmandu 4, a total of 112.

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams, are tabulated below.

Table-7 Bricks process and waste stream

Processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
Kiln types: BTK moving chimney BTK fixed chimney BTK forced Zig Zag BTK natural Zig Zag Clamp Thado Bhatta Hoffman Kiln VSBK	Materials commonly used for firing kilns are: mainly low grade coals; bio-mass fuels like wood etc; some waste materials like plastic, used tires etc.	Mainly stack emissions of dusts, gasses.

4.1.3.7 Metal production industries

Literature reviews reveal numerous other metal related industries under different categories, namely, manufacture of fabricated metal products; structural metal products (tanks, reservoirs, containers of metals); forging, pressing, stamping, and roll-milling of metals; treatment/coatings of metals; manufacture of hand tools, hardware etc.

From the standpoint of toxic waste profile development however, the study is focused more on secondary metal (iron/steel, copper, aluminum, brass, bronze etc.) smelting and casting from scraps, ingots as available in the identified study areas (Note: primary metal producing industries from ores, minerals are not available in Nepal).

Some available data/information on production processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table-8 Metal process and waste stream

Secondary processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
General steps involved are: segregation, cleaning, preparation of metal, alloy scraps/ingots etc.; charging in to the furnace; mixing with flux, additives, reducing agents etc. as required; heating the furnace/melting the charge at the desired temperature; casting the melt in the mould; finishing the cast. The furnaces commonly used to melt metals in foundries are: cupola, electric arc, induction, and crucible. The later two types are commonly used in Nepal.	scraps, turnings, shavings, of metals and alloys contaminated with oils, lubricants, plastics, paints and other contaminants, may form toxic by-products during melting processes; Preheating of contaminated scraps may involve higher emissions of organo-halogen compounds (dioxin);	The most relevant emissions are in the form of gasses, flue dusts and residues (c/o recycling; Flue gasses may be treated in fabric filters, it may be noted that filter dusts/sludge from steel making processes or from sinter plants are sent to non-ferrous metal industries for recovery of non-ferrous metals contained in them (c/o import trade statistics where large amounts of such waste materials are recorded as imported materials in to Nepal).

4.1.3.8 Dry cleaning

Dry cleaning is a process used for cleaning of textile products not by washing with water, but by treating with typical solvents such as perchloroetylene, petrol and chloroflurocarbon (CFC). Dry cleaning comes under small business enterprises not required to be registered in the department of small scale cottage industries of HMG and thus there seems to be no way to getting a list readily or

estimating how many dry cleaning shops are in operation, say in kathmandu valley, thus, inventory/profile development has not been attempted. However, a number of well known dry cleaning shops of Kathmandu valley have been visited, which gives an idea about how much of the residue containing toxic wastes is released in the environment by dry cleaning precess.

Dry cleaning is included in toxic profile development because residues obtained from distillation of spent solvents during solvent recovery, is found to contain toxic substances extracted from textiles during dry cleaning. Where filter cartridges are used for spent liquid filtration, such cartridges too contained residues contaminated by toxic wastes.

In previously described textile section, it is said that during the finishing of textiles, some biocides (e.g. PCP), are introduced in the process to protect the fabric or its raw materials like cotton/wool; or some contaminated dyestuffs are used to color the fabric. These materials are the sources for toxic waste production each time the textile/clothes are dry cleaned.

Some available data/information on dry cleaning processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table-9 Dry cleaning process and waste stream

processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
Cooking the textiles/clothes with solvents and extracting dirts; rinsing the textiles with solvents to remove wastes; distilling the collected spent solvents for solvent recovery or filtering through filter cartridges;	perchloroetylene, petrol and chloroflurocarbon (CFC) etc. extracting contaminated toxic substances from normal clothes/heavy textiles (c/o dioxin)	Toxic releases mainly through bottom stills or spent csrtridges in the form of solid residues or waste water containing suspended residues.

4.1.3.9 Lead Production from Secondary sources (Scraps: vehicle lead-acid batteries)

Considerable quantities of Lead are recovered from secondary sources, particularly vehicular lead-acid batteries. Documentary evidence of such secondary lead recovery plants operating in Nepal is scarce and not available. The existence of Biratnagar based one such industry named Kuliyan battery industry is reported to be operating.

Variety of furnace designs is said to be available for direct smelting of lead from vehicle batteries including rotary and electrical furnaces. Moreover the recovery of lead from scrap batteries having PVC separators is reported to be linked to the emission of PCDD/PCDF apart from lead emission.

Some available data/information on secondary lead recovery processes, probable toxic / negative chemicals involved and waste streams are tabulated below.

Table- 10 Lead-acid battries and waste stream

processes	Agents commonly used, of environmental concern (toxic etc)	Waste Streams Solid / gas/ wastewater
Handling, collection of scrap batteries; activities related to preparation to smelting; smelting in the furnace; molten lead recovery; casting to required forms	Lead acid batteries. Waste acids, PVC separators, contaminated battery bodies, waste plates, cell parts.	Mainly Lead/dust emission into the air/wastewater. PCDD/PCDF emission in the air; contaminated solid waste; residues from APC devices; wastewater contaminated with lead etc.

4.2 Data generation from primary sources (questionnaire survey)

Data generation from primary sources practically means to field visit the selected few industries representing in particular 9 main category industries located in each of the 5 study districts. The

main objective of the visit is to acquire all data/information about the industry, relevant to toxic waste profile development, such as, collection of input output figures, observation of processes involved, from raw material preparation to manufacture of the finished products, waste releases in to various environmental compartments, pollution prevention measures undertaken by the concerned industry etc.

4.2.1 Development of Questionnaires

Individual questionnaires for all 9 main category industries were developed taking in to account all pertinent requirements specific to the industry, as stated earlier. All questionnaires in general, addressed the following points: location specifics of the visited establishments; the name of the respondent knowledgeable enough to respond to the questionnaire (usually a managerial level person; description of the activity rates at each stage of production; quantitative/qualitative data on input and output materials, particularly those of environmental concerns; the types of equipment/devices installed; waste generation at each stage of product development as applicable; waste minimization/control measures; waste treatment methods, if any; waste disposal methods; problems faced by the industry etc.

4.2.2 Selection/identification of industry for field visit

Appropriate industries representing each main category type located at each of the 5 districts were sorted out from the district-wise tentative lists prepared for the purpose (table-1). Before finalizing, it was conformed as far as possible that the industries to be visited do belong to the intended category as required by the activity status and the type of waste streams produced. But as said earlier, the tentative list prepared did not show the required indicator data (activity status, type of waste stream etc.) and in most cases it was not possible to pre-determine the status of the industry.

4.2.3 Industries/establishments visited/studied

During the questionnaire survey, selected industries/establishments were visited, questionnaire topics discussed, relevant data/information as available recorded and documented.

The surveyed industry types and number of establishments in each district are tabulated below:

Table-11 District-wise number of industries surveyed

District Industry	Kathmandu	Lalitpur	Bhaktapur	Sunsari	Morang	Total
Textile	1	3	1	2		6
Tanning				2		2
Pulp/Paper	2		1	2		5
Chemicals/ Products	1		2	2	3	6
Cement						
Bricks		4	4	3	4	15
Metals	4	5	1	7	3	20
Dry cleaning	3	1	1			5
Lead-acid Batteries (vehicle)				1		1
Total	11	13	10	19	10	63

The figures indicated in the above table shows that no cement factory is visited during the study. CBS lists one cement factory in Morang, (National Cement P. Ltd. but not available to visit). A few operating large scale cement factories (clinker producing) are located in other districts of Nepal.

The Lead-acid battery manufacturing establishment visited in Sunsari is supposed to be only one of its kind operating in Nepal.

5.0 Compilation and Classification of data/information obtained from field visits

The data/information obtained from the field visits have been classified district-wise and by the industry types. The data relevant to profile/inventory development have been put in to appropriate columns: name of the industry/establishment; general outline of the manufacturing processes; the type of products/annual production; inputs: raw materials, chemicals. Fuels etc.; waste streams: emission to air, solids (residues, ash, sludge); wastewater; remarks (annual working days, pollution control measures, waste treatments etc).

6.0 Towards Profile Development

District-wise and industry-wise scenario obtained from summarized results of secondary and primary studies is as follows:

6.1 District Kathmandu

6.1.1 Textile: Spinning, Weaving and finishing of textiles

NSIC 1711 Preparation & spinning of textile fibers, weaving of textiles
The number of establishment = 26

NSIC 1712 Finishing of textiles
The number of establishment = 11
The total number establishments =37 (CBS classification)

Visited:

NSIC 1711 i. Bishal Kapas Udyog: Product: Cotton clothes from old materials/scraps**;** Annual production: 75 ton; annual waste water generation from bleaching process = 210 m3, annual bleaching powder consumption = 7.5 ton
Such units 20 to 25 in Nepal

6.1.2 Tanning and Leather

NSIC 1911 Tanning and dressing of leather (none in Kathmandu)

6.1.3 Pulp and Paper Products

NSIC 2101 Manufacture of Pulp and Paper and paperboard

i. Everest art paper
ii. Kalinchok handicraft
iii. Maheswari print
iv. Malla print
v. Natural paper craft
vi. Nepal women craft
vii. Sonamsangbo sherpa nepali kagaj udyog

The total number of establishment = 7 (small scale, for inventory data only)

Visited

NSIC	2101	i.	Natural paper craft: Lokta – caustic soda boiled – pulp – dyeing; product: Craft and media paper**,** annual production = 60000 ready made dyed sheets; input material = 6 ton lokta; 2.2 kg bleaching powder for 10 kg of paper; Black liquor = 7500 liters
NSIC	2211	i.	Bagmati paper industry, annual production = 900000 sheets of Nepali Kagaj;

Annual raw material input: lokta = 45 ton, wheat straw = 15 ton, vegetable dye = 2250 kg; waste stream**:** annual black waste water liquor = 3000 liters. In Nepal 40 industries operate according to handi craft association

National annual production of Nepali Kagaj: 2.4 to 36 million sheets

Black liquor generation = 900 m3 / year.

6.1.4 Manufacture of Chemicals and Chemical products

NSIC 2422 Manufacture of Paints, Varnishes, similar coatings, printing ink, matrices

Reliance paints

Rukmani chemical

No. establishment = 2 (used in profile development)

NSIC 2424 Manufacture of soaps and detergents; cleaning and polishing preparations, perfumes and toilet preparations

Polo chemicals

R.B. brush industries

Variety soap & chemical

No. of small scale establishment = 3 (for inventory)

Visited:

NSIC 2424 i. Polo chemicals: products: liquid toilet soaps, cleaning powder, Perfumed white phenol, glass cleaner, neel ujala**;** annual production **=** 1200 liters; waste water generation = 60000 liters (contaminated washings).

In kathmandu 7 such units are in operation.

The total cleaning chemical production from 7 industries = 8.4 m3.

Total wastewater generation = 420 m3

6.1.5 Manufacture of non-metallic mineral products

NSIC 2693 Manufacture of structural non-refractory clay

i. Adi narayan chimney bhatta (of concern)
ii. B & B Chimney Bhatta (of concern)
iii. Bhaktapur roda udyog
iv. Kosina hum pipe
v. Mahakali ita udyog (of concern)
vi. Riddi ko tile udyog

vii. Shiva shakti hume pipe (none listed)

No. of establishment (of concern) = 3 (bricks, for profile development)

Visited: none

6.1.6 Manufacture of metals

6.1.6.1 Manufacture of basic metals

NSIC 2710 Manufacture of basic iron and steel (none listed in CBS)

NSIC 2720 Manufacture of basic precious and non-ferrous metals

i. Guheswari rolling mills

NSIC 2731 Casting of iron and steel (none listed in CBS)

NSIC 2732 Casting of non-ferrous metals, Number of establishment (listed) = 10 (for profile development)

i. Apolo Steel
ii. Balaju Aluminum
iii. Himali metal
iv. Mahabharat metal
v. Manik metal
vi. Mathura aluminum
vii. Paras metal
viii. Sakya Alminum
ix. Sakya metal
x. Timla metal

Visited:

NSIC 2732

i. Balaju Alminum: products:aluminum utensils (pots, sheets); annual production = 100 ton; imported ingots consumed = 70%, scraps consumed = 30%; annual slag production = 1 % from ingot use & 6 % from scrap use.

ii Paras metal: Brass utensils all from scraps, annual production = 18 ton;

iii Timla metal: Aluminum production = 60 tons

Sakya Aluminum (from scraps): annual production = 36 ton

6.1.6.2 Manufacture of fabricated metal products, except machinery and equipment

NSIC 2891 Forging, pressing, stamping, and roll-forming of metals, powder metallurgy
2 establishments

Total number of establishment = 15 (visited none)

6.2 Lalitpur

6.2.1 Textile: Spinning, Weaving and finishing of textiles

NSIC 1711 Preparation & spinning of textile fibers, weaving of textiles

i. Bagmati dyeing
ii. Bina spinning
iii. Indra dhanus colours
iv. Kathmandu dyeing

Marshyangdi dyeing
Nava jivan textiles
Woolan spinning industry

NSIC 1712 Finishing of textiles
The number of establishment = 20
Total number of establishments = 27.

Textile factory visited:

Navajivan textiles (PID): Production: 450000 (85.7 ton/year); waste water discharge = 450 to 510 m3/yr (5.25 to 5.95 m3 per ton of fabric produced); Sludge = 600 to 1500 kg/yr (7 to 17.5 kg/ton of fabric)

Shree textile (PID): Production 3000000 m (171 ton/yr); wastewater = 1800 m3/yr (10.52 m3 /ton of product).

Nitya Nath textiles: product: Cotton yarn; production = 90000 m (17 ton/yr); waste water = 30 m3 (1.76 m3/ton of product).

6.2.2 Tanning and Leather (none)

6.2.3 Paper and Paper Products (none)

6.2.4 Manufacture of Chemicals and Chemical products (none)

6.2.5 Manufacture of non-metallic mineral products

NSIC 2693 Manufacture of structural non-refractory clay (bricks in this case) No. of establishments = 30.

NSIC 2694 Manufacture of cement, lime and plaster (none)

Industries visited:

NSIC 2693 i. R. K. Ita Bhatta, BTK with fixed chimney; Annual production = 4000000 bricks.

NSIC 2693 ii. Surya Chimney Bhatta with fixed chimney, Annual production =5000000 bricks.

NSIC 2693 iii. Quality ita Udyog, Zig-zag air Bhatta, fixed chimney. Annual production = 6000000

NSIC 2693 iv Harishiddi brick and tiles, Hoffman type, Annual production = 20000000 bricks

6.2.6 Manufacture of metals

6.2.6.1 Manufacture of basic metals

NSIC 2710 Manufacture of basic iron and steel

i. A one wire industry

NSIC 2720 Manufacture of basic precious and non-ferrous metals

i Jay Santoshi rolling mill

ii. Neri mill

NSIC 2731 Casting of iron and steel (none)

NSIC 2732 Casting of non-ferrous metals

i Annapurna houshold appliance

ii. Himalayan cottage crafts

iii Keshav Raj and metal works

iv Laxmi metal

v. M.N. metal industry

vi. Nepal dhalaut udyog

vii. Nepal home appliances

viii. Pashupati rolling mills

ix. Sagar metal industry

x. Surya metal industry

xi. Tamrakar utensil

Total of establishment = 14

Industries visited:

NSIC 2732 i. Nepal Dhalaut Udyog, product: brass/bronze; Annual production = 5 ton.

NSIC 1732 ii. Sagar metal industry (iron and steel foundry), products: steel (switch board etc.); Annual production = 60 ton.

NSIC 2720 i. Jay santoshi rolling mills, product: copper/brass; Annual production = 200 ton.

NSIC 2732 i. Nepal Dhalaut Udyog (satdobato), product: iron & Mn/Cr steel, cast iron, Annual production = 300 ton.

6.2.6.2 Manufacture of fabricated metal products, except machinery and equipment

NSIC 2811 Manufacture of structural metal products

Annapurna Aluminum industry

National structure & engineering

Nepal dhalaut udyog

Shyam metal workshop

Structure Nepal

Thogna Gama rod iron udyog

Vii Sakya handicrafts

Total number of establishment = 7

Visited: none

6.3 District Bhaktapur

6.3.1 Textile: Spinning, Weaving and finishing of textiles

NSIC 1711 Preparation & spinning of textile fibers, weaving of textiles

Prakash tent and tarpoline

Rames Dhago Karkhana

NSIC 1712 Finishing of textiles

Nepo industry

Pagoda handloom industry

NSIC 1721 manufacture of made-up textiles except apparel (none)

Total number of establishments = 4

Visited:

NSIC 1712 i. Nepo textiles, product: synthetic yarns**;** Annual production = 4000 m (700 m weighs 400 kg); Annual waste water = 9000 m3; Sludge = 1200 kg; Dust collcted (Trima cyclone) = 200 kg/day check.

6.3.2 Tanning and Leather (none)

6.3.3 Pulp and Paper Products

NSIC 2101 Manufacture of Pulp and Paper and Paperboard

i. Bhaktapur craft printers
ii. Bhaktapur Kagaj udyig
iii. Eco craft Nepal
iv. Kagaj puna nirman

NSIC 2102 Manufacture of corrugated paper and paperboard and of containers of paper and paperboard (none)

Industry visited

NSIC 2101 i. Bhaktapur Craft industry (BID), product: media paper of various shades, Annual production = 3600 kg (180000 sheets of Nepali Kagaz), black waste liquor = 30000 liters,

6.3.4 Manufacture of Chemicals and Chemical products

NSIC 2422 Manufacture of Paints, Varnishes, similar coatings, printing ink, matrices

i. Awal rangai udyog
ii. Bengal Jens and Nicholson

NSIC 2424 Manufacture of soaps and detergents; cleaning and polishing preparations, perfumes and toilet preparations

i. Kamalasan soap and chemical industry

The total Number of establishment = 4

Visited:

NSIC 2422 i. Nepal paint, annual production = oil-based 510 m3. Cement-based = 225 ton, water-based = 210 m3,

.

NSIC 2422 ii. Berger j & N paints (BID) Annual production = oil-based = 111339 liters,
Cement-based = 101425 kg, and water-based = 205288 liters

6.3.5 Manufacture of non-metallic mineral products

NSIC 2693 Manufacture of structural non-refractory clay (bricks in this case)

The number of brick industries = 35

NSIC 2694 Manufacture of cement, lime and plaster (none)

NSIC 2699 Manufacture of other non-metallic mineral products (under this heading, no industries are registered in CBS directory, but CBS district volume denotes 31 industries, this should include all brick industries listed under 2693 code which lists 34 brick industries) n.e.c.

Visited:

NSIC 2693 i. Jay Guru chimney udyog,BTK fixed chimney bricks, Annual production = 5000000 bricks.

NSIC 2693 ii. Yapi Bhairab chimney bhatta, BTK with fixed chimney, annual production = 10000000 pieces

NSIC 2693 iii. B. A. bricks, BTK with fixed chimney, Annual production = 5000000.

NSIC 2693 iv. Bhaktapur Ita and tiles, Hoffman**,** Production = 15000000.

6.3.6 Manufacture of metals

6.3.6.1 Manufacture of basic metals (none)

NSIC 2710 Manufacture of basic iron and steel (none)
NSIC 2720 Manufacture of basic precious and non-ferrous metals (none)
NSIC 2731 Casting of iron and steel (none)
NSIC 2732 Casting of non-ferrous metals (none)

Total number of establishment = 0

Visited
NSIC i. R.S. metal craft (BID), Copper, Zinc, Brass, Annual production = 5 ton

Remarks: It is reported that there are 10 to 12 such industries operating at Bhaktapur (CBS lists none).

6.4 District Sunsari

6.4.1 Textile: Spinning, Weaving and finishing of textiles

NSIC 1711 Preparation & spinning of textile fibers, weaving of textiles
i. Jay Matadi Kapas udyog
ii. Reliance spinning mills

iii. Reliance yarn udyog

iv. Subarna industtry

NSIC 1712 Finishing of textiles

i. Pragati textile industry

Total number of establishments = 5

Textile factory visited in Sunsari:

i. Pragati textile and reliance mills: Process:- yarn – weaving – dyeing – drying – folding – product (synthetic textiles); annual production = 300 ton (1575000 m); bottom ash (boiler section) =660 ton; waste water = 81000 m3; loss of water in dyeing process = 12000 m3; water use = 120000 m3.

ii. Reliance spinning mills: fiber processing – spinning – yarn – dyeing – product (acrylic polyester, blended, viscous); 12600 ton, 1800 ton fabric dyed; waste water discharge = 77760 m3; treatment: primary sedimentation, sludge generation = 1.5 ton**;** water use = 150000 m3;boiler ash = 360 ton? 1 more such industry in the district.

6.4.2 Tanning and Leather

NSIC 1911 Tanning and dressing of leather

Shri Pioneer tanning industry

United tanneries

The total number of establishment = 2,

Industries visited:

i. Asian leather industries: Raw hides processing – wet blue – finishing – product; production: 166 pieces or 166 kg /day or 47 ton; waste water = 870 to 1170 m3/yr; Sludge = 150 ton/year

ii. United tanneries: daily production = 1200 kg or 1200 sq.m.; yearly 360000 sq. m.; waste water = 675 m3/year; sludge = 24 ton yearly.

6.4.3 Paper and Paper Products

NSIC 2102 Manufacture of corrugated paper and paperboard and of containers of paper and paperboard.

i. Arabind pulp and paper mill

ii. Pashupati papers products

NSIC 2103 Manufacture of other articles of paper and paperboard.

none

the total number of establishment = 2

Visited: i. Baba paper mill, product ; writing, craft, and media paper; annual production = NA

Annual ash (boiler) = 600 ton**;** black liquor = 4500 m3;waste water = 10500 m3; sludge = 900 ton.

ii. Arbind pulp and paper: product: Writing and Printing; annual production = ?

Annual waste production: boiler ash = 20% of rice husk (6000 ton) = 1200 ton; Black liquor = 4500 m3;

Effluent = 9000 m3; Sludge = 600 ton.

6.4.4 Manufacture of Chemicals and Chemical products

NSIC 2422 Manufacture of Paints, Varnishes, similar coatings, printing ink, matrices

Rainbow inks

Shri Pashupati paints

NSIC 2423 Manufacture of pharmaceuticals, medicinal chemicals, and botanical products

i. Manoz Pharmaceutical works

NSIC 2424 Manufacture of soaps and detergents; cleaning and polishing preparations, perfumes and toilet preparations.

i. Annapurna soap and Chemical
ii. Swadeshi sabun

The total Number of establishment = 5

Visited:
i. Pashupati paints: For oil-based: grinding (ball/sand mills,attritor); cement-based: ball milling; water-based: by high speed mixer**;** annual production: oil-based paints = 900 ton, cement based = 900 ton, and water-based = 900 ton
ii. Everest Solvent p. Ltd.: Rice bran extraction by hexane – heated - hexane with oil separated – heated to expel hexane – rice bran oil. Annual production = 15000 ton of rice bran extracted; Residue after extraction is called pinna, annual production of PINNA = 200 to 300 ton (used for animal feed).

6.4.5 Manufacture of non-metallic mineral products

NSIC 2693 Manufacture of structural non-refractory clay (bricks in this case)
The number of brick industries = 29

The total number of establishment = 29

Visited:
i. Himalayan Ita Udyog BTK with fixed chimney Annual production = 10000 ton
ii. Jay Nepal Ita Udyog, BTK with fixed chimney Annual production

=5000 ton

Shri Hari Ita Bhatta, BTK with fixed chimney Annual production = 7500 ton

6.4.6 Manufacture of metals

6.4.6.1 Manufacture of basic metals

NSIC 2710 Manufacture of basic iron and steel

i. Ganesh pherobic
ii Krishna Engineering
iii Mainabati steel industry
iv Shri Pashupati iron and steel

NSIC 2720 Manufacture of basic precious and non-ferrous metals

i D.K. metal industry
ii. Deepak lead oxide udyog
iii. Sunsari Alminium
iv. Surya metal industry

NSIC 2731 Casting of iron and steel (none)

NSIC 2732 Casting of non-ferrous metals

i Akha metal industry
ii. Family utensil
iii Purna Laxmi metal industry

Total of establishment = 11

Visited:

i. Mainabati steel industry: Sheet coil – slitting – rolling – pipe coating with Zinc; Product: Galvanized pipes etc. Annual production: 7000 ton,

i. Sunsari Aluminum Industry: Ingots (or scraps of Alminum) melting in a fire clay crucible (cap. 150 kg) casting – rolling – annealing ; product: utensils; Annual production = from 15 to 75 ton (season);

ii. Pashupati iron and steel: billet shearing – rolling – quenching, product: steel bars. Oil-fired furnace (cap. 20 ton), Annual production = 19500 ton

iii. Surya metal industry: copper/brass scraps – zinc ingot – tin ingot – melting –melting – rolling, product; sheet, crucible cap. = 350 kg, Annual production = 150 ton,

iv. D. K. metal industries: Scrap – melting – framing – rolling – finishing, product: plates, circles (each weighing2 to 10 kg), Annual production = 54 ton.

v. Krishna Engineering: Scraps – melting – molding – framing – cutting – finishing, crucible at about 1400 degree C. product: vehicle body parts. Annual production = 18 ton

vi. Krishna metal crafts: tin sheets cutting – folding – stitching – can/containers, product: tin cans (wt = 1 kg), Annual production = 200 ton

vii. Kallyan battery industry: Lead boiling – grid preparation of lead oxide paste – drying – plate forming - plate washing – drying – cell – cell setting.
Waste water = 120 m3,

6.4.7 Lead acid battery

Only one lead acid battery manufacturing industry of the country is reported to be operating at Sunsari.

Production process: Lead is heated to a boil - lead oxide paste (heating in a furnace at 400 to 450 degree C)– drying – plate forming – washing – cell setting.

Yearly lead production – 150 tons, of which 20 tons is recovered form scraps (used batteries)

Raw material input: lead oxide = 500 kg; lead metal = 500 kg; separators = 200 pieces; box = 50 pieces; Sulfuric acid = 50 kg; Distilled water = 1000 liters.

Wastewater generation = 500 liters daily or 150 m3 yearly

6.5 Morang

6.5.1 Textile: Spinning, Weaving and finishing of textiles

NSIC 1711 Preparation & spinning of textile fibers, weaving of textiles
Jagadamba textiles
Ruby thread Industtry
NSIC 1712 Finishing of textiles
Blue wales silk fabric industry
Everest fiber industry
Everest industries
Rajat knit wares
Unique fashion

Total number of establishments = 7

Textile factory visited in Morang: None

6.5.2 Tanning and Leather

NSIC 1911 Tanning and dressing of leather

Nepal Tanning Industry
Universal Leather Industry

The total number of establishment = 2

Industry visited: none

6.5.3 Paper and Paper Products

NSIC 2101 Manufacture of Pulp and Paper and Paperboard

none

NSIC 2102 Manufacture of corrugated paper and paperboard and of containers of paper and paperboard.

i. Ganga Packing Industry
ii. Jaya Kali Paper Box Udyog
iii. Nepal Stardboard ccompany
iv. Prabin Paper packing Induastry
v. Shri Dahal Print & Pack
vi. Star paper works products

The total number of establishment = 6

Visited: none

6.5.4 Manufacture of Chemicals and Chemical products

NSIC 2411 Basic chemicals except fertilizer and nitrogen compounds

Mahalaxmi Silicate industry

National Silicate industry

NSIC 2422 Manufacture of Paints, Varnishes, similar coatings, printing ink, matrices (none)

NSIC 2424 Manufacture of soaps and detergents; cleaning and polishing preparations, perfumes and toilet preparations.

The total Number of establishment = 2

Visited:

NSIC 2411
i. Pratani soap and silicate industry: product sodium silicate; production = 1100 ton/yr, input: caustic soda = 330 kg/yr, palm oil = 255 ton/yr, waste stream
ii. Mahalaxmi Silicate industry: product: sodium silicate, production = 900 ton/yr, (2 only in Morang)

6.5.5 Manufacture of non-metallic mineral products

NSIC 2693 Manufacture of structural non-refractory clay (bricks in this case)
The number of brick industries = 21

NSIC 2694 Manufacture of cement, lime and plaster
1 industry (National cement, Katahari)

The total number of establishment = 21

Industries visited:

NSIC 2693
i. Anand Ita Bhatta: BTK with fixed chimney, continuous process; Annual production of bricks = 10000 ton.
ii. Sandesh Ita Bhatta: BTK with fixed chimney, continuous process; Annual production of bricks = 10000 ton.
iii. Aec Ita Bhatta: BTK with fixed chimney, continuous process; Annual production of bricks = 7500 ton.
iv. Arbinda Ita Bhatta: BTK with fixed chimney, continuous process; Annual production of bricks = 7500 ton.

6.5.6 Manufacture of metals

6.5.6.1 Manufacture of basic metals

NSIC 2710 Manufacture of basic iron and steel
Himal auto Eng
ii Hulas wire industry

iii Pioneer wire industry

iv Shambhu industrial workshop

NSIC 2720 Manufacture of basic precious and non-ferrous metals

i Shivalaya metals industry

NSIC 2731 Casting of iron and steel (none)

NSIC 2732 Casting of non-ferrous metals

i Hgulas metal craft

ii Megha metal craft

iii Panaroma metal industry

Total of 8 establishments

Industries visited:

NSIC 2732

i. Megha metal craft: Tin plate – cutting – sizing – priming – fabrication; Products: dyed 1 liter containers, production = 125 ton/yr. One other is operating: Koshi metal craft. Annual chemical consumption = 4.8 ton (96 kg of silver paste; 2160 liters of Apoxy Arya; 720 kg rubber solution, vinyl varnish; Annual waste production = 480 kg land filled.

ii. Hulas metal craft: Steel sheets – cutting – pressing – heating – pressing –rolling – polishing – packing. Products: steel utensils; yearly production = 64 ton

Secondary data (Devkota) from Pioneer wire industry:

The report summarizes the results from three industries visited including Pioneer wire (covers the sector: iron/steel galvanizing). The chromium value in the final outlet varies from o to 1.08 mg/l;

The effluent generation varies from 3 m3 /day to 8 m3 /day

6.5.6.2 Manufacture of fabricated metal products, except machinery and equipment

NSIC 2891 Forging, pressing, stamping, and roll-forming of metals, powder metallurgy

i. Arati strips

ii. Kamala rolling mills

Industry visited

NSIC 2891 i. Kamala rolling mills: Billet cutting – heating – rolling twisting – bundling;
Annual production = 21000 ton steel rod. Fuel input: 2000 = 360000 liters of furnace oil.

7.0 Quantities of Toxic Waste Products generated by Industry types (summary from visited industries, 2005)

7.1 Textiles

Table-12 Summary data on textiles visited

S.N.	Name (district)	Annual Production	Waste stream annual release	Waste/ton of product
1	Bishal Kapada (KTM)	7.5 ton	Wastewater: 210 m3	28 m3
2	Navajivan (Lalitpur)	85.7 ton	Wastewater = 450 to 510 m3 Sludge = 600 to 1500 kg	5.25 to 5.95 m3 7 to 17.5 kg
3	Shri textile (L)	171 ton	Wastewater = 1650 to 1950 m3	9.6 to 11. 4 m3
4	Nitya Nath (L)	17 ton	27 m3	
5	Nepo textile (BKT) Synthetic yarn	762 ton	Wastewater = 7500 m3 Sludge = 800 to 1200 kg	9.8 m3 1 to 1.6 kg
6	Pragati textile (Sun)	300 ton	81000 m3	270 m3
7	Reliance spinning (SUN)	12600 ton (?)	59616 m3	4.73 m3

7.2 Tanning/Leather

Table-13 ` Summary data on tanning visited

S.N.	Name (district)	Annual Production	Waste stream, annual release	Waste/ton of product
1	United Tanneries (Sunsari)	360 ton	Wastewater 675 m3 Sludge 150 ton	1.87
2	Asian Leather(Sunsari)	47 ton	Wastewater 870 to 1170 m3 Sludge 150 ton	18.5 to 25 m3

7.3 Pulp and paper

Table-14 Summary data on pulp visited

S.N.	Name (District)	Annual Production	Waste steam, annual	Waste/ton of product
1	Bagmati Paper Kathmandu	Nepali Kagaj 90000 sheets	Wastewater 3000 liters	
2	Natural Paper Craft Kathmandu	Nepali Kagaj 60000 to 450000 sheets	Wastewater 6000 to 10000 liters	
3	Bhaktapur Paper Bhaktapur	Nepali Kagaj 18000 sheets	Wastewater 10000 liters	
4	Arabinda Paper Sunsari		Wastewater 9000 m3 Black liquor 4500 liters sludge 600 ton	
5	Baba Paper Sunsari		Wastewater 10500 m3 Black liquor 5400 m3 sludge	

7.4 Chemical and Chemical Product

Table-15 Summary data on paints visited

S.N	Name	Annual Production	Waste stream, annual
1	Polo Chemicals Kathmandu	1200 liters	Wastewater 60000 liters
2	Berger J & N Paints Bhaktapur	Oil-based = 111339 kg cement-based = 101425 kg water-based = 205288 liters	Wastewater 2933 liters washings from containers
3	Nepal Paints Bhaktapur	Oil-based = 510000 kg cement-based = 225000 kg water-based = 210000 liters	Wastewater 13 m3 liters washings from containers
4	Pashupati Paints Sunsari	Oil-based = 900 tons cement-based = 900 tons kg water-based = 900 tons	
5	Pratani soap & silicate Morang	1100 ton	Wastewater 600 m3

7.5 Bricks

Table 16 Summary data on bricks visited

S.N	Name	Annual Production in brick no.
1	R.K Ita Bhatta, Lalitpur	3.5 to 4 million
2	Surya chimney, Lalitpur	5 to 6 million
3	Quality Ita, Lalitpur	6 million
4	Harishiddi Brick & tiles, Lalitpur	20 million
5	Jay Guru chimney, Bhaktapur	5 to 6 million
6	Yapi Bhairab, Bhaktapur	9 to 10 million
7	B.A. Bricks, Bhaktapur	5 to 6 million
8	Bhaktapur Ita & tiles	15 million
9	Himalayan Ita, Sunsari	4 million
10	Jay Nepal Ita, Sunsari	2 million
11	Shri Hari Ita, Sunsari	3.2 million
12	Ananda Ita, Morang	4 million
13	Sandesh Ita, Morang	4 million
14	Aec Ita, Morang	3 million
15	Arabinda, Morang	3 million

7.6 Ferrous and non-ferrous metals from scraps

Table-17 Summary data on metals visited

S.N.	Name	Annual Production (metal)	No. if industries operating in the district (estimated)
1	Balaju Aluminum Kathmandu	100 ton (Al)	
2	Timila Aluminum Kathmandu	69 tons (Al)	
3	Paras metal Kathmandu	18 tons (Cu/brass)	
4	Sakya Al Kathmandu	84 tons Al	8 to 9 units in Kathmandu
5	Nepal Dhalaut Udyog Lalitpur	5 tons (brass)	
6	Sagar metal (iron/steel Foundry) Lalitpur	60 tons	5 industries in Lalitpur
7	Jay Santoshi rolling mill Lalitpur	200 tons (Cu/brass)	5 to 6 in Lalitpur
8	Nepal Dhalaut Udyog, Iron & steel Lalitpur Satdobato	200 to 300 tons (cast Iron/steel)	Cast iron casting = 5 & Steel producing unit = 1 in Lalitpur.
9	R.S. metal craft Bhaktapur	5 tons (Cu/Brass)	10 to 12 in Bhaktapur
10	Sunsari Aluminum Sunsari	75 tons	40 such industries in Nepal.
11	Iron and steel Pashupati rolling mill Sunsari	19500 tons	6 units in Nepal including 1 in Sunsari
12	Iron and steel Mainabati Sunsari	6300 tons	5 more in Nepal
13	Surya metal Copper, brass Sunsari	150 tons	2 more in Sunsari
14	D.K. metal Roling mill	54 tons (Cu & brass)	1 more in Sunsari
15	Krishna metal Engineering vehicle body Sunsari	18 tons (Fe and Steel)	1 more in Sunsari
16	Krishna metal craft Sunsari (tin sheets)	198 ton	
17	Kamala rolling mills Morang	18000 ton rods	
18	Megha metal craft Tin cans Morang	125 ton	1 more in Morang
19	Hulas metal Steel utensils Morang	64 tons	

7.7 Dry cleaning

Table-18 Summary data on dry-cleaning visited

S. N.	Name	Annual Production	Waste stream, annual
1	Band box Kathmandu	75000 pieces clothes	residue = 75 kg from 15000 liters of spent solvent
2	Fairy dry cleaners Kathmandu	9000 pieces	Residue = kg From 6000 liters of spent solvent
3	Crystal dry cleaning Kathmandu	4500 pieces	
4	Royal dry cleaners Lalitpur	12000 pieces	600 kg from 3000 liters of s[ent solvent
5	My shop Bhaktapur	60000	720 kg from 18000 liters of spent solvent

7.8 Lead acid battery

Only one industry of this kind in the country located at Sunsari.

Yearly production = 150 tons of metal lead, of which 20 tons is produced from used batteries recovery. According to DANIDA, 0.15 %of lead (Pb) is released in the environment (wastewater) during the process of recovering Pb from spent lead-acid batteries. Thus if 20 tons of Pb is produced, yearly release of Pb in waste water comes to 0.03 ton.

8.0 Finalization of Profile Development of Toxic Waste Products in Nepal

In finalizing the profiles of toxic waste products, efforts have been made to integrate data/information obtained from primary sources (questionnaire survey results) with data from secondary sources (literature survey). Toxic waste profiles both at national and district

levels (5 districts) have been developed from available data, which is illustrated by the data given in the following tables.

8.1 Profile of Toxic Waste Products in Nepal (country level), release vector: Water (for COD and Cr)

Table-19 A Profile of toxic waste products (country level), release vector: Water

Type of Industry (no. of industries)	Annual Nepal Total (Ton)	Average Waste Water discharge (m^3 / Ton)	Annual total Waste Water Discharge (m^3)	Annual COD Load		Annual Chromium Load	
				Release rate (mg/lit)	Total (Ton)	Release rate (mg/lit)	Total (Ton)
Textile (-)	5346*	54.77	292809	1066	312.135	0.615	0.180
Tanning (9)	28621**	70.00	2003470	2437	4883.458	178	357
Pulp & Paper (5)	22852 +	115.65	2642880	4100	10835.808		
Paint (11)	11386 x	1.00	11386	456	5.192	0.05	0.00057

Sources: * ESPS, Component 2, (CP), 2002; ** ESPS Component 2 (CP), 2001; + ESPS Component 2 (CP), 2003; x ESPS Component 2 (CP), 2003.

For COD and Cr releases, see references: 13, 14 and 15.

Table-19 B Profile of toxic waste products (country level), release vector: Water (for PCDD/PCDF and Lead).

Type of Industry	Annual Nepal Total (Ton)	Average Waste Water discharge (m^3 / Ton)	Annual total Waste Water Discharge (m^3)	Annual PCDD/PCDF Release in Waste Water		Annual Lead Release	
				Release rate (pg TEQ/ lit	Total (mg TEQ)	Release rate (mg/lit)	Total (Kg)
Textile	5346	54.77	292809				
Tanning	28621	70.00	2003470				
Pulp & Paper	22852	115.65	2642880	70	185		
paint	11386	1.00	11386			1.15	13.1

8.2 Profile of Toxic Waste Products in Nepal, release vector: Air

Cement clinkerization process

Nepal annual cement production = 244500 tons (from Survey results of 4 industries: Hetauda Cement, Udayapur Cement, Maruti Cement and Butawal Cement).

PCDD/PCDF release rate = 0.15 micro-g TEQ/ton.

Annual PCDD/PCDF release = 36.7 mg

Bricks production

Nepal annual production of bricks = 5.63 million ton

PCDD/PCDF release rate = 0.2 micro-g TEQ/ton

Total annual release of PCDD/PCDF = 1126 mg

8.3 Metal production from scraps

Table-20 District-wise total metal industries listed by CBS

District	NSIC 2710	NSIC 2720	NSIC 2731	NSIC 2732	Total Industries
Kathmandu	0	1	0	10	11
Lalitpur	1	2	0	11	14
Bhaktapur	0	0	0	0	0
Sunsari	4	4	0	0	8
Morang	4	1	0	3	8

Note: CBS classification does not provide metal-wise distribution for each district. So, for PCDD/PCDF release calculation, total number of each metal (Cu, brass and iron from scraps) available in the district is taken from information given by industries visited, see table 17.

8.4 District-wise Profile of Toxic Waste Products, release vector: Water

Table-21 A District-wise profile of toxic waste products in water (for COD load)

Coverage	Industry	Number	Weight	Total Waste Water Discharge (m^3)	Annual COD Load (Ton)
Nepal	Textile	156	1	292809.33	312.135
Morang	Textile	13	0.083333	24401	26.011
Sunsari	Textile	11	0.070513	20647	22.010
Lalitpur	Textile	27	0.173077	50679	54.023
Bhaktapur	Textile	15	0.096154	28155	30.013
Kathmandu	Textile	37	0.237179	69448	74.032
5 District Total		103	0.6603	193329	206.089
Nepal	Tanning	9	1	2003470	4883.458
Morang	Tanning	2	0.222	445216	1085.213
Sunsari	Tanning	2	0.222	445216	1085.213
Lalitpur	Tanning	0	0	0	0
Bhaktapur	Tanning	0	0	0	0
Kathmandu	Tanning	0	0	0	0
5 District Total		4	0.444	890432	2170.426
Nepal	Pulp & Paper	5	1	2642880	10835.808
Morang	Pulp & Paper	0	0	0	0
Sunsari	Pulp & Paper	2	0.4	1057152	4334.323
Lalitpur	Pulp & Paper	0	0	0	0
Bhaktapur	Pulp & Paper	0	0	0	0
Kathmandu	Pulp & Paper	0	0	0	0
5 District Total		2	0.4	1057152	4334.323
Nepal	Paint	11	1	11386	5.192
Morang	Paint	2	0.1818181	2070	0.944
Sunsari	Paint	0	0	0	0.000
Lalitpur	Paint	0	0	0	0.000
Bhaktapur	Paint	3	0.2727272	3105	1.416
Kathmandu	Paint	3	0.2727272	3105	1.416
5 District Total		8	0.7272725	8280	3.776

Table-21 B District-wise profile of toxic waste products in water for Cr, PCDD/PCDF and Lead.

Coverage	Industry	Annual Chromium Load (ton)	Annual PCDD/PCDF Release (mg)	Annual Lead Release (kg)
Nepal	Textile	0.1801		
Morang	Textile	0.0150		
Sunsari	Textile	0.0127		
Lalitpur	Textile	0.0312		
Bhaktapur	Textile	0.0173		
Kathmandu	Textile	0.9427		
5 District Total		0.1189		
Nepal	Tanning	178.0		
Morang	Tanning	39.56		
Sunsari	Tanning	39.56		
Lalitpur	Tanning	0		
Bhaktapur	Tanning	0		
Kathmandu	Tanning	0		
5 District Total		79.1		
Nepal	Pulp & Paper		185.0	
Morang	Pulp & Paper		0	
Sunsari	Pulp & Paper		74	
Lalitpur	Pulp & Paper		0	
Bhaktapur	Pulp & Paper		0	
Kathmandu	Pulp & Paper		0	
5 District total			74	
Nepal	Paint			13.1
Morang	Paint			2.38
Sunsari	Paint			0.0
Lalitpur	Paint			0.0
Bhaktapur	Paint			3.57
Kathmandu	Paint			3.57
5 District Total				9.52

Source: Textile: CBS Directory, 2001/2002 Tanning: Industrial Statistics, 2003/2004
Paint: ESPS, 2003

8.5 District-wise profile of toxic waste product, release vector: Air

Table 22 District-wise profile of toxic waste products for metals from scraps (PCDD/PCDF), release vector: Air

Type of Industry	Type	District	Number of Industries	Annual Production (Ton)	Annual PCDD/PCDF Release in Air	
					Release rate (μg TEQ/ Ton)	Total (mg)
Metal from scraps	Alminium	Kathamndu	9	561.0	150	84.15
	Brass	Lalitpur	6	432.0	1	0.432
		Bhaktapur	12	864.0	1	0.864
	Iron/Steel	Lalitpur	6	656.0	10	6.56
		Sunsari	2	218.7	10	2.187

Since the types of metal production are not mentioned in CBS listing, the corresponding toxic releases could not be quantified from the given district wise-data on a number of metal industries. Therefore, the annual PCDD / PCDF release in air is quantified from the surveyed industries in different districts.

8.6 District wise profile of toxic waste products (PCDD/PCDF) for bricks, release vector: Air

Table 23 District-wise profile of toxic waste products, release vector: Air

Type of Industry	District (No. of Indus)	Annual Production (Ton)	Annual PCDD/PCDF Release in Air	
			Release rate (μg TEQ/ Ton)	Total (mg)
Bricks	Kathamandu (3)	34062	0.2	6.812
	Lalitpur (29)	425000	0.2	85.000
	Bhaktapur (34)	658333	0.2	131.667
	Sunsari (29)	217500	0.2	43.500
	Morang (20)	183750	0.2	36.750

Source for District-wise brick factory number: CBS, 2001/2002

9.0 Conclusion and Recommendation

It should be borne in mind that because of the data gaps encountered at almost every stage of the step-wise procedures followed during this profile development (stated elsewhere in this report), the quantities of waste releases for toxic waste products calculated and presented in the following tables at national and district levels, can only be considered as indicative of the states of environmental pollution under the prevailing conditions.

For further development of the profiles of toxic waste products at district and country levels, the following is recommended in particular:

1. The step-wise procedure developed and adopted in this study should be followed as rigorously as possible. However, for toxic waste profile development, the CBS classification system of industries may not be adequate and needs to be supplemented by other sources,

for instance, by survey visits to typical industries to assess the activity types, waste discharges from various manufacturing processes, annual production volumes and the number of such industries operating in the region or the country etc.

2. It is to be understood that large data gaps may occur during quantitative expression of waste releases of particular types (chemicals, substances), because no industries in Nepal is known to keep adequate records of such emissions in various release vectors (air, water etc) by monitoring and time series investigations. To correct this situation, policy specification and legislation dealing with handling and management of hazardous wastes and toxic wastes products should be firmly in place so that concerned institutions in Government and private sectors including toxic waste producing industries and establishments should be made mandatory and responsible in observing and regulating the laws and by-laws regarding waste management and releases.

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Questionnaire for Pulp and paper mills

Name of the firm/establishment_____ Date of visit_____

Name of the Respondent_____designation _____

Address_____Telephone_____

1. Give the types of products produced by the mill and production volume/quantity per year / or per day in tons for each of the following:

   Writing & printing_____ Kraft paper_____

   Media paper_____ Others _____

2. Describe briefly processes involved in paper making: pulping, bleaching, paper finishing etc

   _____

   _____

   _____

3. Provide a copy of the plant layout (attach with this questionnaire).

4. Is elemental chlorine used for bleaching, specify if other bleaching agent is used.

   _____

   _____

5. What are the main raw materials used for pulp making? Give their quantities in tons consumed (annual / daily consumption of each) raw material.

   _____

   _____

6. What chemicals are used in finishing the paper (such as whitening agent and other additives), give their quantities consumed per year in tons/kg.

   _____

   _____

7. What feed materials (types of fuel) are used for boilers, what quantities of fuels are consumed per year / day in tons.

_____

_____

8. Is black materials produced from pulp section used in any way as a feed material in boilers? Give the daily production volume from pulp section of such black liquids.

_____

_____

Waste Generation

9. How much water is used daily for pulp and paper making processes (in cubic Meters)?

_____

10. What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?

_____

11. What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

12. Give estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons).

_____

13. The wastewater generated is discharged in to stream/river or land? _____

14. What happens to the sludge generated? _____

15. Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

16. Is the flue gas from the boilers freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day or, method of disposal of the dust?

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose. All detailed personal observations noted here during the plant visit might assist later to fill up the data gap.

Questionnaire for the production of Bricks (Ita Bhatta)

Name of the Ita Bhatta — Date of visit

Name of the Respondent — designation

Address — Telephone

1.0 Give the types of kiln used for brick production:

i) Bull's Trench Kiln (BTK) with movable chimney.

ii) BTK with fixed chimney

iii) BTK with zigzag setting (forced drought)

iv) BTK with zigzag setting (natural draught).

v) Thado Bhatta with clamps

vi) Hoffman Kiln

vii) Other type

2.0 The kiln is of continuous type? If seasonal, give the approximate number of days the kiln runs in a year.

3.0 Give the number of bricks produced per day or per year.

4.0 Give the quantity of bricks produced in ton per day or per year

5.0 What could be the firing temperature during the cooking of bricks?

6.0 What kind of fuel or the mixture of fuels is used in bricking making?

i)	Coal	estimated quantity burnt per day/yr.
ii)	lignite	
iii)	wood	do
iv)	rice husk/wheat husk	
v)	animal dung	
vi)	used tires	do
vii)	used plastics	

viii) others specify

7.0 Name the type and quantities of additives mixed with clay, in kg or ton per day.

8.0 What could be the length of firing time needed to cook the bricks (days)

9.0 Is any type of dust pollution control method adopted?

10.0 How many such Ita Bhatta are operating in this district?

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

Ferrous and non-ferrous metal production

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: **Iron and steel foundries; Copper production; Aluminum production; Zinc production; Lead production; Brass production; if others, describe**

For each of above, give the following details:

1 Basic technology (smelting, rolling and casting etc) describe.

_____

_____

_____

2 Furnace Type: Cold air cupola or rotary drums or crucible with no Air Pollution Control (APC) measures, with only limited controls like use of fabric filters;
or induction / arc furnaces with FF etc Describe, capacity, temperature attained etc.

_____

_____

_____

3 Give the actual metal production figures: Daily in tons _____yearly in tons_____

4 What types of fluxes are used/slag obtained?_____

5 Give production figures of slag, residue: daily in tons _____ yearly in tons _____

6 What types of fuel is used for heating the furnace?_____

7 Give the consumption figures for each type of

8 fuel daily _____per ton metal produced_____

9 Give the factory running hours daily at full load_____

10 If scraps are used, are they pretreated before processing?, describe_____

11 Give the quantities of scraps consumed in tons, daily _____yearly _____

12 Give an estimate of how many such metal producing / processing industries are operating in Nepal _____or in this district

13 Give an estimate of quantity of scraps of this metal produced in the country or in the district_____

14 Does your factory use scrap or residues or slag brought from other factories or from other countries for any kind of processing or metal recovery etc? _____

15 If the answer of 13 is yes, Give the type of substance brought, its quantity used (yearly) and the country of origin_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

---

_____

_____

Manufacture of Chemicals

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

What types of chemicals are produced here? _____

Levels of technology applied for: manufacture of chemicals such as, pentachlorophenol, chlorinated aromatic / aliphatic compounds, chloranil, chlorine gas etc or if any of the above chemicals is used in producing the final product/products which is different from the above, describe in appropriate question given below:

1 Basic technology / processes of manufacture, short description (attach plan layout)

_____

_____

_____

2 Give the types of raw materials and the quantity of each chemical /raw material used

In toms per day_____year_____ or per ton of product_____

3 Give the actual chemical production figures in ton:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers etc.)

1_____ 2_____ 3_____

5 Give the consumption figures in ton for each type of fuel used: daily_____yearly_____

6 Give the factory running hours daily at full load_____

Waste Generation

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

9 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

10 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)_____

11 The wastewater generated is discharged in to stream/river or land? _____

12 What happens to the sludge generated? _____

13 Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

13 Is the flue gas from the boilers / or other processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

14 Give an estimate of how many such factories are operating in this district_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

_____

_____

Manufacture of Textiles (fiber, yarn, fabric, finished products)

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: manufacture of textiles (cotton, synthetic, others), describe

1 Basic technology / processes of manufacture, short description (attach plan layout)

_____

_____

_____

2 Give the types of materials and the quantity of each material (include dyestuffs, bleaching agents, activators, stabilizers etc.) used in processing textiles, yarns, fibers etc In toms (kg) per day_____year_____ or per ton of product_____

3 Give the actual textile (or yarns, fabric) production figures in ton and in square meters:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers, or for heating purposes)

1_____2_____3_____

5 Give the consumption figures in ton/or kg for each type of fuel used: daily_____yearly-_____

6 Give the factory running hours daily at full load_____

Waste Generation

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

7 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

8 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)

_____

9 The wastewater generated is discharged in to stream/river or land? _____

10 What happens to the sludge generated? _____

Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

11 Is the flue gas from the boilers / or other thermal processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

12 Give an estimate how many such factories are operating in this district? _____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

_____

Manufacture of Leather

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: manufacture of leather / processing of hides / skins

Give the following details:

1 Basic technology / processes, short description (attach plan layout)

_____

_____

_____

2 Give the types of raw materials and the quantity of each raw material (include dyestuffs, preservatives etc) used

In toms (kg) per day_____year_____ or per ton of product_____

3 Give actual textile production figures in ton and in squire meters etc:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers, or for heating purposes)

1_____2_____3_____

5 Give the consumption figures in ton for each type of fuel used: daily_____yearly_____

6 Give the factory running hours yearly at full load_____

<u>Waste Generation</u>

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

9 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

10 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)

_____

11 The wastewater generated is discharged in to stream/river or land? _____

12 What happens to the sludge generated? _____

Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

13 Is the flue gas from the boilers / or other processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

14 Give an estimate of how many such factories are in operation in this district or the country_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

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_____

Questionnaire for dry cleaning waste residues

Name of the firm/establishment_____ Date of visit_____

Name of the Respondent_____designation _____

Address_____Telephone_____

1. What types of textile are dry-cleaned? Normal ☐ Heavy / others ☐

2. Give the quantity of textiles (pieces or …) dry-cleaned daily/ weekly/batches._____

   Normal ☐ Heavy ☐ Others ☐

3. Describe briefly the type of process, equipment, used for dry-cleaning

   _____

   _____

4. Provide a plant layout of dry-cleaning process, if any. (Please clip the layout provided by the respondent with this form)

5. What chemicals/solvents are used for dry-cleaning?

   _____

6. Give the solvent consumption quantity in kg / liters per batch etc._____

7. Give the quantity of waste residue obtained from distillation of spent solvent or filter cartridge in kg /liter per batch._____

8. What is the volume of spent solvent distilled to obtain the residue of 7? _____

9. How often do you recover the solvent for reuse and in what quantity at a time? _____

   _____

10. What is the fate of the residue? _____

    a. Mixed with the municipal waste stream? ☐
    b. Discharged in the surrounding land? ☐
    c. Collected in some container for future disposal? ☐

11. How the residue is finally disposed? _____

_____

12. If you have any comments on this questionnaire or if you have any other process utilized not covered by above, but is relevant to the study, e.g. if you use any kind of filter cartridges, which has to be disposed, please give the information about this.
Give an estimate of how many such dry-cleaning facilities are operating in this district. Or Who can give this kind of information?

_____

_____

_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose. All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

Ferrous and non-ferrous metal production

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: **Iron and steel foundries; Copper production; Aluminum production; Zinc production; Lead production; Brass production; if others, describe**

For each of above, give the following details:

1 Basic technology (smelting, rolling and casting etc) describe.

_____

_____

_____

3 Furnace Type: Cold air cupola or rotary drums or crucible with no Air Pollution Control (APC) measures, with only limited controls like use of fabric filters;
or induction / arc furnaces with FF etc Describe, capacity, temperature attained etc.

_____

_____

_____

3 Give the actual metal production figures: Daily in tons _____yearly in tons_____

4 What types of fluxes are used/slag obtained?_____

16 Give production figures of slag, residue: daily in tons _____ yearly in tons _____

17 What types of fuel is used for heating the furnace?_____

18 Give the consumption figures for each type of

19 fuel daily _____per ton metal produced_____

20 Give the factory running hours daily at full load_____

21 If scraps are used, are they pretreated before processing?, describe_____

22 Give the quantities of scraps consumed in tons, daily _____yearly _____

23 Give an estimate of how many such metal producing / processing industries are operating in Nepal _____or in this district

24 Give an estimate of quantity of scraps of this metal produced in the country or in the district_____

25 Does your factory use scrap or residues or slag brought from other factories or from other countries for any kind of processing or metal recovery etc? _____

26 If the answer of 13 is yes, Give the type of substance brought, its quantity used (yearly) and the country of origin_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

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Manufacture of Chemicals

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

What types of chemicals are produced here? _____

Levels of technology applied for: manufacture of chemicals such as, pentachlorophenol, chlorinated aromatic / aliphatic compounds, chloranil, chlorine gas etc or if any of the above chemicals is used in producing the final product/products which is different from the above, describe in appropriate question given below:

1 Basic technology / processes of manufacture, short description (attach plan layout)

_____

_____

_____

3 Give the types of raw materials and the quantity of each chemical /raw material used

In toms per day_____year_____ or per ton of product_____

3 Give the actual chemical production figures in ton:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers etc.)

1_____ 2_____ 3_____

7 Give the consumption figures in ton for each type of fuel used: daily_____yearly_____

8 Give the factory running hours daily at full load_____

Waste Generation

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

13 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

14 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)_____

15 The wastewater generated is discharged in to stream/river or land? _____

16 What happens to the sludge generated? _____

13 Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

13 Is the flue gas from the boilers / or other processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

15 Give an estimate of how many such factories are operating in this district_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

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Manufacture of Textiles (fiber, yarn, fabric, finished products)

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: manufacture of textiles (cotton, synthetic, others), describe

1 Basic technology / processes of manufacture, short description (attach plan layout)

_____

_____

_____

3 Give the types of materials and the quantity of each material (include dyestuffs, bleaching agents, activators, stabilizers etc.) used in processing textiles, yarns, fibers etc In toms (kg) per day_____year_____ or per ton of product_____

3 Give the actual textile (or yarns, fabric) production figures in ton and in square meters:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers, or for heating purposes)

1_____2_____3_____

11 Give the consumption figures in ton/or kg for each type of fuel used: daily_____yearly-_____

12 Give the factory running hours daily at full load_____

Waste Generation

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

13 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

14 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)

_____

15 The wastewater generated is discharged in to stream/river or land? _____

16 What happens to the sludge generated? _____

Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

11 Is the flue gas from the boilers / or other thermal processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

12 Give an estimate how many such factories are operating in this district? _____

To be filled by the interviewer

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Manufacture of Leather

Name of the factory _____Date of Visit_____

Name of the respondent_____ Designation _____

Address _____Telephone _____

Levels of technology applied for: manufacture of leather / processing of hides / skins

Give the following details:

1 Basic technology / processes, short description (attach plan layout)

_____

_____

_____

3 Give the types of raw materials and the quantity of each raw material (include dyestuffs, preservatives etc) used

In toms (kg) per day_____year_____ or per ton of product_____

3 Give actual textile production figures in ton and in squire meters etc:

Daily_____yearly_____

4 What types of fuel is used for power generation in the factory (in boilers, or for heating purposes)

1_____2_____3_____

7 Give the consumption figures in ton for each type of fuel used: daily_____yearly_____

8 Give the factory running hours yearly at full load_____

Waste Generation

7 How much water is used daily for running all factory processes in cubic meters?_____

8 What is the total volume of waste discharge at the end of the pipe (in cubic meter) per day?_____

13 What sort of wastewater treatment process is used? Describe briefly the process involved.

_____

_____

14 Give an estimate of the amount of sludge, the residue left after treatment (sedimentation etc) generated per day (tons)

_____

15 The wastewater generated is discharged in to stream/river or land? _____

16 What happens to the sludge generated? _____

Is it dumped inside the factory premise, thrown in to land outside, disposed by land filling or other (specify)?

_____

13 Is the flue gas from the boilers / or other processes involved freely emitted in to the air or is there some sort of pollution control measures taken, if flue dusts are collected, give the amount of dust collected per day in ton etc. or, method of disposal of the dust?

_____

_____

14 Give an estimate of how many such factories are in operation in this district or the country_____

To be filled by the interviewer

Personal comments / observation during visit: This can be anything which is not covered by above or which is relevant to the study purpose All detailed personal observations noted here during the plant visit might assist later to fill up the data gap

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