1.1 Introduction

This Environmental Impact Assessment (EIA) guideline for pesticides shall apply to any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products, or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.

Pesticide can be defined as any chemical substance or mixture of substances intended for preventing, destroying, repelling, or mitigating the effect of any pest of plants and animals. They include herbicides, insecticides, rodenticides, fungicides, molluscides, nematicides, repellents and attractants used in agriculture, public health, horticulture, food storage or a chemical substance used for a similar purpose (NAFDAC, 1996).

This term will include any substance intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport (FAO, 2002).

1.2 Pesticides and its uses

Pesticide manufacturing consists of chemical synthesis of active ingredients which is very often the synthesis of complex organic chemical compounds, and subsequent formulation of these active ingredients (usually mixing and grinding processes).

Pesticides cover a wide range of substances including:

(a) Herbicide for controlling weed or unwanted vegetation
(b) Insecticides for controlling a wide variety on of insects
(c) Fungicides used to prevents the growth of molds and fungi
(d) Disinfectants used for preventing the spread of bacteria
(e) Rodenticides used for controlling mice and rat
(f) Bactericides - bacteria
(g) Larvicides - larvae
(h) Algaecides-algae

Insecticides

Insecticides are chemicals used to control insects. Often the word "insecticide" is confused with the word "pesticide." It is, however, just one of many types of pesticides. An insecticide may kill an insect by touching it or it may have to be swallowed to be effective. Some insecticides kill both by touch and by swallowing. Insecticides called systemics may be absorbed, injected, or fed into the plant or animal to be protected. When an insect feeds on this plant or animal, it ingests the systemic chemical and is killed.

Fungicides

Fungicides are chemicals used to control the fungi which cause molds, rots, and plant diseases. All fungicides work by coming in contact with the fungus, because fungi do not "swallow" in the normal sense. Therefore, most fungicides are applied over a large surface area to try to directly hit every fungus. Some fungicides may be systemic in that the plant to be protected may be fed or injected with the chemical.

Herbicides

Herbicide**s** are chemicals used to control unwanted plants. These chemicals are different from other pesticides because they are used to kill or slow the growth of some plants, rather than to protect them. Some herbicides kill every plant they contact, while others kill only certain plants.

- **Nonselective herbicides** are toxic to all plants. These are often used when no plants are wanted in an area. For example, nonselective herbicides could be used for clearing under guardrails or for total control of weeds in industrial areas.
- **Selective herbicides** kill some plants with little or no injury to other plants. Usually selective types will kill either broadleaved plants or grassy plants. These are useful for lawns, golf courses or in areas with desirable trees. Some very selective herbicides may kill only certain plants in a group.

Rodenticides

Rodenticides are chemicals used to control rats, mice and other rodents. Chemicals which control other mammals, birds, and fish are also grouped in this category by regulatory agencies. Most rodenticides are stomach poisons and are often applied as baits. Rodenticides which act by contacting the pest are usually not applied over /large

surfaces because of the hazard to domestic animals or desirable wildlife. They are usually applied in limited areas such as runways, known feeding places, or as baits.

Repellents

Repellants are designed to repel unwanted pests, often by taste or smell.

Bactericides:

Substances used to kill bacteria (bactericides) or inhibit their growth (bacteriostats), such as quinolones, fluoroquinolones, gatifloxacin and moxifloxacin Miticides.

Biopesticides

Biopesticides are types of pesticides that are derived from pathogenic micro-organisms (e.g., bacteria, viruses, fungi, protozoa, rickettsiae and nematodes). These are often referred to as biological or microbial pesticides while botanical pesticides are those derived from plants. Biopesticides are divided into three groups:

- Microbial pesticides (microorganisms that work to kill certain pests), including biological insecticides;
- Biochemical pesticides (naturally occurring substances that control pests through non-toxic routes);
- Plant-incorporated protectants (substances that result from genetic material (i.e. *Bacillus thuringiensis)* being incorporated into a plant).

1.3 Purpose of the EIA Guideline

The purpose of this EIA guideline is to provide clear and concise information to all stakeholders (Proponents, Consultants, Government Ministries, Departments and Agencies, Members of the Public, Expert in relevant disciplines and interested groups, the organized private sector, non-governmental organizations, professional bodies, host and project affected communities) to improve the EIA study carried out for pesticide industry. This guideline will also assist stakeholders to identify the environmental issues, mitigation measures and alternatives that need to be assessed and considered during the study.

Pesticides are methods and techniques as compatible a manner as possible to maintain the pest population at level below that causing economically unacceptable damage or loss.

2.0 Project Justification

A proponent shall provide necessary and adequate information on the justification for the project. This shall include a summary of the report of the Project's feasibility study; the need, value and sustainability (social, cultural and economic) of the Project. Such justification shall expressly define the benefits of the project to its intended end-users and indicate the over-riding advantages or positive impact of the project over its anticipated environmental impacts. The justification may also include the rationale for selecting the project amongst various available options or alternatives and any socio-economic factor's justifying the project.

3.0 Project Description for Pesticide Manufacturing Industry

The project description should detail the types, capacity and chemistry of the pesticide(s) to be manufactured with respect to plant configuration, raw material requirement, utilities and services, infrastructural facilities and waste generation, their quantity, treatment and safe disposal of waste. A flow diagram of the production process for each of the pesticide and a layout of the facility should be detailed.

The EIA study should report a description of the development in relation to the local environment as follows:

- Description of development type with physical characteristics, scale and design.
- An estimate of quantities and types of materials needed during construction and operation phase of the project.
- Description of the main characteristics of the production process with diagrams, plans and maps.
- Description of chemical reactions involved in production of technical grade pesticides such as: alkylation, carboxylation, acetylation, condensation, cyclization, dehydration, halogenation, oxidation, sulphonation, nitration and amination.
- A description of indication of the physical presence and appearance of completed development within the receiving environment.
- The nature of the production processes intended to be employed and expected production rate.
- The land area taken by the development with its location clearly defined on a map.

- The uses to which the land will be put should be described.
- The estimated duration of the construction phase, operational phase and where appropriate, decommission phase should be given.
- The numbers of workers and/or visitors entering the site during construction and operation should be estimated. The access to the site and likely means of transport should be given.
- The means of transporting raw materials and products to and from the site and the approximate quantities involved should be described.
- An estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from operation of the proposed project.

Emphasis should however be given to those components with the most potential for significant short and long term environmental impacts.

4.0 Description of the Environment/ Baseline Data

The area and location of the environment likely to be affected by the development should be described in the EIA Report. The environment expected to be affected by the project should be presented with a suitable map of the area. Description of the existing environment should include the natural (physical and biological environment) and human (cultural, socio-economic) systems and their inter-relationships.

The baseline conditions: a description of the affected environment as it is currently, and as it could be expected to develop if the project were not to proceed, should be presented. The important components of the affected environments should be identified and described. The methods and investigations undertaken for this purpose should be disclosed and be appropriate to the size and magnitude of the project. Secondary data of significance can be sourced for useful utilization including local plans.

Table 1: Environmental Components and Indicators of Existing Environment

Environmental Components	**Indicators**
Climatic variables	Rainfall – Pattern, amount, trend Temperature- patterns Climatic zone Climate variability and Extreme events Climate change projections Prevailing wind – direction (speed)
Topography	Drainage pattern, elevation and slopes {this can be presented with a digital elevation model}, Specific landform types, etc.
Coastal dynamics and morphology	Wave patterns Currents Shoreline morphology – near shore, foreshore Sediment – characteristics and transport, etc.
Soil	Type, properties and characteristics
Water	Availability and abundance Water quality (pH, Ammoniacal Nitrogen, Total Nitrogen, Free Ammoniacal Nitrogen, Nitrate Nitrogen, Cyanide, Vanadium, Arsenic, Suspended Solids, Oil and Grease, Cr as Cr^{+6}, Total Chromium, etc.) Surface water (rivers, lakes, ponds, gullies) – quality, water depths, flooding areas, etc. Ground water – water table, local aquifer storage capacity, specific yield, water level depths and fluctuations, etc. Coastal Floodplains Wastewater discharges Waste discharges, etc.
Air	Ambient air quality (for gaseous and particulate pollutants) Stack and fugitive emissions for PM_{10}, $PM_{2.5}$, NH_3, SO_2, NO_x etc. Air shed, Odour levels, etc.
Noise	Identifying sources of noise

	Noise due to traffic/transportation of vehicles Noise due to heavy equipment operations Duration and variations in noise over time, etc.
Biological	Flora – type, density, exploitation, etc. Fauna – distribution, abundance, rarity, migratory, species diversity, habitat requirements, habitat resilience, economic significance, commercial value, etc. Fisheries – migratory species, species with commercial/ recreational value, etc.
Land Use	Land use pattern, actual and projected, specially designated areas, manmade features, incompatible land use attributes (e.g. public water supply, tourism site, , etc.), ESAs – sensitivity (distance, area and significance).
Socio-Economic Factors	Demography details of all project affected communities, economy (employment rate, income distribution), services (types, capacity, adequacy), housing, etc. cultural

5.0 Associated and Potential Environmental Impacts

The identification, prediction and evaluation of potential impacts of the project on the environment should be investigated and described. The impacts should be broadly defined to cover all potential effects of the environment.

(a) A description of direct impact and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative impact of the project should be addressed.

(b) The types of impact in (a) above should be described with regards to human beings, flora and fauna, soil, water, air, climate, land, cultural and interactions amongst them.

(c) Impacts during construction and operation phases should be considered including impacts that might arise from non-standard operating conditions, accidents etc..

(d) Predicted impacts should be derived from baseline conditions as to prevail as a consequence of the project.

(e) Identification of impacts should be by a systematic methodology such as project specific checklists, matrices, overlays, Ad-hoc, networks, geographic information system (GIS), expert opinion, Delphi technique etc.

(f) A brief description of the impact identification method should be described and the rational for using it.

(g) The significance of impacts should be assessed, taking into account appropriate national and international standards where available. Consideration should also be made for magnitude, location and duration of the impacts. The choice of significance assessment should be justified and any contrary opinion elaborated upon.

(h) The EIA study for pesticide manufacturing projects should also consider the cumulative impacts that could arise from a combination of the impacts due to other projects with those of other existing or planned projects in the surrounding area and including residual impacts.

6.0 Mitigation Measures / Alternatives

(a) For ensuring a thorough site selection process, alternative sites should have been considered where practicable with primary advantages and disadvantages and reasons for the final choice detailed. Including alternative processes, designs, and operating conditions.

(b) Mitigations of all significant adverse impacts for the project type should be considered. Any residual or unmitigated impacts should be justified.

(c) The extent of effectiveness of mitigations measures when implemented should be described.

(d) Mitigation methods considered should include modification of project, compensation and the provision of alternative facilities as well as pollution control.

(e) Details of how the mitigation measures will be implemented and function over the time span for which they are necessary should be highlighted.

(f) Mitigation measure should be described with respect to the impact of significances to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should also be cross-referenced to the project design and operating procedures which elaborate on the technical aspects of implementing the various measures.

(g) Avoiding environmental sensitive areas (ESAs)

(h) Engineered structures

(i) Pollution control devices

(j) Changes in manufacturing, process, technology use, or waste management practices, such as substituting a hazardous chemical with a non-hazardous one, or the re-cycling or re-use of waste materials, etc.

7.0 Environmental Management Plan (EMP)

The Environmental Management Plan (EMP) outlines the mitigation, monitoring and institutional measures to be taken during project implementation and operation to avoid or control adverse environmental impacts, and the actions needed to implement the measures.

(a) The EMP for the pesticide manufacturing industry should be site-specific, focused and logical with a clear framework for management of key environmental impacts that could arise from the project.

(b) The EMP should be prepared with involvement of key stakeholders (proponent, regulators and local community).

(c) The EMP should cover all areas of the environment (human beings, flora and fauna, air, soil, water, land, cultural heritage, waste management, traffic and transport, noise and vibration) etc.

(d) The EMP should also outline the following summary of potential impacts of the project; description of recommended mitigation measures; description of monitoring programme to ensure compliance with relevant standards and residual impacts; allocation of resources and responsibilities for plan implementation; implementation schedule and reporting procedures and contingency plans and disaster management plan.

8.0 Remediation Plans after Decommissioning

The Decommissioning and Remediation Plans should provide a framework for the implementation of decommissioning and rehabilitation activities in the closure phase of the Project. The plan should be in line with the FMEnv guidelines for decommissioning and best international practices. A remediation plan should be drawn by the proponent and approved by all concerned (regulators and

stakeholders) before execution. Both beneficial and adverse environmental effects of the decommissioning or closure should be scrupulously stated. Mitigation measures should be prescribed to ensure health of workers and environmental safeguards and to minimize the risk of possible incidental events during decommissioning phase. Decommissioning and remediation must be aimed at restoring environmental conditions existing before the realization of the pesticide Plant.

9.0 Approach to The EIA study for Pesticides Plant Projects

1. Composition of an EIA Report for pesticides manufacturing industry

i. An introduction and background of the project, the proponent of the project, type and size/capacity of the project. The objectives of the EIA in relation to the project, Terms of Reference (ToR) and a legal, administrative and policy framework for the project.

ii. A justification or the project should be detailed and should address the need for the project, value of the project, project alternatives and envisaged sustainability of the project.

iii. A project and or process description should be discussed extensively and should include;

iv. Type of project and Justification for selecting the proposed unit size.

v. Land requirement for the project including its break up for various purposes, its availability and optimization.

vi. Details of proposed layout clearly demarcating various facilities of the plant.

vii. Complete process flow diagram describing each unit, its processes and operations, along with material balance.

viii. Details of proposed source-specific pollution control schemes and equipments to meet the national standards.

ix. Details on requirement of raw materials (chemicals, auxiliary media, *etc*.), its source, storage and handling at the plant.

x. Details on requirement of energy and water along with its source and authorization from the concerned department.

xi. Details on chemical reactions/processes used in the production of technical grade pesticides.

xii. Details on unit operations involved in liquid/liquid extraction, liquid/liquid separation, liquid/solid separation, gas/solid separation, distillation, crystallization, gas absorption, drying, grinding and mixing, etc.

xiii. Details on water balance including quantity of effluent generated, recycled and reused. Efforts to minimize effluent discharge and to maintain quality of receiving water body.

xiv. Details of effluent treatment plant, inlet and treated water quality with specific efficiency of each treatment unit in reduction in respect of all concerned environmental parameters.

xv. Details on composition, generation and utilization of waste from the plant.

xvi. In case of expansion of existing industries, remediation measures adopted to restore the environmental quality if the groundwater, soil, land, air, etc., are affected and a detailed compliance to the prior environmental clearance/consent conditions.

2. Description of the environment

i. The study area shall be examined and identified for areas that are likely to be affected by the project phases.

ii. Location of the project site and its nearest habitats with distances from the project site.

iii. Land use based on GIS including location specific sensitivities such as settlements and communities in the study area.Demography details of communities that fall within the study area.

iv. Topography details of the project area.

v. The baseline data to be collected from the study area with respect to different components of environment viz. air, water, land, soil, flora and fauna and socio-economic.

vi. Surface water quality of nearby water sources such as streams, river, etc. and other nearby surface drains.

vii. Details on ground water quality.

viii. Site-specific micro-meteorological data.

ix. Data gathering wet and or dry as prescribed by FMEnv.

x. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity.

xi. Geographical features status of the study area.

10.0 Associated and Potential Impacts of a pesticide manufacturing project

The following set of conditions may be used as a guide for assessing and impact of the project:

Will there be a large change in environmental conditions?

Will new features be out-of-scale with the existing environment?

Will the impact be unusual in the area or particularly complex?

Will the impact extend over a large area and continue for a long time?

Will many people be affected?

What receptors will be impacted?

Is there a risk that environmental standards will be breached?

Is there a risk that protected sites, areas, features will be affected?

Is there a high probability of the impacts occurring?

Will the impacts be permanent rather than temporary?

Will the impacts be continuous rather than intermittent?

If it is intermittent will it be frequent rather than rare?

Will the impacts be irreversible?

Will it be difficult to avoid, or reduce or repair or compensate for the impact?

What are the impacts due to transportation of raw materials and end products on the surrounding environment?

What are the impacts due to wastewater generation from the plant on surface water, soil and groundwater?

Impacts due to air emissions such as VOCs, inorganic emissions, odour, noise

11.0 Mitigation Measures and Alternatives

Table 2: Environmental Impacts and Typical Mitigation Measures of Manufacturing

Impacts	
Soil	• Installation of drainage ditches • Runoff and retention ponds • Usage of appropriate monitoring and control facilities for construction equipments deployed • Methods to reuse earth material generated during

Resources – fuel/construction material,	• Availing the resources which could be replenished by natural systems, etc.
Deforestation	• Plant or create similar areas • Initiate a tree planning program in other areas
Water pollution (Ground water/ Surface water)	• Conjunctive use of ground/surface water, to prevent flooding/water logging/depletion of water resources. Including rain water harvesting • Stormwater drainage system to collect surface runoff • All effluents containing acid/alkali/organic/toxic wastes should be properly treated. • Monitoring of ground waters • Use of biodegradable or otherwise readily treatable additives • Neutralization and sedimentation of wastewaters, where applicable • Dewatering of sludges and appropriate disposal of solids • In case of spent oil, oil separation before
Air Pollution	• Periodic checking of vehicles and construction machinery to ensure compliance to emission standards. • Attenuation of pollution/protection of receptor • Dilution of odourant (dilution can change the nature as well as strength of an odour), odour counteraction or neutralise (certain pairs of odours in appropriate concentrations may neutralise each other), odour masking or blanketing (certain weaker malodours

Dust pollution	• Adopt sprinkling of water • Wetting of roadways to reduce traffic dust and entrained particles • Control vehicle speed on site • Ensure periodical wahsing of construction equipment and transport vehicles to prevent accumulated dust. • Providing dust collection equipment at all possible points
Noise pollution	• Use of suitable muffler systems/enclosures/sound-proof glass panelling on heavy equipment/pumps/blowers • Pumps and blowers may be mounted on rubber pads or any other noise absorbing materials • Limiting certain activities • Proper scheduling of high noise generating activities to minimise noise impacts • Usage of well maintained construction equipment meeting the regulatory standards • Placement of equipments emitting high noise in an orientation that directs the noise away from sensitive receptors
	• Use of ear protective devices. • In case of steady noise levels above 85-dB (A), initiation of hearing conservation measures
Biological	• Installation of systems to discourage nesting or perching of birds in dangerous environments • Increased employee awareness to sensitive areas, *etc.*

Social	• Health and safety measures for workers • Development of traffic plan that minimizes road use by workers • Provide sufficient counseling and time to the affected population for relocation • Exploration of alternative approach routes in consultation with local community and other stakeholders
Occupational health and safety	• Provision of worker camps with proper sanitation and medical facilities, as well as making the worker camps self- sufficient with resources like water supply, power supply, etc • Arrangement of periodic health check-ups for early detection and control of communicable diseases. • Arrangement to dispose off the wastes at approved disposal sites.
Construction	• Have a Transport Management Plan in place in order to prevent/minimize the disturbance on surrounding habitats
Solid/Hazardous waste	• Proper handling of excavated soil • Proper plan to collect and dispose off the solid waste generated onsite. • Identify an authorized waste handler for segregation of construction and hazardous waste and its removal on a regular basis to minimise odour, pest and impacts of

12.0 Environmental Management Plan

- The administrative and technical organizational structure to ensure proposed project monitoring programme for approved mitigation measures are implemented including the involvement of the ministry and other stakeholders.
- Monitoring programme for pollution control at source.
- Stack and fugitive emissions monitoring SO_2, NOx, HC, CO, acid mist, HCl, Cl_2.
- Monitoring of carbon foot print

- Specific programme to monitor safety and health protection of workers.
- Development and design of appropriate monitoring network to assess the possible residual impacts on environmental media.
- Details of in-house monitoring capabilities
- The EMP devised to mitigate the adverse impacts of the project should be detailed including allocation of resources and responsibilities for plan implementation.
- Details of the emergency preparedness plan and on-site and off-site disaster management plan should be discussed extensively.
- Environmental Monitoring Program should be detailed to provide specific information on; monitoring pollutants at receiving environment for the appropriate notified parameters – air quality, ground and surface water, land etc during project phases; specific programme to monitor safety and health of workers, appropriate monitoring network has to be designed and proposed, to assess the possible residual impacts on environmental components and details of in-house monitoring capabilities and the recognized Ministry, department and agencies for conducting the monitoring.

13.0 Remediation Plans after Decommissioning

The need to decommission the project (temporarily or permanently) at any point.

Develop appropriate plan for the restoration of the environment to include soil, air, water, land economic, cultural and other components.

13.1 Additional Studies

1. Details on risk assessment and damage control during different phases of the project and proposed safeguard measures.
2. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, etc.
3. Proposed plan to handle the socio-economic influence on the local community. The plan should include quantitative dimension as far as possible.
4. Details on corporate social responsibility (CSR)
5. Addressing pertinent issues identified during scoping.
6. Social Impact Assessment
7. Environmental risk management

14.0 Potential Sources of Emissions during Manufacturing of Pesticides

Media	Potential Sources of Emissions
Air	Point source emissions: stack, vent (e.g., laboratory hood, distillation unit, reactor, storage tank vent), material loading/unloading operations (including cars, tank trucks)
	Fugitive emissions: pumps, valves, flanges, sample collection, mechanical seals, relief devices, tanks
	Secondary emissions: waste and wastewater treatment units, cooling tower, process sewer, sump, spill/leak areas
	Liquid wastes (Organic or Aqueous): Equipment wash solvent/water, lab samples, surplus chemicals, product washes/purifications, seal flushes, scrubber blow down, cooling water, steam jets, vacuum pumps, leaks, spills, spent/used solvents, housekeeping, waste oils/lubricants from maintenance
	Solid Wastes: Spent catalysts, spent filters, sludges, wastewater treatment, biological sludge, old equipment/insulation, packaging material, reaction by-products, spent carbon/resins, drying aids
	Ground Water Contamination: Unlined ditches, process trenches, sumps, pumps/valves/fittings, wastewater treatment ponds, product storage areas, tanks and tank farms, aboveground and underground piping, loading/unloading areas/racks,manufacturing maintenance facilities.

15.0 Guidance to waste treatment from manufacturing of pesticides

- Evaporation system, which includes: Segregation of production waste from utility and sanitation waste.
- Evaporation of the segregated waste in suitably designed evaporation ponds (solar evaporation or forced evaporation)
- Incineration of the concentrated waste
- Detoxification followed by biological treatment (conventional activated sludge process), comprising aeration tanks, secondary clarifier and sludge
- reuse and recycling of equipment wash down waters and other process water as makeup solutions for subsequent batches;

- installation of equalization systems before the wastewater treatment units to manage flow and / or concentration spikes;
- solvent waste streams from different sources should be combined to optimize treatment;
- recovery of solvents such as fractioned distillation to remove low-boiling compounds from wastewater stream
- inert gas stripping and condensation to remove volatile compounds from wastewater stream solvent extraction of organic compounds (e.g. high or refractory halogenated compounds and high COD loads)
- installation of reverse osmosis or ultra-filtration systems to recover and concentrate active ingredients;
- installation of pH adjustment and neutralization systems, as needed;
- use of filtration and settling ponds to reduce TSS and BOD associated with particulate matter;
- installation of biological treatments (e.g. activated sludge systems, trickling filters and / or rotating biological contactors) to control BOD, COD, and TSS concentrations, and to degrade organic constituents;
- installation of a pretreatment stage for wastewater with biodegradability less than 80 percent, such as:
  cyanide destruction through alkaline chlorination, hydrogen peroxide oxidation and hydrolysis treatments, where cyanide based-reagent is generally used for pesticide and / or intermediate synthesis;
  active ingredient detoxification through oxidation, using ultraviolet systems or peroxide solutions
- installation of granular activated carbon adsorption systems to treat BOD / COD and organic compound
- Steam and / or air stripping to treat wastewater containing organics and ammonia, the latter through pH adjustment to values of 10-11
- For biopesticide manufacturing, oxidation of residual products and potential pathogens through hypochlorite and / or other disinfection / sterilization methods
- bio-monitoring and testing of effluents for toxicity to fish, algae, etc., after biological treatment and before discharge.

16.0 Guidance to solid/hazardous waste management from manufacturing of pesticides

Disposal methods that should be considered, depending on type of product and industry location circumstances;

- high-temperature incineration;
- chemical treatment;
- specially engineered landfill (for immobilized materials, incinerator ash and slag);
- long-term controlled storage.

17.0 EIA Study Team Composition

The team identified for the EIA study of pesticide manufacturing study should consist of qualified and experienced professionals from various disciplines in order to address the critical aspects and impacts identified for the project type. Based on the nature of the project, following professionals may be identified for EIA studies:

- Environmental management expert
- Urban and Regional/Landuse planner
- Air quality specialist
- Climatologist
- Organic chemistry specialist
- Toxicologist
- Occupational health Specialist
- Geologist/geo-hydrologist
- Ecologist
- Transportation specialist
- Process operations specialist
- Safety and risk specialist
- Social scientist,
- Waste Management expert etc.

18.0 General EIA Report Writing Format

The reporting format for EIA of pesticides plant projects shall contain the following:

1. Table of Content

2. List of Maps
3. List of Tables
4. List of Figures
5. List of Abbreviations and Acronyms
6. List of EIA Preparers
7. Executive summary
8. Acknowledgement
9. Introduction – Background information, Administrative and legal framework, Terms of Reference
10. Project Justification

- need for the project
- value of the project
- envisaged sustainability
- Alternatives to project

11. Project and/or Process Description

- type
- input and output of raw materials and products
- location
- technological layout
- Construction process
- project operation and maintenance
- project schedule

12. Description of the Environment (baseline data acquisition)

- study approach
- geographical location and topographical features
- field data
- climatic conditions
- air quality/noise/odour assessments
- vegetation cover characteristics
- potential land use and landscape patterns
- ecologically sensitive areas
- terrestrial fauna and wildlife
- soil studies

- aquatic studies, including hydrobiology and fisheries
- groundwater resources
- socio-economic resources
- infrastructural services

13. Associated and Potential Environmental Impacts

- impact prediction methodology
- significant positive impacts
- significant negative impacts
- site preparation and construction impacts
- transportation impacts
- raw material impacts
- process impacts
- project specific incremental environmental changes (if any)
- project specific cumulative effects
- project specific long/short term effects
- project specific direct/indirect effects
- project specific adverse/beneficial effects
- project specific risk and hazard assessments

14. Mitigation Measure/Alternatives

- best available technology/best practicable technology
- liability compensation/resettlement
- site alternative, location/routes
- no project option
- insert a table listing impacts with corresponding mitigation measures

15. Environmental Management Plan

- Monitoring schedule
- parameters to be monitored
- Scope of monitoring

16. Remediation plans after decommissioning/closure
17. Conclusions and Recommendations
18. References and Bibliography
19. Appendices

19.0 Bibliography

FAO (2002b). Manual on development and use of FAO and WHO specifications for pesticides. Rome, Food and Agriculture Organization of the United Nations. Plant Production and Protection Paper No. 173.

NAFDAC (National Agency for food and Drug Administration and control) (1996). Pesticide Registration Regulations. BV303 – B307.

ANNEX

Annex 1

Emission Standards for Pesticide Industry

Emissio	Not to exceed mg/Nm^3
HCL	20
Cl_2	05
H_2S	05
P_2O_5 (as H_3PO_4)	10
NH_3	30
Particulate matter with pesticide	20
CH_3Cl	20
HBr	05

Annex 2

Effluent Standards for Pesticide Industry

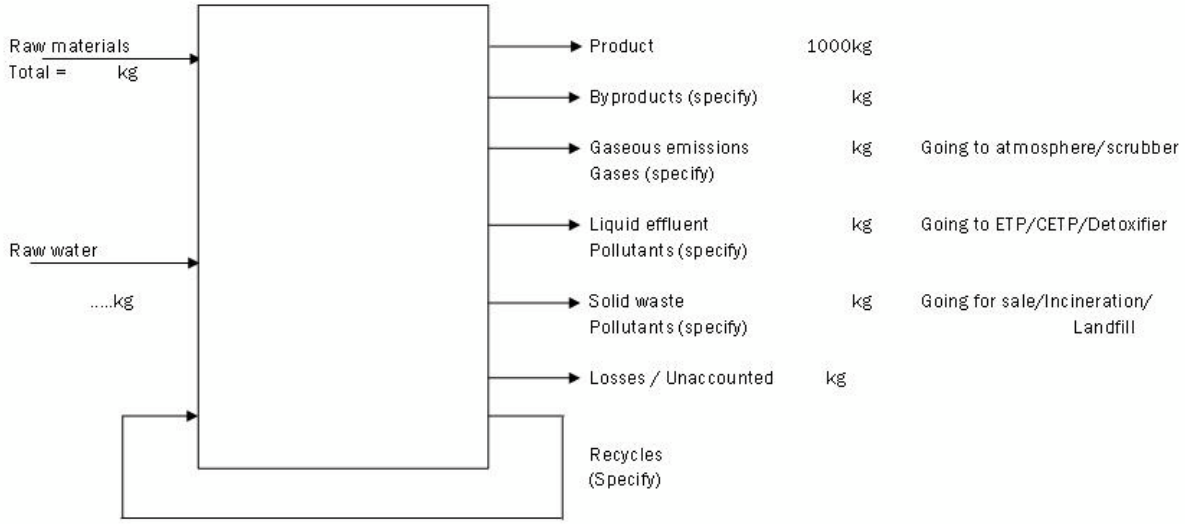
S.No.	Parameter	Concentration not to exceed, mg/l (except pH)
(i)	**Compulsory**	
	PH	6.5-8.5
	BOD(3 days at 27^oC)	100
	Oil & grease	10
	Suspended solids	100
	Bioassay test	Minimum 90% survival of fish after 96 hrs with 90% effluent and 10% dilution water.
(ii)	**Additional**	
(a)	Heavy Metal	
	Copper	1.0
	Manganese	1.0
	Zinc	1.0
	Mercury	0.01
	Tin	0.1
	Any other like nickel	Shall not exceed 5 times the drinking water standards individually
(b)	Organics	
	Phenol & Phenolic	1.0
	Compounds at	

S.No.	Parameter	Concentration not to exceed, mg/l (except pH)	
(c)	Inorganics		
	Arsenic as As	0.2	
	Cyanide as CN	0.2	
	Nitrate as NO_3	50	
	Phosphate as P	5.0	
(d)	Specific pesticide (microgram/litre)		
	Benzene hexachloride	10	
	DDT	10	
	Dimethoate	450	
	Copper oxychloride	6,600	
	Ziram	1,000	
	2.4D	400	
	Paraquat	23,000	
	Propanil	7,300	
	Nitrofen	780	
	Others (below mentioned pesticides	100	
Other Pesticides			
(i)	Insecticides		
	Aluminium phosphide	Lindane	Pyrethrum extract
	Dichlorovos	Malathion	Quinalphos
	EDTC mixer	Methyl bromide	Monocrotophos
	Ethylene dibromide	Nicotine sulphate	Carbaryl
	Ethion	Oxydemeton methyl	Endosulfan
	Fenitrothion	Methyl parathion	Fenvalerate
	Lime-sulphur	Phosphamidon	Phorate
	temephos		
(ii)	Fungicides		
	Aureofungin	Organomercurials (MENC & PMA)	
	Barium polysulphide	Sulphur (Colloidal, Wettable & Dust)	
	Cuprous oxide	Streptocycline	
	Ferbam	Thiram	
	Mancozeb	Zineb	
	Manab	Carbendzim	
	Nickel chloride	Tridemorph	
(iii)	Rodenticides		

S.No.	Parameter	Concentration not to exceed, mg/l (except pH)
	Comafuryl	
	Warfarin	
	Zinc phosphide	
(iv)	Nematicides	
	Metham N-sodium	
(v)	Weedicides	
	Fluchloralin	
	Isoproturon	
	Butachlor	
	Anilphos	
(vi)	Weedicides	
	Fluchloralin	
	Butachlor	
	Anilphos	
(vii)	Plant Growth Regulants	
	Chloromequat chloride	
	Nemphalene acetic acid	
(viii)	Any other pesticide not specific above.	

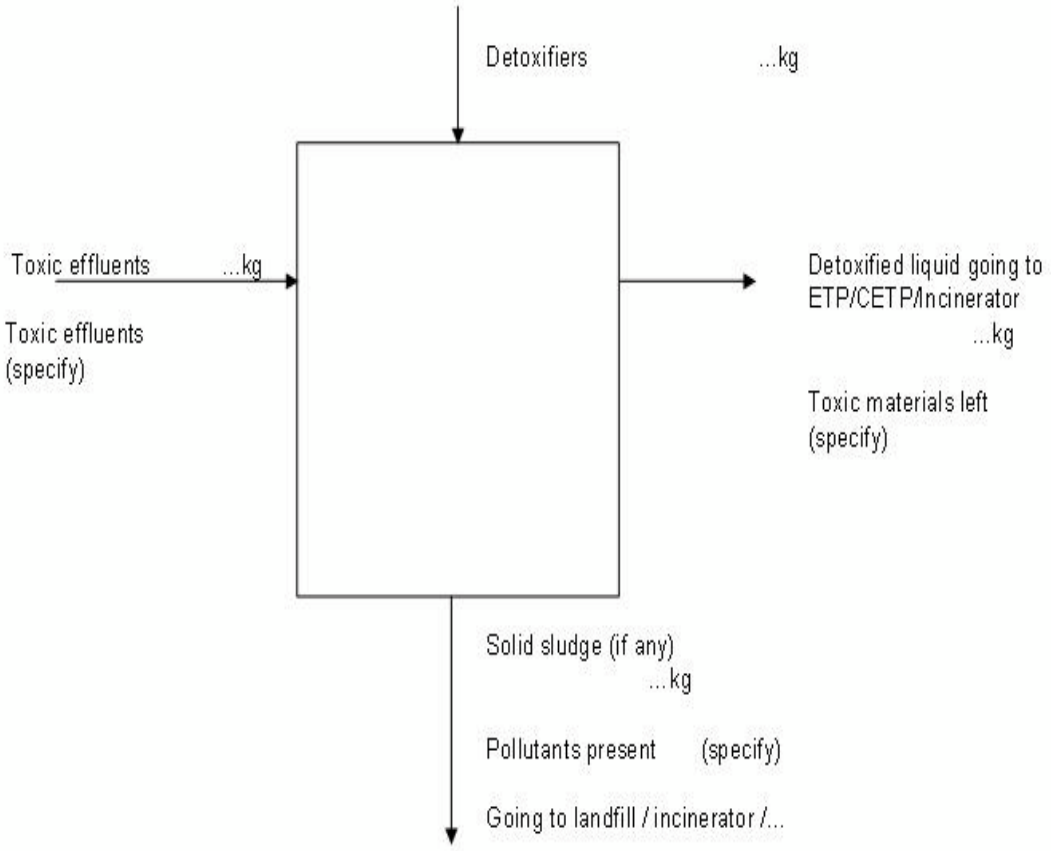
Annex 3

Sample Material Input-Output for a Typical Product of a Pesticide Industry



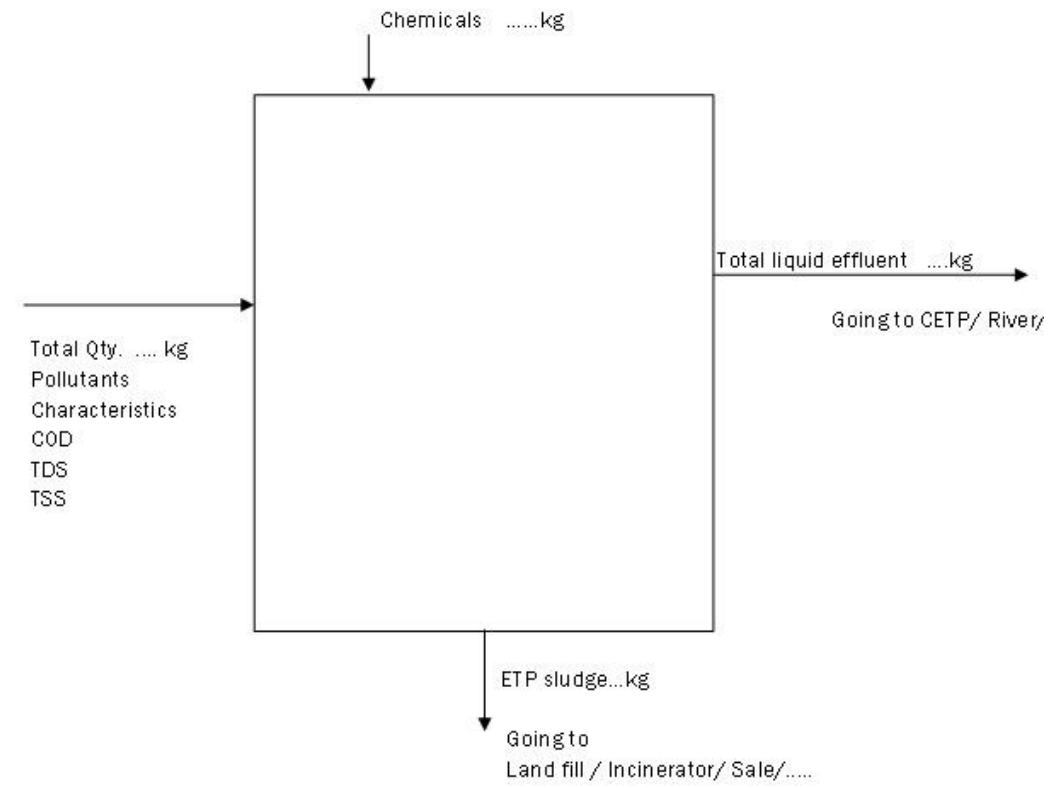
Annex 4

Sample Material Input-Output for a Detoxifier of a Pesticide Industry



Annex 5

Sample Input-Output Quantification for Effluent Treatment Plant for a Pesticide Industry



Annex 6

Sample table for the compilation of Legal and Institution framework for all environmental aspects (activities, products and services) of pesticide manufacturing Industry

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions/sections

Annex 7

Good Environmental Practices for Pesticide Manufacturing Industry

- Metering and controlling the quantities of active ingredients to minimize wastage.
- Reuse of by-products from the process as raw materials or as raw material substitutes in other processes
- Employ the use automated filling to minimize spillage.
- Employ the use "closed" feed systems for batch reactors.
- Use nitrogen blanketing where appropriate on pumps, storage tanks, and other equipment to minimize the release of toxic organics.
- Preference should be given to non-halogenated and non-aromatic solvents where feasible.
- Use high-pressure hoses for equipment cleaning to reduce wastewater.
- Return toxic materials packaging to the supplier for reuse or incinerate as applicable.
- Reduce storage time of off-specification products through regular reprocessing
- Device productive uses for off-specification products to avoid disposal problems.
- Minimize raw material and product inventory to avoid degradation and wastage that could lead to the formation of inactive but toxic isomers or by-products.
- Label and store toxic and hazardous materials in secure, bunded areas.
- Storage areas should be secure and covered, preventing exposure to rain and unauthorized access.
- Basic safety equipment such as fire extinguishers, warning signs, adequate light and ventilation and spill clean-up materials should always be present on site.
- Floors and shelves should be non-porousto prevent sorption of chemicals. If possible, temperature control should be provide to avoid excessive heat or cold.
- Storage areas should be kept clear of combustible material.
- Above-ground fuel storage tanks should have a concrete enclosure (secondary containment).

- nitrate-based and other oxidizing chemicals be stored separately from solvents, fuels and pesticides to reduce fire risk.
- The general principle of storing like chemicals together should be adopted.
- Chemicals should be stored in their original containers, tightly closed, with labels intact and be inspected regularly for leaks.
- Dry chemicals should be stored on pallets to ensure that they do not get wet.
- Chemical storage and maintenance areas, as well as vehicle refueling and maintenance areas, should be located away from wells and surface water bodies in accordance with engineering design and environmental regulations, typically at least 50 to 100 feet away.
- All Material Safety Data Sheets (MSDSs) should be made readily accessible.
- A list of all hazardous chemicals in the facility must be completed and ensure that all their MSDSs are readily available.
- Large quantities of pesticides should not be stored for a long period of time.