The Federal Environmental Protection Authority

Environmental impact Assessment Guideline for fertilizer

NOT FOR CITATION

This guidelines is still under development and shall be binding after consensus is reached between the Environmental Protection Authority and the Environmental Units of Competent Sectoral Agencies

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GLOSSARY OF TERMS

Alternative agriculture:- A collective term for agricultural practices that reject the use of soluble mineral fertilizers and pesticides.

Biofertilizers:- living organisms which augument nutrient supplies in one way or the other, in the strictest sense real biofertilizers are green manures and organics (materials of biological origin) which are added to deliver the nutrients contained in them. It also includes carrier-based inoculants containing cells of efficient strains of specific microorganisms (mainly bacteria).

Ecosystem:- The interacting system of a biological community and its non-living environmental surroundings.

Environment:- The totality of all materials whether in their natural state or modified or changed by human, their external spaces and the interactions which affect their quality or quantity and the welfare of human or other living beings, including but not restricted to land, atmosphere, weather and climate, water, living things, sound, odor, taste, social factors, and aesthetics.

Environmental Impact: - The degree of change in an environment resulting from the effect of an activity on the environment whether desirable or undesirable.

Environmental Impact Assessment: - A method used to predict and identify possible impact of a proposed action on the environment.

Environmental objective: - Overall environmental goal, arising from the environmental policy, that an organization sets, itself to achieve. Eutrophication

The phenomena of high productivity of aquatic system due to increased accumulation of nutrients. This has adverse impacts on quality and life supporting abilities of the aquatic system.

Fertilizer: - A material that furnishes one or more of the chemical elements necessary for the proper development and growth of plants. The most important fertilizers are fertilizer products (also called chemical or mineral fertilizers), manures, and plant residues. A fertilizer product is a material produced by industrial process with the specific purpose of being used as a fertilizer.

Good housekeeping: - Efficient management of resources, equipment, working environment of an institution or organization. In the context of cleaner production, it often refers to the procedures applied in the operation of a production process, to ensure environmental sustainability .

Inorganic fertilizer: - A term used for fertilizer in which the declared nutrients are in the form of inorganic salts obtained by extraction and/or by physical and/ or chemical industrial process (ISO).

Landfills: - 1. Sanitary landfills are land disposal sites for non-hazardous solid wastes, where the waste is spread in layers, compacted to the smallest practical volume and cover material applied at the end of each operating day.

2. Secure chemical landfills are disposal sites for hazardous waste. They are selected and designed to minimize the chance of hazardous substances being released into the environment.

Leachate:- A liquid produced when water collects contaminants as is trickles through wastes, agricultural pesticides or fertilizers. Leaching may occur in farming areas, feedlots or landfills and may result in hazardous substances entering surface water, groundwater or soil.

Mitigation: - Measures taken to prevent, reduce or rectify impacts of a particular project of the evaluation process concludes that the impact s are significant.

Nitrate: - A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and that can have harmful effects on humans and animals. Nitrate in water can cause severe illness in infants and cows.

Organic fertilizer:- Carbonaceous materials mainly of vegetable and/ or animal origins added to the soil specifically for the nutrition of plans (ISO).

Plant nutrient: - Chemical elements that are essential for the proper development and growth of plants.

Pollutant: - Generally, any substance introduced into the environment that has the potential to adversely affect the water, soil or air.

Pollution: - To make fowl, unclear, dirty, any physical, chemical, or biological change that adversely affects the health, survival, or

activities of living organisms or that alters the environment in undesirable ways.

Proponent: - Any organ of government if in the public sector, a person if in the private sector that initiates a project or a public instrument.

Recycling: - the process of minimizing the generation of waste by recovering usable products that might otherwise become waste. Examples are the recycling of aluminum cans, waste papers, bottles, etc.

Waste: - Unwanted materials left over from a manufacturing process and refuse form places of human or animal habitation.

Introduction

Agriculture is the dominant sector in the Ethiopian economy accounting for an average of 48% of the GDP, an estimated 85% of employment and 90% of exports. The sector also provides a lively-hood for 85% of the population of the population. Field crop is the dominant sub-sector accounting for about 64% of the agriculture GDP. But, combination of factors has resulted in serious and growing problems of food insecurity in the country. Adverse climatic changes (drought). Human population pressure and environmental degradation are few among the other factors for food insecurity.

Food insecurity is one of the defining features of rural poverty affecting millions particularly in moisture deficit highlands and pastoral areas. The Government of Ethiopia plans to tackle the, problem of food insecurity through the introduction of small, medium and large-scale irrigation incorporating the use of fertilizers and pesticides, and application of appropriate technologies.

Fertilizers are one of the important agricultural inputs to increase the level of crop production. However the consumption of fertilizer is low in Ethiopia, at about 18 ks / ha on the average and represents about one-fifth of the level needed to achieve the agronomic optimum at the current level of the ecology (compare 48ks/ha for Kenya and 70kg/ha for Zimbabwe).

The 2001/2002 agricultural sample Enumeration results reveals that fertilizers were applied on only 4,055.629 hectares (39.53%) of the total cultivated cropland area. Of this the total fertilized cropland area the share of natural fertilizer applied area was found to be 1,549,968 hectares (38%), while the contribution of chemical fertilizer applied croplands area was 2,505,661 hectares (62%of the total fertilizer cropland area at country level. Moreover, of the above mentioned total fertilized cropland area, the share of rural private agricultural holdings was found to be 3,755,178 hectares (93%). The proportion of the total fertilized cropland areas for urban and commercial farms was 62,755 hectares (1.55%) and 237,697 hectares (5.86%) in that order.

The demand for fertilizer is expected to show a significant increase as a result of the new extension approach that the Government is undertaking. Concerns have been raised about the continued reliance on imported fertilizer for sustainability of the country's agricultural development. However, the Government is promoting the use of indigenous nutrient resources, both organic and inorganic to sustain and improve soil fertility and reduce the country's dependence on fertilizer imports. For long-term sustainability the Government has embarked on

a number of projects and feasibility studies for related nutrient supplies projects aimed at reducing reliance on imported chemical fertilizers.

It has to be recognized that the production and unwise use of fertilizers can contribute some of the present environmental ills. The production and unwise use of fertilizers can be a prime source of pollution, eutrophication of fresh and marine waters, increasing nitrate concentrations in the ground and surface waters, and pesticide residues in soil, water and food.

In the absence of Environmental Impact Assessment (EIA) system, the production and use of the fertilizers could lead to severe impacts on the environment and human health. Thus, in the view of the above-mention concern on the environment, the Environmental Protection Authority (EPA) of the Federal democratic Republic of Ethiopia has prepared this Environmental Impact Assessment guideline for the production and use of fertilizers.

Objective and purpose of the Guideline

The main objectives of this EIA guideline is to bring in to focus any possible negative impacts on the environment at such an early stage in the planning process that these impacts may either be mitigated or avoided in the production and use artificial fertilizers.
The preparation of the guideline has emanated from different perspectives, mainly to protect the environment from any negative impacts so that sustainable use of resources is garneted. The guideline provides basic information on potential impacts of fertilizers in the production and utilization processes.

The guideline, in general assists users to think about how to reduce the potential impacts of fertilizers in the production and utilization processes by identifying various aspects and undertaking various mitagation measures.

This document also assists the proponent and independent consultant to identify various Environmental aspects and impacts so that appropriate mitigation measures could clearly be indicated earlier in the planning stage; and in the environmental impact statement document.

- Crop production and fertilizers, the use of fertilizers and major environmental issues to the production and use of fertilizers is described in chapter 1.
- Environmental policies, laws and conventions are briefly outlined in chapter 2.
- A description of the impacts of fertilizer use on vegetation, soil, aquatic ecosystems, and human health is given in chapter 3.

- Mitigation measures for major adverse impacts of fertilizer production and use, alternatives to fertilizer use, concepts on cleaner production, Environmental management system, and waste treatment methods are described in chapter 4.
- Institution and infrastructure, human resource development, and information exchange form all available sources about the production, use and management of fertilizers is briefly discussed in chapter 5.

Chapter I

Crop production and Fertilizers

We all depend on plants for our food, and plants depend on mineral nutrients for their growth and development. Thirteen elements derived from the soil are indispensible for all plant growth. They are called plant nutrients. Fertilizers are plant nutrients.

1.1 Plant nutrients

Plants form their complex organic matter from water, and nutrients from the soil, carbon dioxide from the air and the energy form sunlight.

Plants use six of the nutrients in relatively large amounts: nitrogen, phosphorus, potassium, sulphur, calcium and magnesium. These are called "major nutrients". They are constituents of many plant components such as proteins, nucleic acids and chlorophyll, and are essential for processes such as energy transfer, maintenance of internal pressure and enzyme function.

The other nutrients are required in small or trace quantities and are referred to as " micro nutrients", or trace elements". They have a variety of essential functions in plant metabolism. The micronutrients include: Chlorine, iron, manganese, zinc, copper, boron and molybdenum.

For optimum plant growth, nutrients must be available for plants:

- in solution in the soil water;
- in appropriate and balanced amounts and,
- at the right time.

Plants are supplied with nutrients mainly from

- release of nutrients from soil reserves,
- decomposing plant residues (roots, straw, etc.)
- organic manures,
- mineral fertilizers,
- bilogical nitrogen fixation,
- Aerial deposition.

Nutrients removed from the soil must be replenished, otherwise the soil becomes exhausted and crops will suffer and eventually fail. Sustainable plant production requires the replacement, of nutrients, which are taken

out through the crops, and fertilizer is critical to achieve the level of agricultural production needed for the rapidly growing population.

Organic versus commercial fertilizers

Organic refer to the use of organic matter, e.g. manure, to meet plants' need for nutrients. As pointed out earlier the plant is a manufacturing entity and requires certain ions for the making of the plant tissue and the numerous manufactured compounds. These ions are absorbed and used by the plant regardless of whether they come from organic matter or from commercial fertilizer. The main reason that commercial fertilizers are extensively used is that they supply the essential ions much more economically than do the various forms of organic matter.

Soil Organic Matter (SOM)

Soil organic matter (SOM) plays a critical role in agricultural productivity and sustainability. It is made up of living and dead components, including living and dead roots, microorganisms, soil fauna (earthworms, insects, etc), leaf litter, crop residues, products of microbial metabolism, and humic substances (gooey residues that can immobilize nutrients and bind bits of soil together into aggregates a healthy structure).

Organic matter is critical to soil fertility.

- It can be the source of the nutrients that microorganisms release in to solution and which are taken up by plants roots.
- It provides for the formation of good soil structure, with proper porosity, oxygen flow, PH, water retention capacity and stability.
- It is the substrate for soil life.
- It can absorb and neutralize toxic substances.
- It can buffer nutrient cycles and thus retard leaching, while providing for their timely release to plants.

Sustainable agriculture practices based on agroecolgical principles focus on managing and increasing the SOM content of soils, as do many of the practices of traditional agriculturalists around the world. The methods are abundant and varied. They include: - plowing crop residues back into the soil, planting cover crops of "green manures" that generate additional biomass, and which are also plowed under; applying compost or animal manure; matching with leaf litter brought form forests or other sources; and many other locally appropriate techniques.

Fertilizer Benefits to the Human Environment

The potential negative environmental aspects of fertilizers are minor when fertilizers are used in the proper quality, at the proper time of the cropping season, and in the adequate quantity.

Fertilizers make significant positive contributions to the human environments. Some of these contributions include:

- improvement of farming efficiency,
- improvement of soil quality,
- improvement of crop quality,
- retardation of soil erosion,
- conservation of water,
- air purification

1.2 Environmental issues related to production and use of Fertilizers

Production and use of fertilizers require activities including mining mechanical and/or chemical processing material transport and handling and ultimately soil application. Therefore, fertilizer producers and users are faced with a number of potential points where adverse impacts on the environment may occur. For example, fertilizer production processes may release emissions containing potential pollutants that may have local environmental impact (e. g acid rain, water acidification, and eurtophication ground water contamination, etc). and theoretically may contribute to global environmental problems (e.g greenhouse effect)

The fertilizer industry operates facilities with different levels of environmental safety and consequently varies considerably form one production complex to another. Similarly, fertilizer use practices have evolved over time and under changing crop production systems and public concerns. Thus, fertilizer use practices vary considerably as to real or potential adverse environmental impacts. Therefore, if fertilizer production processes and use practices are to minimize adverse environmental impact, both locally and globally, it is important that a full range of pollution prevention process are used and operated with the highest standards of operation and maintenance.

1.3 Causes of Fertilizer contamination and Environmental Impacts.

All fertilizers applied to a field are not taken up by the crop plants. A significant proportion is lost. Thus, there will be contamination to the surrounding environment. Part of the reason is excessive application of fertilizer; but more importantly, a combination of crop, soil and climatic factors prevent form being complete.

In natural ecosystems, with an undisturbed plant community, there is very little nitrogen loss because the input to the soil from rainfall and natural fixation is roughly balanced by the amount taken up by living active roots.

Leachate losses are strongly influenced by when and how fertilizers are applied. Timing of application in relation to rainfall, season and crop growth is crucial. Greater uptake result from split applications and the use of slow release compounds. Incorporation also produces less loss than broadcasting the fertilizer, but deep application results in high leachated looses. Up to 96 percent of nitrate fertilizers, which are more mobile, together with 60-80 percent of urea, may be lost if they are deep placed in soils with a high percolation rate.

A significant concern with fertilizers, is problems stemming from nitrates. Concerns have generally centered around the role nitrates play in methemoglobinemia. This ailment is a blood disorder caused by high levels of nitrates. It can affect people of all ages (especially infants and pregnant women) and has resulted in death. Excessive consumption of nitrates can result in gastroenteritis and diarrhea. Nitrates may be converted by the body into compounds known to the carcinogenic. High nitrates in ground water cannot be automatically attributed to fertilizer.

Leaching of the nitrogen leads to eutrophication of the surface water and the contamination of drinking water. Increasing biological production in the surface waters consumes dissolved oxygen and causes eutrophication. Algae present in the waters with excess nutrates (mainly leached nitrogen and phosphorus form soil erosion) grow rapidly and consume most of the oxygen preventing development of other forms of life, e.g. fishes. In some cases eutrophication can lead to the to the total extincition of life in the waters and can make surface waters unusable.

Use of fertilizers also causes emission of gases to the atmosphere. Nitrous oxide and other oxides of nitrogen in the atmosphere are transformed into NO_2, which reacts with ozone in the upper zones. The emission of carbon dioxide and small quantities of nitrogen and sulpher oxides to the atmosphere in the production of ammonia, caused environmental impacts. Minor amounts of light hydrocarbons, ammonia, hydrogen and carbon oxides may be also be due to leaks from flanges and stuffing boxes especially during maintenance operations.

In the production process of Nitric acid the main impact on the environment is from No_x emissions to the atmosphere No_x may

contribute to acid rain and ground level ozone. More over, effluents and emissions form various sources in the fertilizer production processes also may pose various environmental impacts.

Application of organic matter as a fertilizer has also some negative aspects.

- Under continuously reducing conditions (poorly drained rice fields) Organic acids and other organic products may retard plant growth.
- City compost and sewage slurries may be contaminated by the toxic roganic compounds and heavy metals.
- Farm yard manure is a source of cadmium.
- Heavy use of farm yard manure may cuse bacterial pollution of ground water and eutrophication of surface waters.
- The application of biomass requires transportation and disposal of large volumes; thus, it is a labor and energy intensive operation

Chapter II

2. Policies and legal framework

2.1 National policies

In its sectoral Environmental Policies, on "Soil husbandry and sustainable agriculture. The following policy elements are stated.

- "To promote the use of appropriate organic matter and nutrient management for improving soil structure, nutrient status and microbiology in improving soil conservation and land husbandry";
- To safeguard the integrity of the soil and to protect its physical and biological properties through management practices for the production of crops and livestock, which pay particular attention to the proper balance in amounts of chemical and organic fertilizers, including green manures, farmyard manures and compost.
- " To ensure that inputs shall be as diverse and complementing as the physical, chemical and biological components, of the soil require, and shall not focus solely on a quick and transitory increase in plant nutrients to the long-term detriment of soil structure and micro biology".

In its overall policy goal the environmental policy of Ethiopia (EPE) April 12,1997) states: that:
"The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generation to meet their own needs.
The EPE provides sectoral Environmental policies, cross-sectoral policies; in the cross-sectoral policy Environmental Impacts assessment is included.

- "To ensure that environmental impact assessments consider not only physical and biological impacts but also address social, socio economic, political and cultural conditions;
- " To ensure that public and private sector development programmes and projects recognize any environmental impacts early and incorporate their containment into the development design process;

- "To ensure that an environmental impact statement always includes mitigation plans for environmental management problems and contingency plans in case of accident;

2.2 National Laws

2.2.1 The constitution of the Federal Democratic Republic of Ethiopia.

Article 44 of the constitution of the Federal democratic republic of Ethiopia (FDRE) (August 21,1995) provides a basis on Environmental rights to the people in Ethiopia. The article states:

1. All persons have the right to a clean and healthy environment,
2. All persons who have been displaced or whose livelihoods have been adversely affected as a result of state programmes have the right to commensurate monetary or alternative means of compensation, including relocation with adequate state assistance.

Article 92 of the constitution also declares the following about environmental objectives;

- governments shall ensure that all Ethiopians live in a clean and healthy environment.
- peoples have the right to full consultation and expression of views, and
- government and citizens have the duty to protect the environment.

2.2.2 Environmental Impact assessment Proclamation

The **Environmental Impact Assessment Proclamation** (no.299/2002) has made development programmes and projects of the private and public sector subject the to EIA. This proclamation also provides a legal basis to harmonize and integrate environmental, economic, cultural, and social considerations in the planning and decision making process and thereby promotes sustainable development.

2.2.3 Pollution Control Proclamation

Another legal document which necessities the implementation and administration of EIA is the Environmental pollution control proclamation (No.300/2002). This proclamation is promulgated with the view of eliminating, or when not possible to mitigate

pollution as an undesirable consequences of social and economic development activities.

2.3. International conventions

Ethiopia is a party to various international treaties entered into various times since the signing of the Rio agreements and even earlier Ethiopia has also ratified a number of international convention including convention on Biological Diversity, united Nations Framework convention on climate change, the basal convention, etc. The judicial implementation of these international convention entails among others, the placement of the EIA system in the country.

Chapter III

Major Environmental Impacts of Fertilizers use

The nutrients contained in fertilizers will not only promote the growth of crops but also of wild plants, weeds as wells algal and aquatic plants in rivers, lakes and the sea. The general levels of nutrients in excess of those normally present in natural ecosystems will result in considerable disturbance to plant and animal communities, and these may be undesirable from the viewpoint of conservation, aesthetics, or recreation. Damage usually results from nitrogen and phosphorus in excess.

3.1 Impacts on vegetative cover

- Excessive rates of fertilizer application adversely affect crop growth.
- Intensive fertilizing causes damage to soil microorganisms.
- Leguminous plants over-exposed to nitrogen fertilizer become ineffective nitrogen fixers.

3.2 Impacts on the soil

- Heavy use of most nitrogen and some other fertilizers can lead to soil acidification brings and change in biological and physical soil properties.
- Fertilizers are often cited as having a detrimental effect on soil structure, mainly because they are thought to cause a decrease in the soil's content of organic content.
- Increased concentration of heavy metals can have adverse effect on soil life.

3.3 Impacts on aquatic ecosystems

- Eutrophication of surface water bodies
  - Multiplication of algae;
  - Increased demand for dissolved oxygen;
  - Reduced amount of light penetrating to the surface, and reduction of photosynthetic activities;
  - Decomposition of larger amounts of organic remains;
  - Particularly in shallow water bodies such as fishponds, paddy fields, natural lagoons and streams.
- Impairment of aesthetic qualities of surface water bodies

- Excessive algal scum and acquatic weeds.
- Undesirable color, taste and odour.

3.4 Impacts on human health

While fertilizers cause relatively little harm to wild life at least in comparison to the damage caused by pesticides, they are hazardous, in certain circumstances, to human health. These include

- High nitrate concentrations in drinking water can result in clinical metheamoglobineamia (often referred to as the blue baby syndrome)
- Dust exposure is the main occupational health problem in fertilizer manufacture.
- Inqesting of nitrate is implicated in a number of serious diseases, like gastric, bladder esophageal cancer.

Chapter IV

4. Risk management measures

4.1 Mitigation measure for major adverse impacts

In order to protect the environment form the adverse effects of fertilizers programs and projects there are a number of mitigation and management options that can be implemented. Some key consideration are given below.

- Requirement for fertilizer plans.
- Preventing the leaching of nutrients after the growing season by increasing the area under green cover, and by sowing crops with elevated nitrogen demand
- Promoting and subsidizing better application methods, developing new, environmentally sound fertilizers, and promoting soil testing.
- Severely limiting the use of fertilizers in for example, water extraction areas and nature protection areas.
- Take appropriate pollution prevention and control measures.
- Prediction evaluation, and monitoring of impacts
- Inclusion of appropriate engineering, monitoring and management controls.

- Sitting process
- Application of EMS
- Proper handling, management of hazardous material,
- Use of cleaner production.

4.2 Alternatives

Current issues associated with fertilizer use have intensified in new or different farming practices. Several directions can be followed in this context.

- Reduce the need for fertilizer through more efficient management of nutrient cycle and precise application fertilizers.
- Application of organic wastes from animals and crops, and use of crop rotation.
- Crop residue management, green manuring, organic manure and composting.
- Development of less intensive farming methods with reduced levels of fertilizer application (developing practice of alternative agriculture)

Use of biofertilizers, based on renewable energy sources are cost effective supplement to chemical fertilizers and can help to economize on the high investment needed for fertilizer use as far as N and P are concerned. Biofertilizers are known to make a number of positive contributions in agriculture; for example.

- Supplement fertilizer supplies for meeting the nutrient needs of crops.
- They can add 20-200kg N/ha (by fixation) under optimum conditions and solublize/ mobilize, 30-50 kg p_2 0_5/ha.
- They liberate growth promoting substances and vitamins and help to maintain soil fertility.
- Suppress the incidence of pathogens and control diseases.
- They increase crop yield by 10-50%, N-fixers reduce depletion of soil nutrients and provide sustainability to the farming system.
- They are cheaper, pollution free and based on renewable energy sources.
- They improve soil physical properties, tilth and soil health in general.

4.3 Use of Cleaner production technology

Cleaner production is defined as the application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment.

- For production processes, cleaner production includes conserving raw materials and energy, eliminating toxic processing materials and reducing the quality and toxicity of all emissions and wastes before they leave a production process.
- For products, the approach focuses on the reduction of environmental impacts along the entire life cycle of a product, from raw material extraction to the ultimate disposal of the product by appropriate product design.

Cleaner production is good for the environment because it reduces pollution form industry. There are also some direct benefits to the companies that follow this approach, such as:

- Cost saving through reduced wastage of raw materials and energy.
- Improved operating efficiency of the plant.
- Better product quality and consistency because the plant operation is more predictable.
- Recovery of some wasted materials.

Cleaner production requires:

- Applying know-how,
- Improving technology,
- Changing attitudes.

The cleaner production approach to industrial environmental management requires a hierarchical approach to pollutant management practices.

The order of preference in decision-making on design and operation is as follows:

- Prevention of generation of wastes,
- Recycling,
- Treatment,
- Safe disposal.

Cleaner production does not always require new technologies and equipment. Some example of practical cleaner production techniques include:

- Good house keeping and operating procurers,
- Material substitution,
- Technology changes,

- On-site recycling,
- Product design.

4.4 Environmental Management System (EMS)

Environmental management is the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing implementing, achieving, reviewing and maintaining the environmental policy.

It is important that fertilizer manufacturing industries distributors and users have to establish and implement effective environmental management system, which can be integrated with other management requirements so that the industries achieve environmental and economic goals. The success of environmental management system depends on the commitment form all levels and functions, especially from top management.

Environmental Management system requirements
General requirements.

The organization shall establish and maintain an environmental management system. The requirements are described below:

1. Environmental Policy

Top management shall define the organizations environmental policy and ensure that it.

a. In appropriate to the nature, scale and environmental impacts of its activities products or services.
b. Includes a commitment to continual improvement and prevention of pollution.
c. Includes a commitment to comply with relevant environmental legislation and requirements to which the organization subscribes.
d. Provides the framework for setting and reviewing environmental objectives and targets.
e. is documented, implemented and maintained and communicated to all employees
f. is available to the public.

2 Planning of an EMS

Planning of an EMS includes the:

- Identification of significant environmental aspects and their associated environmental impacts.
- Establishment of legal and regulatory requirements relevant to the organizations activities, products and services.
- Development of quantifiable objectives and targets to reduce the organizations significant impacts on the environment.
- Establishment or design and maintenance of environmental management programmes, which include the proper allocation of resources the means and specified time frames within which to achieve stated objectives and targets.

3. Implementation and operation

- The development of training and awareness programmes.
- The allocation of roles and responsibilities within an predefined management or organizational structure.
- Procedures and processes for handling internal and external communications
- The creation of supporting documentation and documentation control mechanisms
- Operational control procedures, and
- Emergency preparedness and response planning and testing.

4. Checking and corrective action

- Maintenance and continual improvement of the EMS including.
  - The monitoring and measurement of operational and management activities.
  - Record keeping
  - The creation of procedures to deal with non conformances with the requirements of the standard, company policy and legislation;
  - The development of procedures, programmes and process to prevent any repeat of non-conformances and
  - EMS audit procedures and programmes.

4.5 Waste treatment

Catalysts used in the production of Ammonia contain solid wastes such as hexavalent chromium, nickel, zinc, iron, and mineral supports. Minor amounts of light hydrocarbons ammonia, hydrogen, and carbon oxides may carbon oxides may be released due to leaks form flanges and stuffing boxes, specialty during maintenance operations. Moreover,

partial oxidation and gasification processes in the production of ammonia produce water with suspended and dissolved impurities.

Boiler blow downs and water treatment plant regeneration produce liquid effluents and spent vacuum catalyst as a solid waste in the production sulfuric acid.

Ammonia and fluorides are pollutants, which are given off in the steam form the reaction, in the production of MAP and Dap. Liquid effluents may contain nitrogen, phosphorus and fluorine in varied concentration

Fertilizer industries have to avail appropriate treatment and disposal techniques, in order to reduce the impacts of wastes released to the environment.

There are hierarchical options in the waste management route.

- Waste reduction at source
- Waste recycling and re-use
- Recovery of raw material and/ or of energy
- Treatment of wastes.
- Disposal of the residues form treatment, and of other unavoidable waste.

Treatment of waste is thus one option in the waste management route. The treatment of wastes serves two purposes.

I. The recovery of materials and/or of energy content of the wastes and,
II. The conversion of wastes to a form that permits its ultimate disposal in a safe and responsible manner.

Focus has to be given to the following components of the waste management cycle, after wastes have been mixec, packaged, stored and collected form the point of generation

- Transportation of wastes to a treatment facility.
- Reception, acceptance and storage at the facility.
- Treatment of wastes to convert them into a form suitable for safe disposal.
- Transpiration of treated wastes to the final disposal site.
- Reception, acceptance and deposition at final disposal site.

Waste treatment process options can be categorized into four basic types: -

A. Physical treatment
   e.g. screening, sedimentation, filtration, etc.
B. Chemical treatment
   e.g Neutralization precipitation, oxidation/ reduction, etc.

C. Biological treatment
e.g Anaerobic digestion, composting, activated sludge etc.

D. Thermal treatment
e.g. Wet air oxidation, pyrolysis, incineration, etc.

4.6 Incineration and landfills

Incineration

Incineration's major purpose is to reduce the volume of waste another benefit, only recently achieved, is the use of the energy released by burning to produce either electricity or steam for heating buildings. Another term commonly used for this technology is energy recovery, or waste-to energy, became the heat-derived form incinerated refuse is a useful resource.

The problems with these waste-to energy processes have been their costs (construction and maintenance of facilities), concern of air pollution, and hazardous components in ash (such as dioxins, toxic components in both bottom components and fey ash). In cineration can reduce the volume of discards by as much as 90 percent and weight by less than 10 percent.

Landfills

Landfills were formerly referred to more mundanely as rubbish dumps. Landfill is the practice of disposing of waste material by placing them in an excavation and usually covering them with soil or other non-waste material. The excavation can be above or below the water table, in aquifers or in poorly permeable formations, and can be lined or unlined. Landfills with an impermeable clay and/or plastic lining that, underlies and encloses the storages area can be uses a site for disposing wastes that generated in the production process of fertizers. Discarded fertilizers form stores or warehouse can also be disposed in properly managed landfills.

4.7 Education and awareness

The role environmental education and awareness plays in the reduction of risks caused by the misuse and mismanagement of fertilizers cannot be under emphasized. Seminars, panel discussions, workshops, drama, folktales, etc. can be used to

educate and sensitize people that are engaged in the production, distribution process, as well as end users of fertilizers.

Brochures, leaflets, magazines, radio, television, etc, are also some of the media that can be used to aware even the larger public, about the potential risks of fertilizer production and use and the care to be taken.

4.8 Judicial application of fertilizers

Over their life cycle, plants require different nutrients with varying intensity, when the supply does not cover, the demand, yields are lower and in case of oversupply the unused parts of nutrients may pollute the environment. Plant nutrient supply from various sources should cover immediate plant nutrient demand. If the risks from leaching, volatilization, identification or fixations are high, such as in rain, tropical climates, it is important to operate in a supply/demand mode rather than in terms of total nutrient doses.

Important considerations has to be taken when planning for application of fertilizers:

- Which commercial fertilizer should be used
- When it should be applied
- How it should be applied.

Which commercial fertilizer to use:- The selection of a suitable fertilizer depends largely.

- The essential element level of the soil with respect to the contents of the fertilizer
- The essential element requirement of the crop, and
- The season of the year i.e. the influence of the temperature of the soil on the natural nitrate–nitrogen supply on a considerable period of the year.

When the fertilizer should be applied. It is essential to recognize that when fertilizers could be up taken and utilized by the crop.

How the fertilizer should be applied: - Any commercial fertilizer may be applied in various ways. Principal methods are:

- Broadcast
- Row
- Side placement
- Perforated and
- Liquid

- Broadcast method:- In this method, fertilizer is applied evenly over the entire surface of the soil. It is usually done after the land is plowed and just before it is harrowed, since harrowing mixes the fertilizer with the upper 8 to 10 centimeters of the soil.
- Row method:- the fertilizer is applied to the bottom of the furrow a week or 10 days before the seed or plants are planted. The fertilizer is either mixed or not mixed with the soil, and usually the land is ridged. This places the fertilizer directly below the plants.
- Side-placement method- in this method, the fertilizer is applied in a continuous band on one or both sides of the row of seed plants. Thus, relatively large quantities of essential raw materials are available during the early stages of growth.
- Perforated method- this method is used to apply fertilizers to mainly ornamental trees. This method consists of making small holes about 30 to 46 centimeters deep around the base of the tree and, at the same time, placing a definite amount of fertilizer in each hole.
- Liquid method- in this method, soluble fertilizer is applied in solution with water.

4.9 Integrated plant Nutrition systems (IPNS)

Plant nutrients are in the soil, in manure and crop residues forming part of the nutrient flow. Nutrients stored in soils are available for crops, but those in crop residues and organic manure's are only available as they are broken down by bacteria. Integrated Plant Nutrient Systems (IPNS) seek to balance the nutrients available to a farmer from all sources, including mineral fertilizers, to make optimal use of them.

Organic matter helps to maintain good physical soil structured and micro fauna needed for water-holding capacity, aeration and the conditions to supply nutrients to plants. There is no fundamental difference where plant nutrients come from organic or mineral fertilizers. However, organic sources help maintain soil structure and texture, usually involve minimal direct cost to the farmer and when combined with the careful application of mineral fertilizers, enhances their effect on yield and helps to compensate for nutrients lost in food production.

Many farmers do not achieve good yield because the fertilizer supply is inadequate to meet demand, the range of fertilizers is

limited and delivery is unreliable. Inappropriate applications can be counter-productive and the non-availability of nutrients at certain stages can reduce the beneficial effects of previous applications. For example, mango is fertilized to enhance flowering, but if insufficient nutrients are available during ripening, fruits fall from the tree before they are ripe.

It is therefore necessary to address the problems of plant nutrition in an integrated way and maintain the overall balance and flow of soil nutrients, seeking maximum efficiency and reducing waste and loss. To this end, research education and training activities should be more focused on the promotion and application of IPNS.

Chapter V

5. Capacity building

5.1 Institutional and infrastructure need.

As concern grows for maintaining and improving the quality of the environment and protecting the human health, fertilizer manufacturing enterprises, large-scale users of fertilizers and those engaged in the distribution of the same, have to turn their attention to the potential environmental impacts of their activities products or services.

To achieve sound environmental performance, organizations have to be committed to organize and/or reorganize functional units and departments that could directly involve in the management of the environment. Installation of treatment plants, waste management strategies, storage and disposal facilities, and other appropriate infrastructure have to be put in place.

The other most important element is the establishment of effective environmental management system, which can assist organizations to achieve environmental and economic goals. Establishing monitoring procedures and laboratories is also essential.

5.2 Human resource development

Trained human resources are of significance importance to sustain the environmental performance of fertilizer industries and the utilization of the product. Thus, establishing and maintaining programmes for educational and training in measures, that could capacitate to reduce and/or mitigate potential environmental impacts that could be posed in the production and use of fertilizers.

5.3 Networking

Exchange of information form all available sources regarding the production, use and management of fertilizers is important. Such exchange of information shall include.

- New innovations and development technologies
- Research findings

- Indigenous and traditional knowledge
- Biotechnology, etc.

Check lists on fertilizer production and use.

Annex 1

The following checklists are designed to establish whether a proposed project is likely to have negative impacts on the environment. All possible negative impacts must be assessed in detail in relation to the projects positive impacts.

Will the project: -

- Lead to a substantial use of manure that can cause desire through human contact?
- Lead to nitrate or ammonia toxicity to humor or animals?
- Result in the transport of nutrients off-site via-off, erosion or leaching?
- Lead to nutrient transport that causes algal blooms, growth of aquatic weeds, and ultimately cause oxygen depletion in water bodies?
- Lead to a substantial pollution of water, air and soil?
- Have a negative effect on surface and ground water quality?
- Cause acute and/or long-term health hazards for personnel handling chemicals, in the production, storage and application?
- Use and/or produce raw material. Or products that can have occupational health effects?
- Emit and/or dispose chemicals that are toxic to humans, animals and the environment/
- Require large land surface for disposal of waster?
- Employ possible alternatives in the production process, e. g cleaner production, good house keeping, etc, Environmental management system, etc?
    - Envisage alternative agriculture, application of bio-fertilizers, & incorporating judicial application of in organic fertilizers, in large-scale farming?

Environmental Approaches.

Annex 2

1 Fertilizer Specifications

Specifications are the requirements with which a fertilizer should conform, as agreed upon between buyer and seller. Fertilizer specifications meet differing requirements depending on the use or intent of the specification information.

Specification are normally used in the contract between the buyer and seller of a fertilizer to ensure agreement on product characteristics or more often to define the product in sufficient detail to effect the satisfaction of both buyer and seller.

More commonly when one refers to specification, it is to specifications that have legal implications for buyers and sellers of large quantities of materials.

A well-written fertilizer specification should include the following elements in detail.

1. Nutrient contents and concentrations
2. Nutrient chemical composition
3. Moisture content
4. Partial size distribution
5. Physical condition
6. Solubility and/or availability
7. Conditioner
8. Special limitations pertaining to photo tonic production by products or additives
9. Packaging details if any
10. Methodology used in quantifying or qualifying items 1 through 9

11. Penalties or discounts for deviation form the stated values of conditions.

2 Industrial Health and Safety

Unsafe situations and technological accidents are due mostly to poor cooperation between different units, poor inspection, unclear instructions and responsibilities, lack of trained employees etc. The company must identify the major hazard and risks, determine how they can be controlled and establish emergency plans to prepare employees to deal with accidents, which could be dangerous for themselves, the surrounding population and the environment. Local communities should be informed; fertilizer associations, local authorities and the government should also be involved.

3 Safety legislation and regulation

Fertilizer production includes the manufacture of toxic chemicals (ammonia), strong mineral acids (sulpheric, nitric and phosphoric) and oxidizing agents (ammonia nitrate) in large quantities. At the various stages of manufacture, distribution and use, several thousands of tones of such chemicals are stored and handled.

Health and safety regulation fail into a number of categories, each, with ists own special requirements. Examples are the control of substances hazardous to health and the control of major accidents. The former deals mainly with the effects of the people handling the chemicals and the latter with the effects on third parties.

Process workers and consumers are protected through various regulations, the aim of which is to ensure that the health risks created during the manufacture or, arising during storage and use, such as dent and toxic fumes are both understood and kept to a minimum. Thus, most of this type of legislation is concerned with information. That is the information, which must be given at all stages of the chain from production to end-use. Information is given in two ways through labeling and safety data sheets.

4 Safety data sheet

Products (or material) safety data sheets serve two purposes as they inform those concerned in handling chemicals of the hazards involved and they also provide the basis for risk assessments.

Safety data sheets should be provided at all stages in the distribution chain and some countries have required their sue under legislation.

In addition to the normal production properties, safety data sheets are required to provide health hazard and eco-toxicological information, which is generally difficult to obtain and interpret.

5 Safety training

Plant safety involves the development of safe working procedures to protect the work force, and training of all employees in health and safety procedures. Personnel.
The training can cover

- Staff awareness of workplace hazards
- Health and safety routines and procedures
- Emergency procedures
- First aid
- Incident reporting
- Accident prevention and safe conduct

6 Fertilizer safety publications/safety manual for fertilizer plants.

Fertilizer manufactures have to provide information on safety practice by preparing manuals. The manual can provide, among other things, information on.

- General safe practices
- Hazards and their handling
- Fire prevention
- Safety aspects in different plants
- Safety inspections
- Guidelines for a disaster management plan

7. Preparing contingency plan

To prepare a contingency plan the following information is necessary

- Identification and analysis of hazards and risk assessment
- Definition of the emergency response resources
- Instructions on the emergency actions.

Annex-3

Handling, Storage and Transportation of fertilizers

Fertilizer Handling

Handling is an activity, which can be defined as the manual and/or mechanized movement under during the transport of fertilizer from factory or port to the end user.

- Bags must be treated so that it should not deteriorate causing spillages loses in their content.
- Care should be taken when lifted, loaded or unloaded
- Handling methods which result in damage to bags when using hooks must be eliminated
- Damaged bags spill out fertilizer contents and exposed to humidity, rain and sun.
- Check vehicles before starting to load (nails, splinter can be removed
- Lay water proof paper, matting or straw to protect the package
- Bags stacked need the doors; badly stacked bags can slip during transit over rough roods or even in the store itself.

Bagging

Correct packaging protects the fertilizer against humidity and bad weather conditions; it eases handling transportation and storage; it simplifies identification and finally it eases use by the end user.

Storage

Another important activity is storing and carefully maintaining fertilizers under optimum conditions for delivery and use at the moment they are used.

The principal action to be taken by dealers and store man to rationalize storage relate to the storage area and stacking of bags,

how to protect them so as to ensure that the fertilizers remain in good conditions, control of stocks and rotation of bags.

The following should be considered in storage

- Keep fertilizers in an orderly fashion
- Stack the bags properly
- Leave a space (of 10cm) between each bag to provide ventilation
- Make allowance of a central corridor (1m wide) to facilitate movement and handling of bags in the store.
- Allow space (20-30) cm between the stacks and the walls of the store to prevent the fertilizer coming into contact with damp walls.
- Avoid direct contact between he fertilizer and the soil (earth floors)
- Install a false floor which isolates the stack of fertilizer from the moist soil and at the same guarantees aeration (bricks, wooden slats, etc)
- Use locally available materials; such as bamboo mating, rice hulls, straw, old sacks, etc).
- In the case of ammonium nitrate, on account of the explosion hazard, it is not recommended to stack this fertilizer on top of organic materials such as straw etc. It can be stacked, however, on a wooden plat from.
- Where bags are stacked near windows facing the sun and liable to be exposed to prolonged sunlight, it is recommended that the window should be darkened by using news paper or old sacks, or by painting the pens of the glass black.
- In periods of high humidity, ventilators, opening windows and doors must be kept firmly shut.
- The store should only be ventilated during certain hours of the day when the ambient humidity is low and the temperature is high. In this way, condensation of water vapors in the store will be avoided.

- Fertilizers should always be stored on a floor, that is kept by continually brushing away any spilled fertilizer or other spilled material, because they hold the dumped cause deterioration of the floor and/or the walls.

Transport

Controls on the transport of fertilizers are limited to those products, which are classified as hazardous (dangerous) goods. In general terms this means those products classified as “oxidizing’ due to the high concentration of ammonium nitrate. (UN classification Group 5.1).

Ammonia is classified as 2.3 (toxic gas), phosphoric and sulphuric acid class 8 (corrosion). There is a much smaller group of products which can exhibit self sustaining decomposition, where thermal decomposition, one stared, will continue even if the source of heat has been removed. Such products, which include NPK fertilizers based on ammonium nitrate, are known as “cigar burners” (\UN classification group 9 type B if the decomposition continues, type C if it stops).

Probably the most important aspect of all the transport legislation and the one which is common to all modes of transport, is the need for careful labeling of packages so that type and degree of hazard can be readily identified in any country. In the case of bulk loads, by land or sea, the relevant information must be included in the documentation which must stay with the material and be readily available to the authorities at all times.

Sea Transport

All sea transport is governed by IMO which is supported by all maritime nations in the world. Regular updating of the IMDG Code ensures that new materials and hazards are covered. The Code imposes restrictions on the types of vessel, which may be used, the quantities, which may be carried, and the form in which they may be handled.

Classification is based on a number of properties such as explosive, oxidizing and toxic, with appropriate methods of test to establish the classification. Within the classifications products, such as fertilizers, may be sub-classified according to composition. The IMDG Code is also concerned with other hazards such as cargo stability and provides test methods for properties such as the angle of repose of bulk materials.

Classification of Ammonium Nitrate (AN) Based Fertilizers

The fertilizers described below are classified as oxidizing because they assist the combustion of other materials. Packaged materials will carry the “oxidizing agent” label, with a yellow diamond symbol, UN class 5, division 5.1.

Type	Fertilizer Mixture Combustible Material	AN Content Not more than
A1	AN+ added matter 0.2 % (inorganic & chemically inert)	90%or more 70-90% 0.4%
A2	AN + calcium carbonate and /or dolomite	80-90% 0.4%
A3	AN + ammonium sulphate	45-70% 0.4%

A4	AN + nitrogen/ phosphate/ potash sources	70-90%	0.4%

Road Transport

Internal transport is normally covered by national regulations which may be based on international agreements such as ADR in Europe. Such regulations not only cover the labeling of the products but also the definitive marking of the vehicles, specification of the documentation required and, in many cases the need for driver training in case of emergencies.

Rail Transport

As with road transport, internal rail movements are normally subject to local regulation, with cross border transport covered by international agreements such as the RID in Europe. These agreements also cover the labeling of packaged goods and transport documentation.

Inland Waterway Transport.

Cross-border traffic is covered by international agreements such as the European provisions concerning the international carriage of dangerous goods by inland waterways (AND) or regional agreements such as the Regulations for the carriage of dangerous substances on the Rhine (ADNR).

Air Transport

Because of the large-scale trade in fertilizer materials, there is virtually no air transport of fertilizers apart from small sample quantities. Such transport is covered by the International Air Transport Association (IATA) rules.

Handling and Storage

The potential for major incidents arising form fires in stores containing large quantities of fertilizers forms the basis for their inclusion in Storage legislation. In some countries such as Germany, Finland and the Netherlands, the maximum quantity of ammonium nitrate which can be stored in individual heaps is 100 tones. This makes the marketing of straight ammonium nitrate fertilizer commercially non-viable in those countries.

A more recent development within the UK has been the linking of local planning consents to the presence of stores and other sites where dangerous chemicals are kept, handled or produced. Exclusion zones have been declared around such sites, within which building may be restricted.

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