ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR PROPOSED FERTILIZER PLANT ON LR. 24605/12, NGELANI VILLAGE, MAVOKO, MACHAKOS COUNTY.

GPS LOCATION: S: 1.416057 E: 37.005048

(Proposed)

PROJECT PROPONENT
ELGON KENYA LTD.
P.O. BOX 46826-00100,
NAIROBI.

LEAD EXPERTS
ANNE W. KAGIRI 0990 &
JOAB OKULLO 6598.
NAKURU.

JANUARY 2026

Director General
National Environment Management Authority (NEMA)
P.O. Box 67839-00200,
Nairobi, Kenya.

RE: ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED STEAM GRANULATED FERTILIZER PLANT ON LR. 24605/12, NGELANI VILLAGE, MAVOKO, MACHAKOS COUNTY.

Pursuant to Section 58(1) of the Environmental Management and Coordination Act (EMCA), No. 8 of 1999 (as amended), and the Environmental (Strategic Assessment, Integrated Impact Assessment and Audit) Regulations, 2017, we hereby submit the Environmental and Social Impact Assessment (ESIA) Study Report for the proposed Steam Granulated Fertilizer Manufacturing Plant to be established on LR No. 24605/12, Ngelani Village, Mavoko Sub-County, Machakos County.

The ESIA study was undertaken between September 2025 and December 2025 and involved site investigations, stakeholder consultations, literature review, and specialist assessments in accordance with NEMA guidelines. The study identifies potential environmental and social impacts associated with the proposed development and proposes appropriate mitigation and monitoring measures through a comprehensive Environmental and Social Management Plan (ESMP).

We respectfully request NEMA's review and consideration of this report and the issuance of an Environmental Impact Assessment License to enable implementation of the proposed project.

SIGNATURES

Anne W. Kagiri

Lead Expert Reg. No. 0990 (NEMA) Tel. 0720428729

Signature: _____ Date: 20/01/2026

Joab Okullo Tel: 0715647651

NEMA Registered Lead Expert (Reg. No. 6598)

Signature: _____ Date: 20/01/2026

For the Project Proponent:

Bimal Kantaria
Managing Director, Elgon Kenya Ltd

Tel: 0733699992

Signature: _____ Date: 18/01/2026

Harpreet Kaur

Project Chemical Expert

Tel: 0722203089

Signature: _____ Date: 18/01/2026

Josephine Anjema

Social Scientist

Tel: 0723885880

Signature: _____ Date: 18/01/2026

ACRONYMS

^0C	Degrees Celsius
CLPs	Consents, Licenses and Permits
CSR	Corporate Social Responsibility
EA	Environmental Audit
EHS	Environmental Health and Safety
ESIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
KM	Kilometres
KPLC	Kenya Power and Lighting Company
NEC	National Environmental Council
NEMA	National Environment Management Authority
SHE	Safety Health and Environment
SWM	Solid Waste Management
TOR	Terms of Reference
WRA	Water Resources Authority

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EXECUTIVE SUMMARY

This Environmental and Social Impact Assessment (ESIA) Study Report is for the Proposed Fertilizer Manufacturing Plant:

Proposed Project Location: LR No. 24605/12, Ngelani Village, Mavoko Sub-County, Machakos County, Kenya (GPS: S 1.416057°, E 37.005048°).

1. Project Overview

Elgon Kenya Ltd proposes to establish a fertilizer manufacturing plant on a 10-acre site within an established industrial zone in Mavoko, Machakos County. The facility will produce compound DAP and NPK fertilizers and associated chemical products to support agricultural productivity, enhance food security and promote local manufacturing in line with Kenya's Vision 2030 and industrialization goals.

II. Project Location and Baseline Context

The site is located in a designated industrial area near Athi River, approximately 25–30 km southeast of Nairobi, with good access via the Nairobi–Mombasa Highway, SGR, and other infrastructure. The area is semi-arid (annual rainfall <500 mm), with flat topography, clay-dominated soils, and existing industrial activities (e.g., cement factories). Water will be sourced from on-site boreholes; no riparian encroachment is anticipated.

III. Key Anticipated Impacts

Positive Impacts

- **Economic and Social Benefits:** Creation of over 200 direct jobs (prioritizing local hiring), boosted local economy through taxes and supply chains, improved infrastructure, and reduced fertilizer import dependency.
- **Agricultural Benefits:** Enhanced crop yields, soil fertility, food security, poverty reduction, and sustainable land use by enabling higher productivity on existing farmland.

Negative Environmental Impacts

- **Air Quality:** Fugitive dust and stack emissions (particulates, SO_2, ammonia) from material handling, granulation, drying, and boilers.
- **Water and Effluents:** Process wastewater, potential nutrient/acid spills, and sanitary waste.
- **Soil and Groundwater:** Risk of contamination from spills or leachate.
- **Noise and Vibration:** From dryers, compressors, granulators, and bagging operations.
- **Solid and Hazardous Waste:** Packaging waste, used oils, spent filters, and chemical residues.
- **Occupational Health and Safety:** Exposure to chemicals, dust, heat, and machinery hazards.

Negative Social Impacts

- Potential health risks from emissions/effluents (respiratory issues, water contamination).
- Economic strain on farmers due to fertilizer price volatility.
- Community concerns related to pollution exposure and resource competition.

IV. Mitigation and Management Measures

Impacts are manageable through proven engineering, administrative, and environmental controls:

Impact Category	Key Mitigation Measures
Air Quality	Baghouse filters, cyclones, enclosed conveyors, stack dispersion modelling, continuous monitoring.
Water & Effluents	Sealed paved areas, interceptors, wastewater treatment/reuse, segregated drainage.
Soil & Groundwater	Bunded/impermeable storage, spill kits, leak detection, good housekeeping.
Noise & Vibration	Acoustic enclosures, silencers, vibration isolators, daytime scheduling.
Waste Management	Segregation, recycling (e.g., dust reuse), licensed disposal of hazardous waste.

Impact Category	Key Mitigation Measures
Occupational Health & Safety	PPE, training, health surveillance, emergency plans, permit-to-work systems.
Community & Social	Stakeholder engagement, green belts, local employment priority, health education.

V. Conclusion and Recommendation

The proposed plant offers significant socio-economic benefits including job creation, agricultural enhancement and reduced reliance on imported fertilizers. Potential environmental and social risks are well-understood and can be effectively mitigated through the proposed engineering controls, operational safeguards, and ongoing monitoring.

With full implementation of the ESMP and adherence to Kenyan environmental regulations (EMCA 1999, EIA/EA Regulations, OSHA 2007, etc.), the project can operate sustainably while delivering substantial benefits to farmers, local communities, and the national economy.

The ESIA recommends that NEMA issue an Environmental Impact Assessment License subject to the conditions and mitigation measures outlined in this report.

Attachments:

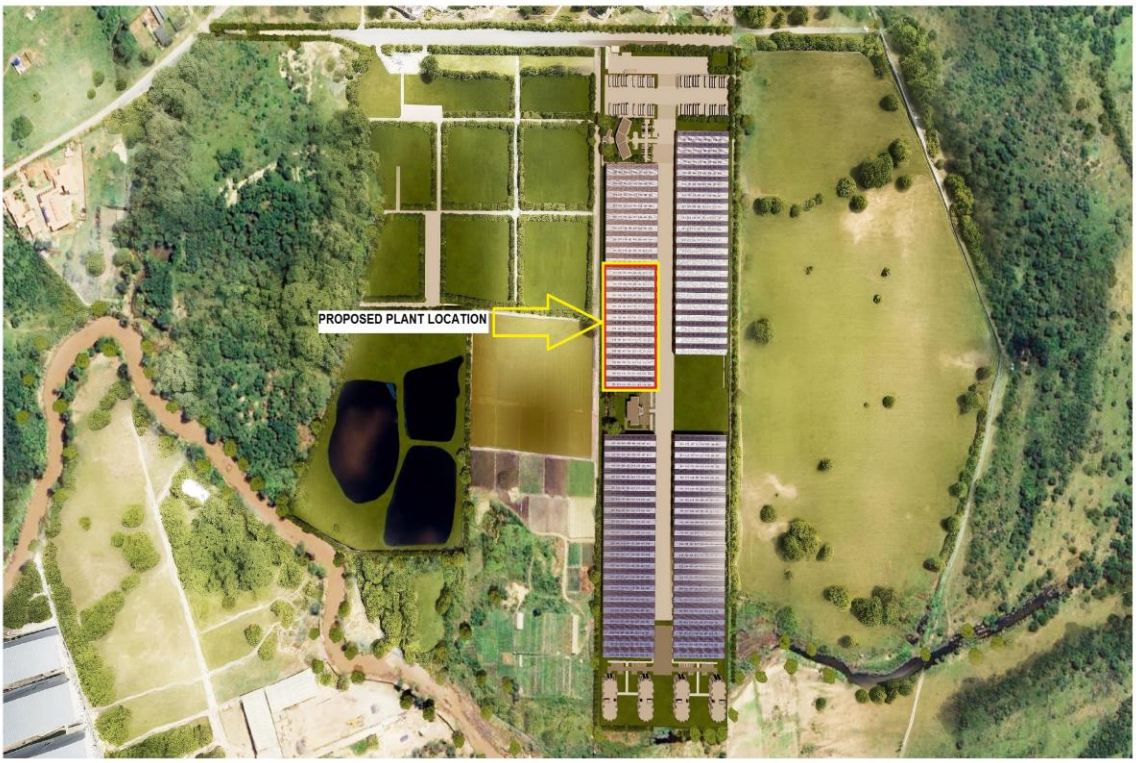
1. Minutes of the two public consultation meetings
2. Project site title deed
3. Layout plan of the proposed development
4. Bill of quantities summary
5. Practicing licenses for the lead experts
6. Other supporting documents as required by NEMA

CHAPTER ONE

1.0 INTRODUCTION

1.1 Project Location

The proposed project site in the Mavoko area of Machakos County, in the formerly Evergreen Crops farm, about 25 km southeast of Nairobi along the Nairobi-Mombasa Highway in Machakos County, near Athi River. The proposed project site lies near to Whistling Morans Hotel and Mbagathi River.



1.2 Project Description

Mavoko area is emerging as a prime area for industrial developments due to significant infrastructure mainly the Mombasa road. Elgon Kenya Limited, is a company engaged in the trading of agricultural inputs, primarily fertilizers, intends to establish a fertilizer manufacturing plant in the area to enhance local production capacity.

1.3 Broad objectives of carrying out the ESIA Study

1. To assess the activities that will take place during the installation and operation of the proposed fertilizer plant on the environment
2. To assess the impacts of the proposed activities during the fertilizer making plant installation and operations.
3. To assess the social impacts of the proposed fertilizer plant project on the proposed locality.
4. To increase the project proponent's awareness of Environmental Management (Environment Awareness Policy and Regulations)
5. To comply with the EMCA 1999
6. Preparing an Environmental and Social Management Plan for the proposed Fertilizer Plant Project.

1.4 The scope of the ESIA Comprehensive study

This ESIA covers the activities that will take place on the proposed site and in the immediate neighborhood. The enterprises that will be established on the project site are: -

- Site preparation activities.
- Setting up the actual fertilizer plant
- Establishment of an elaborate drainage system for storm and wastewater
- Driveway and vehicle parking

1.5 Terms of Reference

The terms of reference agreed between the expert and the project proponent were as follows: -

1. To provide a description of the proposed project activities with a potential focus on potential adverse impacts in the design, construction, operation and abandonment (decommissioning) phases caused by the inputs, waste generated and/or disposal and social-economic aspects.

2. To establish the legal and regulatory aspects and administrative frame of reference, identify governing standards, legislation, and guidelines, and determine the required permits and authorizations for the various sectors, agencies, and institutions.

3. To describe the area of influence and select methods of measuring the environmental aspects of concern, including physical (water, air, soil and noise), biotic environment (vegetation, flora and fauna), chemical, socioeconomic (socio and economic structure, demographic, and socioeconomic background), cultural (aspects of cultural, archaeological, or anthropological interest) and landscape

4. To establish the methods to be used in identifying and quantifying environmental impacts, methodologies for predicting those impacts and how those impacts will be described in terms of character (negative or positive), condition (reversible or irreversible), period (short, medium, or long-term), scope (cumulative, synergistic, direct, indirect) and establish what standards will be used for the ESIA.

5. To establish at what stages of the project the mitigating, corrective, compensatory and other measures will be used to eliminate, minimize or mitigate adverse/significant impacts and how these measures will be selected.

6. To define a schedule of activities, reactions with regard to risk prevention and accident control, objectives, specific tasks and budget through an Environmental Management Plan (EMP) and a Social Impact Assessment Plan (SIAMP).

7. To provide a monitoring program of relevant environmental issues, specific variables to be included in the environmental follow-ups, detection limits and standards to be used and contents of the follow-up program.

8. To establish the stakeholders to be involved in the community/public participation process, methods of reporting the project to the public, procedures to be used for community participation and aspects to be considered in the community participation plan during the development and review of the study.

9. To establish the criteria to be used in defining the composition of the working team of experts and the special requirements and information needed to form the team and characterize the same respectively.

10. To produce a systematic ESIA report in accordance with the Environmental Impact Assessment and Audit Regulations of 2017.

11. Final ESIA Study Report to the Proponent which will be submitted to NEMA as required by law.

1.6 ESIA Methodology

In carrying out the Impact Assessment, the following methodology aspects were incorporated:

1. **Semi-structured interview:** this involved holding individual interviews with the project proponent and other stakeholders using a pre-prepared questionnaire and Impact Assessment checklists and recording the feedback. The importance of this methodology was to create confidentiality of the source of the information.

2. **Literature review:** this involved reviewing all relevant literature and data for the project. The literature included legislation and data kept by the proponents, lead agencies, and government agencies.

3. **Site observation:** this involves a transect walk across the premises and the area to get acquainted with the natural environment and to cross-check issues arising from the semi-

structured interviews above.

4. **Public participation and consultation:** this involved holding public barazas with residents and project stakeholders to obtain their views regarding the environmental/social aspects of the project.

1.7 Project Literature

Fertilizers can be categorized as **organic** (from natural sources like manure and compost) or **inorganic** (synthetic chemical compounds). They are also classified by the nutrients they supply: **straight fertilizers** provide one primary nutrient (N, P, or K), while **complex fertilizers** provide two or more, such as DAP (which contains nitrogen and phosphorus). Different types are used for different plant needs, for example, nitrogen promotes leafy growth, phosphorus supports root development, and potassium aids overall health and flowering.

Types of Fertilizers:

- **Organic Fertilizers:** Made from natural, biodegradable materials like manure, compost, and peat moss.
- **Inorganic Fertilizers:** Also called synthetic or chemical fertilizers, they are manufactured for specific nutrient ratios.
- **Straight Fertilizers:** Supply a single primary nutrient.
    - **Nitrogen (N):** Essential for leafy growth, chlorophyll, and proteins. Examples include Urea and Ammonium Sulphate.
    - **Phosphorus (P):** Promotes root development and flowering. Examples include rock phosphate.
    - **Potassium (K):** Supports overall plant health and flowering. Examples include Potassium chloride and Potassium sulphate.
- **Complex Fertilizers:** Contain a combination of primary nutrients (N, P, and K).

Examples include DAP (Di-ammonium Phosphate) and various NPK blends, such as 10-10-10, 30-0-0, or 5-10-20.

Uses of fertilizers

- **General growth:** Compound NPK fertilizers provide a balance of essential nutrients for overall plant health and development.
- **Leafy growth:** Nitrogen-rich fertilizers are used to promote vigorous leafy growth and green foliage.
- **Root and flowering:** Phosphorus fertilizers are beneficial for root development, while potassium helps with flowering and fruit production.
- **Soil improvement:** Organic fertilizers help improve soil structure and health in addition to providing nutrients.
- **Specific nutrient deficiencies:** Fertilizers containing specific micronutrients like calcium, magnesium, sulfur, boron, or iron are used to correct deficiencies in the soil.
- **Fertilizer and its classification**
  Straight fertilizers are those which supply only one primary plant nutrient (N, P & K). E.g. Urea, Ammonium sulphate, Potassium chl.
- **Difference Between DAP and NPK Fertilizer**
  DAP is best for early root development. NPK promotes fruiting, flowering and overall growth.

1.8 Impacts of the Fertilizer Plant development on the rural economy

1. *Infrastructure Improvement*

Dedicated industrial zones can eliminate inefficient production and urban congestion, providing reliable power, water, waste management, and road networks necessary for industry success.

2. *Enhancing Manufacturing and Trade Efficiency*

A well-designed fertilizer plant can enhance productivity by minimizing logistical challenges. Its strategic location near highways and/or ports facilitate the seamless movement of goods and boost trade.

3. *Promoting Economic Growth and Job Creation*

The fertilizer plant would attract investment, generate jobs and support small and medium-sized enterprises (SMEs). By clustering industries, this project will promote innovation and strengthen Kenya's industrial base.

4. *Alignment with Vision 2030*

The development of the fertilizer plant aligns with Kenya's Vision 2030, which aims to make the country a competitive industrial hub while advancing the government's Big Four Agenda, especially in manufacturing.

5. *Environmental and Social Benefits*

Planned industrial zones reduce environmental impacts and promote sustainable practices while enhancing life quality by reducing urban congestion and encouraging balanced regional development.

1.9 Description of the Project Cycle

A project cycle involves several principal stages, including the project concept, feasibility study, construction and implementation, and decommissioning phases. Each phase is associated with certain unique activities. Some activities associated with setting up the fertilizer plant are described below.

1.9.1 Construction Phase/ Setting up Phase

The following activities will be undertaken during the construction phase:

- Site Preparation and land clearance
- Construction of infrastructure
- Installation of fertilizer plant, manufacturing units, office spaces and support facilities
- Safety and security Installation, including perimeter wall fencing, fire safety systems and security checkpoints

- Environmental Management Measures including construction of stormwater drainage system, erosion control and designated green spaces
- Construction of septic tanks and an ablution block

1.9.2 Operation phase

This phase shall involve the following activities

- Procurement of inputs
- Procurement of labor force
- Waste management activities and emission monitoring
- Maintenance and management
- Industrial and commercial operations

1.9.3 Decommissioning phase

General decommissioning of a facility and property includes removing hazardous materials and waste, cleaning and removing equipment, decontamination and remediation, terminating operational permits and licenses, and physical reconstitution of land. Although the decommissioning of this project is not probable, it is still a possibility. Therefore, it is prudent to develop a decommissioning strategy.

The decommissioning plan will probably include: -

- Dismantling and removal of structures
- Waste disposal and Site Rehabilitation

CHAPTER TWO

2.0 BASELINE INFORMATION FOR PROPOSED SITE

2.1 Proposed Project Site

The project site is situated on Land Reference Number 24605/12, within Athi River area, Mavoko Sub County, Machakos County, Kenya. It lies within an established industrial zone characterized by industrial and warehousing activities. The site is accessible via Nairobi–Mombasa Road and has proximity to key infrastructure such as SGR, Nairobi Expressway and Athi River town.

2.2 Topography

Machakos County has an elevation of 400-2100 m a.s.l and falls under semi-arid to arid climates. The landscape has a mix of flat, low-lying areas and rugged terrain along its western boundary. The region also features remnants of two former plains and a Pleistocene to Recent plain that is still evolving. These landforms shape the region's drainage patterns, soil distribution and land use. The proposed project area is flat and is suitable for fertilizer production. Land leveling will not be required.

2.3. Climate

Mavoko area located in Machakos County, Kenya, has a semi-arid climate characterized by warm temperatures and low, highly variable rainfall. The area experiences a bimodal rainfall pattern, with two distinct rainy seasons: the long rains from March to May and the short rains from October to December. However, rainfall is erratic and unevenly distributed within these seasons, showing significant annual and seasonal variability. The total annual rainfall is generally less than 500 mm, with notable spatial and temporal fluctuations, making water availability unpredictable. Temperatures range between 15°C and 30°C, with hot and dry conditions dominating much of the year. Additionally, Mavoko's proximity to Nairobi introduces some urban climate influences, such as slightly elevated temperatures in built-up areas.

2.4 Soils

Mavoko Municipality has a high prevalence of clay soils formed on Pliocene and Miocene rock types which comprise 60% of clayey soils.

2.5 Land use in Mavoko Area

Mavoko serves as the county's commercial and industrial hub. The municipality's land use is characterized by a combination of industrial, residential and commercial developments. Historically, industrial growth has been significant with establishments like the East Africa Portland Cement Factory and the Kenya Meat Commission setting the foundation for its industrial profile. Additionally, the Mavoko Integrated Strategic Urban Development Plan (ISUDP) has been developed to guide harmonious land use and infrastructure development within the municipality.

[Source: Machakos County Government)

2.6 Commercial activity

Due to its strategic location near Nairobi, Mavoko constituency is a key commercial and industrial hub in Machakos County, Kenya. The area hosts major industries including six cement factories and the Kenya Meat Commission. The retail sector is expanding with developments like supermarkets and malls further boosting the area's economic growth.

2.7 Water sources

The main water supply in this area is the Athi River and boreholes. The proponent has drilled boreholes since the land has been under agriculture.

2.8 Communication

The project area is accessible from Nairobi City through the Nairobi-Mombasa A109 road. The fertilizer plant will be about 30 kilometers from Nairobi CBD along a tarmac road from Crystal Rivers Mall, Cabro and Earth Road.

2.9 Similar Projects in the Country

There are several fertilizer plants in the country. Some are:

- Fertiplant East Africa in Nakuru;
- ETG Agri Inputs in Maai Mahiu;
- Baraka Fertilizer Factory in Nairobi;
- OSHO Chemicals in Nairobi;
- Mavuno Fertilizers in Athi River; and
- MEA Factory in Nakuru.

CHAPTER THREE

RELEVANT POLICY, LEGAL AND LEGISLATIVE FRAMEWORK

This chapter will cover some of the relevant regulations, standards and policies and the local and national levels governing environmental quality, health and safety and protection of sensitive ecosystems. Some of the pertinent legislations that will be considered relevant for the study include:

3.1 Global/International Framework

Fertilizer production is increasingly guided by international best practices and voluntary codes focusing on sustainability, nutrient efficiency, and reduced environmental impacts (e.g., GHG emissions, nutrient runoff and heavy metal contamination).

3.1.1 FAO International Code of Conduct for the Sustainable Use and Management of Fertilizers 2019

Promotes responsible fertilizer use, nutrient stewardship (right source, rate, time, place), and minimization of environmental risks such as eutrophication and soil degradation. The law Encourages integrated nutrient management combining mineral and organic sources.

3.1.2 EU Fertilising Products Regulation (EU) 2019/1009

This law sets limits on contaminants (e.g., cadmium <1.5 mg/kg in certain products), promotes circular economy approaches (e.g., recovered nutrients), and requires conformity assessments. Influences global trade and best practices for low-carbon and bio-based fertilizers.

3.1.3 US EPA Fertilizer Manufacturing Effluent Guidelines (40 CFR Part 418, updated through 2025):

Regulates effluents from phosphate and ammonia-based plants, including limits on phosphorus, fluoride, and ammonia discharges. Serves as a global benchmark for pollution prevention.
Global Best Practices (2025 updates): Emphasis on smart/slow-release fertilizers, precision agriculture

for optimized application, green ammonia production (renewable hydrogen), and enhanced efficiency fertilizers (EEFs) to reduce GHG emissions (e.g., N_2O from nitrogen fertilizers). Initiatives like Canada's 30% emission reduction target by 2030 highlight policy-driven shifts toward low-impact production. These inform Kenya's alignment with UN Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption), and SDG 13 (Climate Action).

3.2 National (Kenya) Framework

Kenya's environmental governance is anchored in the Constitution of Kenya 2010 (Article 42: Right to a clean and healthy environment; Article 69: Sustainable management obligations). Kenya has several laws that determine that projects implemented in the country meet high environmental standards as follows:

3.2.1 Environment Management and Co-ordination Act, 1999

The main objective of the EMCA, 1999 (Amended 2015) is to provide for the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya. The Act further aims to improve the legal and administrative coordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management.

The Environmental Management and Coordination Act (EMCA), 1999, together with the Environmental (Impact Assessment and Audit) Regulations, 2003, form the cornerstone of environmental governance in Kenya and are particularly critical for the establishment of the proposed fertilizer plant. EMCA mandates that any project likely to have significant environmental impacts - such as a fertilizer manufacturing facility must undergo a comprehensive Environmental Impact Assessment (EIA) before any construction or operational activities commence.

The EIA process requires the project proponent to identify, predict and evaluate potential environmental, social, and health impacts arising from the plant’s activities, including air and water pollution, solid and hazardous waste management, and potential risks to local communities and ecosystems. The EIA report must be submitted to the National Environment Management Authority (NEMA), which reviews the findings, facilitates public participation, and determines whether the project should be approved, modified, or rejected.

Approval is only granted if mitigation measures and management plans are deemed adequate to safeguard environmental quality and public health. Furthermore, EMCA and its regulations require continuous environmental auditing and compliance monitoring throughout the plant's lifecycle, ensuring that operations remain within approved standards and any unforeseen impacts are swiftly addressed.

This robust framework not only protects Kenya's environment, but also enhances the social license and long-term sustainability of industrial projects like fertilizer plants.

3.2.1.1 The Environmental (Impact Assessment and Audit) Regulations 2003

On 13th June 2003, the Minister of Environment, Natural Resources and Wildlife promulgated the Environment (Impact Assessment and Audit) regulations 2003 (EIA/EA Regulations) under section 147 of the EMCA. These regulations provide the framework for carrying out EIAs and EAs in Kenya.

3.2.1.2 The Environmental Management and Co-ordination (Water quality) Regulations 2006

The regulations set stringent controls to protect sources of water for domestic use.

Section 4(1) of the regulation states that "Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of these regulations".

Section 4(2) of the regulation states that "No person shall throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution".

Section 5 of the regulation states that "All sources of water for domestic uses shall comply with the standards set out in the first schedule to the regulation".

The regulations also prohibit abstraction of groundwater or carrying out any activity near any lakes, rivers, streams, springs and wells that is likely to have any adverse impact on the quantity and quality of water, without an environmental impact assessment license issued in accordance with the provision of the Act in section 6.

3.2.1.3 The Environmental Management and Co-ordination (Waste Management) Regulations 2006

These regulations are described in legal Notice No. 121 of the Kenya Gazette Supplement No. 69, 2006. They offer legal provisions on handling of a variety of wastes emanating from various projects and activities. These regulations outline requirements for handling, storing, transporting and treatment of all waste categories as provided.

3.2.2 Physical Planning Act (Cap 286)

The Physical and Land Use Planning Act, 2019 is a cornerstone legislative framework guiding the spatial development and land use in Kenya, and it is highly relevant for the establishment of a proposed fertilizer plant. This Act mandates that all developments, including industrial projects such as fertilizer plants, must secure appropriate planning permissions from the respective County Government. The plant must be located in areas designated for industrial use, in accordance with county or municipal zoning plans, to minimize conflicts with residential zones and environmentally sensitive areas.

Before construction, project proponents are required to submit comprehensive site development plans, which are subject to review and approval by the County Physical Planning Committee. The Act also emphasizes public participation, ensuring that local communities and stakeholders are consulted and their views incorporated into planning decisions. Compliance with this Act not only streamlines the approval process but also helps prevent future land use disputes, environmental degradation, and social backlash, thereby facilitating the sustainable integration of the fertilizer plant into the local and regional landscape.

3.2.3 Land Planning Act (Cap 303)

Section 9 of the subsidiary legislation (The Development and Use of Land Regulations, 1961) under this Act requires that before the local authorities submit any plans to then Minister for approval, steps should be taken as may be necessary to acquire the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should be submitted. This intended to reduce conflict with the interest such as settlement and other social and economic activities.

3.2.4 Water Act, 2016

Part II, section 18, of the Water Act 2016 provides for national monitoring and information system on water resources. Following on this, sub-section3 allows the Water Resources Management Authority

(WRA) to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a facility operator and the information thereof furnished to the authority.

Section 73 of the Act allows a person with a license (licensee) to supply water to make regulations for the purposes of protecting against degradation of water resources. Section 75 and sub-section 1 allows the licensee to construct and maintain drains sewers and other works for intercepting, treating or disposing of any foul of arising or flowing upon land for preventing pollution of water sources within his / her jurisdiction.

Section 76 states that no person shall discharge any trade effluent from trade premises into sewers of a licensee without the consent shall be issued on conditions including payment of rates for the discharge as may be provided under section 77 of the same Act.

3.2.5 Penal Code Act (Cap 63)

Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same act says persons / institution is dwelling or business premises in the neighborhood or those passing along public way, commit an offence.

3.2.6 Agriculture Act (Cap 318)

The Agricultural Act cap 318 of the laws of Kenya seeks to promote and maintain a stable Agriculture to provide for the conservation of the soil and its fertility and to stimulate the development of Agricultural land in accordance with the accepted practices of good land management and good husbandry. Following the provisions of the Act, legally acceptable practices should be upheld by proposed project site for sustainable production out of the scheme.

3.2.7 Work Injury Benefits Act, 2007

The Work Injury Benefits Act, 2007 (WIBA) is a critical piece of legislation in Kenya that governs the compensation and welfare of employees who sustain injuries or contract occupational diseases during the course of their employment.

For the proposed fertilizer plant, compliance with WIBA is essential due to the inherent risks associated with the handling of chemicals, heavy machinery and industrial processes. This Act mandates that

employers provide compensation for work-related injuries, disabilities, or fatalities, covering medical expenses, rehabilitation, and, where necessary, financial support to affected employees or their dependents.

Additionally, the Act requires employers to maintain a safe working environment, conduct regular risk assessments, and offer adequate training and protective equipment to minimize workplace hazards. Failure to adhere to WIBA not only exposes the fertilizer plant to legal liabilities and financial penalties, but can also undermine employee morale and productivity. Thus, for the sustainable operation of the fertilizer plant, robust implementation of WIBA provisions should be prioritized, ensuring workers' rights are protected and fostering a culture of safety and compliance within the organization.

3.2.8 Public Health Act

The act provides the impetus for a healthy environment and outlines regulations on waste management, pollution control and Human health. By providing guidelines of water quality, size of rooms, basic hygiene and the optimal sanitation standards. Several issues will arise from irrigation projects such as sanitation issues, disease spread, and communal resource sharing among others. The Act therefore provides for the necessary legal guidelines regulating measures aimed at effective control and management of the said issues.

3.2.9 The Occupational Safety and Health Act (OSHA), 2007

The Occupational Safety and Health Act (OSHA), 2007 is highly relevant to the establishment and operation of a proposed fertilizer plant in Kenya, as it provides a comprehensive legal framework for ensuring the safety, health, and welfare of workers in industrial settings.

Given the hazardous nature of chemicals and processes involved in producing fertilizers—such as the handling of ammonia, acids and other reactive substances—OSHA 2007 mandates that the plant management implements strict safety measures. These include the provision of appropriate personal protective equipment (PPE), regular safety training, and the establishment of emergency response protocols for incidents like chemical spills, fires, or gas leaks.

The Act also requires routine risk assessments, proper labeling and storage of hazardous materials, and maintenance of safe working environments to minimize occupational hazards. Compliance with OSHA 2007 is enforced by the Directorate of Occupational Safety and Health Services (DOSHS), which conducts inspections and audits to ensure adherence to safety standards. Ultimately, strict observance of

OSHA 2007 not only protects employees from workplace injuries and illnesses but also promotes operational efficiency, legal compliance, and community confidence in the proposed fertilizer plant.

3.2.10 The Kenya Roads Board Act

This is the main legal instrument that governs the management of the road network in Kenya. There will be need for consultation with the County Roads Committee before the alteration of some registered roads as well as the establishment of other access roads for canals, drains or other associated physical structures within the project area.

3.2.11 Air Quality Regulations 2014

The "air quality regulations 2014" were set to control and prevent air pollution within the country. These regulations cover aspects like emissions standards, the need for emission licenses for certain facilities, general prohibitions on polluting activities like open burning, and the monitoring of ambient air quality.

3.2.12 Fertilizers and Animal Foodstuffs Act, Cap 345

The Fertilizers and Animal Foodstuffs Act, Cap 345 is a key legislative framework governing the production, importation, sale, and quality assurance of fertilizers in Kenya. For the proposed fertilizer plant, compliance with this Act is crucial, as it stipulates mandatory registration of all fertilizers with the Kenya Plant Health Inspectorate Service (KEPHIS) before they can be distributed or sold.

The Act sets out strict guidelines on the composition, packaging, and labeling of fertilizers to ensure that only products meeting the prescribed Kenya Bureau of Standards (KEBS) specifications reach farmers. This includes requirements for clear labeling of nutrient content and batch numbers to facilitate traceability and quality control.

Furthermore, the Act empowers regulatory authorities to inspect manufacturing facilities and sample products to verify compliance, helping to prevent the circulation of substandard or adulterated fertilizers that could harm agricultural productivity and food safety. Non-compliance can result in legal penalties, including fines, product recalls, and suspension of operating licenses. Therefore, a proposed fertilizer plant must integrate these regulatory requirements into its operational procedures, quality assurance systems, and product registration processes to ensure legal operation and to build trust among stakeholders in the agricultural sector.

3.2.13 Climate Change Act 2016

The Climate Change Act 2016 is a law enacted in Kenya to provide a regulatory framework for addressing climate change, promoting low-carbon development, and mainstreaming climate response into development planning across national and county governments. It establishes institutions like the National Climate Change Council and the Climate Change Directorate to coordinate national climate change actions and provides for mechanisms and measures to build resilience and achieve climate-resilient development.

3.3 Local (Machakos County) Framework

Devolved functions under the County Governments Act 2012 include environmental management, land use, and industrial oversight.

3.3.1 Machakos County Environmental Management Act 2022

Local enforcement of pollution control, waste management, and conservation.

3.3.2 Machakos County Integrated Development Plan (CIDP) 2023–2027 & Annual Development Plan 2025–2026

Prioritizes sustainable industrialization, climate resilience, waste management and environmental safeguards in industrial zones like Mavoko/Athi River.

3.3.3 County Physical Planning and Land Use Regulations:

Zoning compliance (industrial designation); development permits from County Physical Planning Department.

County Water, Irrigation, Environment & Climate Change Department: Reviews ESIA reports, monitors effluents/industrial discharges, enforces noise/air pollution controls, and promotes rainwater harvesting/climate adaptation.

The proposed project complies with this multi-level framework by incorporating mitigation for air/water/soil impacts, hazardous chemical management and sustainable practices. Annual audits and monitoring will ensure ongoing adherence to updated regulations.

CHAPTER FOUR

4.1 Project Description

The proposed project involves the installation and operation of a fertilizer plant to produce blended and granulated fertilizer products for commercial agricultural use.

(a) Raw material Inputs

Urea, Potash and Sulphuric Acid

Steam

Magnesite, Alumina Hydrate, Zinc Oxide

Demineralized water

4.1.1 Production Process

Main production steps include:

1. Raw material reception, weighing, and crushing
2. Mixing and feeding into granulator.
3. Steam granulation.
4. Drying and cooling.
5. Screening and bagging for dispatch.

The proposed plant will use demineralized water which will be outsourced from the Kenyan local market. The plant will consume an approximate 830 kWh/day of power.

4.1.2 Project Outputs

DAP and NPK Fertilizers

4.1.3 Detailed Chemical Description

Sulphuric acid is a key ingredient in the fertilizer industry because it is used to produce other vital fertilizers, most notably phosphoric acid for phosphate-based fertilizers like MAP and DAP, and ammonium sulfate, which provides nitrogen and sulfur to plants. It acts as a chemical intermediate, enabling the creation of these nutrient-rich fertilizers that are essential for crop growth and yield by providing phosphorus, nitrogen and sulfur to the soil.

4.1.4. Key roles of Sulphuric acid in fertilizer production:

- ***Production of Phosphoric Acid:***

  Sulphuric acid reacts with phosphate rock to produce phosphoric acid, which is then used to make essential phosphate fertilizers like monoammonium phosphate (MAP) and diammonium phosphate (DAP).

- ***Production of Ammonium Sulfate:***

  The acid is also used to create ammonium sulfate, a fertilizer that supplies crops with both nitrogen and sulfur, nutrients crucial for healthy plant development.

Why these are important:

- **Plant Nutrients:**

  Phosphate and ammonium sulfate provide the essential primary nutrients—phosphorus and nitrogen, respectively—that crops need to grow and produce high yields.

- **Sulfur Supply:**

  Ammonium sulfate also delivers sulfur, which can be a deficient nutrient for many crops, supporting overall plant health and development.

- **Food Security:**

  By enabling the production of these nutrient-rich fertilizers, Sulphuric acid plays a critical role in boosting agricultural productivity and ensuring food production for a growing global population.

  Sulphuric acid is not directly used as a fertilizer, but is crucial for producing essential nutrient-rich fertilizers, primarily phosphate fertilizers like monoammonium phosphate (MAP), diammonium phosphate (DAP) and superphosphates**. It also helps create ammonium sulfate, a fertilizer containing nitrogen and sulfur. Additionally, concentrated Sulphuric acid can be used to acidify soil or fertilizer solutions, enhancing the availability of locked-up nutrients like phosphorus and iron.

- ***Fertilizers Produced with Sulphuric Acid:***

  Phosphate Fertilizers:

  Phosphoric Acid Production: Sulphuric acid reacts with phosphate rock to produce phosphoric acid.

  Ammonium Phosphates (MAP & DAP): Phosphoric acid is then reacted with ammonia to create MAP and DAP, which provide essential nitrogen and phosphorus to crops.

  Superphosphates (Single & Triple): Sulphuric acid directly reacts with phosphate rock to create single superphosphate (SSP).

  Ammonium Sulfate: Urea can react with Sulphuric acid to form ammonium sulfate, a fertilizer that supplies plants with nitrogen and sulfur.

- **Other Uses in Agriculture:**

  Soil and Solution Acidification: Concentrated Sulphuric acid can be added to fertilizer troughs or soil to lower pH without adding extra nitrogen.

  Nutrient Mobilization: Acidification can make unavailable nutrients like phosphorus and iron more accessible for plants.

  Descaling: It can help descale micro-irrigation systems, preventing blockages.

4.2 Analysis of Project Alternatives

This section presents a discussion on the various alternatives considered during project planning and design, as well as reasons for the selection of the preferred alternative. Alternatives, in relation to a proposed project, mean different ways of meeting the general purpose and requirements of the project and may include the following types of alternatives:

- Location alternatives;
- Type of project development to be undertaken;
- Design or layout of the project development;
- Technology to be used for the development; and
- Operational aspects of the development.

It therefore follows projects such as fertilizer production that may have impacts on the environment may raise issues of concern and alternative causes of actions are always considered. The reason is to assess the effects of these alternatives on the environment against expected benefits. For this project, four main alternatives were considered in all, three of them against the proposed project that was the fourth alternative. The four alternatives considered were therefore as follows:

- The 'No project' option
- Using other locations
- Using a different technology for the proposed production process
- Project execution as proposed

4.3 Project Execution as Proposed

Taking this option means that the proposed fertilizer plant will be constructed. Current challenges facing farmers in the country which include higher fertilizer cost in the country as well as longer delivery time. These problems will be minimized as soon as the proposed project is implemented according to the design. The implication of taking this project alternative, in contrast to the "No Project Alternative", is that cheaper, effective and a less environmentally damaging fertilizer blending plant will be delivered at the end of the construction period. Other implications include enhanced socio-economic impacts to be brought about on the project communities by the execution of the project. Significant positive environmental impacts will also be made if the project is carried out as proposed due to the numerous benefits accruable to the inhabitants of the project area and those in the extended project's area of influence. For instance, socio-economic, educational and health status of the immediate and extended host communities will improve as a result of the execution of the project. The proposed project thus has a high tendency for discouraging rural-urban drift in its area of influence.

4.4 No Project Option

It is essential that the 'no project option' be considered as a first step in mitigation. This alternative implies that the proposed fertilizer production will not go on and this implies the proponent will make no further investments in the area of fertilizer blending/production. This means that the identified benefits presented in the succeeding section will not come into fruition. This alternative is against the desires of the government to boost competitiveness, facilitate manufacturing, industrialization and agricultural self reliance, which will in turn lead to improved access to social services and improved

quality of life.

4.5 Alternative Location

Approximately ten (10) acres of land is already under the possession of Elgon Kenya Ltd which has the necessary amenities (road, electricity, etc.). There is no additional land required for the proposed Project. The location of an industry is an important factor in its success. For example, its location to some extent determines access to markets, ease of transportation of raw materials among other things. Ngelani is a good location for the proposed project.

4.6 Alternative Fertilizer Grades

This alternative entails planning and constructing a plant that will produce NPK fertilizers. There has been growing demand for NPK as farmers move away from DAP, the more popular brand for planting. The proposed production process is a result of an optimized cost-effective engineering design against which several alternative products were considered during the initial design.

4.7 Alternative Energy

Coal will be used as the source of fuel in drying the granules. Coal is energy-efficient and provides hot aired flue gas efficient for granulation exercise in the production process.

Heavy Fuel Oils (HFO) are products based on the residues from various refinery distillation cracking processes. It has a high calorific value with low consumption rate and produces heat that have particularly high viscosity and density which is suitable for the production small amount of light fuel oil in the form of heating oil, gas oil or diesel grades to fire kiln “lighting up” burners, and to heat auxiliary furnaces for raw material drying. This alternative was however not feasible since it would be costly, and design already had a recommendation of another fuel.

Power will be supplied from the national electrical grid (33Kv). The only other alternative is the use of a generator, which is less favorable due to the cost involved.

Solar panel is a feasible alternative for power generation but was not considered since it is expensive exercise.

4.8 Activities for Setting up a fertilizer plant

The key construction activities include:

4.8.1. Site Preparation and Civil Works

- **Land Clearing and Leveling**: Preparing the selected site, which should be away from residential areas due to potential noise and odors, and have a hard geology and low water table.

- **Foundation Work:** Laying foundations for the main plant, equipment bases (e.g., for heavy reactors, granulators, and compressors), storage tanks, and various supporting structures.

- **Infrastructure Development**: Building access roads, setting up water and electricity supply systems, and establishing effective waste management systems (e.g., wastewater treatment and dust collection).

- **Building Construction**: Erecting the main production workshops, raw material warehouses, finished product storage areas, control rooms, and administrative buildings. These buildings are designed to accommodate the specific process flow and equipment layout, and some may require humidity control.

4.8.2 Equipment Installation and Process Integration

- Machinery Installation: Placing and securing all major processing equipment which will be delivered to site complete.
- Common Equipment are:
  - Reactors and fermentation tanks
  - Crushers and blenders
  - Granulators (e.g., drum or disc granulators)
  - Dryers and coolers (often rotary type)
  - Screening and coating machines
  - Conveyor systems and bucket elevators for material transport

- Weighing and automated bagging systems
- Piping and Electrical Systems: Installing extensive piping for material transport (liquids, gases, slurries) and setting up the entire electrical system, including power distribution and lighting.
- Automation and Control Systems: Integrating programmable logic controllers (PLCs) and other automated control systems to monitor and manage the production process, ensuring consistency and safety.

4.8.3. Testing and Commissioning

- System Testing: Conducting rigorous testing of individual machines and integrated systems to identify and resolve any operational issues.
- Process Optimization: Running trial productions to optimize the manufacturing process, ensure product quality, and establish standard operating procedures.
- Operator Training: Providing comprehensive training to engineers, operators, and safety personnel to manage the plant efficiently and safely.
- Regulatory Inspections: Obtaining final inspections and operational licenses from relevant authorities, including environmental and safety clearances, before commencing full-scale commercial production.

4.9 Decommissioning phase

General decommissioning of a facility and property includes removing hazardous materials and wastes, cleaning and removing equipment, decontamination and remediation, terminating the operational permits and licenses, and land physical reconstitution. Although the decommissioning of this project is not probable, it is still a possibility. It is, therefore, prudent to develop a decommissioning strategy.
This will probably include:-

- Removal of the Plant and associated equipments
- Environmental reconstitution
- Decommissioning of the fertilizer plant to allow the development of a different or a new activity.

4.9.1. Fertilizer Plant Decommissioning

Before the decommissioning of the fertilizer plant, the following steps will be undertaken:

- The current conditions, areas of concern and alternatives for future action will be put into consideration.
- An Environmental Assessment (EA) will be performed to identify and determine the nature and extent of any hazardous construction materials or environmental contaminants in the fertilizer plant. This assessment will be directed to areas of concern.
- An equipment inventory will be undertaken as it is important to determine the equipment and materials present inside the premises before it can be decommissioned.

4.10 Public Participation and Stakeholders Engagement.

Stakeholder concerns raised included potential air pollution, water use, employment opportunities, traffic safety and occupational health risks. The project proponent has committed to implementing robust emission control systems, water conservation measures, prioritization of local employment and continuous stakeholder engagement throughout the project lifecycle.

Minutes of public consultations, attendance registers, and photographic evidence are provided as annexes to this report.

CHAPTER FIVE

5.0 ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS

5.1.1 Air quality

Sources of air pollutants include boiler stack emissions and fugitive particulate emissions at receiving, blending, granulation, drying, screening, packing.

IMPACTS

Impacts on Human Health

Air pollution can have the following impacts on human health:-

- Respiratory: Asthma attacks, reduced lung function, coughing, wheezing, pneumonia, COPD.
- Cardiovascular: Increased risk of heart disease, stroke, and heart attacks.
- Neurological: Damage to the brain, potentially affecting cognitive function and increasing risks of conditions like dementia.
- Cancer: Higher rates of lung cancer and other cancers due to carcinogenic pollutants like benzene.
- Other: Eye/throat irritation, headaches, fatigue, birth defects, diabetes, and immune system disorders.

Environmental Effects

Air pollution can also have the following effects on the environment:-

- Acid Rain: Sulfur and nitrogen oxides mix with water, damaging forests, lakes, and buildings.
- Global Warming: Greenhouse gas emissions alter Earth's climate, causing sea levels to rise and glaciers to melt.
- Ozone Depletion: Chlorofluorocarbons (CFCs) deplete the protective ozone layer.
- Ecosystem Damage: Reduces crop yields, harms wildlife (respiratory/neurological issues), and contaminates soil and water.

Mitigations: baghouse/fabric filters on cyclones, enclosed conveyors, negative pressure in buildings

with dust extraction, high-efficiency particulate capture with periodic bag cleaning and proper disposal/recycling of dust, stack height designed per dispersion modelling. Continuous particulate monitors at critical points will be installed.

5.1.2 Water & effluents

Water pollution harms human health (causing diseases like cholera, cancer, organ damage), devastates ecosystems (killing aquatic life, destroying habitats via eutrophication and dead zones), disrupts food chains (contaminating seafood), and creates economic burdens (hurting fisheries, tourism, raising cleanup costs). These impacts stem from pathogens, chemicals, heavy metals, and plastics entering water, leading to illness, reduced biodiversity, and economic setbacks.

Effects on Human Health

- Waterborne Diseases: Pathogens (bacteria, viruses, parasites) from sewage cause cholera, typhoid, dysentery, hepatitis, and giardia.
- Chemical Poisoning: Heavy metals (lead, mercury, arsenic) and pesticides can lead to cancer, neurological disorders, kidney/liver damage, and hormonal disruption.
- Respiratory Issues: Volatile pollutants can evaporate, causing respiratory problems when inhaled.

Effects on Aquatic Ecosystems & Wildlife

Water pollution devastates ecosystems by causing biodiversity loss, eutrophication (algal blooms that create dead zones), disrupting food chains, and harming plants and animals through toxins and habitat destruction, leading to widespread species death and impacting human health via contaminated water and food sources, creating serious ecological and economic consequences.

- Biodiversity Loss: Pollutants destroy habitats, kill fish and other organisms, and disrupt breeding, leading to population declines and extinctions.
- Eutrophication: Excess nutrients (like nitrogen/phosphorus from farms) fuel massive algae growth, which blocks sunlight, consumes oxygen, and creates "dead zones" where life can't survive.
- Food Chain Contamination: Toxins like heavy metals and pesticides build up in organisms

(bioaccumulation), poisoning predators higher up the chain, including humans (biomagnification).

- Habitat Degradation: Sediments, plastics, and chemicals smother plants and disrupt the ability of aquatic life to feed and reproduce.
- Harmful Algal Blooms (HABs): These toxic blooms can directly kill fish, birds, and other wildlife.

Effects on Human Health & Society

- Waterborne Diseases: Pathogens from sewage cause cholera, dysentery, typhoid, and hepatitis.
- Toxic Exposure: Chemicals and heavy metals can cause cancer, neurological disorders (like mercury poisoning), and organ damage.
- Reduced Usable Water: Pollution diminishes the supply of safe drinking water, impacting hygiene, agriculture, and industry.

Economic Impact: Fisheries, tourism and water treatment costs suffer from polluted water.

Other Environmental Impacts

- Disrupted Natural Cycles: Pollution overwhelms natural filtration systems, impacting the water cycle and aquatic self-purification.
- Microplastics: Tiny plastic particles disrupt endocrine systems and enter the food web at its base.
- Thermal Pollution: Heated water from industrial processes can shock aquatic life accustomed to cooler temperatures.

In essence, water pollution creates a domino effect, disrupting the delicate balance of aquatic ecosystems and posing significant threats to all life that depends on clean water.

Potential contaminants: suspended solids, dissolved solids (from washdown), low volume acidic/alkaline spills (if any), nutrients if fertilizer dust enters runoff.

Mitigations: sealed paved areas with oil/dust interceptors; segregated drainage (clean stormwater diverted away); process wastewater collected to a settling tank - neutralization and reuse for dust suppression or boiler feed after treatment (where safe); sanitary wastewater to septic or connection to sewer per county rules.

5.1.3 Soil & groundwater Pollution

Soil and ground water pollution would arise from spills of raw materials or washdown and stockpile leachate. Soil pollution severely degrades ecosystems by reducing soil fertility, killing beneficial microbes, contaminating water, and harming wildlife, leading to biodiversity loss and affecting food security through contaminated crops, while also posing severe health risks (cancer, organ damage) to humans via the food chain and water, contributing to climate change through altered nutrient cycles and causing economic burdens from cleanup and lost productivity.

Effects on Soil & Plants

- Reduced Fertility & Growth: Pollutants alter soil pH and nutrients, hindering plant growth, reducing crop yields, and making land barren.
- Erosion & Desertification: Loss of microbial life weakens soil structure, increasing erosion and desertification.
- Microbial Death: Kills essential bacteria, fungi, and earthworms vital for decomposition and nutrient cycling.

Effects on Water & Air

- Water Contamination: Pollutants leach into groundwater and run off into rivers, contaminating drinking water and harming aquatic life.
- Air Pollution: Volatile chemicals can become airborne, and decomposition of waste can release methane, contributing to global warming.

Mitigations: bunded storage areas with impermeable lining, leak detection, proper housekeeping, spill kits and secondary containment.

5.1.4 Noise & vibration

Noise pollution would be from dryers, granulator, blowers, compressors, bagging lines. Noise pollution significantly harms human health by causing hearing loss, sleep disruption, stress, and cardiovascular issues like hypertension, leading to mental health problems such as anxiety, depression, and cognitive impairment, affecting concentration and memory, especially in children and the elderly, with impacts ranging from temporary annoyance to chronic, severe disease.

Auditory Effects

- **Hearing Loss & Tinnitus:** Constant loud noise can cause permanent damage, leading to Noise-Induced Hearing Loss (NIHL) or ringing in the ears (tinnitus).

Mitigations: islanding noisy equipment inside acoustic enclosures, maintain minimum setback distances to receptors, use silencers and vibration isolation, schedule heavy maintenance during daytime.

5.1.5 Solid & hazardous waste

Solid: packaging waste, waste dust (if not re-used), worn out filters.

Hazardous: used oil, chemical wastes from lab or maintenance, spent baghouse dust containing high nutrient levels (may be recyclable back into process).

Mitigations: waste segregation, reuse/recycle dust where quality allows, licensed hazardous waste disposal for non-recyclables, store hazardous wastes in bunded, labelled area.

5.1.6 Occupational health & safety

Chemical exposure, dust inhalation, heat from dryers/steam, confined spaces, machine safety.

Mitigations: PPE program (respirators, gloves, ear protection), health surveillance, permit-to-work, lockout/tagout, training, first aid & emergency response, Material Safety Data Sheets (MSDS) for all chemicals.

5.2 SOCIAL ENVIRONMENTAL IMPACTS

5.2.1 Positive Social Impacts,

5.2.1.1 Food Security:

Fertilizers increase crop yields, boosting food availability to feed a growing global population.

5.2.1.2 Poverty Reduction:

By increasing agricultural productivity and profitability, fertilizers can help lift millions of people out of poverty.

5.2.1.3 Sustainable Land Use:

Higher yields from fertilizers allow more food to be produced on less land, helping to prevent deforestation and preserve ecosystems.

5.2.1.4 Improved Soil Health:

When applied correctly, fertilizers can help maintain soil fertility, supporting long-term agricultural sustainability and allowing farmers to grow high-quality crops consistently.

5.2.2 Negative Social Impacts

5.2.2.1 Human Health Risks:

Respiratory Problems: Exposure to ammonia released during fertilizer production can cause severe respiratory issues, including asthma and inflammation.

Waterborne Illnesses: Excess nitrates in drinking water can lead to blood disorders like "blue-baby syndrome".

Contaminants: Secondary contaminants in fertilizers can have neurotoxic, carcinogenic, or endocrine-disrupting effects on humans.

5.2.2.2 Economic Strain on Farmers:

Price Volatility: Supply disruptions, policy changes, and global trade issues can cause fertilizer prices to fluctuate, leading to economic instability and undermining efforts to alleviate hunger, according to Science Direct, notes.

Increased Costs: Farmers often face rising costs for fertilizers, which can increase production costs and reduce profitability if not used efficiently.

5.2.2.3 Impacts on Local Communities:

Environmental Justice Concerns: Fertilizer production facilities are often located in or near disadvantaged communities, leading to disproportionate exposure to pollution and health risks, particularly in areas already burdened by multiple pollutants. This may not be the case for Mavoko.

Contaminated Resources: Wastewater from these facilities can contain pollutants that make water unusable, affecting taste, smell, and overall quality for local residents.

5.3 MITIGATION MEASURES

Mitigation measures in a fertilizer factory include engineering controls such

- enclosed material handling,

-advanced dust collection systems,

-explosion venting,

-corrosion-resistant equipment

-alongside administrative controls like stringent safety protocols for reactive substances like ammonium nitrate, regular equipment maintenance, health monitoring for workers, and the use of personal protective equipment (PPE) to protect against hazardous gases and dust. Environmental measures involve managing dust, emissions, and waste, with strategies like recycling dust-laden air, treating wastewater, and planting green belts to buffer against impacts.

Engineering & Process Controls

5.3.1 Enclosed Systems:

Use enclosed belt conveyors and closed unloading systems for raw materials to prevent dust and nutrient runoff into the environment.

5.3.2 Dust Collection:

Install dust collection systems like cyclones and baghouse filters at all points of dust generation, such as screens, crushers and conveyors.

5.3.3 Explosion Prevention:

Equip facilities with explosion venting systems and ensure dust is controlled to safe levels.

- **Corrosion Prevention**:

  Use corrosion-resistant materials and automated cleaning systems to protect equipment from corrosive chemicals.

- **Layout Design:**

  Design the plant with an optimal layout to enhance safety and separation of hazards.

- **Equipment Upgrades:**

  Implement and maintain upgrades to equipment, such as extending chimneys for better gas dilution and renewing dust treatment systems.

Administrative & Operational Controls

5.3.4 Safety Protocols:

Adhere to strict safety protocols, especially for highly reactive substances like ammonium nitrate, including temperature monitoring and controlled mixing.

- **Worker Training:**

  Provide thorough training on handling hazardous materials, operating equipment safely, and proper use of PPE.

- **Health Monitoring:**

  Conduct periodic health examinations for workers exposed to hazardous chemicals and dust.

- **Equipment Maintenance:**

  Implement routine maintenance programs for all equipment, especially noise-generating machinery and systems handling hazardous materials.

- **Risk Assessments:**

  Perform regular risk assessments and consequence analyses to identify potential hazards and inform mitigation strategies.

Environmental Controls

- **Emissions Management:**

  Monitor and control air emissions, ensuring dust is collected and hazardous gases are diluted.

- **Waste Management:**

  Properly manage and dispose of hazardous waste to minimize odor and environmental impact.

- **Green Infrastructure:**

  Plant green trees and vegetation around the factory to create green belts that help reduce dust and noise impacts on surrounding areas.

- **Environmental Monitoring:**

  Conduct ongoing monitoring of environmental parameters like air quality, ground, and surface water in the receiving environment.

CHAPTER SIX

6.0 PROJECTS SOCIAL AND ENVIRONMENTAL IMPACTS PREDICTION AND MANAGEMENT

6.1 Introduction

Development projects are aimed at providing goods and services to improve the community's living standards. Such projects, therefore, present an opportunity for the community to achieve economic and social development for the ultimate well-being of a community or nation.

While development projects are a key driver of economic and human development, the nexus between development and the environment is intricate and delicate. Short-term benefits accruing from development projects may significantly impact the ability of human and natural ecosystems to meet the needs and aspirations of future generations. The concept of sustainable development envisages development that not only allows the present generation to meet its developmental and natural needs but also ensures intergenerational equity through the application of precautionary principles where there are uncertainties.

An important component of sustainable development is assessing the potential environmental, economic and social impacts of a project before its implementation. This is aimed at identifying, evaluating and predicting possible impacts of a project with the sole aim of enhancing anticipated positive impacts while at the same time incorporating into the project design measures for minimization of negative impacts.

In order to establish and assess the likely social and economic impacts of the proposed fertilizer plant in Mavoko area, Machakos County, views were obtained from the members of the public residing close to the project site. In addition, the assessors reviewed reports on similar projects and other literature. This section discusses the anticipated social and economic impacts of the project based on the aforementioned sources.

The major purpose of the fertilizer plant construction is to increase industrial productivity and consequently improve the economic and social development of the area of the project and the country at large.

6.2 Social Impacts associated with Industrial Development projects

6.2.1 Population Change

Commercial construction projects are labour intensive and tend to encourage population densities to increase because the increased prosperity of the area attracts incomers. The increase of labour raises local demand for food, housing and other social amenities.

6.2.2 Income and Amenity

Commercial construction projects introduce a large labour force that is better paid than the local labour. This decreases the available labour force for existing local jobs and drives labour fees up.

6.2.3 Human Migration

Large, new commercial developments projects attract temporary populations during construction and provision for their accommodation needs to be anticipated.

6.2.4 Creation of Employment

The proposed project will create employment opportunities for both skilled and unskilled labour. The project is expected to employ more than 200 persons within the first five years of operation. Much of the work will be manual and will not require any specialized training. This will thus open opportunities for the rural women and youths who comprise the largest proportion of the region's population. Priority will be given to persons from the local community to ensure that the project uplifts their living standards. Unemployment is rampant in urban areas and especially in areas that have low agricultural potential.

6.2.5 Boost local economy

The proposed project will boost the local economy through payment of loyalties, taxes, levies and other charges to the County and Central governments. The project will also open up the area for similar and other varied investments. The net effect will be improved infrastructure in the area and better living standards.

6.2.7 Moral decadence

The presence of a large workforce in an area, some of whom will move away from their families in order to reside near the place of work, may ultimately lead to vices such as prostitution, drug abuse, and increased incidence of HIV/AIDS among the workers and neighboring communities. Cases of insecurity may also increase, targeting the working class.

6.2.8 Impact on Culture

The movement of newcomers into the area will expose the local culture to integration with the cultures of other people, leading to gradual cultural change as has happened in other areas. The loss of culture not only eliminates the harmful practices in a community but may also interfere with the norms and value systems that helps sustain peace and harmony within a community. There may be changes in traditional livelihood strategies and conflict resolution mechanisms that may significantly impact the community's development (either negative or positive).

CHAPTER SEVEN

7.0 MITIGATION OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 Aesthetic value and soil erosion

After completion of fertilizer plant construction, the management should ensure that the aesthetics of the area is restored. The proponent needs to:

- Ensure that the activities of the proposed project do not encroach into the riparian reserve
- Construct water drains along the drive way and other areas within the premises prone to flooding due to rains.

7.2 Noise Pollution and Air Quality

Control at source:

- Workers use ear protectors and dust masks.
- Minimize the generation of air pollutants through the modification/replacement of worn-out process equipment and the use of alternative, better methods to achieve the same goals.
- Regular monitoring of air quality on the project site. Monitoring items include SO_2, dust and other pollutants.

Maintenance of an optimum level of green spaces in the compound is important. Vegetation extracts pollutants from the air, stimulates turbulence and interrupts sound and shock waves. Furthermore, green spaces have beneficial effects on microclimate and also on the psychological state of the inhabitants due to its aesthetic appeal.

7.3 Water use

Economic use of water should be encouraged as availability is not always ensured. The project's water supply will be from a drilled borehole already drilled on the adjacent site. Water conservation measures within the premises will be encouraged.

7.4 Health and safety

7.4.1 Personal Protective Equipment (PPE)

During construction and park operations, workers are provided with appropriate protective clothing, such as dust masks, gloves and safety goggles.

7.4.2. Employees' proactive safety attitudes

Regular training on proactive safety attitudes for employees would instill a sense of responsibility and in this way, increase their efforts to avoid accidents due to negligence, ignorance or carelessness.

7.4.3 Training in Occupational Health Safety

This is most important and should be regular. Health and safety audits should be carried out every year.

7.4.4 First Aid

Training and availing First Aid kits is recommended.

7.4.5 Sanitary provision

These should be provided. Toilets should always be clean and drinking water should be pathogens free. There will be separate toilet facilities for male and female workers, with those for females being fitted with disposable sanitary towel receptor bins. In addition, hand-washing facilities should be provided near the toilets to promote personal hygiene.

7.4.6 Control of Health Hazards

There should be adequate medical supervision personnel comprising pre-hiring clinical screening, periodic medical examination and rehabilitative care for any affected workers. A comprehensive risk assessment should be carried out on the commencement of operations so that specific measures for control and mitigation of workplace hazards and risks are put in place.

7.4.7 Ergonomics

All personnel should be trained on the basic ergonomics principles. This should cover the correct lifting, carrying and setting down techniques to prevent incidences of hernias, sprains, strains, back injuries and other muscular-skeletal disorders due to improper handling heavy objects.

7.5 Waste management

- Hazardous waste (chemical containers etc.) to be incinerated
- Re-usable waste will be repurposed
- Wastewater to be directed into soak pits
- Storm water to be harvested for use in sanitary areas
- Medical waste (from first aid services) to be incinerated

7.6 Environmental monitoring

The company will formulate a comprehensive environmental monitoring programme. This will, among others, include.

- Regular environmental audits
- Health and safety audits
- Water quality monitoring
- Internal inspections by EHS team
- Maintain waste tracking records at the premises
- Monitor water and power consumption
- Air quality monitoring
- Conduct a noise survey

CHAPTER EIGHT

CLIMATE RISKS AND VULNERABILITY ASSESSMENT AND MITIGATION MEASURES

A fertilizer manufacturing plant is exposed to a variety of climate-related risks stemming from rising temperatures, shifting rainfall patterns, and increasing frequency of extreme weather events.

One of the most significant risks is the rise in temperature and more frequent heatwaves, which can reduce the efficiency of heat-sensitive processes, increase cooling energy demand, and pose health and safety risks to workers. Higher temperatures can also affect the quality and stability of stored fertilizers, especially those prone to caking or decomposition under heat stress. Water scarcity is another major concern, as fertilizer production - particularly ammonia and urea synthesis requires substantial volumes of water for cooling, steam generation and washing systems. Increasing drought frequency and competition for water from other sectors can lead to operational interruptions and higher operational costs.

Extreme rainfall and flooding pose substantial threats as well. Floodwaters can damage equipment, contaminate stormwater with chemicals and disrupt transportation of raw materials and finished products. In areas prone to cyclones or severe storms, strong winds may damage storage tanks, pipelines, and other structures, raising the risk of accidental chemical releases.

Facilities located near coasts may also face long-term risks from sea-level rise, including saltwater intrusion into groundwater resources and accelerated corrosion of metals, which can shorten equipment lifespan. In addition to physical climate risks, the plant may face transitional risks driven by stricter environmental regulations, shifts towards low-carbon fertilizers and volatility in fossil fuel markets as global energy systems evolve.

To mitigate the environmental impact of the plant and reduce greenhouse gas emissions, several measures can be adopted.

Mitigation and adaptation measures

- Improving energy efficiency through high-efficiency boilers, heat-recovery systems, and combined heat and power units can significantly lower fuel consumption.

- Integrating renewable energy sources, such as onsite solar photovoltaic systems, can further reduce dependence on fossil fuels.
- Emissions can be minimized by installing technologies such as selective catalytic reduction for NO_2 control, N_2O abatement systems, and ammonia scrubbers.
- Adopting cleaner production methods, using low-carbon ammonia where feasible, and enhancing recycling and reuse of process heat and byproducts can also strengthen the plant's sustainability profile.

CHAPTER NINE

9.0 ENVIRONMENTAL MANAGEMENT PLAN FOR THE PROPOSED FERTILIZER PLANT

9.1 Environmental Management Plan during the Fertilizer Plant Installation:

Impact	Source of impact	Mitigation measures	Time frame	Responsibility	Cost (Kshs)	Remarks
Landscaping and other civil works	Land preparation for construction	Ensure that land is leveled and practice soil trapping	During construction	Proponent (contractor)	50,000	No landscaping will be done. The area is flat
Loss of vegetation and biodiversity	Land clearing	Greening of the premises area Establish biodiversity banks	During construction	Supervisor	8,000	The area for the proposed fertilizer plant is under cultivation of herbs.
Air pollution	Construction and landscaping	Sprinkling water on the soil surface to minimize the generation of dust	During construction	Proponent (contractor)	5,000	
	Transport of goods.	Emphasize on switching off the engine when not in use	Always	Proponent	Nil	
	Pesticide use	Scouting, spot spraying and integrated pest management	Always	Proponent		
Disregard to environmental	Lack of Environmental	Ensure incorporation of environmental issues in activity	This should be part and parcel of all	Proponent	80,000	To ensure continuous surveillance of environment

issues- pollution	Monitoring	calendar. Proper records should be kept on waste analysis, Ensure annual environmental audit is carried out.	project activities, from construction to decommissioning Not more than one year after project commissioning			and avoid deterioration of standards.
Water pollution	Pollution from agrochemicals	Continuous monitoring of irrigation, water. Safe disposal of waste water through constructed wetlands	Twice a year Always	Manager	40,000	To prevent water pollution
Soil erosion	Soil quality monitoring	Ensure good soil conservation measures Safe water disposal to discharge points	Always	Manager	30,000	To prevent soil erosion To ensure constant water availability.
Water misuse	Water storage facilities	Installation of storage dams. Encourage roof harvesting of the commodity	During construction Always	Manager	80,000	To ensure constant water availability

9.2 Environmental Management Plan during operation of the fertilizer plant

Impact	Source of impact	Mitigation measures	Time frame	Responsibility	Cost (Kshs)	Remarks
Occupational Health and safety.	Workplace hazards Production and handling	Have a Safety and Health Work Plan	On commencement of farm operations	Proponent OSHA Expert	100,000	
Air pollution	Dust produced by various activities	Dust control measures like sprinkling water Use of dust masks	always	Proponent OSHA Expert	50,000	
	Transport of goods	Emphasize on switching off the engine when not in use	Always	Proponent OSHA Expert	Nil	
Disregard to environmental issues- pollution	Lack of Environmental Monitoring	Ensure incorporation of environmental issues in activity calendar. Proper records should be kept on waste analysis, Ensure annual environmental audit is carried out.	This should be part and parcel of all project activities, from construction to decommissioning Not more than one year after project commissioning	Proponent OSHA Expert	80,000	To ensure continuous surveillance of the environment and avoid deterioration of standards.

Water pollution	Pollution from agrochemicals	Continuous monitoring of water. Safe disposal of wastewater through septic tanks.	Twice a year Always	Manager OSHA Expert	40,000	To prevent water pollution
Soil erosion	Soil quality monitoring	Ensure good soil conservation measures Safe water disposal to discharge points	Always	Manager OSHA Expert	30,000	To prevent soil erosion To ensure constant water availability.
Water misuse	Water storage facilities	Installation of storage dams. Encourage roof harvesting of the commodity	During construction Always	Manager OSHA Expert	80,000	To ensure constant water availability

9.3 Environmental Management Plan for the Decommissioning Phase

ENVIRONMENTAL MANAGEMENT PLAN (EMP)			
Planned Activities and Mitigation Measures	**Responsible Party**	**Time Frame**	**Cost (Kshs)**
1. Pre-decommissioning requirements			**To be determined**
1. Obtain all licenses necessary for construction to kick off from NEMA and other relevant authorities.	Proponent, OSHA Expert	2 months	
2. Provide information to workers on project termination and create awareness to workers who are losing employment about alternative income generating activities (includes giving notes of termination of contracts).	Proponent, OSHA Expert	1 month	
3. Payment of compensation and terminal benefits to workers	Proponent, OSHA Expert	1 month	
2. Demolition waste management			
1. All buildings, machinery, equipment, partitions that will not be used for other purposes must be removed and recycled/reused as far as possible	Contractor, Proponent, OSHA Expert	2 months	
2. All foundations must be removed and recycled, reused or disposed of at a licensed disposal site.	Proponent, OSHA Expert	3 weeks	
3. Where recycling/reuse of the machinery, equipment, implements, structures, partitions, and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Contractor, Proponent, OSHA Expert	2 weeks	
4. Donate/ sell reusable demolition waste to other organizations, individuals and institutions in need.	Proponent, OSHA Expert	1 month	
3. Rehabilitation of the project site			

1. Leveling of site to match its original state	Proponent, OSHA Expert	2 months	
2. Implement an appropriate re-vegetation programme to restore the site to its original status	Contractor, Proponent, OSHA Expert	3 months	
3. Consider the use of indigenous plant species in re-vegetation	Contractor, Proponent, OSHA Expert	One-off	
4. Trees should be planted at suitable locations to interrupt slight lines (screen planting), between the adjacent homesteads area and the development.	Contractor, Proponent, OSHA Expert	Once-off	

CONCLUSION AND RECOMMENDATION

The project has clear social and economic benefits and will contribute to the improvement of the quality of life for the people associated with it, the neighbors, and the society in general. The project will not bring any serious conflict with any major national physical or environmental protection policies. The on-site or off-site anticipated impacts identified are of varying significance, and these could be adequately mitigated to reduce any threat to the environment. When the environmental management plan developed during the assessment is fully implemented, the health, safety, and environment policy is set up. This will result in an overall improvement in the environmental quality of the project area and its surroundings.

From the foregoing discussions, it is recommended that;

1. The proponent shall ensure that the development camouflages within the setting and offers a serene environment to allay concerns. All activities concerning construction and maintenance such as work execution, site inspection and material testing, shall be strictly monitored by a contractor or a designated official who is trained and experienced enough to judge the appropriateness of the works being carried out.

2. Implementing an environmental management system is integral to any company's growth and development. It makes employees and contractors aware of the need to take a responsible approach to managing the environment in their operations. The overall objective is to achieve continual improvement through monitoring and measuring performance.

3. A waste management strategy is critical to such a facility’s operations. Otherwise, the 7Rs—refuse, return, refill, reduce, reuse, recycle, and recover - are good practices for the facility.

4. The proponent shall comply with the relevant principle laws, by-laws and guidelines issued for the development of such projects.

5. Annual environmental audits should be carried out on the project to ensure compliance with mitigation measures outlined in the Environmental Management Plan (EMP).

REFERENCES

- Government of Kenya (2000). Environmental Management and Coordination Act No 8 of 1999. Kenya Gazette Supplement. Government Printers, Nairobi.
- Government of Kenya (2003) Environmental (Impact Assessment and Audit) Regulations. Kenya Gazette Supplement No 56, Legal notice No 101, Government printers Nairobi.
- Government of Kenya The Pest Control Products Act (CAP 346, 1997)
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- Government of Kenya The Physical Planning Act (CAP 286):
- Government of Kenya The Wildlife (Conservation and Management) Act (CAP 376),
- Government of Kenya Food, Drugs and Chemical Substance Act (CAP 274),
- Government of Kenya The Chiefs Authority Act (Cap 128),
- Government of Kenya The Penal Code Act (Cap 63),
- Government of Kenya The Forest Act, 2005.

ADDENDUM

NPK Fertilizer Plant

Diammonium phosphate and its use in NPK fertilizer:

Brief Description:

Diammonium phosphate DAP, chemical formula $(NH_4)_2HPO_4$, (18-46-0) is manufactured by:

a) Producing wet-process phosphoric acid by acidulating phosphate rock with sulphuric acid that generates phosphogypsum as a byproduct.

b) Neutralizing the phosphoric acid with ammonia and granulating/drying the product to produce DAP.

Major by product is phosphogypsum (solid) which used in other fertilizer plants. Major wastes are acidic wastewater, air emissions (dust, acid mists), and small amounts of process dust and ammonia fugitive emissions.

2) Detailed process description

a) Raw-material preparation

- Phosphate rock: receive, store under cover, primary crushing and grinding to required particle size to increase reactivity. Screening and blending to achieve a consistent feed.
- Sulphuric acid: bulk storage and handling systems (concentration 98%).
- Ammonia: stored as anhydrous liquid; vapour-tight handling with pressure systems.

  Operational controls: dust suppression at rock handling and crushers; acid-resistant storage.

b) Wet-process phosphoric acid production (acidulation / digestion)

- Acidulation / digestion: Finely ground phosphate rock is reacted with sulphuric acid in a reactor (digester) to convert phosphate rock into phosphoric acid and calcium sulfate (gypsum) under

typical conditions: controlled acid addition, temperature control, agitation; reaction is exothermic.

Reaction (simplified):

$Ca_3(PO_4)_2 + 3\ H_2SO_4 + 6\ H_2O \rightarrow 2\ H_3PO_4 + 3\ CaSO_4 \cdot 2H_2O$ (phosphogypsum).

- Solid-liquid separation: After digestion, the slurry is filtered/centrifuged to separate the wet phosphogypsum (PG) from the acidic phosphoric acid liquor. Filtration systems, washing steps and handling conveyors for PG are used.

  Concentration / clarification: The filtrate (acid) is clarified (remove fines) and then concentrated to the phosphoric acid concentration needed for fertilizer manufacture 33% P_2O_5 for wet-process acid feed into fertilizer plants. Cooling and storage in acid-resistant tanks follow.

c) Conversion to DAP (neutralization and granulation)

- Ammoniation / neutralization: Concentrated phosphoric acid is fed to a reactor (ammoniator) where gaseous ammonia is metered to neutralize the acid to the desired stoichiometry and pH.

  $H_3PO_4 + 2\ NH_3 \rightarrow (NH_4)_2HPO_4$ (DAP).

Temperature and residence time are controlled to manage reaction heat and water content.

Granulation / prilling / compaction: The ammoniated slurry is granulated using rotary granulator to form granules of target size. Additives or seed material may be used to promote granulation.

Drying & cooling: Wet granules are passed through dryers to an acceptable moisture, then cooled in a cooling drum.

Quality check: Quality controls include crush-strength, moisture, and size distribution.

Screening, screening rejects & recycling: Oversize and undersize material is recycled to the granulator; dust collectors recover fine dust. Final product is coated (anti-caking) if required, bagged and stored.

3) Key chemical equations & simple mass considerations

• Main acidulation reaction.

$Ca_3(PO_4)_2 + 3\ H_2SO_4 + 6\ H_2O \rightarrow 2\ H_3PO_4 + 3\ CaSO_4 \cdot 2H_2O$ (phosphogypsum).

• DAP formation (neutralization):

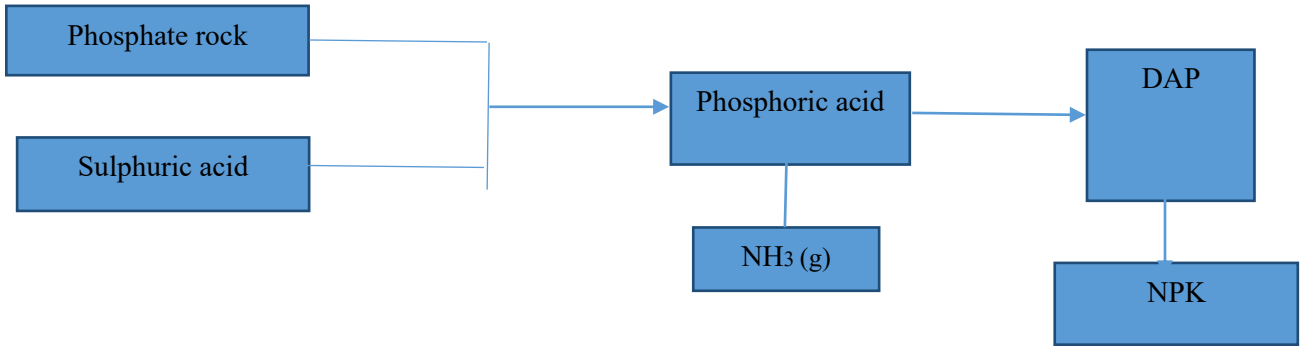
$H_3PO_4 + 2\ NH_3 \rightarrow (NH_4)_2HPO_4$ (DAP).

Solid by product — Phosphogypsum

• Composition: mainly gypsum ($CaSO_4 \cdot 2H_2O$)

This can be used in other fertilizer plants.

Flow chart:



4) Wastes, emissions and environmental hazards

a) Aqueous wastes — Acidic process water & wash waters

- The wet-process generates acidic cooling and wash waters that will be treated using an effluent plant.

b) Air emissions

- Dust from crushing, grinding, handling, screening and from product transfer.
- Acid mists from digestion and filtration will be controlled using scrubbing system.
- Ammonia vapour fugitive emissions during NH_3 handling and neutralization will be controlled using vapour recovery, scrubbing system.
- SO_2 is captured when making sulphuric acid upstream will be controlled using scrubbing system.

5) Typical mitigation, management and monitoring measures

- Phosphogypsum management: engineered stacking facility, stack slope and cover, water balance to minimize effluent.
- Wastewater: closed-loop water circuits where possible; neutralization removal (adsorption/precipitation), treatment ponds with liners, monitoring of pH, total P, heavy metals before any discharge..
- Air controls: baghouses will be installed for dust; wet scrubbers for acid mist; ammonia abatement using scrubbers, leak detection on NH_3 systems will be installed. Continuous emissions monitoring will be in place to minimize the effect.
- Emergency & safety: acid spill bunds, secondary containment for acid and ammonia storage, acid neutralization stations, PPE, and community emergency response plan to be in place.

6) DAP's role in NPK fertilizers

- Composition & solubility: DAP (18-46-0) (18% N, 46% P_2O_5). It is highly water-soluble and gives readily plant-available phosphate and ammonium nitrogen. Solution pH around dissolving granules is moderately alkaline (localised), which can temporarily raise pH around the granule.
- Usage in NPK blends: DAP is widely used as the primary P source in NPK compound fertilizers or blends because of its high P concentration it supplies N. It's used for basal (starter) applications and in fertilizer blends.