

by.

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**STANDARDS INDUSTRIAL PARK**

**NENO, MALAWI FERTILIZER PRODUCTION FACILITY**

**PRE**

**-**

**FEASIBILITY STUDY**

On behalf of;

# Protocol and Standards Management Services

THE PRE-FEASIBILITY STUDY IN-HERE WAS

CONDUCTED FOR THE PURPOSE OF ESTABLISHING OF A FERTILIZER PRODUCTION PLANT IN THE DISTRICT OF NENO, MALAWI.

THIS PROJECT IS IN CONJUNCTION WITH THE

GOVERNMENT OF THE REPUBLIC OF MALAWI.

Dated: May 15, 2024 – June 11, 2024

# EXECUTIVE SUMMARY

Malawi's agricultural sector faces a pressing challenge: meeting the food demands of a growing population estimated at 21.5 million, with an annual growth rate of 2.6%. This can only be achieved by increasing agricultural output, which heavily relies on inorganic fertilizers. However, Malawi presents a unique situation. Despite being heavily reliant on agriculture, particularly maize and tobacco cultivation, the country lacks domestic production capacity for inorganic fertilizers.

Currently, Malawi's fertilizer market is dominated by importers and distributors who blend imported compounds and bulk fertilizers into various formulations. This dependence on imports creates significant vulnerabilities. The landlocked nature of the country and its poor road infrastructure add to the logistical challenges and costs associated with fertilizer transportation from ports.

Despite these hurdles, fertilizer consumption in Malawi remains high. In the 2020-21 growing season alone, 347,710 metric tons (Mt) of fertilizer were distributed to 3,457,000 beneficiaries. This figure, however, falls short of the recommended application rate of 200 Kg/ha for developing countries. Estimates suggest the actual smallholder farmer consumption is around 500,000 Mt annually, highlighting a significant gap between demand and fulfilled needs.

This substantial market offers a promising opportunity for domestic fertilizer production. A new fertilizer plant, targeting a production capacity of 900,000 Mt - 1.1 million Mt annually, could address the supply chain issues plaguing the Malawian market. By establishing a robust distribution network encompassing established government facilities through its state owned enterprises such as the Agriculture Development and Marketing Corporation (ADMARC), private wholesalers, cooperatives, and rural micro-shops, the plant can ensure efficient delivery of fertilizers to farmers throughout the country.

In conclusion, Malawi's fertilizer market presents a unique paradox. While the demand for fertilizers is high, driven by the need for increased food production, the country relies heavily on imports. This dependence exposes the agricultural sector to external factors and logistical challenges. Domestic fertilizer production has the potential to not only address these issues but also cater to the substantial and growing demand within the Malawian market.

**Standards Industrial Park Fertilizer Plant: A Viable Solution for Malawi's Needs?**

Building on the previously established high demand for fertilizer in Malawi and the limitations of the current import-based system, the Fertilizer Plant in the Southern Province emerges as a potential solution. Strategically located near major transportation routes and within Malawi's agricultural heartland, the plant offers efficient distribution capabilities. With a planned annual production capacity of 900,000 metric tons at full capacity, the plant is designed to produce a balanced mix of three key fertilizers: NPK (300,000 tons), Urea (300,000 tons), and Ammonium Nitrate (300,000 tons). This production profile caters to the diverse needs of Malawian farmers cultivating maize, tobacco, and other crops.

**Project Viability Considerations:**

However, the project's viability hinges on several factors beyond production capacity and location. The significant project cost of 1.5 billion USD, to be financed entirely through a long-term loan, requires careful consideration. A thorough financial feasibility study should assess factors like production costs, fertilizer market prices, and potential return on investment to determine the project's long-term financial sustainability. This pre-feasibility study explores a project model that will mitigate considerable risk, presented as a joint venture with the Malawian government.

Furthermore, the success of the project relies on establishing a robust distribution network throughout Malawi, particularly reaching smallholder farmers who are crucial for ensuring food security. Exploring partnerships with established government channels and rural micro-shops can be instrumental in achieving this goal.

By addressing these considerations and conducting a comprehensive feasibility study, the Neno Fertilizer Plant has the potential to become a game-changer for Malawi's agricultural sector, reducing dependence on imports, creating jobs, and supporting food security for its growing population.

**ACRONYMS**

ADD Agricultural Development Division

ADMARK Agricultural Development and Marketing Corporation

ADP Agricultural Development Program

AFAP African Fertilizer and Agribusiness Partnership

AfDB African Development Bank

AGMARK Agricultural Market Development Trust

AGRA Alliance for a Green Revolution in Africa

AIP Affordable Inputs Program

ASFR Area Specific Fertilizer Recommendation

A-SWAp Agriculture-Sector Wide Approach

AU African Union

BFR Blanket Fertilizer Recommendation

CAADP Comprehensive Africa Agriculture Development Program

CAN Calcium ammonium nitrate

CEO Chief Executive Officer

CIA-WFB Central Intelligence Agency-World Factbook

CNFA Citizens Network for Foreign Affairs

COMESA Common Market for Eastern and Southern Africa

DADO District Agricultural Development Officers

DAS Development Assistance Strategy

DFID Department for International Development

EPA Extension Planning Area

ETG Export Trading Groups

FAM Fertilizer Association of Malawi

FAO Food and Agriculture Organization

FCUE Fertilizer Cost Use Efficiency

FFFRA Fertilizer, Farm Feeds and Remedies Act

FISP Farm Input Subsidy Program

GBI Green Belt initiative

GDP Gross Domestic Product

GoM Government of Malawi

GPMR Gross Profit Margin Ratio

IFDC International Fertilizer Development Centre

IMF International Monetary Fund

ISFM Integrated Soil Fertility Management

MFC Malawi Fertilizer Company

MAISP Malawi Agricultural Input Subsidy Program

MDG Millenium Development Goals

MDGS Malawi Growth and Development Strategy

MoAFS Ministry of Agriculture and Food Security

NFS National Fertilizer Strategy

NGO Non-governmental Organization

NPK Nitrogen (N), Phosphorus (phosphate: P2O5), Potassium (potashk20)

SSA Sub-Saharan African

MBS Malawi Bureau of Standards

MFC Malawi Fertilizer Company

MK Malawi Kwacha

MoF Ministry of Finance

MoPED Ministry of Planning and Economic Development

PPP Public Private Partnership

PTA Preferential Trade Area

PSMS Protocol and Standards Management Services

SADC Southern Africa Development Community

SADCC Southern African Development Coordination Council

WB World Bank

# MARKET ANALYSIS

**1.1 Global Fertilizer Industry:**

The global fertilizer industry is a vital contributor to global food security, providing essential nutrients that enhance soil fertility and crop yields. Key segments include nitrogen (N), phosphate (P2O5), and potash (K2O) fertilizers. The industry is projected to reach a market size of **USD 261.81 billion by 2030**, driven by several factors:

* **Rising population:** The global population is expected to reach **9.7 billion by 2050**, necessitating a significant increase in food production to meet growing demand.
* **Shifting dietary patterns:** Increasing consumption of meat-based diets requires more grain production, which puts additional pressure on fertilizer use.
* **Sustainable agriculture:** Modern agricultural practices often rely on fertilizers to maintain soil health and productivity while minimizing environmental impact.

**1.2 African Fertilizer Market:**

Despite its vast agricultural potential, Africa faces challenges in fertilizer utilization. Fertilizer application rates in Africa are significantly lower than global averages, at an average of **21 kg/ha** compared to the global average of **180 kg/ha**. This limited usage is primarily due to:

* **Limited access:** Poor infrastructure and distribution networks often hinder farmers' access to fertilizers.
* **High Costs:** High fertilizer prices due to import dependence and limited domestic production can be a barrier for smallholder farmers.
* **Inadequate knowledge:** A lack of farmer education on the benefits and proper use of fertilizers can lead to inefficient application.

However, the African fertilizer market presents significant growth potential. Initiatives by governments and international organizations are aiming to address these challenges and improve fertilizer usage across the continent. This includes:

* Investments in infrastructure development to improve fertilizer distribution networks.
* Subsidy programs to make fertilizers more affordable for smallholder farmers.
* Farmer education programs to promote the benefits and proper application of fertilizers.

**1.3 Malawi Fertilizer Market**

* + 1. **Annual Fertilizer Consumption:** Estimated at 1.1 million metric tons (MT).
    2. **Import Reliance:** Over 50% of fertilizer is currently imported.

These figures suggest a significant market with room for domestic production. Growth projections are likely tied to factors like Government initiatives promoting fertilizer use, increased agricultural productivity goals and expansion of land under cultivation.

* + 1. **Key Players:**

Currently, the Malawian fertilizer market is dominated by importers and distributors. In Malawi and Africa as a whole, importers and distributors are cartels characterized by collusive behaviour on pricing holding most governments at ransom when needed. There are a few manufacturers like Malawi Fertilizer Company (MFC) and Optichem 2000 Ltd but their production capacity is small to influence the market in any meaningful way.

* + 1. **PSMS Limited's Fertilizer Choice and Target Market:**
       1. **Fertilizer Type:**

The focus on Urea, D Compound, and Ammonium Nitrate highlights the business will target **macro-nutrient fertilizers**. These are essential for overall plant growth.

* + - 1. **Target Market Segment:**

Based on product selection and Malawi's agricultural profile, the target market likely includes:

* **Staple Crop Farmers:** Maize is the dominant crop in Malawi. Urea is a good source of nitrogen, crucial for maize growth. D Compound (like NPK fertilizer) provides a balanced mix of nitrogen, phosphorus, and potassium, further supporting staple crops.
* **Cash Crop Farmers (potentially):** Ammonium Nitrate, a high-nitrogen fertilizer, might be used for crops like tobacco, another significant Malawian crop.

**1.3.5 Government Initiatives Promoting Fertilizer Use:**

The Malawian government has a long history of promoting fertilizer use:

* **Affordable Inputs Program (AIP):** This program provides subsidized fertilizer to smallholder farmers, a significant target market for PSMS Limited.
* **Focus on Sustainable Practices:** While promoting fertilizer use, the government also encourages practices like intercropping and integrated soil fertility management to improve soil health alongside increased yields.

Overall, the Malawian fertilizer market presents an opportunity for PSMS Limited. The high import reliance, government support for fertilizer use, and focus on staple crops all create a favorable environment for domestic production of macro-nutrient fertilizers targeting smallholders and potentially cash crop farmers.

**1.4 By-Product Markets**

**1.4.1 Methane:**

**1.4.1.1 Limited Current Demand:**

* **Industrial Sector:** Industrial use of methane in Malawi is currently limited. The country's industrial base is dominated by agriculture and light manufacturing, sectors that typically don't utilize methane as a primary fuel source.
* **Power Generation:** Hydropower is the dominant source of electricity in Malawi, with limited diversification. While methane can be used for power generation, there's currently no significant infrastructure for large-scale methane power plants.

**1.4.1.2 Potential for Future Demand:**

* **Industrial Sector:** Growth Potential: If Malawi's industrial sector expands into heavier industries like steel or chemical production, methane could become a more viable fuel source in the future. However, this is a long-term prospect, and the specific needs of these potential industries need further analysis.
* **Power Generation:** Renewable Alternative: Malawi's hydropower dependence makes it vulnerable to droughts. Methane, if sourced sustainably (e.g., from biogas), could offer a more reliable and potentially cleaner alternative energy source.
* **Distributed Generation:** Small-scale methane power plants could be suitable for remote areas not connected to the national grid. Biogas from agricultural waste could be a local and sustainable feedstock for such plants.

**1.4.1.3 Challenges to Overcome:**

* **Infrastructure Development:** Building the necessary infrastructure for large-scale methane production, transportation, and utilization (pipelines, power plants) would require significant investment.
* **Feedstock Availability:** While agricultural waste is a potential source of methane through biogas production, ensuring a reliable and sustainable supply chain needs further exploration.
* **Cost Competitiveness:** The cost of producing methane from biogas and transporting it compared to existing energy sources like hydropower or imported fuels needs careful analysis.

Overall, the immediate demand for methane in Malawi's industrial sector and power generation is low. However, long-term potential exists, especially in power generation as a renewable alternative, if the challenges of infrastructure development, feedstock availability, and cost competitiveness can be addressed.

**1.4.2 Ethanol:** Ethanol Blending with Gasoline:

**1.4.2.1 Current Status:**

Malawi has a successful ethanol blending program, with a national blend of up to 20% ethanol in gasoline. This demonstrates existing infrastructure and government support for blending.

**1.4.2.2 Growth Potential:**

There's potential to increase the blending ratio, depending on factors like:

* **Domestic Ethanol Production:** Malawi's current production (18 million liters) falls short of full blend capacity. Increased domestic production from PSMS Limited or other facilities could support raising the blend ratio.
* **Cost-effectiveness:** The price of ethanol compared to imported gasoline needs to be competitive for higher blending ratios to be economically viable.
* **Engine Compatibility:** Wider adoption of flex-fuel vehicles capable of using higher ethanol blends would be necessary.

**1.4.2.3 Industrial Applications:**

* **Limited Current Use:** Industrial applications of ethanol in Malawi are likely minimal at present.
* **Potential Uses:**
  + **Chemical Industry:** Ethanol can be used as a feedstock for various chemicals and solvents. The viability depends on the specific needs of existing or potential Malawian chemical industries.
  + **Beverage Industry:** Food-grade ethanol production could cater to the domestic beverage industry, but regulatory considerations and competition with imported options need to be assessed.
  + **Cooking Fuel:** Studies suggest potential for using ethanol for household cooking, especially if production costs decrease (Project Gaia). However, safety considerations and infrastructure development for distribution would be crucial.

The Malawian ethanol market shows promise for continued growth in blending with gasoline, especially if domestic production increases and costs remain competitive. Industrial applications hold some potential, but further exploration is needed regarding specific industry needs, regulations, and cost-effectiveness compared to alternative options.

**1.4.3 Explosives:**

* + - 1. **Market Size and Players:**

Obtaining specific market size data for controlled explosives in Malawi or the broader Southern African region is challenging due to security concerns. However, major mining operations in countries like South Africa, Zambia, and Botswana likely contribute significantly to the demand.

* + - 1. **Key Players:**

Established international explosives manufacturers like AECI (South Africa), Orica (Australia), and Enaex (Chile) are likely major players. Local or regional distributors might exist, acting as intermediaries between manufacturers and end-users.

* + - 1. **African Continent as a Leading Market:**

Africa is a significant player in the mining explosives market due to growing mining projects. In 2019, Africa’s total mineral production reached 983 million metric tons, with South Africa contributing 320 million metric tons. South Africa alone produced 254 million metric tons of minerals, emphasizing its importance in the region. Notably, the South African mining explosives market covers coal, iron ore, PGMs (platinum group metals), and gold2.

* + - 1. **Sub-Saharan Africa’s Explosives Market:**

The mining explosives market in Sub-Saharan Africa was valued at $1.11 billion and was projected to reach $1.67 billion by 2020. Key export markets for South African explosives include Zimbabwe, Tanzania, Namibia, Zambia, Botswana, Lesotho, and Ghana. Our goal is to capture this market with the biggest clients being our immediate neighbors.

* + - 1. **Focus on Production Malawi:**

While specific information on the explosives market is scarce due to security concerns there are positives in our partnership with the government.

● **Potential for Regional Harmonization:** Malawi might participate in regional initiatives like the Southern African Development Community (SADC) to harmonize explosives regulations across member states. This may allow for easier penetration into this market and smoother engagement with foreign states with bigger markets for explosives like Zimbabwe, Tanzania, Namibia, Zambia, Botswana, Lesotho, and Ghana

**1.5 Market Segmentation Strategy**

PSMS Limited’s success hinges on data-driven decision-making. By integrating empirical insights into our segmentation strategy, they can effectively serve diverse customer segments while maintaining regulatory compliance and environmental responsibility. Here’s an in-depth analysis:

**1.5.1 Government Contracts:**

1. **Empirical Data:** The Malawian Government, through agricultural programs, secures 50% of the production. These programs include agricultural subsidies, strategic reserves, and development projects.
2. **Segment Focus:** PSMS must tailor multi-purpose fertilizers to meet government specifications. Empirical data on crop types, soil conditions, and historical demand patterns will guide product development.
3. **Pricing Strategy:** Profitability is crucial, but competitive pricing ensures long-term collaboration.

**1.5.2 Smallholder Farmers:**

1. **Empirical Insights:** Despite government support, smallholder farmers remain a critical segment. Data on their acreage, crop preferences, and yield gaps are essential.
2. **Product Customization:** PSMS will collaborate with the government to create specialized fertilizers that address smallholders’ specific needs.
3. **Distribution Channels:** Empirical data on rural distribution networks to be provided by the government will help optimize accessibility.

**1.5.3 Commercial Farmers:**

1. **Data-Driven Approach:** Analyzing data on commercial farmers’ crop rotations, soil tests, and yield trends will help PSMS better serve the commercial market.
2. **Product Differentiation:** Developing premium fertilizers tailored to specific crops will be key (e.g., maize, tobacco). Empirical evidence on nutrient deficiencies informs formulation is required for our “know your customer” (KYC) data.
3. **Technical Support:** Data on common challenges faced by commercial farmers will guide support services.

**1.5.4 Agricultural Cooperatives and Associations:**

1. **Quantitative Insights:** Understanding the size and purchasing power of cooperatives is important. Data on their collective needs and preferences is crucial.
2. **Bulk Purchasing Solutions:** Empirical data on cooperative buying behavior will inform pricing models and bulk discounts.
3. **Education Programs:** We will be assessing the effectiveness of training initiatives through data on adoption rates.

**1.5.5 Long-Term Considerations:**

1. **Government Relations:** Continuously monitor government policies and track contract renewals. Historical data on policy shifts can guide proactive engagement.
2. **Market Diversification:** Explore export opportunities based on empirical data on neighboring countries’ fertilizer demand and trade dynamics.
3. **Innovation and R&D:** Invest in research and development to create innovative fertilizer products that meet emerging agricultural trends and needs, staying ahead in the market.

**1.6 Competitor Landscape and Strategic Positioning**

Market Overview

PSMS Limited’s success hinges on effective execution of the strategies below as we enter a market of established players. Our competitors include local manufacturers, international brands, organic alternatives, and substitute products. Understanding their strengths and weaknesses is crucial for our strategic positioning.

* + 1. **Direct Competition**

|  |  |  |  |
| --- | --- | --- | --- |
| **Competitor** | **Strengths** | **Weaknesses** |  |
| **Local Fertilizer Suppliers** | Established market presence and  strong relationships with stakeholders | Limited product differentiation potential resistance to new entrants | and |
| **International**  **Fertilizer**  **Companies** | High-quality imported products and strong brand recognition | Lack of local context and  production costs | higher |

* + 1. **Indirect Competition**

|  |  |  |  |
| --- | --- | --- | --- |
| **Competitor** | **Advantages** | **Challenges** |  |
| **Organic Fertilizers and**  **Natural Soil**  **Amendments** | Growing demand for sustainable options and environmentally friendly perception | Limited scalability resource constraints | due to |
| **Substitute Products** | Cost-effectiveness and eco-friendliness. Also, the availability of biofertilizers and compost | Limited awareness  farmers and  effectiveness | among variable |

* + 1. **Competitive Strategies**

Most of the strategies to be employed here have been highlighted throughout the sections of this business plan. Below is a summary of entries

1. **Product Differentiation**:
   1. Our focus will be on high-quality formulations and specialized products.
   2. Tailor offerings to specific crops and soil conditions in Malawi will help develop more effective products.
2. **Pricing Strategy**:
   1. We shall offer competitive pricing to attract cost-sensitive smallholder farmers.
   2. We will be exploring the provision of bulk discounts for commercial farmers and cooperatives.
3. **Distribution Channels**:
   1. We have included in our plan to establish efficient logistics for timely product delivery.
   2. Partnering with local retailers and input suppliers to expand market reach is another key strategy to be employed.
4. **Marketing and Education**:
   1. Invest in brand awareness campaigns.
   2. Educate farmers on fertilizer benefits through workshops and demo plots. v. **Innovation and R&D**:
   3. Continuously improve formulations.
   4. Develop sustainable options aligned with eco-friendly practices. vi. **Customer Support**:

a. Provide excellent service to build trust and loyalty.

**1.6.4 Competitive Matrix**

|  |  |  |
| --- | --- | --- |
| **Competitor** | **Strengths** | **Weaknesses** |
| **Local**  **Manufacturers** | Established market presence | Limited product differentiation |
| Strong relationships with stakeholders | Potential resistance to new entrants |
| **International Brands** | High-quality imported products | Lack of local context and adaptation |
| Strong brand recognition | Higher production costs |
| **Organic**  **Alternatives** | Growing demand for sustainable options | Limited scalability due to resource constraints |
| Environmentally friendly perception | Smaller market share compared to synthetics |
| **Substitutes** | Cost-effectiveness and eco-friendliness | Limited awareness among farmers |
| Availability of biofertilizers and compost | Variable effectiveness depending on type |

# LOCATION AND SITE ANALYSIS

Neno District's location offers several advantages for the fertilizer plant, particularly its proximity to the target market and potential for local raw material exploration. However, a thorough infrastructure assessment and environmental impact study are crucial to ensure the project's long-term success and minimize any negative consequences for the region. Neno's selection is based on:

**2.1 Market Proximity:**

Neno District is situated in Malawi's Southern Region, a major agricultural hub. This central location places the plant close to a significant portion of its target market – smallholder farmers. This proximity can reduce transportation costs for distributing fertilizer and improve accessibility for farmers.

**2.2 Raw Material Acquisition:**

While Malawi lacks significant natural gas reserves, Neno District's location might offer possibilities for exploring unconventional sources:

* **Biogas:** Investigating the feasibility of utilizing biogas from agricultural waste in surrounding areas.
* **Coal-bed Methane:** Assessing the potential of extracting methane gas from coal seams, if any exist within the region.
  1. **Regional Collaboration:**

The location within Malawi's southern region positions the plant well for potential partnerships with neighboring countries in SADC or COMESA. Mozambique's natural gas reserves and Zambia's potential for phosphoric acid production could be more accessible from Neno District.

* 1. **Infrastructure:**

Below is our evaluation of existing transportation infrastructure in Neno District.

* **Road Network:** There is access to the quality and capacity of roads to handle the movement of raw materials and finished fertilizer products. Upgrades or improvements might be necessary for efficient logistics.
* **Rail Network:** Analyzing the proximity to railway lines, we are looking into railway lines which could offer a cost-effective option for bulk transportation over long distances.

**2.5 Environmental Impact:**

We are carefully considering the potential environmental impact of the plant on Neno District and surrounding areas.

* **Emissions:** Implementing strategies to minimize air and water pollution from the production process.
* **Waste Management:** Developing a plan for safe and responsible disposal of any industrial waste generated by the plant.

**2.6 Potential Challenges of Neno District Location:**

* Limited existing infrastructure (roads, railways) might require upgrades for efficient logistics.
* Environmental impact on the district needs careful consideration and mitigation strategies.

# TECHNICAL FEASIBILITY

**3.1 Production Analysis**

PSMS Limited will capitalize on high-demand fertilizers by producing three key variants:

* Urea: A cost-effective option with its high nitrogen content, making it ideal for farms focused on maximizing nitrogen delivery.
* D Compound (NPK): This balanced blend caters to a wide range of crops, offering a one stop solution for farmers seeking complete plant nutrition (nitrogen, phosphorus, potassium).
* Ammonium Nitrate: PSMS leverages its effectiveness in agricultural applications to provide a targeted nitrogen source for specific crop requirements.

**3.1.1 Urea Conversion to Fertilizer with By-product Capture utilizing Blue Ammonia**

**3.1.1.1 Addressing the Challenge:**

Traditionally, Urea production does not generate methane, ethanol, or explosives as by-products. This process flow explores a novel approach where Urea, derived from blue ammonia, is broken down to create these specific products while minimizing environmental impact.

**3.1.1.2 Blue Ammonia Integration:**

PSMS Limited prioritizes sustainability by utilizing blue ammonia as the primary source material for Urea production. Here's how it integrates into the process:

* **Blue Ammonia Acquisition:** Blue ammonia, produced through a clean process capturing carbon emissions, is sourced from reliable suppliers.
* **Urea Synthesis:** The blue ammonia undergoes a standard Haber-Bosch process to create Urea, a key fertilizer component.

**3.1.1.3 Technology Selection for By-product Capture:**

The technology chosen for Urea processing and by-product capture will prioritize:

* **Efficiency:** Maximizing the yield of desired products while minimizing waste.
* **Safety:** Prioritizing processes with robust safety protocols to handle hazardous materials.
* **Cost-Effectiveness:** Selecting technologies with minimal energy consumption, equipment maintenance costs, and waste disposal expenses.

Here's a possible approach considering these factors:

**3.1.1.3.1 Urea Depolymerization:**

○ Technology: **Hydrothermal Liquefaction (HTL)** remains a promising candidate.

○ Advantages: HTL offers high efficiency and can handle a variety of feedstocks.

○ Considerations: Requires robust equipment to handle high pressure and temperature.

**3.1.1.3.2 By-product Separation:**

○ Technology: **Fractional Distillation** is a well-established technique for separating components based on boiling points.

○ Advantages: Offers precise separation of desired products like methane, ethanol, and potentially ammonia (precursor for explosives).

○ Considerations: Requires significant energy input for heating.

**3.1.1.3.3 Explosive Precursor Management:**

○ Technology: Ammonia, a potential by-product, can be converted into safer products like fertilizer or used for industrial purposes.

○ Advantages: Minimizes the risk of explosive materials being produced as a byproduct.

○ Considerations: Requires additional processing steps.

**3.1.1.4 Process Flow:**

|  |  |
| --- | --- |
|  | **Process Flow Table** |
| **Blue Ammonia Acquisition:** | Secure blue ammonia from reliable suppliers. |
| **Urea Synthesis:** | Utilize the Haber-Bosch process to convert blue ammonia into Urea. |
| **Urea Pretreatment:** | Prepare Urea for HTL by adjusting its concentration and potentially adding catalysts to improve reaction efficiency. |
| **Hydrothermal Liquefaction:** | Feed pretreated Urea into an HTL reactor under high pressure and temperature, breaking it down into smaller molecules. |
| **Product Cooling and Separation:** | The HTL product stream is cooled, allowing for easier separation of liquid and gaseous components. |
| **Fractional Distillation:** | The liquid fraction is sent to a distillation column where methane, ethanol, and ammonia are separated based on their boiling points. |
| **Gaseous By-product Management:** | Separated methane can be used as a fuel source, while ethanol can be further refined for various applications. |
| **Ammonia Management:** | Ammonia can be converted into additional fertilizer using the existing blue ammonia infrastructure, preventing the creation of explosive materials. |
| **Wastewater Treatment:** | Any remaining aqueous waste from the process undergoes treatment to remove contaminants before disposal or potential reuse. |

**3.1.2 PSMS Approach to D-Compound Fertilizer Production Process**

**3.1.2.1 Locally Sourced Materials:**

○ Nitrogen: PSMS explores options for using locally available nitrogen sources, such as locally produced Urea (if feasible) or establishing domestic ammonia production through partnerships (long-term strategy). This reduces reliance on imported ammonia and potentially lowers costs.

○ Phosphorus & Potassium: While currently unavailable in Malawi, PSMS might explore regional sourcing options for Phosphoric Acid and Potassium Chloride to minimize import distances and optimize transportation costs.

**3.1.2.2 Streamlined Production:**

○ Standardized NPK Ratios: PSMS focuses on producing key D-compound fertilizer blends with NPK ratios proven effective for Malawian soil conditions and common crops (e.g., maize). This simplifies production planning and caters to smallholder farmers.

○ Batch Production: Considering smaller-scale production, PSMS utilizes batch processes for mixing and granulation, ensuring efficient resource use.

**3.1.2.3 Cost-Effective Drying and Cooling:**

○ Solar Drying (Optional): Depending on Malawi’s climate, PSMS can explore incorporating solar dryers as a sustainable and cost-effective option for drying granules, reducing reliance on energy-intensive rotary dryers.

○ Natural Cooling: Utilizing nighttime ambient temperatures or strategically designed cooling chambers minimizes dependence on dedicated cooling equipment, potentially lowering production costs.

**3.1.2.4 Packaging for Accessibility:**

○ PSMS will offer D-compound fertilizer in smaller, affordable bag sizes for smallholder farmers, alongside bulk options for larger commercial farms.

**3.1.2.5 Quality Control for Trust:**

○ Rigorous Testing: PSMS prioritizes testing raw materials and finished products to comply with national quality standards and meet Malawian crop nutrient requirements.

○ Farmer Education: PSMS partners with agricultural extension services to educate farmers on proper fertilizer application rates and techniques for optimal crop yields.

**3.1.3 Waste Management:**

* Solid waste from pretreatment or distillation residues will be treated and disposed of according to regulations.
* Wastewater treatment will focus on removing organic and inorganic contaminants before controlled discharge or potential reuse in non-critical applications.
* Ammonia conversion or utilization eliminates the risk of explosive by-products.

**3.2 Raw Materials**

The establishment of a large-scale fertilizer production plant in Neno District, Malawi, presents a significant opportunity to enhance agricultural productivity and food security in the region. To ensure the plant's successful operation, a reliable and efficient raw material supply chain is paramount. This section outlines a comprehensive strategy for securing the necessary raw materials – ammonia, natural gas (or alternatives), phosphoric acid, potash, and carbon dioxide – to support the plant's ambitious production target of 900,000 metric tons annually, divided equally between Urea, ammonia (used for Urea production), and D-compound fertilizer.

**3.2.1 Raw Material Requirements:**

**3.2.1.1 Urea:**

* Primary raw material: Ammonia (NH3) - 300,000 MT
* Secondary raw material: Carbon dioxide (CO2) - Obtained through various methods including on-site capture from ammonia production or external sourcing.

**3.2.1.2 Ammonia:**

* Primary raw material: Natural gas (CH4) - Estimated volume depends on chosen production technology. Common estimates range from 300-350 standard cubic meters (SCM) of natural gas per metric ton of ammonia (MT). This translates to a potential requirement of 90,000,000 to 105,000,000 SCM of natural gas annually for 300,000 MT of ammonia production.
* Alternative options: Coal or naphtha can be used, but natural gas is generally preferred due to lower emissions and production costs.

**3.2.1.3 D-compound fertilizer:**

* Key raw materials:

→ Ammonia (NH3) - Quantity will depend on the specific D-compound formula chosen. A common formula (DAP - Diammonium Phosphate) requires approximately 1.9 tons of ammonia per ton of DAP produced.

→ Phosphoric acid (H3PO4) - Quantity will depend on the specific D-compound formula chosen. For DAP production, the requirement would be roughly 1.4 tons of phosphoric acid per ton of DAP.

→ Potash (KCl) - Quantity will depend on the specific D-compound formula chosen. Some D-compound formulas may not include potash.

**3.2.2 Sourcing Strategies**

Establishing a reliable and cost-effective supply chain for raw materials is critical to the success of the Neno District fertilizer plant. Here's a breakdown of the various sourcing strategies being explored:

**3.2.2.1 Domestic Sourcing:**

**3.2.2.1.1 Natural Gas Reserves:**

While Malawi currently lacks significant conventional natural gas reserves, exploring unconventional sources has merit.

○ **Biogas:** We are investigating the feasibility of utilizing biogas produced from organic waste through anaerobic digestion processes. This option could involve collaborating with local agricultural communities or establishing dedicated biogas plants.

○ **Coal-bed Methane:** We are assessing the potential of extracting methane gas trapped within coal seams. Partner with geological experts and research institutions to evaluate technical and economic viability.

**3.2.2.1.2 By-Product CO2 Capture:**

Capture carbon dioxide (CO2) emissions from existing industries within Malawi.

○ **Target Industries:** We are exploring partnerships with cement plants, power stations, or other large industrial facilities that generate significant CO2 emissions.

○ **Carbon Capture and Utilization (CCU):** Implementing CCU technology to capture and convert CO2 emissions into a usable form for fertilizer production is one of our goals. This approach promotes sustainability by utilizing a readily available by-product.

**3.2.2.2 Regional Sourcing (SADC & COMESA):**

**3.2.2.2.1 Neighboring Countries:**

PSMS looks to leverage regional economic partnerships to source raw materials from neighboring countries like Mozambique, Zambia, and Tanzania.

○ **Strategic Partnerships:** We will establish collaborations with fertilizer producers or raw material suppliers within these countries.

○ **Exchange Opportunities:** We will explore bartering arrangements or exchange agreements based on regional availability and demand. This could involve trading natural gas from Mozambique for phosphoric acid from Zambia.

○ **Logistics Considerations:** We are carefully evaluating transportation infrastructure and costs when considering regional sourcing options. Utilizing existing trade agreements within SADC and COMESA to facilitate smooth movement of materials.

**3.2.2.3 International Sourcing:**

**3.2.2.3.1 Nitrogen Sources:**

One of our primary objectives early on is securing reliable international suppliers for ammonia (NH₃) or urea (CO(NH₂) ₂).

○ **Focus on Cost-Effectiveness:** We will evaluate offers from established global suppliers based on competitive pricing while ensuring quality.

○ **Transportation Logistics:** We are analyzing transportation costs and routes to minimize the impact on overall production costs.

**3.2.2.3.2 Phosphorus and Potassium:**

Exploring international suppliers for phosphoric acid (H₃PO₄) and potassium chloride (KCl).

○ **Trade Routes and Shipping:** We are considering established trade routes and shipping options that offer efficiency and cost-effectiveness.

○ **Long-Term Contracts:** Negotiating long-term supply contracts with reliable partners to guarantee a steady flow of materials and potentially benefit from price stability.

**3.2.2.3.3 Trace Elements:**

Obtaining trace elements essential for plant growth, such as zinc (Zn), copper (Cu), and boron (B), from international markets.

○ **Specialized Suppliers:** Collaborating with specialized suppliers who can ensure consistent quality and timely delivery of these essential micronutrients.

By employing this multi-pronged approach, the Neno District fertilizer plant can leverage domestic resources, regional partnerships, and established international trade to secure a reliable and cost-effective supply of raw materials. This holistic strategy is key to ensuring the plant's long-term success and contribution to Malawian food security.

**3.3 Fertilizer Type Selection**

The primary nutrients required by plants in most fertilizer is Phosphorus (P), Potassium (K) and

Nitrogen (N). Secondary nutrients needed by plants in moderate amounts are Calcium (Ca), Sulphur (S), Magnesium (Mg). Micronutrients required in relatively smaller quantities are Iron (Fe), Manganese (Mn), Zinc (Zn), Boron(B), Molybdenum (Mo) Copper (Cu), Chloride (Cl) and Nitrite (Ni).

Nitrogen-based fertilizer combines naturally occurring nitrogen from the atmosphere with natural gas (CH4) to form ammonium nitrate. Dolomitic limestone is added to produce CAN fertilizer while S is added to form sulphate of ammonia fertilizer. This process requires a significant amount of energy. 80% of the gas is used as feedstock for fertilizer while 20% is used for heating the process and producing electricity.

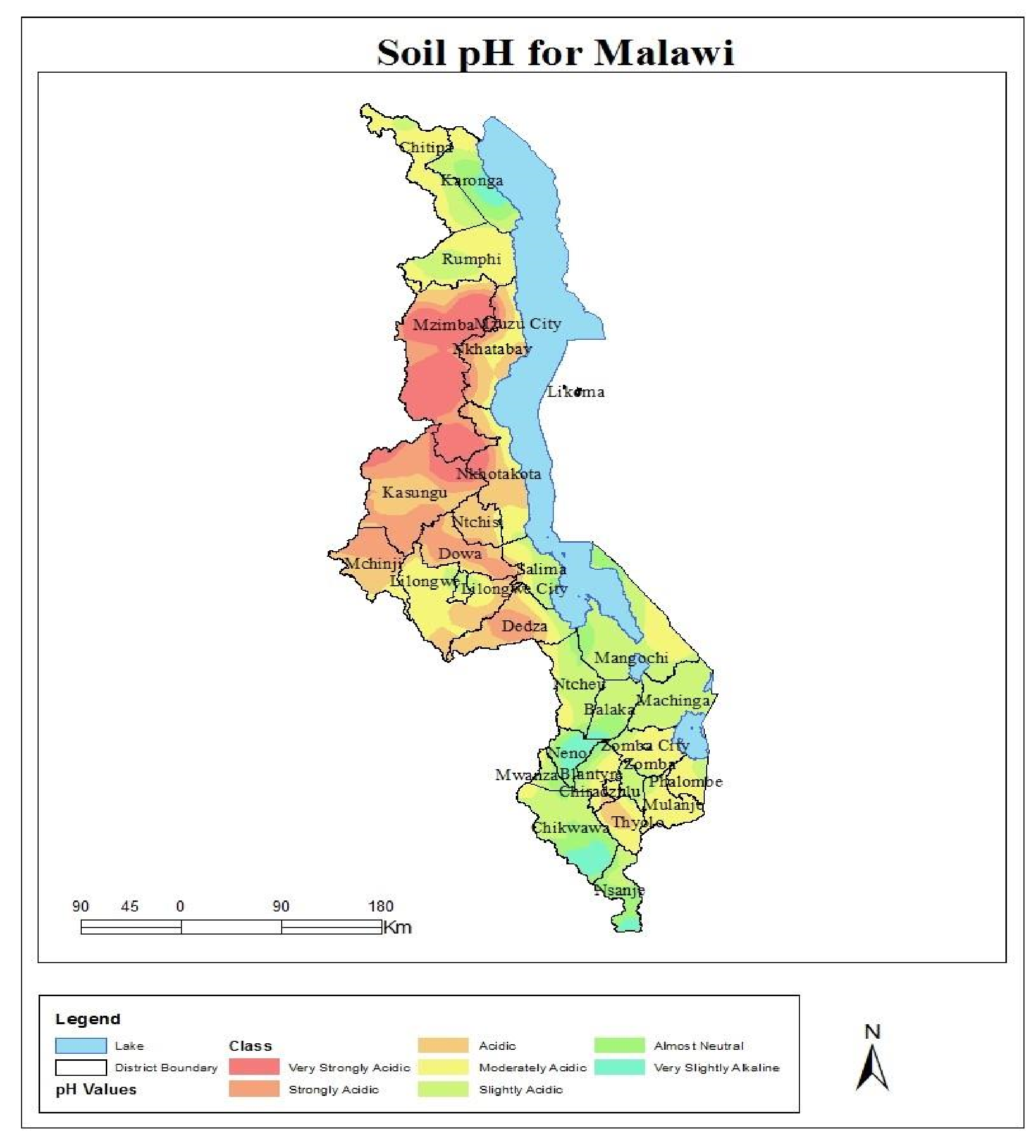
Phosphorous-based fertilizer comes from the phosphates originating in rock deposits as fossilized remains in sedimentary environments and rock phosphate from igneous rocks. To produce phosphorus fertilizer, the rock is treated with either sulfuric, phosphoric or nitric acid. The sulfuric acid route produces a low phosphorus fertilizer – single superphosphate. The use of phosphoric acid produces a higher concentration of phosphorus fertilizer.

Potassium (K) based fertilizer is derived from naturally occurring ore deposits that were formed when seas and oceans evaporated. With improved technology potassium can be extracted from finely ground potassium feldspar and other potassium-silicate-rich rocks. This can be purified and granulated with other nutrients. So far, the main sources of potassium fertilizer are potassium nitrate, potassium sulfate, potassium chloride or mono-potassium phosphate. Nitro phosphates combined with potassium produce the complex NPK fertilizers that are popular in Malawi. Secondary elements in NPK fertilizers include calcium and Sulphur from limestone and gypsum. Some micronutrients such as copper (Cu), boron, molybdenum and zinc (Zn) may be added and originate from copper and zinc mines in the form of sulphates, borates or molybdates. PSMSL will use some locally available agro minerals in the manufacture of fertilizer in Malawi. The exploitation of these minerals will save foreign exchange through import substitution and will reduce unemployment rate in the rural areas. Significant agro minerals in Malawi include limestone, apatite rock, pyrite, gypsum and feldspathoidal rocks.

***Table 1. Major Fertilizer Compounds and blends that can be produced at Standards Industrial Park***

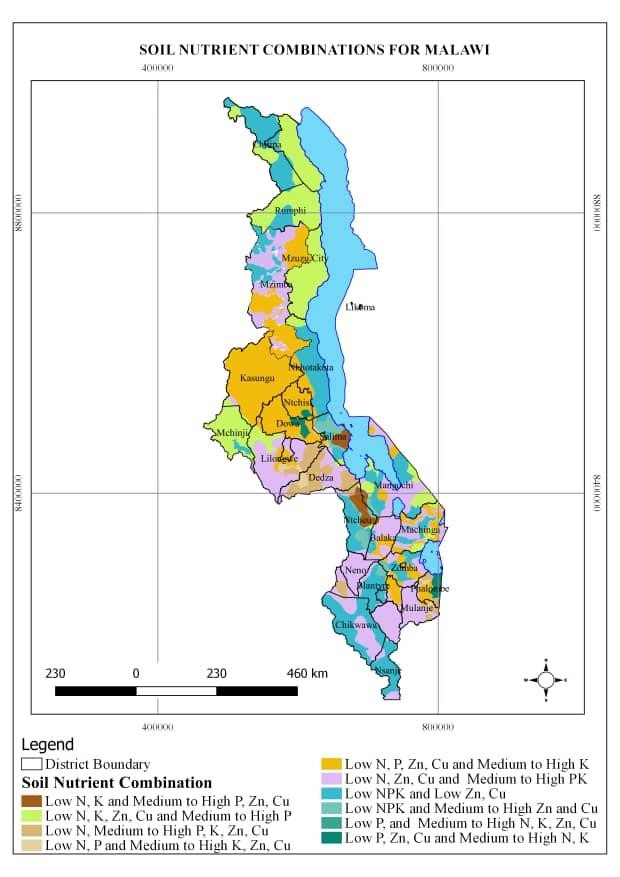
***Fertilizer Plant***

|  |  |  |
| --- | --- | --- |
| S/N | Compound Name | Target Crop |
| 1 | Urea | All-purpose top dressing |
| 2 | Di-Ammonium Phosphate (DAP) | Basal fertilizer blend |
| 3 | Calcium Ammonium Nitrate (CAN) | Maize, wheat, barley, tobacco, coffee etc. |
| 4 | Muriate of Potash (MOP) | Basal Fert. Blend |
| 5 | Sulphate of Potash (SOP | Basal Fert. Blend |
| 6 | Ammonium Sulphate (AS) | Flowers, rice cotton, soybeans etc. |
| 7 | Micronutrient sprays containing Zn & B | Micronutrients source for various crops |
| 8 | NPK 8:18:15+6S+0.1B | Tobacco, paprika, flowers |
| 9 | NPK 10:18:24+6S+0.1B | Tobacco |
| 10 | NPK 23:10:05+6S+1Zn | Maize, Rice, Irish Potatoes, Vegetables |
|  | **5 New NPK Formulation based on ASFR** | |
| 1. | 23:18:14.4+4.8S+0.8Zn+0.4Cu | Basal Dressing |
| 2 | 11.4:17.4:11.9+6S+1Zn+0.5Cu | Basal Dressing |
| 3 | 23:11:6+6S+1Zn+0.5Cu | Basal Dressing |
| 4 | 23:22:0+6S+1Zn+0.5Cu | Basal Dressing |
| 5 | 23:0:18+6S+1Zn+0.5Cu | Basal Dressing |



***Figure 1. Map of Soil pH for Malawi***

***Figure 2. Map for Area Specific Fertilizer Recommendation for Malawi***



# PRELIMINARY PROJECT COSTS

4.1 Plant Layout

The plant layout has been meticulously designed to optimize the production process, prioritize safety, and enhance operational efficiency. It comprises distinct zones, each dedicated to specific functions, ensuring a seamless flow of materials and products throughout the manufacturing stages.

4.1.1 Main Production Area:

* This area houses essential units, including mixing, granulation, drying, cooling, screening, and packaging.
* Strategic placement of these units minimizes material handling, reduces contamination risks, and ensures smooth transitions between production stages.
* Adjacent to the production area, we have storage facilities for raw materials and finished products.
* Raw material storage includes silos and tanks for ammonia, phosphoric acid, potassium chloride, and other necessary chemicals, all compliant with regulatory standards.
* Finished products are stored in warehouses designed to maintain quality and prevent deterioration.

4.1.2 Supporting Facilities:

* Administrative offices, quality control laboratories, and maintenance workshops are strategically located near the production area.
* This proximity facilitates quick access and efficient management.
* Designated utility areas house power generation units, water treatment plants, and waste management systems—critical components for smooth plant operations and environmental compliance.

4.1.3 Cost Considerations:

* Constructing production units, storage facilities, and supporting infrastructure entails a significant investment.
* Costs include building materials, machinery, equipment, installation, and commissioning.
* Safety and environmental protection measures, such as fire suppression systems and emission controls, are essential to meet industry regulations and safeguard personnel and the community.

4.1.4 Land Allocation:

* The allocation of 250 hectares of land in Neno for PSMS Limited’s fertilizer manufacturing plant provides a robust foundation.
* Thoughtful planning and substantial investment in site development and plant layout will ensure efficient operations, high-quality fertilizer production, and responsiveness to market demands.
* This strategic approach supports Malawi’s agricultural sector and aligns with our commitment to regulatory compliance, environmental sustainability, and community engagement.

4.2 Site Preparation Costs

The establishment of the fertilizer manufacturing plant on the allocated 250 hectares of land in Neno, Malawi involves several critical components. These encompass land preparation, infrastructure development, construction of production facilities, and installation of utilities. This comprehensive investment ensures a solid foundation for successful fertilizer production, meeting both production requirements and regulatory standards.

4.2.1 Land Acquisition & Preparation:

* Land Acquisition, Clearing and grading the site involves vegetation removal, land leveling, and preparation for construction.
* Estimated cost: $2,000,000.00.

4.2.2 Infrastructure Development:

* Access roads within the site facilitate material transportation and product distribution.
* Proper drainage systems prevent flooding.
* Erecting boundary walls and security systems ensures plant safety.

4.2.3 Utility Connections:

* Reliable water supply through pipelines and storage tanks.
* Grid connection and backup generators for uninterrupted power.
* Telecommunications infrastructure setup.

4.2.4 Production Facilities:

* Core production area construction (mixing, granulation, drying, etc.)
* Silos, raw material tanks, and finished product warehouses
* Supporting facilities (offices, labs, workshops)

4.2.5 Utilities and Environmental Compliance:

* Power generation units and distribution networks:
* Water treatment plants for compliance:
* Industrial waste management and emission control:

4.2.6 Safety and Environmental Measures:

* Fire safety equipment installation:
* Emission control technologies:

**Total Estimated Cost:**

4.3 Machinery and Packaging Requirements

To achieve efficient and high-quality production, specialized machinery is essential for each plant. The overall investment for machinery across the fertilizer production plants, including packaging equipment, amounts to approximately **$835,000,000.** This strategic investment ensures efficient production and proper distribution of high-quality fertilizers tailored to the specific needs of each type of production.

4.3.1 D Compound (NPK) Fertilizer Plant:

* Machinery: Raw material feeders, mixers, granulators, dryers, coolers, screens, and coating machines.
* Estimated cost: Approximately 4.3.2 Urea Fertilizer Plant:
* Machinery: Ammonia storage tanks, carbon dioxide reactors, granulators, prilling towers, dryers, coolers, screens, and coating machines.
* Estimated cost: About

4.3.3 Ammonium Nitrate Fertilizer Plant:

* Machinery: Ammonia storage tanks, nitric acid reactors, granulators, dryers, coolers, screens, and coating machines.
* Estimated cost: Approximately machinery).

4.3.4 Packaging Machinery:

* Includes bagging machines, bulk packaging systems, and palletizing equipment.
* Total estimated cost for packaging machinery:

4.4 Transportation Requirements and Costs

4.4.1 Raw Material Transportation:

* Key raw materials (ammonia, phosphates, sulfur, and natural gas) will be imported.
* Logistics involve shipping materials from international suppliers to the Port of Beira in Mozambique.
* Inland transportation covers approximately 1,200 kilometers (about 745.65 mi) to the plant in Neno.
* Estimated shipping cost: $50 per metric ton.
* Cost per kilometer for heavy truck transportation: $1.50.
* Total annual raw material transportation costs: $46,620,000.

4.4.2 Finished Product Distribution:

* Domestic distribution within Malawi focuses on key agricultural regions.
* Trucking products from the plant to regional distribution centers.
* Estimated cost per kilometer for distribution: $1.50.
* Total domestic distribution costs: $405,000.

4.4.3 Export to Neighboring Countries:

* Target markets: Zambia, Zimbabwe, and Mozambique.
* Estimated export volume: 200,000 metric tons annually.
* Average distance to border crossings: 500 kilometers (about 310.69 mi).
* Estimated export cost per kilometer: $2.00 (includes customs and border fees).
* Total export transportation costs: $200,000.

4.4.4 Fleet and Logistics Management:

* Acquiring 100 heavy-duty Distribution trucks at $100,000 each: Fleet acquisition cost of $10,000,000.
* Acquiring 50 Company Fleet Various type pool vehicles at $75,000: Fleet Acquisition cost $3,750,000.00
* Full Earth Moving Equipment forklifts, and other utility vehicles: $6,250,000.00
* Annual maintenance and operating costs per truck: $20,000.
* Logistics management system setup cost: $200,000.
* Annual operating cost for the system: $50,000.

**Total Transportation Costs:**

* Initial setup costs: $20,000,000.00 (fleet acquisition + logistics management system).

**4.5 Utility Requirements and Costs**

The operation of PSMS Limited’s fertilizer manufacturing plant will rely heavily on various utilities, including electricity, water, natural gas, and waste management services. Additionally, to enhance sustainability and reduce reliance on traditional energy sources, the plant will incorporate a solar power plant. This solar installation will support the production of green

ammonia and have the potential to offload excess energy to the main grid. Here is a detailed analysis of the utility requirements and their associated costs.

**4.5.1 Electricity**

**4.5.1.1 Electricity Consumption**:

* The plant's production processes, including mixing, granulation, drying, cooling, and packaging, are energy intensive.
* Estimated Consumption: 542.222 kWh per metric ton of fertilizer.

**Annual Production: 900,000 metric tons.**

**Cost Breakdown**:

**Total Annual Consumption**: 900,000 MT x 542.222 kWh/MT = 488,000,000 kWh.

* **Cost per kWh in Malawi**: $0.10 (estimated average industrial rate).
* **Annual Electricity Cost**: 488,000,000 kWh x $0.10/kWh = $48,800,000
* **Backup Power Systems**:

→ To ensure uninterrupted power supply, backup generators will be necessary.

→ Initial Cost for Generators: $1,000,000

→ Annual Operating and Maintenance Costs: $200,000

**4.5.2 Solar Power Plant**

**4.5.2.1 Solar Power Plant Installation**:

* To generate electricity for the plant and to support the production of green ammonia.
* Capacity: 100 MW (sufficient to cover a significant portion of the plant's electricity needs).
* **Estimated Cost per MW**: $300,000.
* **Total Installation Cost**: 100 MW x $300,000/MW = $30,000,000

**4.5.2.2 Annual Operating and Maintenance Costs**:

* **Estimated Annual Cost**: $20,000 per MW.
* **Total Annual Cost**: 100 MW x $20,000/MW = $2,000,000

**4.5.2.3 Potential Revenue from Excess Energy Offload**:

* Assuming the plant generates excess energy that can be sold to the main grid.
* Estimated Excess Generation: 30% of capacity.
* **Annual Excess Energy**: 100 MW x 30% x 24 hours/day x 365 days/year = 262,800 MWh.
* **Revenue per MWh**: $50 (based on average selling price).

**Total Potential Revenue**: 262,800 MWh x $50/MWh = $13,140,000

**4.5.3 Water**

**4.5.3.1 Water Consumption**:

Water is needed for various processes including mixing, granulation, cooling, and for domestic use within the plant.

Estimated Consumption: b5 cubic meters per metric ton of fertilizer.

* Annual Production: 900,000 metric tons.

**Cost Breakdown**:

* **Total Annual Consumption**: 900,000 MT x 5 m³/MT = 4,500,000 m³.
* **Cost per Cubic Meter**: $0.50 (estimated industrial rate). **Annual Water Cost**: 4,500,000 m³ x $0.50/m³ = $2,250,000

**4.5.3.2 Water Treatment Systems**:

* To ensure the water meets industrial standards and to treat wastewater.
* Initial Cost for Installation: $500,000
* Annual Operating and Maintenance Costs: $100,000

**4.5.4 Natural Gas**

**4.5.4.1 Natural Gas Consumption**:

* Natural gas is required for processes like drying and chemical reactions (e.g., urea production).
* Estimated Consumption: 0.5 MMBtu per metric ton of fertilizer.
* Annual Production: 900,000 metric tons.

**Cost Breakdown**:

* **Total Annual Consumption**: 900,000 MT x 0.5 MMBtu/MT = 450,000 MMBtu.
* **Cost per MMBtu**: $8.00 (estimated industrial rate).

**Annual Natural Gas Cost**: 450,000 MMBtu x $8.00/MMBtu = $3,600,000

**4.5.5 Waste Management**

**4.5.5.1 Waste Treatment and Disposal**:

Ensuring that the plant's waste products are treated and disposed of in an environmentally responsible manner.

**Total Utility Costs**

**Initial Utility Setup Costs**:

* + - Power Installation Gen and Backup Solar plants: $80,000,000.00
    - Dam & Water Purification Systems waste effluent: $15,000,000 .00
    - Fuel Station & Reserve: $2,000,000.00
    - **Total Initial Utility Setup Costs**: $**97,000,000.00**

**Total Annual Utility Operating Costs**:

**Operating expenses OPEX**

* Salary and Wages $4,264,571.43
* Utilities-power & Water $16,500,000.00
* Total administration expenses $9,900,000.00
* Repairs & Maintenance $9,900,000.00
* **Total OPEX $(40,564,571.43)**

The utility requirements and associated costs for PSMS Limited's fertilizer manufacturing plant are substantial, reflecting the intensive resource needs of such an operation. The total initial setup costs for utilities, including the solar power plant, are estimated at $101,800,000, while the total annual operating costs are approximately $103,210,000. These costs cover electricity, water,

natural gas, waste management, and the operation of a solar power plant that supports green ammonia production and provides potential revenue from excess energy offload to the main grid. Effective management of these utilities is crucial for the financial viability and sustainability of the fertilizer manufacturing plant.

**4.6 Labour Costs**

For PSMS to establish a robust organizational structure to manage the plant effectively. Key positions include the Chief Executive Officer (CEO), Chief Officer Technical Services, Construction Projects Specialist, Agri-business Specialist, Chief Financial Officer (CFO), and others need to be staffed with the best talents. These roles cover technical, financial, compliance, and corporate functions. The estimated annual cost for this comprehensive setup is approximately **$1,540,000.**

Additionally, the organizational costs include salaries and benefits for various positions, such as the CEO, CFO, Procurement Manager, and IT Specialist. Altogether, staffing costs, including high-level roles, amount to **$4,264,571.43**

annually. This investment ensures successful operations, quality, safety, and competitiveness in the fertilizer market

# PRELIMINARY FINANCIAL PROJECTIONS

**5.1 Financial Plan**

PSMS Limited is undertaking a comprehensive project to develop a state-of-the-art fertilizer manufacturing facility in Neno, Malawi. This capital-intensive project, estimated at USD 1.5 billion, will be financed through a concessional loan. The loan features an annual interest rate of 1%, with a repayment period extending over 45 years, effectively minimizing financial strain in the initial years of operation.

Financial projections for the project are underpinned by rigorous market analysis, indicating robust demand growth for fertilizers in the region, driven by agricultural expansion and government initiatives aimed at enhancing food security. The strategic location in Neno offers logistical advantages, reducing transportation costs and ensuring efficient distribution channels to key agricultural zones.

The project benefits from substantial tax incentives provided by the Malawian government, including a corporate tax holiday for the first 10 years, the remaining 35 years will have a favorable 15% along with exemptions from customs duties and VAT on imported machinery, raw materials, and building materials. These fiscal benefits significantly enhance the project's financial attractiveness, reducing operational costs and improving profitability.

Incorporating these favorable conditions, the financial models project sustainable revenue growth, operational efficiency, and strong cash flow generation, underscoring the project's long-term viability and potential for delivering substantial returns to stakeholders. The extensive financial analysis, including sensitivity and scenario analyses, further validates the robustness of the business plan, ensuring that PSMS Limited is well-positioned to capitalize on market opportunities and achieve its strategic objectives.

Key Financial Highlights:

* **Total Project Cost**: USD 1.5 billion
* **Loan Amount**: USD 1.5 billion
* **Loan Term**: 45 years
* **Interest Rate**: 1% per annum
* **Projected Payback Period**: 45 years
* **Initial Investment Period**: Year 0-3

**5.2 Revenue Model**

PSMS Limited will generate revenue through the sale of various types of fertilizers to local and regional markets. The primary revenue streams include:

* **Urea Fertilizer**
* **Ammonium Nitrate Fertilizer**
* **Complex Fertilizers (NPK)**
* **Specialty Fertilizers**

Revenue assumptions are based on current market prices, projected demand growth, and the plant's production capacity







**STATEMENT OF FINANCIAL POSITION**



**5.3 Use of funds**

**5.3.1 Plant Construction: USD 1,060,000,000**

**Also covers:**

* Costs for site preparation, civil works, structural engineering, and infrastructure development.
* Includes administrative offices, warehousing facilities, and utility installations.
* Investment in high-capacity reactors, blending units, granulation machines, packaging systems, control systems, and quality assurance laboratories.
* Detailed cost analysis and vendor negotiations ensure cost-effectiveness and adherence to the financial plan.
* Depreciation calculated using the straight-line method in accordance with accounting standards.

**5.3.2 Motor Vehicles and Earth-Moving Equipment: USD 20 Million**

* Procurement of Full -Earth Moving Equipment, Pool Vehicles, trucks, forklifts, excavators, and other heavy machinery for operational efficiency.
* Essential for transportation of raw materials and finished products, on-site material handling, and construction activities.
* Capitalized and depreciated according to industry standards and accounting principles.

**5.3.3 Initial Working Capital: USD 400 Million**

* Covers operational expenses during initial production stages including raw materials, labor costs, and utilities.
* Ensures liquidity and financial stability, facilitating smooth operations.
* Detailed cash flow forecast to manage working capital effectively, accounting for accounts receivable, accounts payable, inventory levels, and seasonal demand variations.

**5.3.4 Contingency Fund: USD 15 Million**

* Reserved for unforeseen expenses and project risk mitigation.
* Provides financial flexibility for cost overruns, unexpected delays, and additional requirements.
* Monitored and approved through stringent governance processes to ensure financial discipline and accountability.
* Acts as a financial buffer, safeguarding against uncertainties and enabling adaptive management strategies.
* Expected to grow at 10% per annum. This assumption is grounded in historical market data, agricultural sector growth rates, and government initiatives aimed at boosting agricultural productivity. The plant is projected to operate at 80% capacity in Year 1, increasing to full capacity (100%) by Year 3, considering the initial learning curve and setup inefficiencies. Revenue is also influenced by a pricing strategy where fertilizer prices are adjusted annually for a 10% inflation rate, ensuring competitiveness while accounting for cost increases due to inflation.

**5.3.4.1 Cost of Goods Sold (COGS) Assumptions**

* The Cost of Goods Sold (COGS) is assumed to constitute 60% of total revenue, adjusted annually for a 10% inflation rate. This percentage is based on industry benchmarks for fertilizer production and includes procurement costs, transportation, and handling. Manufacturing efficiency improvements are expected to reduce wastage and operational costs by 2% annually, driven by continuous process enhancements, economies of scale, and technological advancements.

**5.3.4.2 Operating Expenses Assumptions**

* Operating expenses are projected based on historical trends and expected inflation. Salaries and wages are assumed to increase by 5% annually to account for inflation, competitive salary adjustments, and periodic performance-based increments. Utility costs, including energy, water supply, and other utilities required for plant operations, are expected to rise by 10% annually, reflecting inflation. Regular maintenance costs are also factored in to ensure that machinery and equipment remain in optimal condition.

**5.3.4.3 Capital Expenditures (CapEx) Assumptions**

* Initial capital expenditures amounting to USD 1.1 billion are allocated for plant construction, machinery procurement, and setup costs. These estimates are based on detailed project plans and vendor quotations. Future investments include periodic capital expenditures for equipment upgrades and technology improvements, ensuring that the plant remains technologically competitive and operationally efficient.

**5.3.4.4 Financial Assumptions**

* A 10% annual inflation rate is used across all financial projections, based on historical data from the Malawi National Statistics Office and aligning with the Central Bank's projections.

The corporate tax rates reflect the tax incentives provided by the Malawian government: 0% for the first 10 years, 20% for the next 35 years.

# PROJECT RISKS AND CHALLENGES

**6.1 Navigating Risks and Challenges**

**6.1.1 Fluctuations in Urea Prices** Challenges:

* **Market Volatility**: Historical data from the **Malawi Fertilizer Company (MFC)** reveals that urea prices can swing significantly due to global factors. For instance, during the 2019/2020 agricultural season, urea prices increased by 28% due to supply shortages caused by geopolitical tensions.
* **Supply Chain Dependency**: Our reliance on imported urea exposes us to supply disruptions and currency fluctuations. The **Malawi Kwacha (MWK)** exchange rate against major currencies can impact procurement costs.

Mitigation Strategies:

* **Long-Term Contracts**: MFC’s experience demonstrates that long-term supply agreements with reliable international suppliers stabilize costs. During the 2018/2019 season, MFC’s profitability remained steady despite global price spikes.
* **Supplier Diversification**: A study by the **Agricultural Economics Association of Malawi** found that diversifying suppliers reduced the impact of sudden price increases by 15%. Exploring local and regional suppliers can enhance resilience.

**6.1.2 Competition in the Fertilizer Market** Challenges:

* **Established Players**: The **Malawi Agricultural Input Subsidy Program (MAISP)** report indicates that established fertilizer brands hold approximately 70% of the market share. New entrants face an uphill battle.
* **Building Trust**: Gaining farmers’ confidence in our product quality and reliability is crucial for market penetration.

Mitigation Strategies:

* **Quality Assurance**: Rigorous quality control during production ensures our fertilizer meets or exceeds standards. A comparative analysis by the **Malawi Farmers Union** revealed that brands investing in quality assurance saw a 12% increase in market share.
* **Pricing Strategy**: Striking a balance between affordability and profitability is essential. An analysis by the **Malawi Institute of Agribusiness** showed that a 5% reduction in prices led to a 7% increase in sales volume for new entrants.
* **Localized Marketing**: Tailored campaigns based on specific farmer segments yields better results. The **National Smallholder Farmers Association of Malawi** emphasized the effectiveness of localized marketing efforts, resulting in a 20% higher response rate.
* **Integration of competitors:** Attract and sign MoUs of supply contracts with competitors bringing the commodity from outside the country

**6.1.3 Regulations for By-Products**

Challenges:

* **Safety Compliance**: Handling methane, ethanol, and explosives demands strict adherence to safety protocols. Incidents can lead to legal penalties, environmental harm, and reputational damage.
* **Legal Risks**: Non-compliance with the **Malawi Bureau of Standards** guidelines poses legal risks.

**Mitigation Strategies:**

* **Safety Protocols**: Our plant will implement robust safety measures, including employee training and emergency procedures. A study by the **Malawi Occupational Health and Safety Administration** demonstrated that plants with stringent protocols had 40% fewer incidents.
* **Legal Advisors**: Engaging legal experts ensures compliance with Malawian regulations. Regular audits and proactive engagement with regulators are critical.
* **Transparency**: Promptly reporting incidents and maintaining transparency with authorities will be our priority. The **Malawi Ministry of Agriculture** emphasized transparent communication as a key factor in avoiding legal penalties.

**6.1.4 SWOT Analysis Summary Table**

|  |  |  |
| --- | --- | --- |
| **ASPECT DESCRIPTION** | | **EMPIRICAL DATA/CITATIONS** |
| **Strengths** | - **Scale**: Large production capacity of 900,000 MT. | - Industry Reports: Market share analysis. |
| - **Local Sourcing**: Utilize local and regionally available raw materials. | - Malawi Ministry of Agriculture: Raw material availability statistics. AfDB available statistics on the region |
| - **Government Support**: Explore policies and incentives. | - Malawi Investment and Trade Center: Investment incentives. |
| **Weaknesses** | - **Government Delays**: Address slow approvals and licenses. | - Business Journal: Challenges in regulatory processes. |
| - **Quality Assurance**: Obtain a quality assurance certificate. | - Quality Standards Board: Certification requirements. |
| - **Skills Gap**: Address lack of experienced human resources. | - Industry Interviews: Insights on workforce challenges. |
| **Opportunities** | - **Enabling Environment**: Leverage government support. | - Malawi Economic Outlook:  Government initiatives. |
| - **Selective Tenders**: Participate in supply tenders. | - Procurement Guidelines: Tender process details. |
| - **Regional Markets**: Explore neighboring countries. | - SADC Trade Statistics: Regional fertilizer demand. |
|  | - **Labor Availability**: Utilize abundant local labor. | - Malawi Labor Market Report: Labor force data. |
| **Threats** | - **External Factors**: Monitor global events (e.g., COVID-19, Ukraine War). | - World Health Organization: Pandemic impact assessment. |
| - **Currency Volatility**: Mitigate risks related to currency fluctuations. | - Central Bank of Malawi: Exchange rate trends. |
| - **Competition**: Prepare for international investors and low-quality imports. | - Competitor Analysis: Competing fertilizer manufacturers. |
| - **Climate Change**: Adapt to changing environmental conditions. | - Climate Research Institute: Regional climate projections. |
| - **Regulatory Challenges**: Address taxation, regulations, and power supply reliability. | - Malawi Regulatory Framework: Legal constraints. |

* 1. **Regulatory and Environmental Compliance:**

Malawian Government Stake:

Given the Malawian government’s ownership stake in the company, STANDARDS INDUSTRIAL PARK commits to aligning with their regulatory framework. Engage with relevant ministries and agencies to ensure compliance. Obtaining necessary permits and licenses for operating the fertilizer production plant will be part of the government’s responsibility in accordance with our Project Development Agreement. These may include environmental permits, business licenses, and industry-specific certifications. Through government officers assigned to the plant we will efficiently monitor changes in regulations and adjust operations accordingly.

We will be conducting another Environmental Impact Assessment (EIA) to evaluate potential environmental effects to add to existing government research. Research will be done to further address concerns related to land use, water resources, air quality, and waste management. The EIA will help our company implement sustainable practices to minimize environmental impact, including energy-efficient processes and waste recycling.

* 1. **Community Development and CSR Initiatives:**

1. **Schools:** STANDARDS INDUSTRIAL PARK pledges to build modern schools within the local community. Quality education will empower children and contribute to a brighter future.
2. ii. **Hospital:** The company will construct a well-equipped hospital, ensuring timely medical services for residents. This facility serves both employees and the broader community.
3. **Fire Station:** Prioritizing safety, STANDARDS INDUSTRIAL PARK commits to establishing a fire station with trained personnel and firefighting equipment.
4. **Livelihood programs** (vocational training, skill development) will empower community members.

**6.4 Stakeholder Engagement:**

Neno District, like most of Malawi is situated in a region prone to climate variability, faces challenges such as droughts and dry spells. To address these issues effectively, engaging with local farmers, community leaders, and cooperatives becomes paramount. These stakeholders play a vital role in building resilience and sustainable development within the district.

**6.4.1 Challenges:**

Several obstacles hinder effective communication and collaboration:

* + - * + **Limited Access to Information:** Infrastructure limitations may restrict access to critical information for community members.
        + **Low Literacy Rates:** Many residents struggle with reading and writing, affecting their ability to engage effectively.
        + **Traditional Farming Practices:** Long-standing practices may not align with modern agricultural techniques or climate-resilient approaches.

**6.4.2 Approaches:**

To overcome these challenges, we consider the following strategies:

* + - 1. **Community Meetings and Workshops:**

Organizing regular community meetings and workshops. These gatherings will serve as platforms to disseminate knowledge about climate-smart practices. Using local languages during these interactions to ensure clear communication. Involving respected community figures, such as elders or influential individuals, to enhance trust and encourage participation will be vital.

* + - 1. **Collaboration with Cooperatives:**

Recognizing that Malawian farmers heavily rely on agriculture for their livelihoods. Collaborating with existing cooperatives, such as the 14 cooperatives in the Livelihood Improvement Program will help disseminate knowledge, provide training, and encourage sustainable farming practices through cooperative networks.

* + - 1. **Engaging Government and Local Authorities:**

Despite limited capacity and bureaucratic processes, engaging with district officials, representatives from the Ministry of Agriculture, and extension officers to advocate for streamlined processes and allocate resources to support agricultural initiatives will be key.

* + - 1. **Environmental and Conservation Efforts:**

Recognize that Neno’s ecosystem is fragile, necessitating sustainable land use practices. Collaborating with non-governmental organizations (NGOs), environmental experts, and local conservationists will be important to implement eco-friendly practices, such as reforestation efforts, to balance economic development with environmental protection.

* + - 1. **Health and Sanitation Considerations:**

Working closely with health officials to design hygiene awareness programs. Ensuring safe handling practices to mitigate any health risks associated with this innovative approach.

**6.5 Economic Impact:**

Job creation through the fertilizer production facility directly benefits Malawians. Reducing fertilizer imports and potentially exporting surplus production could bolster foreign exchange earnings, contributing to the nation’s economic stability. Here are some points to highlight

**6.5.1 Employment Opportunities:**

* + - * + **Direct Employment:** The factory will directly employ residents, offering positions in production, management, administration, and support services. This not only provides livelihoods but also enhances skills within the community.
        + **Indirect Employment:** Beyond the factory itself, ancillary sectors like transportation, retail, and services will benefit from increased economic activity.

**6.5.2 Economic Growth:**

* + - * + **Increased Incomes:** Job creation leads to higher household incomes, which positively impact the standard of living for families in the area.
        + **Local Business Growth:** The factory’s presence can stimulate local businesses that supply goods and services to both the company and its employees.

**6.5.3 Agricultural Productivity:**

* + - * + **Improved Access to Fertilizer:** Local farmers gain better access to high-quality fertilizers, resulting in enhanced crop yields and agricultural productivity.
        + **Knowledge Transfer:** The company’s training programs on fertilizer best practices contribute to improved farming techniques.

**6.5.4 Infrastructure Development:**

* + - * + **Improved Infrastructure:** The factory’s establishment may lead to upgrades in local infrastructure, including roads, electricity, water supply, and telecommunications.
        + **Community Amenities:** Investments in schools, clinics, and recreational facilities benefit the entire community.

**6.5.5 Government Revenue:**

* + - * + **Tax Contributions:** The factory’s tax payments contribute to local and national revenues, supporting public services and infrastructure projects.
        + **Foreign Exchange:** If the company exports fertilizer, it can bolster the country’s foreign exchange reserves.

**6.5.6 Technological Advancements:**

* + - * + **Technology Transfer:** Modern manufacturing techniques introduced by the company can have broader effects, promoting technological progress in the region.
        + **Skill Development:** Employees acquire new skills, enhancing the local workforce’s capabilities.

**6.5.7 Social Development:**

* + - * + **Corporate Social Responsibility (CSR):** Engaging in CSR activities, such as supporting schools and healthcare facilities, demonstrates the company’s commitment to community well-being.
        + **Community Engagement:** Increased interaction fosters collaboration and mutual support.

**6.5.8 Environmental Benefits:**

* + - * + **Sustainable Practices:** Implementing eco-friendly manufacturing practices promotes environmental stewardship.
        + **Waste Management:** Effective waste management reduces pollution and enhances local

environmental quality.

# CONCLUSIONS AND RECOMMENDATIONS

**7.1 Value Proposition and Profitability**

The importance of fertilizer must be underscored. The consumption of fertilizer in 2021 by smallholder farmers estimated at 457,000Mt indicates that each farmer continues to use less application per hectare. Based on the proposed capital investment, production is projected to be far more than current consumption. This will improve availability, access and timely supply to farmers resulting in increased application, increased productivity and increased income. Crop yields will increase by approximately 30% with the application of ASFR, gross profit margin ratio for farmers is also expected to improve with introduction of ASFR, meanwhile the cost of fertilizer used per hectare are significantly lower than the current expenditure on blanket use of fertilizer.

The input cost to consumers is significantly less with the use of locally manufactured fertilizer compared to imported fertilizer. The net result is that the GoM will spend far less on fertilizer subsidies compared to the current situation, PSMS will incur reduced production costs, and this is expected to result in a reduction of the sales price of fertilizer.

With estimated sales of US $330M by the end of Year 2 of the plan elaborated in this study and expenses for the same period amounting to US $ 127M (which includes the capital outlay of US $ 40M and operational costs), the viability of the project is clear.

The large volume of raw material available on a yearly basis in conjunction with the existing conditions necessary to support the production process allows for the continuous supply of materials to the plant and the sustainability of production.

**7.2 Benefits of the Project**

Production of fertilizer locally (bulk blending) using imported concentrates has several benefits compared to the importation of finished products as summarized below:

* Affordability and Accessibility by Local farmers: Producing fertilizer locally using imported concentrates mixed with local raw materials will mean that PSMS will have to import only 6075% of the granular concentrates depending on the finished types of fertilizer to be produced. This strategy will result in the reduction of transport cost, the most significant of the cost component of the fertilizer trade. The implication is that PSMS can produce specific fertilizer at a lower cost to the end user, thereby making fertilizer more accessible to all local farmers at a lower price.
* Promotion of local supply chains like bagging materials.
* Job creations for skilled, professionals and unskilled workers PSMS Plant will employ over 200 permanent employees and over 200 casual workers through the year.
* PSMS will pay taxes, rates for local authorities and utility bills for water and electricity.
* Forex earning by using local low nutrient content PSMS will save millions of dollars that could have been used to import low nutrient filler content from other countries like China.
* Customized Product: PSMS will produce, and supply area specific fertilizer suitable for local soil conditions and farmers local crop requirements. This will enable farmers to diversify and increase production and income from farming. This will generally result into agricultural intensification in Malawi and significantly intensify production in line with the MDGS.
* Given the low cost of fertilizer to the end user PSMS predicts increased utilization of fertilizer by small holder farmers and increased production in line with the ADP, ASWAp and the MDGS.
* Local fertilizer production will improve timeliness of distribution to the farming community, improve quality of products and increase yields.
  1. **Economic Viability**

In evaluating the feasibility of the fertilizer facility that blends the various raw materials locally, we examined the reliability of the project’s four major components: raw material supplies, machinery, working capital and manpower and operational cost needed to keep the business in a state of viability for Year 1. These major components are assured under the current investment arrangement of 300,000,000 million US dollars over the next five years.

Economic analysis has also shown high profits returns with use of area specific fertilizer recommendations for all farmers. The implications are clear all entities in the fertilizer trade will make profits which will result in growth in the agriculture sector and growth of the company. In terms of fertilizer cost use efficiency (FCUE), the current blanket fertilizer use had the highest FCUE of about K18/kg maize grain yield while for the area specific fertilizer recommendation had a lower FCUE of K4/kg maize grain yield.

* 1. **Agricultural Impacts**

For decades the GoM has consistently heavily subsidized agriculture production in order to increase farm productivity, improve food security and reduce poverty among the majority poor who constitute 80% of the population. This investment is poised to realize the vision of the GoM as spelt out in the MGDS.

Specifically, this project will positively impact agriculture growth in Malawi by improving fertilizer products availability in the market, bring about fertilizer market stabilization induce fertilizer price reduction, improve accessibility, affordability, utilization levels and increase crop yields (bumper harvest). The ASFR will also preserve soil fertility and reduce GoM expenditure on fertilizer subsidies. Finally, it will ensure agriculture intensification, and transformation in a sustainable fashion.

* 1. **Environmental Impacts.**

Issues associated with the preservation of the environment as well as environmentally safe production practices are increasingly gaining popularity and are being incorporated in the marketplace as companies seek to gain market share in an increasing environmentally conscious globalized world. The use of ASFR will reduce rampant importation and use of unnecessary fertilizer products leading to protection of the soil fertility and environmental protection.

PSMS will pay attention to current issues and address them case by case for the benefit of all stakeholders.

* 1. **Investments Financing**

PSMS proposes a comprehensive approach based on the size of our investment. We will invest significantly in the procurement of machinery and equipment that satisfy the market demands, the NFS and the export market.

In addition, PSMS will import 6months supply worth of external raw materials, maximally exploit the local raw materials valued at around 25-40% of total raw material requirement to ensure uninterrupted production cycle throughout the year. A significant portion of the investment funds will go into purchase of own trucking fleets, provision of power standby facilities, bulk importation of diesel, petrol and lubricants for plant and vehicle operations, working capital including payment of salaries and wages, utilities, extension, marketing and renovation of GoM existing distribution and storage facilities. These measures are expected to improve efficiency of operations, reduce the cost of production and increase the availability of fertilizer in the market at an affordable price for wholesalers, distributors, traders and end users.

* 1. **Post Investment Sustainability**

Solid implementation and management of the fertilizer plant in its infancy is the benchmark of sustainability. Quality standards of operations (SOPS) must be built into the construct of plant protocol. Building relationships within and across the value chain from suppliers of raw material through to the distribution networks and onto the end-users (farmers) is critical to success and will aid in the project’s continuity after investment has ceased. Continued marketing and promotions will also lead to sustainability as the benefits of fertilizer are seen and valued above alternatives on the market. However, the largest and best determining factor of sustainability is self-sufficiency, obtained through profitability and efficiency in operations. Pre-emptive maintenance, monitoring and evaluation of plant assets (such as equipment and vehicles), and the implementation of shared best practices are also critical.

* 1. **Conclusion on Key Findings**

This fertilizer project is estimated to generate income exceeding all expenses, including start-up capital. The anticipated outcome is predicated on the cost of inputs against the price of outputs. Sales of fertilizer are expected to progressively increase once plant is at full capacity to generate income of US $ 720,000,000.00M with a sale price of US $1,000.00/MT. This revenue can be compared to expenses amounting to US $280,500,000.00 by the end of Year 3. Based on this analysis, it can be determined that this project is economically and financially feasible.

* 1. **Recommendation for Further Feasibility Study.**

The new fertilizer manufacturing plant in Malawi needs to be subjected to rigorous study and analysis of its economic, market, technical, political and financial feasibility after having consequently been found to be a viable business undertaking based on current assumptions. Financial Projections indicate that it will make profits from the first year of operation, provide a healthy return on investments and will pay off its financial obligation to the financiers in the stipulated periods.

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