LITERATURE REVIEW ON PRODUCT SPECIFICATIONS FOR INORGANIC FERTILIZERS

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Executive Summary

Inorganic fertilizer usage in the Philippines saw a remarkable surge, increasing by 1,000% between 1961 to 2004 (Magcale-Macandog et al., 2016). In 2021, the Philippines ranked as the 29th largest importer of mixed mineral or chemical fertilizers with imports valued at $254 million. As an exporter in 2021, the Philippines stood as the 69th largest globally, exporting mixed mineral or chemical fertilizers with imports valued at $12.5 million (Observatory of Economic Complexity [OEC], n.d.). The data suggested that the Philippines is highly dependent on inorganic fertilizers to produce its food, and that the Philippines is heavily reliant on imported inorganic fertilizers.

Globally, synthetic fertilizers are behind the bulk of global food production and their significance is particularly pronounced in developing countries (United Nations Environment Programme [UNEP], 2020). The Green Revolution Program in 1960 marked the beginning of intensive application of inorganic fertilizers in farming in the Philippines that resulted in a significant increase in inorganic fertilizer usage (Magcale-Macandog et al., 2016). In 1973, Masagana 99 program of the Philippine government was developed as an emergency agricultural program with the aim of solving the severe rice shortage due to pests and natural disasters occurring at the time (Peralta, 2020). The package of technology promoted under Masagana 99 included low-cost inorganic fertilizers, subsidized credit, among others. This further increased the use of inorganic fertilizers in the Philippines.

With the increasing use of inorganic fertilizers, countries developed specifications for various fertilizers (Food and Agriculture Organization [FAO], n.d.). Specifications in inorganic fertilizers are essential for both international and domestic trade because the pricing of specific fertilizer types can vary based on the desired quality and specifications (FAO, n.d.). Specifications for inorganic fertilizers serve as essential guidelines for identifying fake and non-conforming fertilizers as provided in regulations (Thailand, 2012; Viet Nam, 2019). Additionally, nutrient specifications also serve as basis for determining and addressing adulteration and deliberate production of low-quality fertilizers (Central Fertilizers Quality Control & Training Institute [CFQCTI], 2023).

Presidential Decree (PD) No. 1144 was promulgated on May 30, 1977 creating the Fertilizer and Pesticide Authority (FPA) as an attached agency of the Department of Agriculture (DA). One of the functions of the DA-FPA is to establish and implement regulations governing the import and export of fertilizer and fertilizer inputs. Another function of the DA-FPA is to regulate and control the quality of the different grades of [inorganic] fertilizers and set new grades when necessary.

The DA-FPA produced the Fertilizer Regulatory Policies and Implementing Guidelines, updated in 2020 (DA-FPA, 2020). This specifies that the DA-FPA use as reference the FAO Fertilizer Control Order (FCO) 1985 specifications as the minimum standards for registration particularly for traditional fertilizer products or the commonly used fertilizers (DA-FPA, 2020). Additional guidance tailored to the local context was identified as a necessary complement. As reported by DA-FPA, the Philippine National Standard (PNS) for Organic Soil Amendments v. 2016 has been used to support the Guidelines even in the case of inorganic fertilizers with low nutrient levels.

Presently, the DA-Bureau of Agriculture and Fisheries Standards (BAFS) has produced the PNS for Organic Fertilizers (PNS BAFS 40:2014) which was later replaced by PNS for Organic Soil Amendments (PNS/BAFS 183:2020) with expanded scope

There is, however, no corresponding PNS for inorganic fertilizers. Thus, in February, 2022 the DA FPA requested the DA-BAFS to establish a PNS for inorganic fertilizers, including specifications for primary macronutrients with low levels of macro-nutrients. The intention of DA-FPA is to use the PNS in inorganic fertilizers as DA-FPA's guidelines for accepting inorganic fertilizer product registration applications. By year end of 2022, this request was evaluated against the prioritization criteria established by DA-BAFS Standards Development Division (SDD). Based on the results of the evaluation, it was included in the work program for standards development and new work on the PNS for inorganic fertilizer was targeted to commence in the 2nd semester of 2026. In preparation for this new work, the DA-BAFS SDD requested the DA-BAFS Standards Research Division (SRD) to conduct a literature review to support the development of PNS on inorganic fertilizer in 2023.

This study aimed to provide secondary data on the product description, and quality and food safety specifications for inorganic fertilizers. More specifically, it aimed to characterize inorganic fertilizers and their primary macronutrient and heavy metal specifications based on existing international standards and standards from major producing countries and trading partners. The findings of this study will serve as input for the development of a PNS on inorganic fertilizers.

The key findings of the study are as follows:

1. Inorganic fertilizers, also called mineral, synthetic, chemical or conventional fertilizers, are nutrient rich fertilizers produced through industrial methods like chemical reaction, mineral extraction or mechanical grinding (FAO, 2019; UNEP et al., 2022). Inorganic fertilizers are either "straight" with one primary nutrient (N, P, or K), or "compound" with two or more primary nutrients (UNEP et al., 2022). Solid compound inorganic fertilizers are further divided into "mixed" (physically blended) fertilizers, and "complex" (chemically combined) fertilizers where all nutrients are in the same granule (UNEP et al., 2022);
2. The FAO, China, Indonesia, and India established primary macronutrient specifications for various inorganic fertilizers. Compared to the FAO, China's

specifications were in line with FAO specifications for 2 fertilizers, Indonesia for 6 and India for all 11 fertilizers. Nutrient specifications for inorganic fertilizers not considered by FAO provided by the three countries were as follows: China for 3, Indonesia for 1, and India for 22 fertilizers. The differences in the fertilizers with established minimum fertilizer specifications could be attributed to differences in government regulations (CIRS Group, 2021; India, 1985);

3. Certain standards stipulate minimum nutrient content requirements for inorganic fertilizers. In the context of Viet Nam, a minimum content of 18% was mandated for any straight fertilizer or for the total NPK of 2-3 elements of complex inorganic fertilizer (Vietnam, 2008). A minimum of 4% or less was established as the minimum primary macronutrient specification for fertilizers in the US (AAPFCO, 2023). The US employed the concept of using permissible thresholds on guaranteed analysis to define the minimum specifications for all fertilizers (AAPFCO, 2023) not found in other countries studied;
4. FAO, India, Indonesia, and Viet Nam have not set limits for heavy metals in inorganic fertilizers (FAO, n.d.; India, 1985; Indonesia, 2009; & Viet Nam, 2008, 2018 & 2019). Although extensive testing in the US showed that some phosphate, micronutrient and liming fertilizers contain elevated levels of arsenic, cadmium and lead, risk assessments by the US Environmental Protection Agency and others have concluded that the hazardous constituents in inorganic fertilizers generally do not pose risks to public health or the environment (Minnesota Department of Health, 2023); and
5. Organo-mineral fertilizers (OMF), a novel category of fertilizers, is a blend of inorganic and organic fertilizers (Bouhia, 2022; UNEP et al., 2022). They typically have lower primary macronutrient specifications compared to pure inorganic fertilizers and include organic carbon content. Some fertilizers registered by FPA as inorganic fertilizers show similar characteristics (DA-FPA, 2023). The European Union (EU) has established standards for OMF mandating a minimum total content of N, P2O5 and K2O of at least 8%, and organic carbon content of at least 7.5% (European Parliament and Council, 2019).

Based on the key findings, the following are recommended:

1. Consider adopting the description for inorganic fertilizers provided by FAO (2019) and UNEP et al. (2022);
2. Consider using the FAO fertilizer specifications as a benchmark when establishing primary macro nutrient specifications for fertilizers. The specifications are as found in Table 1 below:

Table 1.

Inorganic fertilizer product specifications (FAO, n.d.)

Fertilizer	Nutrient	Specification, (%)
Straight Nitrogenous Fertilizers		
1. Urea	N	46, Total (in free flowing & granular fertilizers)
2. Ammonium sulfate	N	20, Total
3. Calcium ammonium nitrate	N	26, Total
Straight Phosphorus Fertilizers		
4. Single superphosphate (powdered & granular)	P_2O_5	15.8, Water soluble
5. Triple superphosphate	P_2O_5	46, Total
Straight Potassium Fertilizers		
6. Potassium chloride or muriate of potash, granular	K_20	60, Water soluble
7. Potassium sulfate or sulfate of potash	K_20	50, as potash content
N-P Complex Fertilizers		
8. Diammonium phosphate 18-46-0	N	18, Total
	P_2O_5	46, Neutral ammonium citrate soluble
	P_2O_5	41, Water soluble
N-P-K Complex Fertilizers		

9. NPK Complex 15-15-15	N	15, Total
	P_2O_5	15, Ammonium citrate soluble
	P_2O_5	12, Water soluble
	K_20	12, Water soluble
Fertilizer	**Nutrient**	**Specification, (%)**
10. NPK Complex 17-17-17	N	17, Total
	P_2O_5	17, Ammonium citrate soluble
	P_2O_5	17, Water soluble
	K_20	17, Water soluble
11. NPK Complex 19-19-19	N	19, Total
	P_2O_5	19, Ammonium citrate soluble
	P_2O_5	15.2, Water soluble
	K_20	19, Water soluble

Reference: Food and Agriculture Organization (FAO). (n.d.). Fertilizer specifications. Retrieved from https://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/plantnutrition/fertspecs/en/#c29988

3. Consider adopting Viet Nam's 18% minimum primary macronutrient specification for straight and complex (2-3 macronutrient) inorganic fertilizers, with due consideration to factors such as agricultural needs;
4. Consider the non-inclusion of heavy metals in the PNS for inorganic fertilizers in accordance with the standards of FAO, India, Indonesia and Viet Nam; and
5. In relation to OMF which is a blend of inorganic and organic fertilizers, the DA-BAFS may consider a separate PNS for OMF aside from PNS on inorganic fertilizer in collaboration with FPA and based on EUstandards on OMF. The EU standard specifications are summarized in Table 2 below:

Table 2.

Solid OMF product specifications (EU, 2019)

Criteria for Solid OMF	Requirements

A. For OMF with at least one declared primary macronutrients	
Total Nitrogen Content	At least 2.5% total N (of which 1% shall be organic N)
Criteria for Solid OMF	**Requirements**
Phosphorus (P2O5) Content	At least 2% P2O5
Potassium (K2O) Content	At least 2% K2O
Organic Carbon Content	At least 7.5%
B. For OMF with more than one declared primary macronutrients	
Total Nitrogen Content	At least 2% total N (of which 0.5% shall be organic N)
Phosphorus (P2O5) Content	At least 2% P2O5
Potassium (K2O) Content	At least 2% K2O
Total Nutrient Content	The sum of nutrient contents shall be at least 8%
Organic Carbon Content	At least 7.5%

Reference: European Parliament and Council. (2019). Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019.
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1009