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AFRICA BUREAU FERTILIZER AND SOIL FERTILITY FACTSHEET

(short version)

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Inorganic fertilizers are nutrient-rich products made industrially by chemical processes, mineral extraction or by mechanical grinding (FAO, 2019). They provide a known amount of nutrients in a form that is quickly available for plant uptake. Inorganic fertilizers can be classified as:

- Single or straight - contain only one nutrient
- Compound or mixed (NPK fertilizers) - contain 2 or 3 macronutrients
- Secondary – required by plant in smaller quantities (calcium, magnesium, sulfur) and/or micronutrient (zinc, manganese, boron, etc.)

Organic fertilizers are carbon-rich and are derived from organic materials (FAO, 2019). Organic fertilizer types include:

- Vegetative: crop residues, green manures, cover crops, fallow periods, and N-fixing legumes
- Transformed: compost, vermicompost, animal manure, and biochar
- Industrial: biosolids, wastewater, milling wastes (e.g., rice husks, sugarcane mill mud/ash), residues from agroindustry, and urban wastes

Organic fertilizers can help improve soil structure, reduce compaction, hold soil moisture and nutrients, enhance water infiltration, and promote good aeration for plant root growth. Most of the nutrients in organic fertilizers have to be converted into inorganic form (i.e., nitrate, phosphate, etc.) by soil microorganisms before plants can use them.

The purpose of this factsheet is to:

- inform Missions and implementing partners about USAID’s environmental compliance procedures for fertilizer procurement and use;
- provide guidance for identifying potential adverse environmental, health and safety impacts of fertilizer handling, storage, and application; and
- provide guidance for identifying mitigation measures for consideration during implementation of agriculture activities.

The information on this factsheet will be particularly useful to USAID staff developing 22 CFR 216 environmental analysis and monitoring documents, such as Initial Environmental Examinations (IEEs) and Environmental Mitigation and Monitoring Plans (EMMPs). *For more details see Fertilizer and Soil Fertility Factsheet (Long Version).*

FERTILIZERS AND USAID ENVIRONMENTAL PROCEDURES

A fertilizer is any chemical or natural substance that is used to provide nutrients to plants. This factsheet addresses the environmental and human health risk of inorganic and organic fertilizer use.

Fertilizers are frequently lumped together with pesticides under the generic heading of “agrochemicals.” From an environmental compliance perspective (22 CFR 216), as well as from a field-level implementation point of view, this is inappropriate, because it implies that fertilizers require the same level of scrutiny reserved for pesticides. Whereas pesticides are subject to clearly defined environmental review procedures [22 CFR 216.3(b)(1)], and an approval process to promote safer use and integrated pest management, such procedures do not apply to fertilizers.

However, procurement and use of fertilizers must comply with [ADS Chapter 312](#) and [ADS 312mad Federal Fertilizer Guidance](#). Additionally, any purchase of ammonium nitrate or calcium ammonium nitrate fertilizer with USAID funding must receive prior approval from the USAID/RFS Chief Scientist and is subject to various specific standards (see [Guidance for Fertilizers Containing Ammonium Nitrate](#)) due to the risk of Ammonium Nitrate and Calcium Ammonium Nitrate use to create improvised explosive devices.



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TABLE 1: ENVIRONMENTAL, HEALTH AND SAFETY IMPACTS AND MITIGATIONS FOR FERTILIZER USE

IMPACT	ROOT CAUSE	MITIGATION MEASURES BUILD AWARENESS AND TRAIN FARMERS TO:
<p>Surface water and groundwater contamination</p> <p>Oversupply of nutrients in water sources resulting in eutrophication - dense growth of plant life, algal blooms, and death of aquatic animal life from lack of oxygen</p>	<ul style="list-style-type: none"> • Runoff of fertilizer into nearby waters or leaching into groundwater due to over-application, excessive irrigation or heavy rainfall. • Soil erosion removes soil particles and nutrients which are then deposited in nearby low-lying sites downstream, causing major water pollution. • Improper storing of fertilizers where they wash into water sources or leach into groundwater. 	<ul style="list-style-type: none"> • Always avoid indiscriminate use of fertilizers. • Consider the weather and do not to apply fertilizers when the risks of leaching losses are high (i.e., during periods of heavy rain or water logging). • Maintain buffer zones separating application and storage of fertilizer from any adjacent water sources. • To prevent nutrient losses: <ul style="list-style-type: none"> • Reduce soil erosion by practicing Conservation Agriculture and Integrated Soil Fertility Management (ISFM). See Africa Soil Health Consortium Handbook for more information. • Where possible, identify nutrient deficiencies by soil analysis, plant analysis and/or obtaining historical information. • Implement 4 Rs (4 “rights”) of fertilizer management – right source, right rate, right time, and right place.
<p>Air pollution, Greenhouse Gas (GHG) Emissions</p>	<ul style="list-style-type: none"> • Nitrous oxide (N₂O) emission in soils that are periodically flooded or experience occasional heavy rains. Methane (CH₄) emissions largely from rice paddy cultivation and residue burning. 	<ul style="list-style-type: none"> • Prevent nutrient losses and improve fertilizer use efficiency. • Do not apply fertilizers when the risks of gaseous losses are high (i.e., during periods of heavy rain or water logging). • Where possible, use controlled release formulations. • Where appropriate, apply fertilizer by direct injection to minimize evaporation.
<p>Soil acidification, leading to nutrient imbalances, crop deficiencies and plant toxicity</p> <p>Soil biodiversity decline</p>	<ul style="list-style-type: none"> • Ammonium-based fertilizers acidify the soil reducing the availability of major crop nutrients but increasing the availability of micronutrients, resulting in toxicity to plants. • Increased application of inorganic fertilizers and loss of organic matter may lead to decline in soil biodiversity. 	<ul style="list-style-type: none"> • Always avoid indiscriminate use of inorganic fertilizers. • Practice 4Rs, Conservation Agriculture and ISFM. See Fertilizer and Soil Fertility Fact Sheet - Long Version and Africa Soil Health Consortium Handbook for more information. • Consider soil properties when applying fertilizers.
<p>Shifts in microbial composition of soil</p>	<ul style="list-style-type: none"> • Excessive chemical fertilizer application aggravates the decline of soil organic matter and loss of beneficial bacterial communities that are responsible for improving soil moisture, resistance to erosion, plant nutrition and breakdown of organic matter. 	<ul style="list-style-type: none"> • Do not overuse chemical fertilizers. • Use organic fertilizers, such as composted animal manure, plant residues and other organic matter. • Practice Conservation Agriculture, ISFM, and 4Rs.
<p>Crop Damage/Chemical burn</p>	<ul style="list-style-type: none"> • Fertilizer over-application and inappropriate timing and placement can result in crop damage referred to as “fertilizer burn” due to excess salts. 	<ul style="list-style-type: none"> • Implement 4 Rs. • Where possible, use slow-release fertilizers. • Use compost to minimize risk of fertilizer burn. • Do not fertilize during droughts or when plants are wet. • Water thoroughly after applying granular fertilizer to rinse the fertilizer off the plants.

IMPACT	ROOT CAUSE	MITIGATION MEASURES BUILD AWARENESS AND TRAIN FARMERS TO:
Human Health Hazard (skin irritation, ingestion, respiratory problems, toxic fume inhalation, methemoglobinemia)	<ul style="list-style-type: none"> • Solid inorganic fertilizers can generate harmful particulate matter during broadcast application. • Inhalation of fumes from fertilizers can result in irritation of the nose, throat, and lungs. • Handling of fertilizers with bare hands can result in burns. • Inappropriately storing fertilizer can produce toxic fumes. • Prolonged ingestion of nitrate can cause methemoglobinemia (also known as blue baby syndrome) that can be fatal for babies. 	<ul style="list-style-type: none"> • Handle, store, and apply fertilizers properly and safely to protect the environment and human health. • Assign an area dedicated to fertilizer storage that is protected from flooding and is away from nearby surface and groundwater sources. • Store in dry locations in their original containers unless damaged, and food/beverage containers should never be used for storage. • Use appropriate personal protective equipment (PPE) when handling fertilizers and ensure PPE available for activities in which fertilizers are directly provided. • Dispose of fertilizer bags and containers as specified by their label.
Inadvertent accumulation and release of heavy metals and other toxic substances	<ul style="list-style-type: none"> • Inorganic fertilizers, as well as some organic fertilizers (manures, sewage sludge, biosolids) can contain heavy metals such as mercury, lead, chromium, cadmium, and arsenic that can leach into water, accumulate in soils and plants/harvest, and create risk for human exposure. 	<ul style="list-style-type: none"> • Maintain buffer zones and do not apply or store fertilizers near water sources. • Do not apply fertilizers where the risks of leaching are high. • Select fertilizers that have low concentrations of heavy metals, and where possible, test to ascertain quality. • Where heavy metal contamination potential exists, test and monitor soil and water.
Release of pathogens, veterinary pharmaceuticals and endocrine disruptors from organic fertilizers	<ul style="list-style-type: none"> • Waste-derived and non-composted manure fertilizers can carry various pathogens such as Shiga toxin-producing Escherichia coli (STEC), Salmonella spp., and Listeria spp., frequently involved in fresh produce outbreaks, and/or expose people to harmful chemicals such as antibiotics or other drugs used for treatment of animals. 	<ul style="list-style-type: none"> • Maintain buffer zones and do not apply or store fertilizers near water sources. • Do not apply fertilizers where the risks of leaching are high. • Apply only properly treated manures and sewage sludge to crops. • When possible, use composting, as this process can effectively reduce pathogens and the bioavailability of heavy metals by converting some metals into stable organic forms, and can potentially degrade organic contaminants and other emerging substances of concern.
Odor issues	<ul style="list-style-type: none"> • Manure odors can be a nuisance for nearby neighbors and communities, and constant nuisance to odors can degrade the quality of life. • Storing bagged fertilizers where people work and live causes odor nuisance, indoor air pollution and adverse impacts on human health. 	<ul style="list-style-type: none"> • Where appropriate, broadcast with incorporation, which means mixing the fertilizer into the soil immediately or within a few days after broadcasting. • Where appropriate, direct injection beneath the soil surface can also minimize odors. • Do not store bagged fertilizer in homes and offices.
Reactivity Fertilizers can be flammable and explosive	<ul style="list-style-type: none"> • Ammonium nitrate explodes violently on contact with a source of ignition and even from extreme heat. 	<ul style="list-style-type: none"> • Follow all storage instructions on the fertilizer label. • Assign an area dedicated to fertilizer storage protected from extreme heat. • Always keep sources of ignition away from fertilizers and do not store fertilizers with sources of ignition (e.g. fuels, lubricants).

RESOURCES

- Fairhurst, T., ed. 2013. "Africa Soil Health Consortium: Handbook for Integrated Soil Fertility Management," March. Available online at: <https://doi.org/10.1079/9781780642857.0000>.
- FAO, 2019. The International Code of Conduct for the Sustainable Use and Management of Fertilizers. Rome. Available online at: <https://www.fao.org/documents/card/en/c/ca5253en>.