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**Backgrounder: Organic fertilizers**

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This backgrounder discusses the nature and benefits of organic fertilizers and lists a variety of organic fertilizers that farmers may choose to use.

**What is soil?**

Soil fertility is strongly related to the organic matter content of the soil. The higher the organic matter content of a soil, the more potentially fertile it is.

It should be noted that there is a difference between what is referred to as a *fertilizer\** and an *amendment*. \* A fertilizer, whether organic or a synthetic chemical, is made up of soluble \* elements that can be used directly, and generally includes N (nitrogen), P (phosphorus) and K (potassium). Many fertilizers also contain an enormous amount of soil organic matter and, therefore, can also be referred to as soil amendments. These amendments are animal or plant sources of organic matter that restore or condition the soil through their effects on soil structure, porosity, and the formation of aggregates. \*

In sub-Saharan Africa, many farmers turn first to amendments such as manure and compost. Chemical fertilizers are expensive, can pollute soils, make them more acidic, and threaten soil productivity and sustainability.

Organic matter plays an essential role in soil functioning, and maintains the physical, chemical, and biological properties of soils. It can improve soils’ capacity to retain water, limit compaction, and contribute to the improvement of the soil's structural stability. Organic matter allows the soil to maintain good porosity that improves natural drainage without altering the capacity of the soil to retain water.

Feeding the planet without degrading soil quality is a major and ongoing global challenge. Over the last decades, agriculture in many African countries has been facing a decline in production. Therefore, it is important to find solutions for food self-sufficiency while preserving the environment. One promising avenue to achieve food security while preserving natural resources is using organic fertilizers to fertilize and amend soils, particularly those damaged by human activities and the effects of climate and weather.

In this backgrounder, we will focus on the organic fertilizers used by farmers to help their plants grow.

**Essential information about organic fertilizers**

* Organic fertilizers nourish the soil, maintain its fertility, and improve its physical, chemical, and biological characteristics.
* Organic fertilizers are derived from naturally-occurring waste, i.e., they are derived from matter originating from living beings (animal or plant).
* They release elements such as nitrogen, phosphorus, and potassium into the soil gradually through the action of soil microorganisms. This ensures that plants do not suffer from excessively rapid effects that would prevent them from developing normally. Organic fertilizers are less harmful to soil and plants than chemical fertilizers.
* It is easy to make your own natural fertilizers, especially in solid and liquid forms.
* Natural fertilizers help producers save money.
* They are generally easy to store after production.

**Predicted impacts of climate change on organic fertilizers**

Carbon sequestration \* can help regulate the climate by retaining carbon in the soil rather than allowing it to escape into the atmosphere**.**

* Using organic fertilizers can help reduce nitrous oxide \* emissions, which have a greenhouse effect three hundred times stronger than carbon dioxide (CO2).

**Gender dimensions of organic fertilizer production**

* Producing some types of organic fertilizer requires a lot of labour, time, and strength. This may be difficult for women, especially mothers of young children who are very busy. Composting can be made easier by dividing the work into groups. During the composting process, only the first steps (turning the pile) are difficult. After several weeks, the organic matter becomes soft and easy to turn.

**Misinformation or misconceptions about organic fertilizers**

* Organic fertilizers are always expensive.
* It is always very time-consuming to produce organic fertilizer.

*For more information, see documents 5, 6, 9, and 12.*

**Key information about fertilizers**

*The different types of organic fertilizers*

Organic fertilizers are created from raw material of plant, mineral, and animal origin. Here are some organic fertilizers that producers can use to fertilize their land.

1. **Compost**

Composting can be defined as managing the decomposition of organic matter by a succession of microorganism communities in aerobic \* and anaerobic \* environments. These organisms break down materials into substances that are directly useful for plant growth and soil improvement. There are different methods of composting, including the following techniques:

## Pile composting

Choose a spacious, secluded spot in the garden, preferably half-shaded and well-drained, then pile organic matter in small successive green (nitrogen-rich) and brown (carbon-rich) layers, forming a pile. Periodically turn the pile over to aerate it and make sure it is moist but not wet.

## Composting in a silo

Organic waste is added as it becomes available. Periodic mixing encourages decomposition by aerobic bacteria.

There are different types of silos or bins on the market: made of wood, plastic, or mesh, with or without lids, on or without supports, with or without a removable door or top.

You can also make them yourself.

The simplest to make is the wooden silo. Collect pallets and assemble them with wire. The key points are:

* Access to the inside of the bin from the front must be easy.
* Turning the compost over or transferring it must be easy.
* Ventilation or aeration must be good.
* It must have a removable or hinged lid.

*Pit composting*

A common method is to dig a pit about three metres wide and one metre deep. The pit should preferably be located in a shaded area away from direct sunlight and water infiltration. The walls of the pit can be stabilized by coating with cement and stones. Provide a ledge of about 20 centimetres.

Chop or grind crop residues. Note that any carbon-rich "brown" material can be used for this layer, including dried crop residues and small branches. Add a layer about 20 centimetres thick and water it until moist.

Cover this layer with ashes and then a layer of manure about 10 centimetres thick. Water generously and cover with ashes.

Alternate layers of straw/ash/manure/ash until you reach the edge of the pit.

Water evenly as needed to keep the compost moist.

Turn the contents of the pit weekly to accelerate mineralization \* and decomposition. Composting typically ends in approximately 40 to 50 days.

*For more information, see document 16.*

# Liquid organic fertilizer

Making liquid fertilizer addresses two of farmers’ major concerns about organic fertilizer: the production time and the efficiency of organic fertilizer.

Liquid organic fertilizer can be produced after 14 days of aerobic decomposition of a mixture of organic matter, water, and other locally available elements. It is very rich in nutrients and must be diluted before application in fields or gardens.

## How is liquid organic fertilizer made?

You need a container, the ingredients, and a stick to mix the solution.

The container must not leak and have no trace of oil or other petroleum products and other toxic products.

The ingredients include manure of any animal species, green vegetation, soil, ash, and water.

Combine these ingredients according to the following proportions and objectives:

* Manure accounts for 1/3 of the contents. For best results, combine different types of animal manure. Note that the quality and quantity of nitrogen in manure varies depending on the type of manure and the length of time it is exposed to sun or shade and other factors.
* Green matter (green grass, green leaves, or kitchen waste if it is green) also accounts for 1/3 of the contents.
* Soil and ash: two to three shovelfuls of each. The soil increases the variety of useful microorganisms while the ash adds minerals and potassium to the fertilizer.
* Water accounts for the final third of the contents.
* The stick is used to thoroughly mix the ingredients in order to create a solution similar to a "sauce." After this initial mixing, the liquid fertilizer should be mixed with the stick every day for five to ten minutes for two weeks.

Liquid fertilizer is made in the shade, out of direct sunlight. The container must be covered after each mixing for hygienic reasons and to ensure that it is not diluted by rainwater.

After 14 days, the liquid fertilizer is ready to use. It can be used for nurseries, gardens, fruit trees, and large-scale crops.

## How to use liquid fertilizer

* Filter to extract the liquid part of the mixture.
* Dilute one part of this liquid with fifteen to twenty parts water.
* Use this diluted solution to water or spray the base of plants once or twice a week.
* Mulch the base of the plants before using liquid fertilizer.
* Start using the liquid fertilizer seven to ten days after plant germination and continue as necessary.

*For more information, see document 15.*

1. **Ashes**

Ashes are used as fertilizer because they contain mineral salts, especially potash (which is largely potassium), calcium, trace elements, and other minerals.

Wood ashes make soil more alkaline because of their lime and potassium content. They act quickly on soil pH, but this effect is short-lived. The supply of trace elements in ash is much longer-lasting and sustainable if crops are not too intensively farmed.

Ashes should be incorporated into soil or compost just before the beginning of the rainy season, depending on the needs of the soil and the crops that will be grown.

Ashes provide many of the minerals needed for plant growth. However, they should not be the only soil amendment, since they are not rich in nitrogen.

Wood ashes are very soluble and saline, and it’s important not to add so much that an excess of salts inhibits plant growth and kills soil microorganisms, though this is not typically a problem in West African soils, which tend to be more acid. Also, due to their highly alkaline nature, ashes can (like lime) strongly damage the parts of plants with which they have been in direct contact.

*For more information, see document 18.*

1. **Green manure**

A green manure is a plant sown by a farmer and intended to be incorporated into the soil to improve its fertility. Green manures can be divided into three main categories:

* Intercrops, which are sown at the same time as or after the main crop and between the rows of the main crop.
* Green manure cover crops, which are grown either before or after the main crop.
* Full-season green manures, which replace the main crop for an entire season.

The easily degradable plant matter in green manure crops is a source of food for soil microorganisms and thus increases the biological activity of the soil after being dug into the soil. Green manures are also sometimes leguminous, and add nitrogen to the soil when incorporated.

*For more information, see document 10.*

1. **Manure**

Manure is organic matter resulting from animal waste (excrement and urine), often mixed with animal bedding. After composting, it can be used as an agricultural amendment. Manure releases nutrients to crops and helps maintain soil properties. Properly moistened manure enriches the soil with carbon and other nutrients for plant growth and soil health.

Manure has been used for centuries because:

* It contains a high level of nutrients that facilitate plant growth.
* It is a valuable amendment and a low concentration fertilizer (compared to chemical fertilizers). Manure contains, on average, four to thirty kilograms per tonne of the main nutrients needed for plant growth. (Poultry manure is four times more concentrated than ruminant manure).

*For more information, see document 13.*

1. **Faecal matter**

This refers to the safe and beneficial use of animal or human excreta, i.e., faeces and urine.

#### This involves using the organic matter and the nutrients they naturally contain in forms that can be assimilated by plants and in balanced proportions.

#### Using human urine and faeces in agriculture is the subject of research and is gaining the support of some producers, especially within the framework of the [ECOSAN](http://scripts.farmradio.fm/radio-resource-packs/package-86/ecosan-latrines-bring-benefits-to-village-health-and-farming/) concept. Faeces and urine are rich in nutrients that are beneficial to plants, including nitrogen, phosphorus, sulfur, and potassium. They also contain trace elements that can be directly used by plants.

#### ECOSAN promotes low-cost hygienic latrines from which farmers can produce and obtain compost for agriculture.

*For more information, see document 11.*

### Mulch

Mulch is defined as various types of organic matter (cake, crop residues, straw, leaves, tree bark, etc.) used to cover the soil. It ensures that the soil is not left bare and creates a favourable microclimate, reduces moisture loss, decreases the amount of irrigation water needed, and limits weed development.

Mulch also protects crops from gullying and erosion as a result of bad weather. The organic matter in mulch also enriches the soil as it decomposes.

## Benefits of mulching

Mulch nourishes the soil. Organic matter, especially when it decomposes easily, is absorbed, digested, and transformed by soil microorganisms into nutrients that are readily available to crops.

## **How do you mulch**?

Gather green waste or straw from harvest residues or other types of vegetation such as:

* Waste collected during weeding
* Mature compost
* Dead leaves
* Nut shells
* Straw
* Sand mixed with compost.

*For more information, see documents 12 and 13.*

1. **Liquid manure**

In organic agriculture, liquid manure is created by maceration\*, infusion\*, or decoction\* of specific plants (for example, nettle and wormwood) and algae (Phaeophyceae).

These liquid manures can be used as insecticides, fungicides, fertilizers, or compost activators. \*

When produced and used on the farm, they are normally much less expensive than synthetic fertilizers.

*Preparation*

* Coarsely chop 100 grams of leaves and stems.
* Place the plants in a litre of cold water and leave to macerate for 5-6 days.
* Stir every day.
* Filter before use.

*Use*

Spray plant foliage once a month with diluted extract at a ratio of one-part extract to 19 parts water.

Water compost piles with diluted extract at a ratio of one-part extract to nine parts water.

*For further information, see document 14.*

1. **Rhizobial inoculation**

Products containing Rhizobium bacteria are called nitrogen inoculants. Rhizobial inoculation introduces a sufficient number of appropriate Rhizobium bacteria to the soil to ensure successful nodulation \* and start the process of nitrogen fixation \*. This is done by coating seeds with an inoculant, or by treating the soil with an inoculant. Thus, inoculation supplies nutrients (mainly nitrogen and phosphorus) that improve plant growth and productivity without using chemical fertilizers.

This technique makes it possible to:

* Avoid the use of chemical fertilizers.
* Improve soil fertility by enhancing the performance of soil microorganisms.
* Improve agricultural production.

*For more information, see document 17.*

1. **Ramial chipped wood**

Ramial chipped wood refers to a method of shredding branches to produce a substance that improves soil. Shredded fragments of twigs and small branches are spread and then incorporated into the soil.

Green twigs (branches less than seven centimetres in diameter) are rich in nutrients that help reduce the need for water, the use of pesticides and fungicides, and tillage.

Ramial chipped wood has various benefits:

* It adds nutrients to soil.
* It reduces the need for irrigation water and improves soil structure.
* It protects the soil from overheating.

To make ramial chopped wood, shred freshly cut green branches, then incorporate into the top four centimetres of soil. In degraded soils, incorporate into the top 20 centimetres or more. After incorporation, earthworms and other decomposing organisms feed on and transform the wood into nutrients.

*How to use:*

* Spread shortly before the rainy season.
* Chipped wood should be at least two centimetres thick, although three centimetres is the recommended standard thickness.
* Ensure that the wood is in direct contact with the soil to ensure a good start.
* After 6-10 months, the soil will turn black, indicating the presence of humus\*.
* The layer of humus develops from the soil surface, and can reach a depth of 10 centimetres after six months, and 20-30 centimetres after a year.
* If the area to be treated is 500 square metres, make ten cubic metres of ramial chopped wood to get a thickness of two centimetres. (This technique is best suited to areas with a large quantity of branches.)
* Spread chopped wood immediately after chopping. The wood sap contains numerous elements that are good for the soil, while dried wood lacks these elements.
* If incorporating chopped wood near a tree, leave a 15-centimetre space around the tree. Then plant in a line with the foliage, making sure that the tree trunk is well-ventilated.

*For more information, see document 1.*

**Comparing organic and chemical fertilizers**

*The advantages of organic fertilizers*

* Improve soil structure by promoting the formation of aggregates.
* Improve soil porosity and aeration.
* Reduce water and nutrient loss through leaching.
* Act over the long term, progressively enhancing soil fertility over time.

*Environmental and health effects of chemical fertilizers*

Chemical fertilizers can be detrimental to the soil microorganisms involved in soil fertility, and also cause human health and environmental risks. They can also deplete soil through acidification and pollution of the water table.

*Environmental effects of chemical fertilizers*

The intensive use of chemical fertilizers in agriculture may have the following harmful effects:

Contamination of groundwater and watercourses through the release of nitrates that have accumulated in the soil.

Pollution of drinking water (linked to nitrate toxicity).

Eutrophication\* of fresh and salt waters through leaching of soluble minerals, either to the water table or to watercourses through runoff.

*Advantages and disadvantages of organic fertilizers*

The negative consequences of intensive farming production in terms of the destruction of biological life in the soil, water pollution, and human health risks have led to a global shift in production systems towards alternative systems which are more respectful of the environment and human health.

*Advantages of organic fertilizers*

* Some people choose organic fertilizers because they are minimally processed. Nutrients retain their natural form and are not synthesized.
* They are biodegradable and sustainable.
* Organic fertilizers do not emit harmful chemicals into the atmosphere.

### Disadvantages of organic fertilizers

* Purchased (rather than homemade) organic fertilizers can be more expensive than chemical fertilizers. But they can save farmers money in a variety of ways, including reduced irrigation and pest control costs.
* It requires a much higher volume of organic fertilizer to provide the same level of nutrients to the soil compared to chemical fertilizer.
* Lower yield on average, depending on crop and location.
* The effectiveness of organic fertilizers is limited in the wet season.
* Organic fertilizers are slower to act than chemical fertilizers.

*For more information, see documents 2, 3, and 4.*

Key definitions

Aerobic: An aerobic environment is one characterized by the presence of free oxygen (O2),

Aggregates: Clumps of soil particles held closely together by moist clay, organic matter, and organic compounds. Good aggregate stability influences air and water storage, creates more habitat for soil microorganisms, reduces erosion, assists in nutrient cycling and transport, and allows for root development and penetration.

Amendment: Organic or mineral materials that improve a soil's physical condition (e.g., soil structure or water infiltration), indirectly affecting plant growth.

Anaerobic: An anaerobic environment is one that devoid of free oxygen (O2).

Carbon sequestration: a natural or artificial process through which carbon dioxide is removed from the atmosphere and held in solid or liquid form.

Compost activators: Materials that jump-start the composting process by providing a missing nutrient, usually nitrogen, needed by the microorganisms in the pile. Compost activators help break down materials high in carbon but low in nitrogen—for example, large amounts of fallen leaves.

Decoction: The extract produced by concentrating the essence of a substance by heating or boiling.

Eutrophication: Excessive richness of nutrients in a lake or other body of water, frequently due to runoff from land. Eutrophication causes dense growth of plant life and death of animal life from lack of oxygen.

Fertility: The ability of soil to sustain plant growth and result in sustained and consistent yields of high quality.

Fertilizers: Organic or mineral nutrients that improve the supply of nutrients in the soil, directly affecting plant growth.

*Humus:* The organic component of soil, formed by the decomposition of leaves and other plant material by soil microorganisms.

Infusion: A liquid or extract prepared by soaking the leaves of a plant in liquid.

Maceration: The process of softening by soaking in a liquid.

Mineralization: The conversion if organic compounds into inorganic compounds (minerals) through decomposition.

Nitrogen fixation: the process by which molecular nitrogen in the air is converted into ammonia or related nitrogen compounds in soil.

Nitrous oxide: A potent greenhouse gas with about 300 times the heat-trapping power of carbon dioxide.

Nodulation: the process of forming nodules, especially nitrogen-rich root nodules.

Organic amendment: Any material of plant or animal origin that can be added to the soil to improve its physical properties, including water retention, permeability, water infiltration, drainage, aeration, and structure.

Soil quality: The capacity of a soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. Soil Organic Matter and soil biology play a major role in soil quality.

Soluble: Able to be dissolved, especially in water.

SOM (Soil Organic Matter): The organic matter component of soil, consisting of plant and animal materials at various stages of decomposition, cells and tissues of soil microbes, and substances that soil microbes synthesize.

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