

Editor's notes

How soil pollution may kill you and your farm

Today, we look at soil (eraki). Although this is the most important element in any agriculture venture, most farmers take it for granted. Dr Paul Gitta, a researcher put it elaborately that there are so many things that destroy the soil, which farmers can easily avoid, but unfortunately they do not do so. For example, have you ever traced the path of the shopping bag (kaveera) during its lifecycle? Well, of course, like all things its final resting place will be the soil or landfill.

Since most of our country has no waste management system people resort to dumping this waste in the gardens or backyards. But unlike natural or organic things the kaveera will not degrade (be broken down) to become useful soil that supports us all. Instead it will get logged in the soil. It will obstruct the penetration of the plant roots in the soils and prevent all activities that God set into motion to ensure that his people are supported for food by the soils.

Now there is a very elaborate technical process that creates the soil which feeds the plants that we eat and our animals and us. It is an intricate one that involves break down of dead plants and animals (humans inclusive) into soil. This involves many small but very important organisms (mites, beetles, maggots, earthworms, fungi, etc). But with increasing use of pesticides, most of these organisms are killed.

and all other inorganic waste that are dumped in backyards and gardens including sanitary pads, glass, plastics etc cannot be broken down to form soil. They stay for hundreds of years. It is like disposable diapers that are only when exposed to air. When covered in plastic they last for much longer. If we were to use just four diapers, they would have lasted 30 months (the result in the potty). If you use ten in your garden you are left with

Uganda's soils must



Prof. Kitungulu (right) inspecting a coffee garden and testing the soil fertility level. Photo by Joshua Kato

By Joshua Kato and Prossy Nandudzi

Soil is the base or mother of agriculture in Uganda, however, most soils in Uganda are dead. They are less productive than they were a few years ago, according to Prof. Julius Kitungulu Zaake, a soil scientist. For example, he points out that while one was able to harvest two tonnes of maize from an acre without applying fertilisers in the mid 1990s, it is difficult to achieve that today. Professor Kitungulu trained farmers in soil management at the Harvest Money expo, at Nambooke stadium in February. At the expo, farmers were given tips on how to maintain soil fertility, proper use of fertilisers, choice of crops for which type of soils, how to access experts to do soil testing and sampling, among others.

Status of soils in Uganda
Prof. Kitungulu said the proportion of soil fertility is low. The proportions where fertility is between high to medium in Ugandan soils stands at 26%. Meanwhile, medium to low fertility stands at 47% and low to negligible fertility stands at 27% across the country. Volcanic soils especially in mountainous areas are not as productive as they should be due to rapid population growth. This has had a resultant pressure on land for both cultivation and settlement. For example, in Kigezi region, land ownership is as low as one family per acre, as opposed to a national average of two acres per family. Such other areas include the Rwenzori and Elgon ranges. Soil fertility has been exacerbated by weather

Proper fertiliser usage

- To get the best out of fertiliser use, the following are important:
 - Use the right seed variety; this can be known by consulting a genuine seed supplier.
 - Good land preparation; this includes early ploughing before rains set in.
 - Appropriate weed management; this involves timely weeding.
 - Pest and disease control, because presence of pests affects the balance of nutrients in the soils.

Good soil should have both small and large particles

vagaries such as floods, which run-off with top soils, depriving it of vital nutrients.

Determinants of soil fertility
Soil has large and small spaces. The small spaces take in water, while the large spaces take in oxygen. For plants to grow as expected, the soils must have all the nutrients.

Good soils should have physical properties such as small and large air particles, chemical nutrients such as nitrogen, phosphorus and potassium (NPK). Other nutrients are magnesium,

calcium and sulphur, required in small quantities. While iron, copper, boron, manganese, zinc, chlorine and sodium are required in minute amounts. All these contribute to the growth of crops, that NPK is a single fertiliser or nutrient for the soil, yet it is not. He says NPK is a combination of three nutrients needed by plants for the different stages of growth.

When planting, the first interest is root formation, so farmers should apply phosphorus because it helps roots develop.

When leaves start to show, nitrogen should be applied because it is key to foliar development. When it comes to fruiting, that is when potassium can be added to make a complete set of NPK.

How soil loses fertility
Organic matter which is always on top of the soil is washed away through erosion. Bush burning leads to loss of nutrients such as nitrogen and sulphur. When these are missing from the soil, it

be fed to feed population



Farmers packing organic manure in sacks. Soils need both organic and inorganic fertilisers

- Soil erosion—loss of top fertile soil, occurs when it rains heavily.
- Bush burning causes loss of nitrogen.
- Over tillage/over ploughing, leads to loss of soil structure due to over compaction. It is similar to over using the soils.
- Over grazing leaves the soils bare, hence it is affected by direct sunshine and soil erosion.
- Clean weeding where the soil is left bare before planting and after planting leads to loss of nutrients.
- Not replacing removed nutrients leads to negative nutrient balance of -21, -8 and -43 for NPK
- Mono-cropping every season deprives soils of nutrients. This is why intercropping is important. You can, for example, plant legumes such as beans, soy or maize with bananas and coffee. Beans too can be planted on top of potato mounds etc.
- Use of non-biodegradable materials – polythene, because they prevent water from sipping into the soils.
- Concrete structures near the farmland, for example graves. Cement affects the nutrients in the soils because it sucks out water.
- Over compacted soils cannot allow root penetration, but also the larger spaces that take in air, will be blocked and nutrients including oxygen will not find their way in the soil to get to the roots. Continuous tillage/ploughing affects the larger spaces for air which tend to disappear, especially where there is clay. This affects fertility.
- Weeding by removing all the weeds and placing them on the boundary exposes the soil to direct heat and rains. This again takes away fertility in the top soils. The best thing is to weed and leave cut grass decompose in the garden.

How farmers contribute to loss of soil fertility

Unfortunately many farmers do not replace lost nutrients after harvesting their crops. When farmers harvest crops, they have to replenish the lost nutrients through application of fertilisers, which has not been embraced by most Ugandans.

Prof. Kitungulu says for comparison purposes, an average farmer in South Africa uses 51kg of NPK per year and a Kenyan farmer uses 23kg per year. In Malawi, Mozambique and Tanzania the figure stands at 16kg, 4kg and 6kg respectively while in

Uganda we use an average of 1.5kg per year. This means that Uganda is in negative nutrient balance, which is against 2005 AU/ resolution in which member countries were tasked to use at least 50kg of nitrogen per year.

If farmers do not replace the nutrients in the soil after harvest, production goes down. It is like having a shop that one sets up but is reluctant to restock.

How to deal with farmers' reluctance

For farmers to know which nutrients are lacking in their soils, they should contact experts at National Agricultural Research Organisation (NARO) centres, including consulting extension workers near them for information on how best they can understand their soils.

There are only two major centres with such services that is National Agriculture Research Laboratories (Kawanda) and Makerere University (Kabanyoro).

How is soil analysis done?

The five soil samples are put in a basin and mixed thoroughly before 1kg of soil is put in a clean container. This is taken for analysis in a laboratory.

Soil sampling and analysis starts with experts visiting the garden. Samples to a depth of 0-15cm are taken from all parts of the garden.

The areas from which the samples are taken should not have any trace of organic manure such as cow dung, chicken droppings or any other fertiliser as these could compromise the final results.

Experts look out for the pH, which is the acidity and alkalinity of the soil, organic matter, NPK, sodium, calcium and the proportion of sand clay and silt in addition to physical properties.

To maintain soil fertility farmers should apply both organic and inorganic fertilisers. Organic fertilisers can be got from cow dung, chicken and goat droppings.

Best practices

- For appropriate nutrient use follow the 4R nutrient stewardship.
- Right source of nutrients
 - Right rate
 - Right time and stage of plant growth
 - Right method



Dry leaves and grass can decompose into organic manure and also keep soil moist

Key tips on soil management

Soil pH includes organic matter, nitrogen, phosphorous, potassium, sodium, calcium, magnesium and sand, silt and clay. These are used to forecast soil management requirements.

- Soil pH gives the levels of soil acidity or alkalinity. Using agricultural lime of up to pH6.
- Best material to use is dolomite, at a rate of 1-2 tonnes per acre or about 1/3 kg around each plant or a cup in a planting hole. Wood ash, or calcite may be used. Application must be made at least one month before planting, mix in soil using a forked hoe.
- Organic matter is also low at about 3%. Materials such as coffee husks, composts, crop residue, livestock manure can be used at the rate of five to 10 tonnes per hectare or one to two basins in a planting hole.
- Nitrogen is also deficient in soil. It should be at least 0.2%. Nitrogen is vital for vegetative growth. It is lost through rain and high temperatures. It is required at the vegetative stage. At planting only 20-50g/hole, but at vegetative stage the plants need about 200-300g/hole.
- Phosphorous is deficient in soil due to high soil acidity, high temperature, global warming, also low organic matter. It is required at planting stage, around 200-300g/hole. It promotes root growth. SSP is better than TSP. It may be mixed with manure at planting.
- Potassium is also becoming deficient because it is easily lost through rain and at harvests. It is mostly required at fruiting stage to cater for quality of produce, which include cup taste or sieve size of coffee beans. It requires up to 300g for each plant.
- Calcium and magnesium these are also liming materials. Provided when putting the pH right.
- Sand, silt and clay; also influence plant growth regulate air and water spaces in soil. It is required for soil air, soil water and consequently root proliferation. Importantly, soil must breathe for life processes. Organic matter and soil tillage moderate the function of sand, silt and clay

Fertiliser applications should be done at the beginning of the rainy seasons. Fertilisers are applied in the pits.

It is not cost effective to irrigate without applying fertilisers. It is also not recommended to fertilise in acid, compacted or dry soils because the fertilisers will not be effective.

Use soluble fertilisers (nitrogen and potassium) in split doses, for example, 10grammes per plant per dose across three weeks.

Intensification necessary when fertilisers are used (more plants per unit area). For example, if one is using fertilisers in bananas, they can increase the number of pits from 450 to 600 per acre.

Maize can take 30kg per acre instead of the normal 20kg because the crops have got additional food to feed on.

Farmers' training needed in use of fertilisers and soil sampling for analyses

