Minimising nutrient losses

i) *Preventing soil erosion*:
Since soil organic matter and most nutrients are found in the top soil, preventing erosion is an important aspect of soil fertility management. It can be achieved by maintaining a permanent soil cover (using dead mulch, living mulch e.g. cover crops), reducing runoff through construction of terraces, contour bunds and ridges, strip cropping, and reduced tillage, among others.

ii) *Nutrient replenishment*:
Replenishing lost soil nutrients is an important aspect of soil fertility management. This can be achieved through addition of external inputs eg. fertilizers (organic and inorganic), biological nitrogen fixation (BNF) and recycling of plant residues, among others. Judicious use of fertilizers supplements the natural soil nutrient supply (Table 2)

Common organic fertilisers include: green manures and farm wastes e.g. crop residues, animal manure (farmyard manure (FYM), liquid manure), compost (mixture of decomposed plant and animal residues).

Common inorganic fertilisers include: phosphorus sources— DAP, TSP and SSP (tripple and single super phosphate); nitrogen sources— urea, CAN, DAP; potassium sources— sulphate of potash and muriate of potash; and compound fertilisers— different nutrient combinations meant for specific crops.

Table 2. Nutrient content of some materials

Material	kg nutrient per 100 kg dry wt		
	N	P	K
Farmyard manure	0.7-2.3	0.1-1.1	0.6-0.8
Compost	2.0	0.7	2.0
Mucuna	3.5	0.2	0.7
Elephant grass (leaf)	1.1	0.38	5.3
Coffee husks	0.5-2.2	0.1-0.2	1.0-4.0
Urea	46	0	0
DAP	20	21.8	0
TSP	0	20.1	0
NPK (25:5:5)	25	2.2	4.1

iii) *Sound crop rotations*: Crop rotations and fallows (natural or improved) helps to reduce soil fertility decline and improve soil fertility. Crop rotations involving shallow followed by deep-rooted crops help to recycle nutrients back into the root zone. We encourage the use of legume enriched fallows (i.e. the use of leguminous plants e.g. *Mucuna*, *Canavalia*, *Crotalaria*, *Lablab*) rather than leaving the land/field under a natural (weedy) fallow.

Managing soil acidity

Soil nutrient availability is affected by soil acidity. Continuous cropping increases soil acidity. Most crops survive best in pH range of 5.5 to 6.5. In this pH range nutrients in the soil are available for crop uptake. For more acid soils (pH below 5.0), farmers are advised to grow acid tolerant crops eg. Coffee, pineapples, tea or grow deep rooted crops in rotation with shallow rooted ones so as to recycle leached bases or lime soils to a pH of at least 5.5 to improve nutrient availability Possible liming materials are agricultural lime and wood ash. In relatively acid soils use the less acidifying fertilisers e.g. CAN.

Use of inputs

All inputs involve costs. Study the options available to you before you make a choice. A combination of organic and inorganic inputs often gives the best results.

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SOIL FERTILITY MANAGEMENT

Soils Brochure Series 1

NATIONAL AGRICULTURAL RESEARCH ORGANISATION

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Introduction

Soil fertility is the capacity of the soil to supply essential plant nutrients in a balanced way. It addresses the supply and availability of plant nutrients from the soil, and processes affecting this supply and availability of nutrients for crop uptake.

Essential plant nutrients

There are 19 elements essential/beneficial for plant growth and development. These are Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphur (S), Iron (Fe), Copper (Cu), Zinc (Zn), Manganese (Mn), Molybdenum (Mo), Boron (B) and Cobalt (Co), Chlorine (Cl), Silicon (Si), and Sodium (Na).

Plants obtain C, H and O from the air and water and the rest from the soil. Of the 16 nutrients obtained from the soil, six (N, P, K, Ca, Mg and S) are taken up by plants in relatively large amounts (Table 1). This means that they should be available in the soil in relatively large amounts. These are called macronutrients. The other 10 are taken up in very small amounts, 0.01-1.0 kg from a hectare in a season. These are referred to as micronutrients.

Table 1: Average amounts of macronutrients taken up by some crops.

Crop	Yield (t/ha)	Amounts of macro-nutrients taken up from the soil in kg/ha					
		N	P	K	Ca	Mg	S
Beans (Grain + Haulms)	10.0	240	73	192	120	55	28
Maize (Grain)	6.3	163	63	121	17	37	17
Cassava (Whole plant)	18.0	95	23	77	23	52	7
Bananas (Bunches)	22.5	148	30	420	154	66	14

The Nature of Uganda's Soils

Soils develop from parent material (rocks) through weathering processes. Young soils are rich in weatherable minerals and therefore can supply plant nutrients. In Uganda, young soils are associated with areas of recent volcanic activity mainly the eastern and western highlands. As soils get older, the nutrient-rich minerals decrease and soil can no longer adequately replenish nutrients removed through cropping and erosion.

Most Uganda soils are old with very little weatherable minerals. They therefore have very low nutrient reserves. However, soils are not uniform; much of the differences are brought about by topography, with soils in the valley bottoms being generally more fertile than those on hill slopes. In a countrywide survey, 138 soil units were identified in Uganda. Many soils have low inherent fertility because they were derived from poor parent material (rocks). Some soils are light, being dominated by sandy particles, while others are heavy, dominated by clay particles, again depending on parent material.

Factors affecting soil fertility

The fertility of soils depends on a number of factors. For Uganda there are three major factors:

- *Parent material*:

This determines type of soil, its nutrient reserves, and other properties (e.g. whether soil is light or heavy).

- *Soil reaction*:

Soil acidity/alkalinity (pH) affects processes governing nutrient availability in the soil.

- *Organic matter*:

This is an important component of the soil medium. It improves soil physical, chemical and biological properties; serves as a nutrient reserve; many soil nutrients are replenished through organic matter decomposition.

Soil fertility in Uganda and its management

Soil fertility in most Uganda soils is associated with organic matter found mainly in the surface layer, hence susceptible to losses through erosion if soils are not properly managed. In addition, soil nutrient losses occur through crop harvests, leaching, immobilization, fixation, denitrification and volatilization. Due to these nutrient losses, soil fertility gradually declines with continuous cultivation. The most limiting nutrients in Uganda soils include those taken up by crops in large quantities i.e., nitrogen, phosphorus and potassium. In addition physical properties deteriorate as soil organic matter decreases during continuous cropping.

Soil fertility management in these soils basically involves managing organic matter, preventing nutrient losses, replenishing lost nutrients, recycling leached nutrients, and adding nutrients to the soil to meet crops' requirements, thus minimising nutrient mining. Good soil fertility management results in more stable yield levels, and a better resistance to pests and diseases.

Organic matter management

Good organic matter management implies recycling of crop residues rather than burning, mulching, use of compost, farmyard manure, animal manure, green manures, cover crops, etc. It also implies prevention of soil erosion since organic matter is mainly found in the topsoil. Fallows and minimum tillage reduce organic matter depletion. Better organic matter management also helps to improve soil biological and physical properties resulting in better rainfall infiltration, improved soil aeration and root development.