General soil threats of the region – Africa south of the Sahara

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SUBTROP

SOIL THREAT 3 – SOIL NUTRIENT DEPLETION

Soils in large parts of South Africa are strongly weathered, inherently low in organic matter and with very low resilience (recovery potential) (Nortjé, 2014). Because of the increasing pressure on land, natural replenishment of nutrients during fallow periods or between harvests is insufficient to maintain soil productivity over the long term. Insufficient nutrient replacement in agricultural systems results in soil degradation on land with poor to moderate potential (marginal land) in the short term, and in the long term on high potential land.

Soil nutrient depletion is essentially a direct result of the different forms of soil degradation, i.e. erosion, compaction and poor soil management. Besides soil erosion (Fig. 1), other processes contributing to nutrient depletion are:

- the decline of organic matter and soil biology (Nortjé, 2016a, b);
- degradation of soil structure and loss of other soil physical qualities;
- reduction in the availability of major nutrients (N, P and K); and
- the increase in toxicity, due to acidification and pollution (Nortjé, 2016a, b).

The above-mentioned are all **direct causes of nutrient depletion**.
Soil moisture stress already inherently constrains land productivity on a large percentage of soils in South Africa. Soil fertility degradation places an additional serious human-induced limitation on productivity. The low nutrient status of most soils in Southern Africa is further exacerbated by the insufficient use of fertilisers and manure, and by the practice of mono-cropping.

Overall use of inorganic fertilisers in Southern Africa is the lowest in the world at an average of only 12 kg/ha. Crops remove nutrients from the soil in order to produce, and these nutrients need to be replenished. A large percentage of soils in Southern Africa are acidic, and therefore deficient of phosphorus (P), calcium (Ca) and magnesium (Mg), with often toxic levels of aluminium (Al). These deficiencies also contribute greatly to negative nutrient (Ca/Mg-ratio, CEC and K/Ca + Mg) balances in the soil (Gray, 2005). Nutrient losses to the amounts of 110 kg/ha N, 2,5 kg/ha P and 70 kg/ha K are reported from various agricultural production systems.

More nitrogen (N) and potassium (K) than phosphorous (P) get depleted from Southern African soils. Nitrogen and potassium losses primarily arise from leaching and soil erosion. These problems result mainly from mono-cropping without rotation, inappropriate soil conservation practices, and inadequate fertiliser use. Although many commercial and emerging growers have developed soil management strategies to address the poor quality of their soils, low inputs of nutrients, including of organic matter, contribute to poor crop growth and to the depletion of soil nutrients. Subtropical fruit and tree crops are highly dependent on the addition of organic material through mulches and compost.

Except for the above-mentioned direct causes of nutrient depletion, there are also various factors that **indirectly influence** nutrient depletion in soil. Indirect causes vary between and within ecological regions and between countries. The high costs of inputs (for example fertilisers) in Africa is such an example, and not within the reach of a large quantity of commercial and especially small farmers (Barnard *et al.*, 2002). The other is proper infrastructure (high transport costs, poor infrastructure) to get the available fertilisers to these areas, often very remote.

The result is that farmers in remote areas often suffer the most. Many farmers also do not follow recommended fertiliser ratios due to cash constraints, with the result of nutrient depletion and poor harvest (Bationo *et al.*, 2012). Output/crop instability and relevant markets close enough to production areas are also problems.

All of these indirect causes of nutrient depletion should not be a problem in countries like South Africa, with a highly developed commercial agricultural sector, good markets, expertise and relatively good infrastructure.

Figure 1. Severe soil erosion.

REFERENCES

BARNARD, R.O., VAN DER MERWE, A.J., NELL, J.P., DE VILLIERS, M.C., VAN DER MERWE, G.M.E. & MULIBANA, N.E. 2002. Technical country report/in-depth study on problem soils including degraded soil in South Africa: Extent, present use, management & rehabilitation (with emphasis on salt-affected soils). 4th Meeting of FAO Global Network Integrated Soil Management for Sustainable use of Salt-affected Soils. Spain, Valencia.

BATIONO, A., WASWA, B., KIHARA, J., ADOLWA, I., VANLAUWE, B. & SAIDOU, K. 2012. Lessons learned from long-term soil fertility management experiments in Africa. Springer Science & Business Media.

GRAY, K.M. 2005. Changing soil degradation trends in Senegal with carbon sequestration payments. Montana State University. MSc thesis. pp. 135.

NORTJÉ, G.P. 2014. Studies on the impacts of off-road driving and the influence of tourists' consciousness and attitudes on soil compaction and associated vegetation in the Makuleke Contractual Park, Kruger National Park. (Unpublished Ph.D. thesis). University of Pretoria, Pretoria, South Africa.

NORTJÉ, G.P. 2016a. General Soil Threats of the Region – Africa South of the Sahara: Soil Threat 1 – Erosion by water and wind. *Subtrop Journal* Vol 13, Apr-June 2016, pp. 6-8.

NORTJÉ, G.P. 2016b. General Soil Threats of the Region – Africa South of the Sahara: Soil Threat 2 – Loss of Soil Organic Matter (OM). *Subtrop Journal* Vol 14, July-Aug 2016, pp. 8-9.