USE OF PHOSPHATE ROCK AND OTHER LOW COST AGRICULTURAL INPUTS TO ENHANCE FOOD SECURITY IN SUB-SAHARAN AFRICA

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SUMMARY

Most soils in Sub-Saharan Africa are losing minerals necessary for sustainable agriculture. As a result these soils are being mined[1] . Since agriculture is the main occupation of most of the African continent, increasing poverty is often the result. Interventions designed to improve living standards may be unsustainable and often counter productive if they address only the symptoms and not the root cause of poverty in Africa- which is poor soils due to poor farming practices by resource poor small scale farmers.

Nitrates and phosphates are the main agronutrients mined by current sub-Saharan small scale agricultural practices. Conventional chemically manufactured N and P inputs like ammonium nitrate and superphosphates have high energy cost components and are already too expensive to be affordable at adequate levels for low output farmers – unless continuous subsidies are provided by taxpayers or donors. The result is that most small scale farmers use little or no fertilizer inputs, and consequently soil quality and soil organic matter decline, and soil erosion accelerates. Pressure increases to take over well farmed land from large scale farmers, and more erodible land is cleared for cultivation.

Small scale farming yields of staple crops like maize in a 750mm summer rainfall Southern African climate are typically 500kg to 1 tonne per hectare, against potential yields of ten times this on the same soils and with the same rainfall if farmed with adequate investment in soil fertility. Yields of 7 tonnes of maize per hectare are average for competent large scale commercial farmers under these conditions.

Conventional high cost chemical fertilizers like ammonium nitrates and superphosphates are likely to become more expensive in real terms with time, as the real cost of energy used in their manufacture increases relative to crop prices.

Increasing the use of low cost inputs by small scale farmers seems to be the only practical and sustainable way to increase food production in most of sub-Saharan Africa

Several studies on the availability of sources for low cost agro-inputs in the continent have been done. Van Straaten's excellent publication **Rocks for Crops** (quoted from below) is available via www.uoguelph.ca/~geology/**rocks**_for_**crops** and there is a very comprehensive FAO study on the use of rock phosphate for agriculture via http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/007/y5053e/y5053e00.htm

FROM VAN STRAATEN- ROCKS FOR CROPS- 2002

At present, the main nutrient limiting factors in sub-Saharan Africa soils are nitrogen (N) and phosphorus (P).

While nitrogen can be introduced to the soil through various organic inputs, including manures, plant and tree prunings, and leguminous mulches, there is no equivalent

process to nitrogen fixation for the introduction of P into the farming system.

Phosphorus can be supplied in small amounts through organic residues and by-products, but the amount is generally insufficient to meet crop demand (Palm 1995; Sanchez and Palm 1996). Phosphorus must be added to the depleted soils in a concentrated form, either as P-containing fertilizers or locally available phosphate rocks. Low soil phosphorus supplying capacity is a widespread problem limiting crop production in the SADC countries and in sub-Saharan Africa. Phosphorus is a nutrient second only to nitrogen in importance for the production of healthy plants and profitable crop yields.

As a result of long periods of intense weathering, which is, characteristic of soils in the tropics and sub tropics extensive losses of P occur. In addition, low availability of P is a function of the aluminum and iron combinations that are the dominant forms of P in these tropical soils.

However, undisturbed natural ecosystems in these regions contain enough P in the biomass and soil organic matter to maintain standing the vegetation. Very little is lost as long as the system remains undisturbed (Brady and Weil 1996). Once cleared for agriculture, the losses of P occur through soil erosion and in biomass removals (harvest). Within just a few years the system may lose most of the phosphorus that had cycled between the plants and the soils.

Leguminous plants that might be expected to replenish soil nitrogen supplies are particularly hard hit by P deficiency because low supply inhibits effective nodulation and retards the biological nitrogen fixation process. Deficient in both nitrogen and phosphorus plants can hardly provide vegetative cover to prevent heavy rains from washing away the surface soil. The resulting erosion will further reduce soil fertility and water holding capacity. The increasingly impoverished soils can support less vegetative cover, and so the degradation accelerates. Such a scenario prevails in the smallholder farming community in Tanzania, Malawi and Zambia and many of the SADC countries.

For soil fertility to be sustainable, exported soil nutrients must equal imported nutrients. But in large areas of Africa more soil nutrients are exported than replenished. As a consequence, soils are ‘mined’ (Van der Pol 1993)

The low cost alternative to conventional fertilizers is to use regionally available rock phosphate and lime resources. Legumes adapted to the local climate for interplants or rotations should be used to fix N, in conjunction with any compost or manure available. Minor nutrients like potassium, sulphur, boron etc, together with bio-inputs such as N fixing and P solubilising bacteria, should also be added where necessary.

Phosphate and lime deposits have been identified in many African countries. In some cases, mines have been developed and rock phosphate is already available from local sources - but so far has not been widely used.

While the costs of using such inputs are much lower than those of soluble "chemical" fertilizers, there are difficulties to be overcome in promoting the use of low cost inputs. Use of legumes to fix N is practiced in Africa- but rotational legumes need a time horizon beyond one year- labour is needed and land taken out of production for the period of the crop with limited or no returns. Legume interplants often involve a first year reduction in crop yield. Rock phosphate, depending on the source, can be "insoluble" in soils without organic matter and a suitable mineral and acid balance, and rock phosphate can become available over several years rather than immediately. However rock phosphate can be less prone to fixation in the soil, and a one-off investment in phosphate can provide a "pump prime", providing a necessary condition for increasing yields several times. Other soils inputs are also necessary for this to happen – use of legumes to provide N and organic matter for example – but these involve mainly family labour inputs rather than cash purchases.

Time horizons tend to be short in Africa- for various cultural and political reasons- one of which is the limited security of tenure provided by communal ownership. Promotion of more secure tenure systems such as long leasehold without restriction on sale of the lease, and freehold tenure is of obvious benefit, but is often resisted by local interested parties. The surveying of plots has become much easier with the availability of low cost GPS readers and satellite mapping.

The best way to promote the use of low cost inputs is generally to develop local distribution businesses supplying these inputs, backed by local research and demonstration plots. Grower packs are made available with low cost inputs suitable to the local environment, and initially distribution may be funded by donors to encourage the use of new methods that produce results over a few years rather than just in the season of application.

Investment in this approach by donors would encourage the propagation of an alternative low input cost method of farming, rather than the current open-ended commitment to poverty alleviation by subsidizing unsustainable high input cost farming practices.

Note 1: Unreplaced losses of N and P are estimated at 6.1m and 740,000 tons respectively during the year 2000 in sub-Saharan Africa (quoted in Brady and Weil, Soils and the World's Food Supply, 11th Edition, Prentice Hall.)