

NUTRIENT DEPLETION IN THE AGRICULTURAL SOILS OF AFRICA

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About two-thirds of Africans depend on agriculture for their livelihoods. The fate of agricultural production, therefore, directly affects economic growth, social improvement, and trade in Africa. As the region's population continues to grow rapidly, outpacing the growth rate in other regions of the world, its agricultural land is becoming increasingly degraded. Farmers are intensifying land use to meet food needs without proper management practices and external inputs. The resulting depletion of nutrients from soils has caused crop production to stagnate or decline in many African countries. In some cases, notably in the East African highlands, the rate of depletion is so high that even drastic measures, such as doubling the application of fertilizer or manure or halving erosion losses, would not be enough to offset nutrient deficits. Unless African governments, supported by the international community, take the lead in confronting the problems of nutrient depletion, deteriorating agricultural productivity will seriously undermine the foundations of sustainable economic growth in Africa.

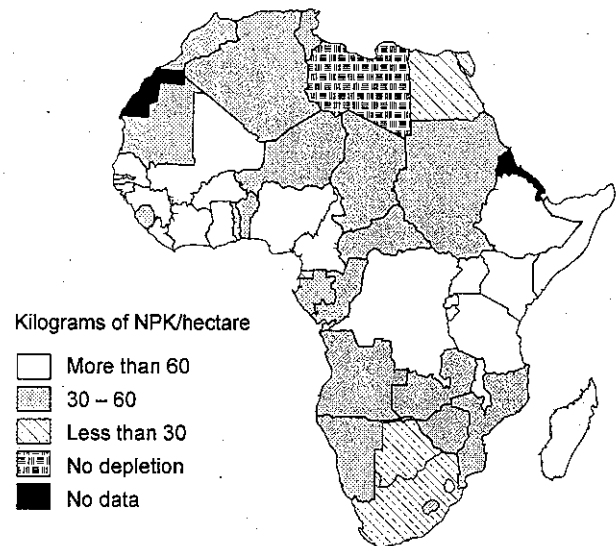
THE EXTENT OF NUTRIENT DEPLETION

All African countries, except Mauritius, Reunion, and Libya, show negative nutrient balances every year (see Figure 1). In the semiarid, arid, and Sudano-Sahelian areas that are more densely populated, soils lose 60–100 kilograms of nitrogen, phosphorus, and potassium (NPK) per hectare each year. The soils of these areas are shallow, highly weathered, and subject to intensive cultivation but with low levels of fertilizer application. Limited water availability and intensified land use due to increasing population size have restricted crop diversification and the adoption of proper management practices. Short growing seasons contribute to additional pressure on the land.

In other important agricultural areas, such as those located in the subhumid and humid regions and in the savannas and forest areas, nutrient losses vary greatly. Rates of nutrient depletion range from moderate (30 to 60 kilograms of NPK per hectare per year) in the humid forests and wetlands in southern Central Africa, to high (above 60 kilograms) in the East African highlands.

In 1993–95 the difference between nutrient inputs and nutrient losses in the continent ranged from –14 kilograms of NPK per hectare per year in South Africa to –136 kilograms in Rwanda. Burundi and Malawi also experienced rates of nutrient depletion above 100 kilograms of NPK per hectare per year. About 86 percent of African countries show annual nutrient deficits greater than 30 kilograms of NPK per hectare per year. More countries fall into the high depletion range than the medium range. Nutrient imbalances are highest where fertilizer use is particularly low and nutrient loss, mainly from soil erosion,

Figure 1— Average annual nutrient depletion (NPK) in Africa, 1993–95



is high. The low gains in nutrients, inherently low mineral stocks in these soils, and the harsh climate of the interior plains and plateaus aggravate the consequences of nutrient depletion.

The estimated net annual losses of nutrients vary considerably by subregion: 384,800 metric tons for North Africa, 110,900 metric tons for South Africa, and 7,629,900 metric tons for Sub-Saharan Africa. This represents a total loss of US\$1.5 billion per year in terms of the cost of nutrients as fertilizers. Forfeited yields cause additional financial losses. Most crop yields in Africa did not change substantially between 1981 and 1995, remaining close to the average obtained by smallholders with rainfed land and moderate to low soil fertility.

More nitrogen and potassium than phosphorus get depleted from African soils. Nitrogen and potassium losses primarily arise from leaching and soil erosion. These soil problems result mainly from continuous cropping of cereals without rotation with legumes, inappropriate soil conservation practices, and inadequate amounts of fertilizer use. Guinea Bissau and Nigeria experience the highest annual losses of nitrogen and potassium in West Africa. Nitrogen loss in East Africa is highest in Burundi, Ethiopia, Malawi, Rwanda, and Uganda, and phosphorus loss is highest in Burundi, Malawi, and Rwanda.

Losses of potassium are associated with severe erosion. The highest rates of potassium depletion occur in Guinea Bissau



and Nigeria in West Africa, and Burundi, Kenya, Malawi, Rwanda, Swaziland, and Uganda in East and Southern Africa.

NUTRIENT REQUIREMENTS AND SOIL MANAGEMENT PRACTICES

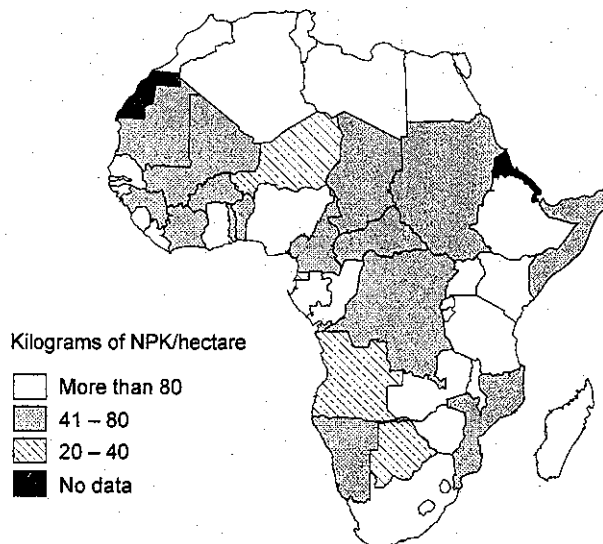
Nutrient gains in African soils come about mainly through mineral fertilizer application, nutrient deposition, and nitrogen fixation. The negative nutrient balances clearly indicate that not enough nutrients are being applied in most areas. The current (1993–95) annual use of nutrients in Africa averages about 10 kilograms of NPK per hectare. Fertilizer use ranges from nearly 234 kilograms per hectare in Egypt to 46 kilograms in Kenya to less than 10 kilograms in most countries in Sub-Saharan Africa. North Africa, with about 20 percent of the continent's land area, accounts for 41 percent of the fertilizer consumption.

Fertilizer tends to be used mostly on cash and plantation crops because of the high profitability of fertilizers in the production of export crops. Food crops get less fertilizer because of unfavorable crop/fertilizer price ratios and financial constraints faced by farmers.

To maintain current average levels of crop production without depleting soil nutrients, Africa will require approximately 11.7 million metric tons of NPK each year, roughly three times more than it currently uses (3.6 million metric tons) (see Figure 2). Sub-Saharan Africa will need by far the largest proportion of this amount, 76 percent, because its current average level of fertilizer use is so low. Total nutrient requirements per hectare per year in this subregion range from Botswana's 24.5 NPK (a figure 350 percent above current usage) to Reunion's 437.3 NPK (about 20 NPK per hectare less than the country consumes). Burkina Faso would have to increase its NPK consumption more than 11 times to maintain crop production levels without depleting nutrients and Swaziland would have to double its consumption. Estimated average use for Africa as a whole would have to increase about 4 times to meet nutrient needs at the current level of production. Generally more nitrogen is required than potassium, and more potassium than phosphorus.

Although increasing the use of mineral fertilizer may be the centerpiece of the strategy to balance nutrient depletion and improve soil productivity in Africa, it should not be taken to mean that fertilizer levels should be increased beyond basic requirements. Indeed, surpassing recommended levels for less-responsive varieties and in poorly managed cropping systems can lead to high nutrient losses and low yields. Moreover, to achieve intended goals, fertilizer use must be combined with a broad spectrum of complementary practices, such as soil conservation, recycling of crop residues, livestock management, and use of organic fertilizers. Such practices could reduce the mineral fertilizer required to maintain current average yields by as much as 44 percent.

Figure 2— Annual requirements for maintaining current yields without depleting nutrients, 1993–95



IMPLICATIONS FOR POLICY

If nutrient depletion and land degradation continue at current rates, one has to wonder how farmers in African countries will be able to grow enough food for ever-larger populations in the next century. To avoid possible crises, national governments and donors should address the threat of nutrient depletion and land degradation through policies and programs that promote increased productivity of land resources and conservation of the resource base. Significant policy changes will be required to establish an environment that makes agricultural inputs easily available, that encourages farmers to use these inputs more efficiently, and that helps improve local extension services and farmer support. Structural adjustments, market development, trade and price policies, credit systems, infrastructure improvement, and institutional support services should be reevaluated and assessed for their impact on the resource base and the sustainable expansion of agricultural production and productivity.

Many countries and regions need to integrate natural resource management with economic and sector policies. More economic and environmental impact analyses at the country level are needed to help set priorities for agricultural land issues, to assess the costs and benefits of policy decisions, and to expedite identification of the type of investments that will be required to prevent land degradation and increase production. Prevention of nutrient mining through sound economic policies, research, information dissemination, and human resource development should be actively promoted in Africa.

For more information see the full report by Julio Henao and Carlos Baanante, *Estimating Rates of Nutrient Depletion in Soils of Agricultural Lands of Africa* (Muscle Shoals, Alabama, USA: International Fertilizer Development Center, 1999).

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