Soil fertility depletion in smallholder farms is the fundamental biophysical root cause for declining per capita food production in sub-Saharan Africa. An average of 660 kg N ha$^{-1}$, 75 kg P ha$^{-1}$, and 450 kg K ha$^{-1}$ has been lost during the last 30 yr from about 200 million ha of cultivated land in 37 African countries. We propose an alternative approach, the replenishment of soil fertility as an investment in natural resource capital.

This approach combines basic principles of soil science with environmental economics. Combinations of P fertilizers and organic inputs can replenish soil N and P nutrient stocks in Africa and restore service flows to near original levels. Phosphorus replenishment strategies are mainly mineral-fertilizer based, with biological supplementation. Nitrogen replenishment strategies are mainly biologically based with mineral-fertilizer supplementation. Africa has ample phosphate rock (PR) deposits that can be either used directly or processed to reverse P depletion. Decomposing organic inputs may facilitate the use of PR in P-depleted soils. Leguminous tree fallows and herbaceous cover crops grown in situ play a major role in N capture and internal cycling in ways compatible with farmer constraints. Soil-fertility replenishment was found profitable in three case studies, but smallholder farmers lack the capital and access to credit to make the initial investment. A cost-shared initial capital investment to purchase P fertilizer and germplasm for growth of organic inputs combined with effective microcredit for recurring costs such as fertilizers and hybrid seed is seen as the way forward.

The continued threat to the world’s land resources is exacerbated by the need to reduce poverty and unsustainable farming practices. During the last decade, food security was not a global priority, but studies such as the 2020 Vision (IFPRI, 1995, 1996) and the World Food Summit (FAO, 1996) have shown that food security is one of the main global concerns as we move into the next century. Food insecurity encompasses food scarcity as well as the inability to purchase food, a poverty-related issue. Although food insecurity occurs throughout the developing world, it is most acute in sub-Saharan Africa (hereafter referred to as Africa), where the attainment of food security is intrinsically linked with reversing agricultural stagnation, safeguarding the natural resource base, and reducing population growth rates (Cleaver & Schreiber, 1994).

In contrast to sustained increases in other parts of the developing world, per capita food production continues to decrease in Africa (Fig. 1-1; World Bank, 1996a). This is largely a result of continuing rapid population growth, the high-est of any region in the world, and rapid land depletion (Badiane & Delgado, 1995; World Bank, 1995). In addition, about one-half of Africa’s population is classified as absolute poor (those subsisting on per capita incomes of <1 U.S. dollar per day), and Africa has the highest proportion of undernourished children. To reverse this situation by the year 2020, Africa needs an annual, sustained growth rate in agricultural production of 4% (Badiane & Delgado, 1995).
Soil fertility replenishment for sustaining crop productivity should use all possible sources of plant nutrients in an integrated manner (FAO, 1993). It is within this context that this study was therefore, is analogous to the need for Green Revolution-type germplasm in Asia three decades ago. Food security was only remedied, per capita food production in Africa will continue to decrease unless soil-fertility depletion is effectively addressed. During in the 1960s, the fundamental root cause of declining per capita food production was the lack of short-statured, high-yielding varieties of rice (Oryza sativa L.) and wheat (Triticum aestivum L.) in Asia. Food security was only effectively addressed with the advent of improved germplasm in this region. Then other key aspects that had been largely ineffective (irrigation, seed production, fertilizer use, pest management, research and extension services, and enabling government policies) came into play in support of the new varieties in Asia. The need for soil-fertility replenishment in Africa, therefore, is analogous to the need for Green Revolution-type germplasm in Asia three decades ago.

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