Land Degradation in SubSaharan Africa: What Explains the Widespread Adoption of Unsustainable Farming Practices?

Bocar Diagana
Department of Agricultural Economics and Economics
Montana State University

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(*revised draft*)

by

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A central question to the sustainable agricultural development debate in SSA is '*why many African farmers unsustainably exploit soils and water and why many do not adopt or adapt other, seemingly superior and already available technologies*' (Barrett *et al*.). In other words**, what explains soil degradation in SSA** or **why is there continued adoption and use of practices that degrade soils?** Existing evidence suggests that there are no simple and unique answers to this question as various, complex and interlinked factors seem to lead to the deplorable situation of resource degradation (especially land degradation) that jeopardizes development efforts. The main objective of this paper is to **contribute to the understanding of these causative factors**. It specifically draws upon a review of existing literature to:

- assess the policy environment under which farmers are operating by describing past and current economic and agricultural policies in SSA;
- identify and discuss the main factors or root causes that have been formulated as hypotheses explaining the soil degradation (SD) phenomenon.

I. Context of Agricultural Production in SSA

Most economies in SSA are agriculturally-based and about two-thirds of Africans depend on agriculture for their livelihoods. In this region, most farmers are smallholders with 0.5 to 2ha, earn less than US$1 a day, face 3-5 hunger months, have large families and are malnourished. The fate of the agricultural sector, therefore, directly affects economic growth, poverty alleviation and social welfare in Africa. As the region's population continues to grow rapidly

(3% per annum), outpacing the growth rate in other regions of the world, the carrying capacity of its agricultural land is becoming lower, bringing closer the land frontier. Extensification on to marginal and quality-poor lands has reached upper limits and, when farmers do intensify land use to meet increasing food and fiber needs, they do it without proper management practices and with little or no external inputs. Resulting consequences are a lowering of soil organic matter in already poor soils, a depletion of nutrients that have contributed to a stagnation or decline of crop production in many African countries. In some cases, the rate of nutrient 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 factors that cause nutrient depletion and land degradation, deteriorating agricultural productivity will seriously undermine efforts to bring about food security and to strengthen the foundations of sustainable economic growth in SSA.

II. A Serious Soil Degradation Process Threatening Food Security and Sustainable Agricultural Growth in Sub-Saharan Africa:

Agricultural productivity and food security in SSA are being seriously threatened by the steady decline in soil fertility, defined as "a net decrease in available nutrients and organic matter in the soil"[1] (Scherr), and caused by the continued nutrient mining of already degraded soils by farmers seeking to increase output. Declining soil fertility jeopardizes the sustainability of farming systems in SSA, especially in arid and semi-arid areas that are ecologically fragile. Highly variable and declining rainfall patterns observed since the 1970s

compound the ecological fragility of these regions which account for half of the cultivable land in SSA (Marter and Gordon). Brady estimated only 12% of African soils to be "moderately fertile, well-drained soils", compared to 33% in Asia.

2.1 **Extent of SD problem:** Batjes reports that degraded soils amount to about 494 millions ha in Africa. It is also estimated that 65 per cent of SSA's agricultural land is degraded because of water and soil erosion, chemical and physical degradation (Oldeman *et al.*; Scherr). Forms of degradation vary with the causative factor: loss of topsoil, terrain deformation, mass movement or overblowing (water and wind erosion), loss of nutrient and organic matter, salinization/alkalization, acidification, pollution (chemical deterioration), compacting/crusting, waterlogging, subsidence of organic soils (physical deterioration). Of the total degraded area, overgrazing, agricultural mismanagement, deforestation and overexploitation of natural resources are said to account respectively for 49, 24, 14 and 13 percent (Oldeman *et al.*; Batjes).

2.2 **Human-induced SD**: through overgrazing, deforestation and inappropriate agricultural activities, it poses a serious threat to land productivity. Response to declining land productivity has been the abandonment of existing degraded pasture and cropland and the move to new land for grazing and cultivation. Unless there are investments in soil conservation, the process will repeat itself in a vicious circle with overgrazing and cultivation causing land degradation, and then the search for new pasture and cropland (Barbier, 2000a).

2.3 **Soil nutrient mining**: Research has shown that soil nutrient depletion resulting from soil mining or the practice of growing crops with insufficient replacement of macro-nutrients removed from the soil is an important problem in low income countries (Bishop and

Allen; Stocking), a fundamental biophysical constraint to steady growth of food production and a very serious cause of SD (Donovan and Casey; Borlaug). On a per ha basis, 22 kg N, 2.5 kg P and 15 kg K are being lost annually as a result of long-term cropping with little or no external nutrient inputs and returned crop residues (Smaling and Stoorvogel; Weight and Kelly).

III. What Explains SD in SSA?

A 3-stage path can picture the process that led to the SD problem described above: poor initial agroecological conditions, degradation process fueled by various factors, and a resulting state of serious degradation (low level equilibrium). Despite adverse and fragile initial conditions, the case can be clearly made that human action bears substantial responsibility in fueling the process of SD, whether unintentionally because of a lack of information/knowledge or voluntarily by responding to existing socioeconomic incentives offered by the policy environment. Various studies stress the role played by resource-poor farmers in human-induced natural resource degradation (Bruntland Commission; Reardon and Vosti; Barbier, 2000a).

3.1 The starting conditions have been rated as *poor* by commonly accepted physical and ecological standards. Under initial conditions, cultivated soils in many regions of SSA are poorly endowed in macronutrients (N, P, S, Mg, Zn), heavily leached, acid and have low soil organic matter (Wong *et al.*). These soils have also been subjected to inappropriate management practices, wind and water erosion. This has triggered a process of vast soil degradation characterized by organic matter and nutrient losses, all of which combine to

affect the soil physical, chemical and thermal properties. Hence, cultivated lands have poor fertility status, reduced soil productivity and low agricultural potential.

3.2 The general policy environment has so far failed to create incentives to adopt sustainable land use and management practices.

3.2.1 Past and current agricultural policies as described in the following historical sequence of voluntary or imposed reforms did not create an enabling environment for sustained agricultural development in SSA. For illustration, Barrett *et al.* present a detailed historical review of agricultural policies in SSA while Kelly *et al.* revisit Senegal agricultural history that reflects what took place in most West African countries. Common features of these two reviews can be briefly summarized in four distinct periods, dating as far back in time as the colonial era:

3.2.1.1. *Colonial period – 1960 political independence*: agricultural development was driven by the needs of the colonial power and mostly centered on developing a cash crop for the colonial economy. The local government ruler was established as the prime mover in the agricultural sector: provision of inputs and credit, guaranteed purchasing of cash crop, import of food from outside (rice from Asia). Research and extension focused on the cash crops, and crop marketing was carried out by the colonial commercial houses.

3.2.1.2.*1960-80*: this was a period of Government expansion, reflective of African socialist ideals that prevailed during the first post independence years in most African countries. The emphasis was on state provision of inputs (subsidized credit and fertilizer), establishment of institutions supporting agriculture through parastatal marketing bodies that gradually replaced the colonial commercial houses and national agricultural R&E services. Heavy handed government interventions, over-

centralization, inefficiency and corruption in the input distribution and marketing parastatal and top down design with restriction in information flow proved fiscally unsustainable, too costly to maintain, distorted farmer incentives to invest in agriculture, sowing the seeds of institutional collapse. The serious economic crisis in the late 70s exposed many of the previously hidden weaknesses of the agricultural development policies and programs.

3.2.1.3. *1980-mid 1990s*: following the macroeconomic crisis in the early 80s, an era of liberalization and structural adjustment was imposed by the Bretton Woods institutions. Drastic reforms aimed at curtailing direct government interventions in the agricultural sector while encouraging private sector actors to fill the gap and at eliminating government subsidies and taxes. The focus was on relying on market mechanisms to 'get prices right'. Reduction in the subsidization of farm inputs caused rise in input prices. Lack of accompanying ancillary investments in physical and institutional infrastructures to support markets reduced the availability of inputs, undermined profitability of crops, thus reduced incentives to invest in soil, water conservation, etc.

3.2.1.4. *Recently (mid 1990s to now):* current development strategies emphasize democratization, good governance and civil society after mediocre results of market-oriented reforms to reduce rural poverty. With the realization that the existence of functioning political and legal institutions is a prerequisite to working market reforms, the focus is now on institutions and information. The virtues of participatory approaches to development, free press, social capital are praised. Attention is on building of community-based organizations, reducing information costs and increasing

information and financial flows through farmer field schools, farmer research committees, and microfinance institutions.

However, despite these voluntary and/or imposed macro policy reforms and strategy changes, the performances of the agricultural sector have remained well below expectations by translating into mediocre results of agriculturally-based economies in SSA. Growing needs of a rapidly increasing population are to a large extent unmet and the natural resource base is still deteriorating. The prevailing economic explanation for the continuing trend towards resource degradation is that push (demographics) and pull (economic incentives) factors often encourage degradation and discourage conservation. As shown below, incentive problems have been attributed to adverse government policies, poor farmers' high discount rates, lack of well-functioning political, legal and financial institutions causing market failures, high capital and transport costs (World Bank), insecure property rights, lack of knowledge and limited availability of fodder for grazing or fuel for cooking and heating (e.g., Lutz, Pagiola, and Reiche).

3.2.2 Push Factor: High demographic growth

High population growth and migration in response to the shortage of land resources are important factors contributing to the degradation of agricultural land in SSA. SSA population continues to grow at higher rates than any other region of the world (3% per year), increasing the need for more food, fiber and other resources (fertile land, water, fuelwood, etc). High population densities occur in many parts of Western Eastern and Central Africa. FAO estimates of the actual supporting capacity of land ranges from 10 to 500 persons per square km. Reviewing data from 37 countries in SSA, Drechsel *et al*.confirmed a significant relationship between population pressure, reduced fallows and soil nutrient depletion. This

indicates a generally unsustainable nexus between population, agriculture and environment that leads through a downward spiral into a poverty trap, instead of the Boserup mechanism of population-driven intensification.

3.2.3 Pull factors that weaken the incentive system

3.2.3.1 Distorted public price and trade policies: An adverse economic environment for agriculture is caused, in part, by the well-known policy bias in many SSA countries against agriculture and rural areas. Pro-urban domestic policies with heavy government spending have contributed to the squeeze on agricultural prices while export crops have been heavily taxed to raise state revenues. These domestic policy biases are aggravated by low and unstable commodity prices caused in part by continued subsidization of agriculture in much of the developed world. These low prices reduce monetary gains from crop production and weaken the incentive to invest in agriculture. Inward-looking trade policies based on import substitution strategies, widespread use of tariff and nontariff barriers to reduce external competition were blamed for increasing input prices, cost of capital, and choking growth. Policy reforms and currency devaluation with immediate and complete effects on prices of imported agrochemicals have reinforced rise in input costs, especially fertilizers (Kherallah *et al*.), but have had partial and/or lagged impact on farm product prices (Reardon *et al*., 1997; 1999). Moreover, there has been some expressed concern that trade liberalization and economy-wide reforms in SSA have opened up the agroindustrial sectors, thus increasing their export orientation, spurring agroindustrialization, rural development and economic, but at the costs of direct and indirect impacts on rural resource degradation, with displacement of landless rural poor to marginal and forest frontier regions (Barbier, 2000b).

3.2.3.2. Farmers' time preferences and high discount rates: many farmers in SSA live on the edge of survival and therefore have been claimed to have myopic time preferences and high discount rates. Hence, it has been argued that these farmers may rationally choose to depreciate their soil resources, e.g., when short-term survival is at stake, or when resources extracted from soils can be more profitably invested elsewhere (McConnell; Diagana). However, Moseley challenged the conventional wisdom of high discount rates by the poor by pointing to observed evidence from the food security and famine early warning fields in Africa that the poor often knowingly eat less in the present in order to preserve productive capital (plough, oxen, seed stock) and improve their chance of producing food in the future; the resulting low rate of time preference calls into question views regarding growth-driven conservation and poverty-induced environmental degradation.

3.2.3.3 Lack of well-functioning political, legal and financial institutions: they result into market failures often associated with resource degradation. Koning *et al*. mention structural 'handicaps' that impede farmer investments in soil improvement techniques. High degree of political and social instability in most SSA countries (civil wars, uprisings against governments, unrest from drought and famine) both increase insecurity for farmers and investment risks. Poor physical infrastructure translate in high transport costs, inflating the difference between prices in urban and rural markets, augmenting farmers' transaction costs and raising the costs of inputs. Insecure property rights inhibit long-term investments in soil conservation.

3.2.3.4 Lack of knowledge/education: Farmers operating small plots of marginal land often lack education and knowledge of how their management degrades soil productivity. Thus, they

may take actions that degrade soil resources, as illustrated by soil fertility 'mining' practices observed in many areas (Stoorvogel, Smaling and Jensen).

3.2.3.5 Limited availability of fodder for grazing or fuel for cooking and heating: crop residues often have a relatively high value when used for animal feed, fuel, and other non-agricultural uses, whereas returns to investments in soil fertility by reincorporating crop residues in the soil are often relatively low. For example, in Senegal, the growth in population and the demand for animal protein, especially in urban areas, has contributed to the increase in the demand for peanut crop residues used for animal feed (Tiffen).

IV. How to Reverse the SD Trend and Meet the Productivity Growth Challenge?

4.1 The productivity growth challenge in SSA: agricultural production grew annually at less than 2 per cent between 1965 and 1980, and at around 1.4 per cent during the 1990s (UNDP/UNECA Report), well under the rapid pace of demographic growth at around 3 per cent per year. To meet soaring food and fiber needs from a fast growing population, it's been argued that agricultural production should grow at an estimated rate of 4 per cent per annum. This would then require an annual increase of 1.5 per cent for labor productivity and of 3 per cent for land productivity (Delgado *et al.*; Cleaver and Schreiber; Larson and Frisvold).

4.2 The Corresponding Nutrient Requirements: 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). 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. Average fertilizer use

has been estimated in SSA at less than 15 kg per hectare as of 1994/95, compared to more than 200 kg in East Asia, 125 kg for Asia as a whole and 65 kg in Latin America (UNDP/UNECA Report). 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 substantially reduce the mineral fertilizer required to maintain current average yields.

4.3 Technology Alone Would Not Work: To reduce net soil nutrient losses, hence reverse SD, several technological options are available to farmers: crop rotation, fallows, use of crop residues or fertilization, or a combination of them. Rotating or sequencing crops allows a smoothing of macronutrient consumption across crops, resulting in high crop yields relative to monocropping, in addition to reduced soil erosion, less negative environmental externalities, better soil fertility and less need for commercial fertilizer (Gebremedhin and Schwab). Regenerative long-term fallows or shorter improved fallow techniques have been progressively abandoned or reduced under the pressure of high population densities (Drechsel *et al*.). The utilization of productivity-enhancing inputs (such as fertilizer) and technologies is very low. McIntire and Powell underscore the enormity of the required pasture areas to produce enough manure to maintain soil fertility in the absence of mineral fertilizer whereas Williams *et al.* claim that, with present intensity of land use in semi-arid West African countries, manure alone would not increase crop yields in a sustainable manner. Competing livestock feed, fuel and construction uses of crop residues constrain their availability for incorporation in soils. In sum, the current situation highlights difficulties of promoting each of the technological

alternatives mentioned above. The reality is that full solution to the ongoing SD requires more than a technological fix, but rather a combination of economic incentives, appropriate technologies, market reform and structural policies.

4.4 Policy Alternatives: To address the threat of nutrient depletion and land degradation, 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 (Debrah *et al*.). Input and output 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. More economic and environmental impact analyses at the country level are necessary to help set priorities for agricultural land issues, to assess the costs and benefits of policy decisions, and to expedite the identification of the type of investments that will be required to prevent land degradation and increase production.

V. Conclusions:

Various causative factors have been identified to explain the adoption of farming practices that have fueled the SD process in SSA. Among them, weak socioeconomic incentives from the existing policy environment have led farmers to respond in ways that have degraded the natural resource base, undermining efforts to promote sustainable agricultural development. Since attempts to solve this problem through the development of improved agricultural practices and related conservation technologies alone have not been successful in most parts

of SSA, the role of socioeconomic incentives becomes important. A combination of technological and policy options should be at the centerpiece of any strategy to combat both poverty and environmental degradation. It appears that emerging policies to mitigate green house gas (GHG) emissions, such as the Kyoto Protocol and other international and national policies, could provide a way to create incentives for farmers to adopt and maintain practices that would have long-term benefits to them individually while also contributing to the global goal of reducing net GHG emissions.

However, promoting carbon sequestration alone to mitigate climate change and reduce net GHG emissions may not attract strong and direct farmer support and participation in SSA. This option has the potential under the CDM of the Kyoto Protocol (if adopted) to be a winning cause and fare better in the arid and semi-arid zones of SSA if addressed jointly with other pressing challenges such as land degradation, declining agricultural productivity, biodiversity preservation, in short the sustainability of agroecosystems. With right policy approaches and socioeconomic incentives, appropriate technologies and integrated management practices, the combined productivity and environmental effects can lead to *win-win* scenarios ensuring farmers' livelihoods, alleviating poverty and protecting the natural resource base. An integrated assessment of these impacts will therefore be necessary to assist policymakers in the formulation of sound and well informed policy measures to reverse SD trends and sustain agricultural development efforts and investments. The SM CRSP Tradeoffs Analysis Project has developed methodological approaches and tools designed for this purpose.

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