NUTRIENT DEPLETION AND SOIL MINING IN SUB-SAHARAN AFRICAN AGRICULTURE

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Agriculture and agro-based industries have long been the backbone of African countries. The production of food, shelter, clothing and energy has gone on throughout man's existence. This practice has gone on without much regards to replenishing the soil nutrients taken up by the crops. A serious limiting factor to the enhancement of agriculture productivity is the steady decline of soil fertility or loss of soil nutrient throughout Sub-Saharan Africa. The region's soils are fragile and deficient in nutrients and organic matter and in the absence of conservation measures, they become susceptible to degradation and loss of nutrients over time from intensive use or misuse. It is known that about 320 million hectares of vegetated lands have been degraded over the past decades in Sub-Saharan Africa.

Nutrient mining is significant in the sub-region especially in arable lands that undergo continuous intensive cropping for extended periods without replenishment of essential nutrients which are removed by growing plants. Estimates indicate a net loss of about 700kg of N, 100kg ofP, and 450kg of K per hectare in about 100 million hectares of cultivated lands over the last 30 years. By contrast, during the same period commercial farms in North America and Europe built nutrient capital by about 2,000kg of N, 700kg of P, and 1000kg of K per hectare.

The major impact of nutrient mining is on crop yield and total food supply. Agricultural production in the sub-region increased by only 1.6% between 1965 and 1980, and about 1.3% per annum during the 1980's. The current yields of cereals in sub-saharan Africa now average 1 metric ton per hectares.

In the past, without direct fertilization by peasant farmers who form the bulk of the agricultural producers, the only means of restoring soil fertility after the land is cropped for sometime was by shifting cultivation or land rotation. This practice which allowed a piece of previously cropped land to rest for some years and naturally restore its fertility, is no more practicable. This is because of the need for more lands for agriculture to produce more for the ever increasing population and more lands for other non-agricultural uses.

The answer to this problem is to keep the land in permanent production with effective restoration of its fertility at all times. This can be achieved through the application of fertilizers, both organic and inorganic.

In view of the fragile nature of our tropical soils, their continuous cultivation and harsh environmental conditions, special measures are required to stabilize soil fertility. There is clearly a need for rapidly changing farming practices involving much greater fertilizer use in combination with high levels of organic residues.

The problems associated with the use of fertilizers are many and are usually beyond the solution of peasant farmers. The policies of fertilizer use in most of our countries do not encourage the peasant farmers to adopt fertilization resulting in soil mining.

Low fertilizer usage has been due to a number of constraints such as:-

1. Fertilizer availability and price affordability
2. Correct methods of application - rates and time of application
3. Genuiness of imported fertilizers
4. Storage problems
5. Distribution systems
6. Credit and subsidy policies
7. Ineffective extension services

Even though fertilizers are the major inputs in food production accounting for over 50% of crop yield increases in Africa, levels of fertilizer input in sub-saharan Africa is very low, being less than 10kg/ha, compared to 70kg/ha in India and 260kg/ha in China (Sobulo, 1993). Meller et al (1987) gave fertilizer the first functional priority in accelerating food production in the sub-saharan Africa and suggested that even under existing technology, it should be possible to achieve a 15% rate of growth in fertilizer consumption leading to a very significant impact on food production.

FAO (1981) has indicated that 55% of the increases in crop yield in developing countries during 1956-76 came from fertilizer uses and that there is a clear relationship between higher fertilizer application and above average agricultural production. The FAO estimates that for all developing African Countries, fertilizer consumption needs to increase to between 4.1 and 6.7 million tonnes by the year 2000.

Even though the general fertilizer use is low in sub-saharan Africa, consumption is increasing steadily. With a total consumption 146,000 tonnes in 1974 there has been a steady growth to 269,000 tonnes in 1977, 389,000 tonnes in 1981 and 491, tonnes in 1985.

The modest growth in rates of fertilizer consumption differ in various countries in the sub-region for a range of technical and socio-logical reasons. Fertilizer consumption in the sub-region is dominated by Nigeria, Senegal, Cote d'Ivoire, Cameroon and Ghana.

In 1989, the average fertilizer use per hectare increased from 1 to 6kg/ha, 1 to 8kg/ha and 2 to 12kg/ha in Burkina Faso, Togo and Nigeria respectively. In Cote d'Ivoire, Ghana and Senegal, there were sharp variations in the levels of fertilizer use over time from 3 to 24kg/ha. During the same period average fertilizer use for Zimbabwe varied between 51 and 68kg/ha; 21 to 68kg/ha in India; 28 to 78kg/ha for all developing countries and 105 to 124 kg/ha for all developed countries (Safo, 1993).

One major factor underlying the low use of fertilizers in sub-saharan Africa is the small local production base. The bulk of the fertilizer production in the sub-region is undertaken mainly by Cote d'Ivoire, Nigeria and Senegal; the remaining countries rely exclusively on fertilizer imports.

Other practices that caue reduction in soil fertility include:-

1. Removal of vegetative covers
2. Charcoal production
3. Annual bushfires
4. Organic materials for other uses
5. Soil erosion
6. Land tenure

Practices that remove the vegetative covers prevent addition of organic matter into the soil. Organic matter is the main source of fertilization in peasant farms in absence of commercial fertilizers.

Organic matter not only supply plant nutrients, but also plays a major role in the maintenance of physical, chemical and biological properties of the soil.

In tropical soils organic matter supplies most of the soil Nitrogen, Phosphorus and Sulphur. Typically, 95% of the total N and S and 55% to 80% P are in the organic form. There is positive correlation between soil organic matter and soil CEC, micro and macronutrients, biological activities and soil physical characteristics (Agboola, 1993).

The main sources of domestic fuel are charcoal and fuelwoods, in the sub-region Charcoal production results in deforestation of the environment and burning of the soils and its organic matter content depriving crops of nutrients. Living organisms are also destroyed. Carbonation of the wood for charcoal occurs on sites for 10 to 14 days causing continuous burning on the site to great depth, and caking the subsoils, (Asiamah, 1989). Shifting of the practices from site to site results in a total sum of large area of the landscape burnt and devoid of plant nutrients. Charcoal production occurs extensively in our rural areas supplying the urban dwellers large quantities of charcoal. It is reported that in the city of Accra and its environ, 79% of the households use only charcoal for their energy (Nketia et a al, 1988).

Bush fires are common in the sub-region not only in the savanna regions but even in the high rainforest zones. The annual burning of the vegetation deprive the soil of plant nutrients.

Most of the organic materials that can be used in place of unavailable commercial fertilizers are in most cases used for non-agricultural purposes especially in our savanna regions, where woody plants are scarce.

Left-overs after harvest are collected and used for a number of works in the home. Building of living rooms, fencing and roof thatch and cooking are the main practices to which the woody fractions of agricultural left overs are put. The leafy materials are also collected off the farm for domestic uses. These practices deprive the farms of organic matter.

Accelerated soil erosion causes loss of soil fertility in the sub-region through loss of the relatively humus-rich and fertile top soils.

It's threat to continued and sustained agricultural production. The erodibility of the soils is high. Soil loss through both wind and water erosion is common in our forest and savanna areas. Several thousands hectares of once biologically fertile lands have become improductive as a results of erosion.

Studies have reveal alarming rates of erosion loss in the sub-region. In the Interior Savannah Region of Ghana, Adu (1972) reported a loss of 90cm of soil by sheet and rill erosion. Some severely eroded savannah land has also lost all of its 120cm thick solum above the unweathered parent rock. Run off plot studies in various ecological zones in Ghana show soil loss to range from 187 ton/ha/year in the semi-deciduous forest zone to 0.56 to/ha/year in the Coastal Savannah Zone (Bonsu, 1979).

In Ghana, results of Soil Research Institute investigations revealed that, 29.5% of the Country is liable to slight to moderate sheet erosion, 43.3% to severe sheet and gully erosion and 23% to very severe sheet and gully erosion (Asiamah, 1987). This trend is common to sub-saharan African countries.

The inappropriate land-use, poor management coupled with defforestation of arable lands have caused the prevailing decline in productivity and increasing land degradation (Sant'Anna 1989).

Land tenure varies from country to country and tribe to tribe. There are quite a number of land tenure and most of them do no encourage the tenant farmers to improve the productivity of the land. In situations where farmers have no permanent title to a piece of land, there is reluctance to adopt conservation and fertility improvement measures. The less secure the land, the greater the tedency to exploit it.

In most parts of Africa, the land is held in trust by the chiefs and family heads or tindanis and are leased to tenants under special conditions. In Ghana, all lands of the Ashanti tribe, belong to the Golden Stool and are held in trust by the paramount chiefs. No land can be bought. Tenant farmers agree either to pay some fixed amount per period or share the crop yields. In some cases, the land may be taken away from the tenant at close notice when he defaults, or when " better tenant" is found. In such situation tenants are not eager to invest to improve the productivity of land but continue to mine the soil.

In most parts of Africa, the problem of food security as a result of poor agricultural yield is becoming more grave annually. This is not due to land availability but principally due to the decline of the productive power of the soils. This condition is due to the absence of culture of maintaining soil fertility at the acceptable levels at all times.

There is an urgent need to adopt policies that will enhance the usage of soil amendments to enrich the soils in Africa. This can be achieved through the strengthening of extension services, making the essential fertilizers available to the farmers at affordable prices and at the correct time of need.

Total solution of the problems mitigating the high and constant yields of our agricultural efforts will definitely help Africa out of its crisis. Experts put it that African countries need Agriculture growth rate of at least 4% annually to solve its food problems. The present trend in food production without effective fertilization and soil conservation must change rapidly to reduce poverty and increase household income. Without restoration of soil fertility, Africa will continue to face the prospects of serious food inbalances and widespread malnutrition and eventual famine. A framework for the restoration of soil fertility should be established in Africa. Opportunities abound in African countries to revitalize agriculture and become self-sufficient in food production.

Total Arable land and land under permanent Crops, Total Fertilizer use and Average Fertilizer Rate per Hectare

	1975	1980	1985	1987	1989
Burkina Faso - 274,200sq km					
a) Crop Area (1000 Ha)	2,536	2,785	3,035	3,140	3,568
b) Total Fert. Use (1000 MT)	1	4	12	18	21
c) Av. Fert.Rate ($kgN + P_2O_5 + K_2O$/Ha)	1	1	4	6	6
Cote d'Ivoire - 322,463sq km					
a) Crop Area (1000 Ha)	2,915	3,095	3,580	3,640	3,660
b) Total Fert. Use (1000 MT)	38	53	42	33	41
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	13	17	12	9	11
Gambia - 11,295sq km					
a) Crop Area (1000 Ha)	152	156	165	170	178
b) Total Fert. Use (1000 MT)	1	2	4	3	2
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	7	13	24	18	11
Ghana - 238,537sq km					
a) Crop Area (1000 Ha)	2,700	2,760	2,820	2,870	2,720
b) Total Fert. Use (1000 MT)	25	12	13	11	8
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	9	4	5	4	3
Nigeria - 923, 768sq km					
a) Crop Area (1000 Ha)	30,000	30,385	31,085	31,335	31,335
b) Total Fert. Use (1000 MT)	54	174	316	310	378
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	2	6	10	10	12
Senegal - 196,192sq km					
a) Crop Area (1000 Ha)	5,000	5,225	2,225	5,225	5,225
b) Total Fert. Use (1000 MT)	47	19	21	21	29
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	9	4	4	4	6
Togo - 56,000sq km					
a) Crop Area (1000 Ha)	1,415	1,420	1,427	1,431	1,444
b) Total Fert. Use (1000 MT)	2	3	10	11	12
c) Av. Fert. Rate ($kgN + P_2O_5 + K_2O$/Ha)	1	2	7	8	8

Source: FAO Agricultural Statistics (1990)

Crop Area represents Total Arable and Land under Permanent Crops.

Fertilizer Production in West Africa: N, P_2O_5 and Total NP
(metric tonnes)

Country	1984/85	1985/86	1986/87	1987/88	1988/98	1989/90
Nitrogen						
Cote d'Ivoire	1,000	2,600	1,000	1,600	-	-
Nigeria	-	-	-	73,000	243,400	272,400
Senegal	10,000	12,000	5,600	16,000	12,000	17,000
N Total	11,000	14,600	6,600	90,600	225,400	289,400
Phosphate						
Cote d'Ivoire	3,100	2,600	2,700	900	1,500	2,500
Nigeria	5,000	5,000	5,000	5,000	27,400	44,100
Senegal	30,000	37,500	30,000	35,000	35,000	42,000
P_2O_5 Total	38,100	45,100	37,700	40,900	63,900	88,600
$N + P_2O_5$						
Cote d'Ivoire	4,100	5,200	3,700	2,500	1,500	2,500
Nigeria	5,000	5,000	5,000	78,000	270,800	316,500
Senegal	40,000	49,000	35,000	51,000	47,000	59,000
NP Total	49,100	59,700	43,700	131,500	319,300	378,000

Source: FAO Fertilizer yearbook, 1990

Average fertilizer use (Kg/ha) in 1989

Burkina Faso	1 - 6
Togo	1 - 8
Nigeria	2 -12
Zimbabwe	51 - 68
India	21 - 68
Developing Countries	28 - 78
Developed Countries	105 - 124

Source: Safo 1993

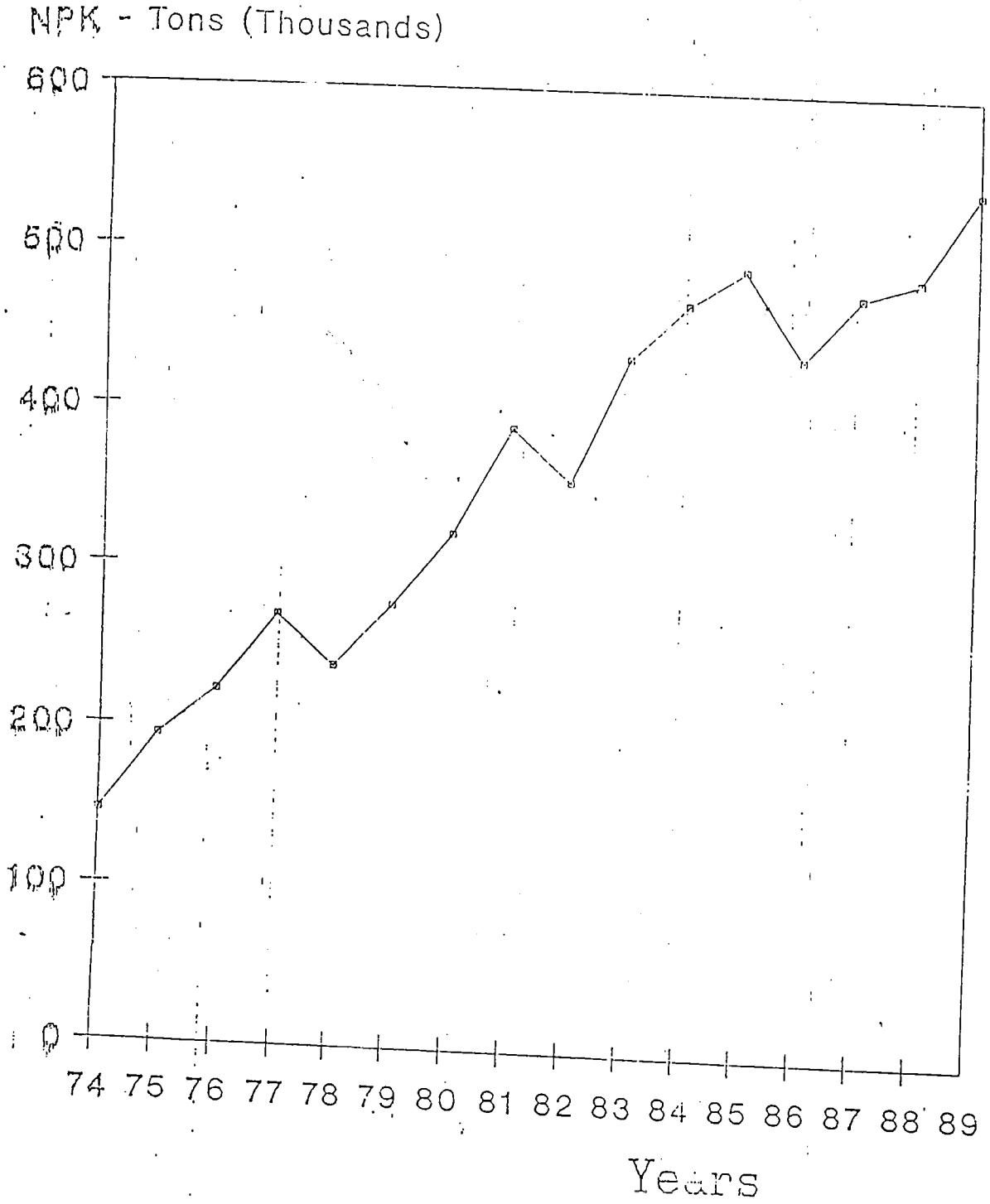

FIGURE 1. FERTILIZER CONSUMPTION - WEST AFRICA (1974-89)

Literature Cited

1. Adu, S.V. (1972): Eroded Savannah Soils of the Navrongo-Bawku Area, Northern Ghana - Ghana Journal of Agric. Sci. 5, 3 - 12

2. Agboola, A.A. (1993): Organic Fertilizer, the key to Sustainable Agricultural Production in Africa. Report on workshop on policies, local sources and usage of fertilizers in Africa. SOFERNET Paper No. 9 Dakar, Senegal.

3. Asiamah, R.D. (1987): Soil Resources and their Agricultural Utilization in Ghana. First Conference on Resources Conservation for Ghana's Sustainable Development. 28 - 30 April, 1987, EPC, Accra, Ghana

4. Asiamah, R.D. (1989): The effect of charcoal burning on the Soils of Afram Plains. Misc. Paper No. 243, SRI, Kwadaso-Kumasi.

5. Bonsu, M. (1979): Soil erosion studies under different cultural policies practices within the various ecological zones of Ghana. Lecture Notes. FAO Training Course in Soil Conservation and Management, SRI, Kumasi.

6. FAO (1981): Agriculture Toward 2000. FAO, Rome

7. Meller, J.M. et al (1987): Accelerating food production in Sub-Saharan Africa. John Hopkins University Press Baltimore. P.353 - 375.

8. Nketia, K.S. et al (1988): The charcoal cycle in Ghana - A baseline study. UNDP/NEB, Accra.

9. Safo, E.Y. (1993): Policies, Local Sources and Usage of Fertilizer in West Africa. Report on workshop on policies, local sources and usage of fertilizers in Africa. SOFERNET Paper No.9, Dakar, Senegal.

10. Sant'Anna, R. (1989): Soil Resources of Africa with particular reference to Ghana. Proceedings Annual Seminar of Agric Eng. Dept., U.S.T., Kumasi.

11. Sobulo, R. (1993): Policies, local sources and Usage of Fertilizers in Africa. Report on Workshop on policies, local sources and Usage of fertilizers in Africa. SOFERNET Paper No. 9. Dakar, Senegal.