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Sustainable and Unsustainable Agriculture in Ghana and Nigeria: 1960 – 2009

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Abstract

The agricultural sector of African economies has faced considerable challenges within the past 50 years or so. Although agricultural production on the continent rose by an annual average of 2% between 1965 and 1980 and has continued to increase by 1.8% annually since then, population growth of 2.9% per year has resulted in a per capita decline in agricultural production. From self-sufficiency in food production before the 1960s, many African countries have become net food importers, with a handful of them facing severe food shortages arising from drought, desertification, climate change and wars. In this paper we use the case of Ghana and Nigeria to explore some of the salient dynamics that have resulted in the current crisis in the agricultural sector of African economies. We argue that soil conditions, climate change, population growth, in combination with ineffective economic policies have contributed immensely to the sordid state of agriculture in Africa. We use historical and contemporary evidence gathered from Ghana and Nigeria during several visits to show how economic policies have interacted with biophysical and environmental factors to generate an unsustainable use of land, agricultural labor, and natural resources. Based on our field research, we propose an "agro-entrepreneurial" model of agriculture that combines sustainable farming practices with entrepreneurship. This model enables farmers to take advantage of emerging markets in the food value chain, as well as enhance their living standards and self-esteem.

Introduction

Most analysts agree that African agriculture has been on an unsustainable path for the past five decades or so; however, there is no consensus on the factors responsible for this unsustainability (Pretty, 1999; Kuyek, 2002; Bryceson 2004). Explanations of the causes of the agrarian crisis in Africa have tended to be monocausal in nature, focusing on single factors like the so-called irrationality of African farmers (Mortimore and Adams, 2001), anachronistic land tenure systems/social structures (Niemeijer, 1996; McCusker, 2004)) and ineffective economic policies that generate perverse incentives for agricultural development (Lipton, 2007). Monocausal explanations have limited our understanding of the dynamics of African agriculture because of a number of reasons. First, they are too narrow in the sense that they ignore several

factors that affect sustainable agriculture. Second, they seem to be Eurocentric by examining African agriculture on the basis of assumptions relevant to Western economies and society (Ochieng, 2002; Hoben 1995). Third, they gloss over the interconnectedness and biophysical feedback loops between the various factors affecting African agriculture.

We believe a more useful approach for understanding African agriculture is an integrated methodology that explores the role of multiple factors that interact in mutually reinforcing ways. In this paper, we seek to provide a historical, biophysical, and socio-economic context for why Africa has become unsustainable in agriculture.[1] Evidence gathered from our visits to Ghana and Nigeria between 2001 – 2008, as well as reports by the World Bank and the FAO, are used to support our analysis. Throughout, we combine multiple perspectives that include economics and environmental sciences. Given the amorphous nature of the concept of sustainability, it is important that we explain our notion of agricultural sustainability upfront before presenting empirical evidence.

Definition of Sustainability

Sustainable development was originally defined in the Brundtland Commission's report, "Our Common Future," as "development in which present generations find ways to satisfy their needs without compromising the chances of future generations to satisfy their needs" (Brundtland 1987). As the field of sustainable development has grown, so has the ambiguity surrounding the precise meaning of sustainability. Arguments have ensued over whether the correct term is sustainable growth or sustainable development, whether or not something can be classified as weak or strong sustainability, and whether or not certain aspects of sustainability are

[1] As Easterly (2006, pp 281-282) points out, agriculture in West Africa was sustainable prior to the 1960s. Farmers were very rational, and used sustainable farming practices that were well-adapted to soil erosion and other biophysical challenges.

viable indicators (Daly 1990, Ayres 2008, Rigby 2001). As of 1995, there were 386 definitions of sustainability, a number which has surely risen in the time since (Jones 1995).

Defining sustainable agriculture in developing countries is a daunting task, as many of the current definitions are couched in ways that make it difficult for objective assessments of the extent of sustainability. Typically, definitions and proposals for sustainable development prepared by environmentalists give insufficient attention to issues of equity and economic well-being of humans, focusing instead on ecosystem health. Conversely, when economists define sustainability there is a tendency to overlook long-term environmental impacts. Our integrated approach to sustainability considers both human inhabitants and ecosystem services.

One common thread in the conventional definition of agricultural sustainability is the notion that sustainable agriculture is a system that "makes the best use of nature's goods and services whilst not damaging the environment" (Altieri, 1995). In other words, sustainable agriculture enhances the "productive values of natural, social and human capital." (Pretty, 1999).

We begin our assessment of agricultural sustainability in Ghana and Nigeria by proposing a conceptual framework that allows for a more objective assessment of the dynamics of agricultural sustainability in Africa. Agricultural sustainability has environmental, economic, and equity ramifications. From an economic standpoint, agriculture is sustainable if farmers are able to generate and sustain output levels that support *a decent living standard* in ways that are both equitable and protective of natural and human capital.[2] For African farmers, a decent living standard includes food security, access to durable housing with sufficient space, clean water and sanitation, basic education for their children, healthcare and self-esteem (Sen, 1999).

From an equity perspective, agricultural sustainability can be perceived in terms of whether a given agricultural system has narrowed or accentuated the inequality between farmers

[2] Since the notion of a "decent living standard" is subjective and varies in time and space, the concept of agricultural sustainability must necessarily be region/culture specific.

and other sectors of the economy. A wide gap in living standards would induce rural dwellers to migrate to urban areas, which would in turn undermine agricultural production and community viability in the rural sector.

Finally, from an environmental perspective agricultural sustainability must include the management of carbon, nitrogen, and water. Even developing countries must consider the global impacts of their agricultural and industrial practices.

First, agriculture must strive to be at the bare minimum carbon neutral, and preferably, given current atmospheric levels of carbon dioxide, transfer carbon from the atmosphere to the biosphere and geosphere. Second, water, specifically virtual water (the water used to grow or produce an item, analogous to embodied energy) should not create a net water deficit within a watershed or country (Hoekstra 2009, Hoekstra 2007). Third, nitrogen must be managed carefully, an often overlooked barrier to sustainable development in both developed and developing countries (Gruber and Galloway 2008).

In developing countries failure to manage nitrogen in agriculture effectively limits sustainable development. Developing countries like Ghana and Nigeria cannot always afford to purchase sufficient levels of nitrogen fertilizer to optimize crop yields, and population pressure on forest cover has shortened rotation times in traditional slash and burn agriculture to the point where nitrogen replenishment of soils by nitrogen fixing plants is insufficient. On the opposite end of the nitrogen use continuum, the extensive disposal of human waste and general absence of well-functioning sewage treatment facilities creates a failure of sustainability as it relates to diminished human health and decreased quality of life.

Transformation of Agriculture in Ghana and Nigeria, 1960-2009

Sustainability, as the previous section showed, has environmental, economic and equity dimensions. In this section, we use these three criteria to show that agriculture in Ghana and Nigeria has worsened over the last fifty years.

Environment

Through direct observation and evaluation of available data we have measured trends in precipitation, soil fertility and fertilizer use, forest cover, and agricultural practices.

Precipitation

Rainfall patterns in both Ghana and Nigeria have been shifting over the past fifty years. The Ghanaian EPA estimates that rainfall for all of Ghana has been decreasing by 2.4% per decade since 1960 (Haven 2004). Similarly, the length of the rainy season in North East Nigeria has been decreasing since 1961, as has the total amount of rainfall received (Hess et al. 1995). In the northern regions of both countries rainfall is already becoming more sporadic, intense, and less reliable (All Africa 2008 a,b,c).

On repeated visits to Ghana and Nigeria we were told by long-term residents that the beginning of the rainy season was delayed and shorter in overall duration. Additionally, farmers described rainfall as being more intense, causing greater runoff, flooding, and erosion, as well as lower rates of infiltration. Rainfall intensity is important to farmers because it can dictate success or failure of crops, whereas total rainfall gathered in collectors might not reflect this impact.

Changes in precipitation intensity, duration, and quantity over the last fifty years would have been enough to raise challenges to sustainability, but these effects have been compounded

by a series of additional environmental factors, anthropogenic impacts on the environment, and economic stresses.

Forests

Multiple factors have led to the increasing rate of deforestation in Ghana and Nigeria. When Ghana received independence in 1957, forest cover measured 8.2 million hectares. In the time since, deforestation has progressed at an annual average of 65,000 hectares lost per year, leaving only 1.6 million hectares of forest cover (Safo 2002). Ninety-five percent of Ghana's high forest has already been logged and only 1% of what is left is within protected areas such as wildlife sanctuaries, game reserves, and sacred groves (Anane 2007) (Figures 1 and 2).

In Nigeria, areas dominated by guinea vegetation (trees, woodlands, and shrubs) decreased by 50% during the same period, with the majority of the area converting to agricultural use in the 1990s. Between 1986 and 1990, forest area declined by 3.1 million hectares and between 1990 and 1995, the amount of covered area declined by an additional 3.3 million hectares (FAO 2002).

Causes of deforestation include increasing population, resulting in shorter rotations of slash and burn agriculture and increased demands for charcoal production. Several rural communities in Ghana are cutting down trees for processing into charcoal, which has become a source of income for cash-strapped rural dwellers (See section on Economy for further discussion of charcoal processing). Village women describe having to walk increasingly long distances – sometimes 12 hours – to gather sufficient fuelwood for home use.

Soil Quality

Declining soil fertility is now a serious constraint to agricultural production even though more land is under cultivation (See arable land and deforestation graphs). Ghanaian and

Nigerian soils are developed on thoroughly weathered parent materials and have been leached for a long time, leaving very few of the nutrients necessary to support plant growth. As a result of population increase, pressure on land has reduced the 8-15 years natural fallow period that is required to regenerate soil fertility after 1-3 years of cropping to only 2-3 years, further reducing soil fertility (FAO 2004 a, b). Soils are not adequately protected by cover crops as crop rotation is hardly practiced, resulting in easily fragile soils that are easily eroded, a problem exacerbated by overfarming.

Almost all the nutrient balances in Ghana show a deficit as more nutrients are removed by harvesting or lost to erosion than are applied as fertilizers (FAO, 2004). This represents a loss of potential yield and progressive soil impoverishment. According to FAO estimates, cassava and yams account for almost 20 percent of the cropped area, but 37 percent of the nitrogen deficit. The highest depletion rates are in the southeast and the central west parts of Ghana, which correspond to the cassava area (FAO 2005).

These nitrogen deficiencies, though, are not overcome with fertilizer application as is the case in the developed world. The application of fertilizers to soils throughout Ghana is very low, as fertilizer use has been on the decline instead of increasing as the cropped area expands. In the 1980s fertilizer imports were reduced and subsidies removed, resulting in the price being too high for most farmers (See discussion below regarding impact of structural adjustment programs of the 1980s). Fertilizer use declined from 21.9 kg of fertilizer material per hectare arable land in 1978 to 7.3 kg/ha in 1993. At the same time that Ghanaians and Nigerians are running nitrogen deficits in their agricultural fields they are also failing to recapture nitrogen from human waste, which is largely untreated. The indiscriminate disposal of human waste also creates a human health hazard. Data such as these reinforce the notion that nitrogen management must be considered in any definition of sustainability.

Economy

From an economic standpoint, Ghana and Nigeria have transitioned from an era of sustainable agriculture to an unsustainable period. Following the United Nations' declaration of the 1960s as the "First Development Decade" for developing countries, several Sub-Saharan African (SSA) countries achieved impressive growth rates that averaged 6-8% per annum. More encouraging, perhaps, is the fact that these growth rates were accompanied by a robust agricultural sector that proved to be sustainable from the economics standpoint.. The agricultural sector was not only the mainstay of the Ghanaian and Nigerian economies in the 1960s, it did so without posing serious threats to these countries' ecosystems and natural environment. As Table 1 shows, agricultural output in Ghana was robust (with value added/GDP ratio of more than 40%) in the 1960s without intensive use of forest land. For instance, just half of Ghana's land area was devoted to agriculture. In Nigeria agricultural exports represented about 85% of total exports in the 1960s, and contributed 60% of the GDP (Cohen, 1981, p.39), though about three-quarters of the country's land area was under cultivation. Subsistence agriculture in both Ghana and Nigeria was based largely on the time-tested methods of shifting cultivation, crop rotation, and organic farming, without extensive use of fertilizers.

Things began to take a dramatic turn, however, in the 1970s. Agriculture's role in the Ghanaian and Nigerian economies not only began to falter, but also glided into a new trajectory that proved to be unsustainable. While agricultural value added began to decline in the 1970s, agricultural land and the area devoted to farming were on the rise - a phenomenon that signaled the onset of declining productivity in the sector. As Figure 2 shows, agricultural land as a percentage of land area in Ghana rose from 51% in the late 1960s to 65% in 2005. Arable land as a percentage of land area also increased from 7% in 1969 to 18% in 2005. There were similar changes in land use in Nigeria, but they were not as dramatic as those of Ghana. For instance,

agricultural land as a percentage of land area rose from 77% in 1969 to 81% in 2005, while arable land as a percentage of land area increased from 30% to 35% within the same period.

The patterns of agriculture that emerged in Ghana and Nigeria from the 1970s onward are unsustainable for a variety of reasons. First, despite increases in agricultural and arable land, agricultural value added as a percentage of GDP in Ghana dropped from 46% in 1969 to 37% in 2005. Second, arable land per person continued to remain at zero, implying the scarcity of land for agricultural production. Although data on agricultural value added in Nigeria during the 1960s to 1990s are not available, data for the 2000s suggest a downward trend. Agricultural value added as a percentage of GDP fell from 40% in 2002 to 33% in 2005, while arable land per person plummeted from 1 hectare to zero (see Tables 1 and 2).

Equity

Agriculture in the 1960s was equitable in Ghana and Nigeria because farmers were able to generate decent income levels. Notice from Tables 1 and 2 that GDP per capita in the 1960s in both countries were not significantly different from the levels in the 1900s (1900s?) and beyond. In recent years, however, farmers in Ghana and Nigeria have witnessed a deterioration in their living conditions. Indeed, it is now believed that many Ghanaians and Nigerians enjoyed higher living standards in the 1960s than they did in the 1990s (Ayittey, 1999). The expansion of both agricultural and arable land, amid falling agricultural value added, implies that Ghanaians and Nigerians are using up more and more resources to produce less and less output. Consequently, they are increasingly becoming dependent on food imports to meet growing shortfalls in

domestic food supply.[3] As subsistence agriculture has not been able to generate sufficient income for rural farmers, more and more people have begun to migrate to urban areas in both Ghana and Nigeria. In 1961 76% of the Ghanaian population and 83% of the Nigerian population lived in rural areas. By 2005, these numbers had dropped drastically, to 52% for Ghana and 54% for Nigeria (Figure 3). Furthermore, of those living in urban areas in Ghana and Nigeria, 70% and 79%, respectively, were living in slums, as designated by the United Nations Human Settlements Program (UN-HABITAT).

Post-Independence Development Strategy and the Agrarian Crises in Ghana and Nigeria

As Ochieng (2002) points out, sustainable agriculture in Africa cannot be understood without analyzing the "historical, biophysical, socio-economic, and politico-institutional factors" in which it is embedded. We focus on the socio-economic dimension of African agriculture in this section.

The transition by Ghana and Nigeria into unsustainable agricultural systems can be attributed to their adoption of ineffective development strategies after independence. The problems created by this development strategy have also been exacerbated by the implementation in the 1980s of structural adjustment programs (SAP) by both countries, and rapid population growth especially in rural and poorer segments of the population.

Following their explicit commitment to economic development and self-reliance, the post-independence governments in Ghana and Nigeria adopted the Import-Substitution

[3] In May 2008, the Ghanaian government entered into a bilateral agreement with the Ethiopian government for the importation of meat from the latter country (See the Ghanaian Times, May 24, 2008). This is despite the availability of large swaths of land in northern Ghana. At about the same time that the agreement was signed, the Ghanaian government provided several hectares of land in Tamale (northern Ghana) to a Norwegian bio-diesel company for growing *jatropha* ---- a plant that produces seeds used for making bio-diesel. There is a debate amongst economists with regard to whether it makes more sense for an African country to focus on agricultural activities that generate cash (such as jatropha, cocoa, and palm-kernel) or on food production that makes it unnecessary to import food. Those who favor the former approach argue that the cash generated could be used to finance food imports, while those in favor of the latter strategy contend that it reduces the dependency of the country on food imports.

Industrialization (ISI) strategy that focused on the promotion (through tariff protection, tax concessions, and other incentives) of "infant" industrial enterprises.[4] Apart from the expected foreign exchange savings from smaller imports of manufactured goods, ISI was also expected to create more jobs, transfer technology and skills to the local population, and help diversify the monocultural economy – an economy that had been encouraged by the colonial administration to produce and export cash crops (Ake, 1981). The theoretical basis for ISI was Arthur Lewis's "Theory of Surplus Labor," which contends that low productivity arising from surplus labor in the agricultural sector of developing countries is mainly responsible for the poverty and underdevelopment of rural dwellers.[5] The Lewis model also assumes that, due to surplus labor, the marginal product of labor in the agricultural sector is negative. The solution to the low productivity and poverty in the rural sector, according to this model, is to draw labor away from the agricultural sector to the industrial sector until the marginal product of labor becomes positive. Thus, a policy of accelerated industrialization is what is needed to transform rural communities.

However, ISI generated unanticipated backwash effects that undermined agricultural development in Ghana and Nigeria. For instance, the government sought to promote industrial development by transferring funds generated in the agricultural sector to finance industrial development. This was accomplished by the establishment of "marketing boards" that set mandatory prices for cash crops, which resulted in the loss of income for farmers, particularly when world prices for those commodities were rising.[6] Thus, many primary producers in villages across developing countries experienced worsening commodity terms of trade and

[4] Ghana was the first country in SSA to achieve independence in March, 1957, followed by Nigeria in October 1960.
[5] Lewis won the Nobel Prize in Economics in 1979 for his work on economic development. He was (and still is) the first black economist to win the Nobel Prize.
[6] The marketing boards typically set commodity prices below international levels, and keep the difference for use in the industrial sector.

immiserizing growth.[7] Terms of trade were unfavorable to rural farmers during the post-independence era because of "selective industrial protection, subsidized food imports, compulsory procurement of farm products and exchange rate over valuation." (Lipton, 2007, p.56). At the same time, the prices of manufactured goods were rising, worsening the living conditions of rural dwellers in villages across West Africa. And ultimately the world price for agricultural goods like rice, cocoa, tea, groundnuts, also fell.

To attract foreign investors in the industrial sector, the Ghanaian and Nigerian governments promoted infrastructural development in urban areas, and neglected rural communities. This partly explains why rural communities in Africa lack basic social amenities like water, electricity, sewage systems, health centers and schools.[8] Additionally, the concentration of industrial enterprises in the urban areas meant that villagers could only find non-agricultural jobs by migrating to the urban areas –a process that led to the neglect of agriculture and abandonment of the rural sector.

Structural Adjustment and Sustainable Agriculture in Ghana and Nigeria

The Lewisian assumption that ISI would promote industrial development and draw surplus labor away from the agricultural sector became illusory after two decades of its implementation. In fact, Africa appears to have had the worst of two worlds: a world in which agriculture has become more unsustainable, and another in which the continent's industrial performance has been abysmal.[9]

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[7] Immiserizing growth is a phenomenon whereby, as a result of unfavorable terms of trade, farmers' indifference curves shift toward the origin as they increase their output. In other words, they experience declining welfare as their output rises. The wave of rural-urban migration witnessed by several African countries in the 1960s and 1970s was attributable to this phenomenon.

[8] During our trip to Ghana in the summers of 2007 and 2008, we visited several villages that lacked basic amenities, especially clean water and roads.

[9] Most countries usually find themselves in *one* of the following situations: a vibrant agricultural sector, but weak industrial sector; a strong industrial sector, but weak agricultural sector, or with both a strong industrial and agricultural sectors.

By the early 1980s, a decade aptly characterized as a “lost decade” for Africa, it became obvious that the continent was sliding over a dangerous economic cliff. To prevent deterioration in their economies, and upon the urging of the World Bank and the IMF, many African countries implemented neoliberal economic policies or Structural Adjustment Programs (SAP) in the 1980s. The introduction of SAP was expected to not only reverse this inglorious industrial development trajectory, but also to set African enterprises on a new path of efficiency, higher productivity, and international competitiveness. SAP is premised on the notion that once African countries get “their prices right” through trade liberalization, devaluation, privatization, removal of government subsidies, and reduction or elimination of budget deficits, firms will respond by reducing inefficiency, eliminating wastes, and raising total-factor productivity.

SAP is predicated on the same assumption of the Lewis model: the notion that industrial development is the key for transforming the rural sector. In addition to promoting industrial development SAP also introduced explicit policies (mainly price incentives) for strengthening the agricultural sector. A key component of structural adjustment is the removal of price controls and the abolition of marketing boards that had for many years monopolized the buying and selling of primary products. Structural adjustment and the removal of price controls were expected to boost farmers’ incomes. With the attractiveness of agricultural production under SAP, farmers are expected to invest in land acquisition and improvement. In some cases, marginal land may be brought under cultivation.

Rather than promote agricultural development, SAP has exacerbated some of the problems created by ISI. One of those problems is rural-urban migration, which has now taken a new dimension. Following the liberalization of product markets under SAP, the prices of goods and services have increased significantly in both Ghana and Nigeria. For instance, the consumer price index for all items in rural areas more than doubled from 482.3 (with 1975 as a base year) in 1985, a year before SAP was introduced in Nigeria, to 1,194.6 in 1989 [Central Bank of

Nigeria, quoted in Anyanwu (1992, p.20)]. Rural dwellers are also now required to pay user fees for social services previously provided free-of-charge by the government, or heavily subsidized. This means that farmers have to generate additional income to cope with the increase in the cost of living. Unable to cope with the escalation in the cost of living, many young rural dwellers are migrating to urban areas to explore better job opportunities. Our visits to villages in Ghana and Nigeria show that a preponderance of rural dweller are mainly older men and women who, by virtue of old age, are unable to migrate. They are also too frail to work long hours on the farm, thus leading to a reduction in agricultural productivity.

Following a review of rural household surveys in a number of African countries, Bryceson (2002, 2004) concludes that neo-liberalism (or SAP) has exacerbated poverty in rural Africa by weakening the continent's "agrarian foundation" and by accelerating the pace of "deagrarianisation and depeasantisation" of the region. According to Bryceson (2002, 2004), the removal of subsidies for agricultural inputs and social programs such as health and education, has forced rural farmers to diversify their income sources. This attempt at diversification has resulted in a shift of resources to non-agricultural activities, thus undermining agricultural production–which structural adjustment ostensibly strives to promote.

Several rural communities in Ghana appear to be coping with the escalation in the cost of living by resorting to unsustainable use of natural resources. Specifically, they are cutting down trees for processing into charcoal, which has become a source of income for cash-strapped rural dwellers. It is not uncommon to find hundreds of bags of charcoal along the Kumasi-Tamale highway, waiting to be transported onward to Accra, Cape Coast and other cities in Ghana. It is estimated that structural adjustment in Ghana caused a 4% loss in GDP just due to environmental degradation. Agriculture imposed the greatest environmental costs, at 69% of the total or 28.8 billion cedis (U.S. $88.5 million). These costs were reflected in wind and water erosion, soil compaction, surface soil crusting and loss of soil stability and fertility, nor forgetting the

indiscriminate use of fertilizers and pesticides. While these unsustainable agricultural practices had adverse effects on the environment, they also intensified the poor living conditions of a majority of Ghanaians (Anane 2007).

The Village of Umuluwe, Southeast Nigeria as an example of unsustainability

To really understand the impact of failing sustainability of agriculture on widening the equity gap for rural dwellers in Ghana and Nigeria we describe below the village of Umuluwe in Nigeria. In our travels in Ghana and Nigeria we found many villages like Umuluwe suffering the effects of failing biophysical factors, increased population pressure, and poor economic strategies resulting in extreme poverty and inequity.

We carried out two surveys of about 300 individuals in the small village of Umuluwe in Southeast Nigeria in 2001 and 2007. The village of Umuluwe is situated within the predominantly Christian southeast region of Nigeria, and is about 30 miles west of the regional capital of Owerri. Like most communities in Igboland, the Umuluwe people live in a close-knit village of about 3000 people. Except for interaction (through marriages, the church, and trade) with other neighboring villages, Umuluwe residents have limited contact with the outside world.

Umuluwe is representative of rural West African villages with difficult access from outside areas. The roads are quite a challenge for regular cars that, due to the pervasive poverty, are a luxury only very few can afford. There is no bus line, and people walk daily for hours back and forth to reach the nearby villages and the markets where their products are sold. As a consequence of inadequate infrastructure, people cannot commute to work outside the village. Electricity was introduced only in the last seven years, due to the concerted effort of the community. However, because of undersupply and transmission problems, a chronic problem in

Nigeria, power is on intermittently. There is no running water; the only water source is a small spring about one mile away from the center of the village. The soil has low fertility, and the absence of livestock makes agriculture unsustainable in a poor community unable to afford chemical fertilizers.

Per capita income in the village is about $150 per annum, and the main sources of income are cash crops (palm trees and fruit), water and paving stone – the same sources of income it has relied on for at least the past five decades. Farming is mainly for subsistence, although surpluses are sometimes produced and sold at the weekly markets in neighboring villages. Proceeds from such surpluses are used to purchase items such as meat, milk, sugar and bread. The villagers also use the proceeds to pay community dues, school fees for their children, and healthcare costs.

With support from four research assistants who are residents of the village, socio-economic data were gathered from villagers who still reside in the village and those who migrated to Obigbo–a satellite town about 120 miles from the village.[10] Data were collected on income, savings, investment, assets, debt, remittances, occupation, education, apprenticeship training, gender, age, marital status, etc. Many of the individuals were also interviewed face-to-face in order to obtain descriptive information.

We use the survey data to compute *the poverty headcount index* for the village. The poverty headcount index was calculated by finding the ratio of individuals who lived below the poverty line to all the individuals in the survey.[11] The index is reported in Table 3, and it reveals a very high poverty rate in the village, with 87 percent of all the respondents living below $1 per day. An upward revision of the poverty line to $2 per day increases the poverty rate amongst the respondents to an alarming 94 percent; a rate rarely seen in most developing countries. A

[10] About 80 percent of the respondents belonged to the non-migrant category, and the rest were migrants. With the help of a local research assistant, we were able to trace the migrant households to their location in Obigbo. We lived in the town of Obigbo for about one week.

[11] We follow the conventional definition of the poverty line as an income of $1 per day, which was equivalent to Naira100 in the year 2000, the reference year for the income data collected for the village.

follow-up survey was undertaken in the same village in 2007 in order to investigate whether the poverty profile of the villagers had changed. Data on the poverty headcount index are summarized in Table 4. As the table shows, poverty was still prevalent in 2007, but at a lower rate compared to the 2001 levels.

Non-income measures of poverty such as protein consumption, number of meals per day, the proportion of income spent on food, type of fuel used for cooking, savings, debt, landownership, etc. may be better markers for how really poor the villagers are. Data on some non-income measures of poverty in Umuluwe are summarized in Table 5. Three of these measures point to the existence of chronic poverty in the village. About 75% of the respondents indicated that food accounted for the largest proportion of their expenditures, and only 33% consumes milk at least once weekly.[12] About 24% indicated that they consume meat at least once every week. Over 60% of the respondents were in some type of debt. Surprisingly, over 90% used firewood as the main mode of cooking, while about half of the respondents owned no land.[13]

Although undernourishment is not a major problem in Ghana and Nigeria (only 10% of the population in these countries are hungry), Table 5 suggests that low protein consumption is widespread. Malnourishment is of greater concern in Ghana, where protein production and consumption are very low. Ghanaians survive on a surfeit of starchy vegetables such as cassava, yam, and coco yam to provide an adequate number of calories. Compared to other non-African countries and Nigeria, the average Ghanaian receives very little protein from either animal sources or pulse consumption. Moreover, the over reliance in Ghana on starchy vegetables has

[12] According to Engel's law, expenditure on food is an important determinant of poverty. Poor households spend a large proportion of their income on food, and that proportion declines as income increases.

[13] Chronically poor individuals in Umuluwe often resort to the sale of their land as a strategy for responding to shocks. This response mechanism has rendered many of them landless and more vulnerable to exogenous shocks. They become, according to Khan (2000, p.27) "noncultivators" who rely on "seasonal demand for labor in agriculture and in rural informal, small-scale industries and services."

led to a vitamin A deficiency, as the vitamin is found primarily in green and orange fruits and vegetables. The deficiency can lead to stunted growth and blindness, especially in children (Aguayo et al. 2007). Nigerians also consume very few calories from animal products compared to other non-African countries, but their level of pulse production is equal to more advanced countries in Latin America and Asia. Ghana imports nearly no supplemental protein, further increasing the deficiency (FAO 2004a).[14] In earlier times when forests were more abundant, bushmeat was a more readily available protein source (Barth 2008). Similarly, when water was more abundant and populations were smaller, fish provided sufficient protein to a greater proportion of the population. Neither forest nor aquatic ecosystems are now able to provide adequate nourishment to the rising population. While there is not a calorie crisis in either country at the present time, the prognosis for the future is not bright, if agricultural practices do not change in either country. In the next section, we propose a model of agriculture that has the potential of promoting environmental sustainability, while ensuring economic viability and equity for farmers.

An Integrated Approach to Sustainable Agriculture in Ghana and Nigeria: The Ebenezer Farm

Given the failure of SAP and other approaches to agricultural development in Africa, a completely new approach to sustainable agricultural is required. One precondition for sustainable agriculture in Africa is economic empowerment within rural communities that ensures food security and access to the basic needs of life in a way that also protects the natural environment. Rural farmers in Africa will continue to use resources in unsustainable ways, as long as they are economically desperate, socially isolated, and politically marginalized.

[14] In recognition of the low level of protein consumption in Ghana, the Ghanaian government entered into a bilateral agreement with the Ethiopian government in June 2008 for the importation of beef from Ethiopia ((See the Ghanaian Times, May 24, 2008)

We propose an "agro-entrepreneurial" approach to sustainability that combines farmers' innate entrepreneurial abilities with sustainable agricultural practices. This approach is appropriate for African farmers because of a number of reasons. First, African farmers are unlikely to increase output or income significantly without resorting to unsustainable agricultural systems ---fertilizer use, Genetically Modified Organisms (GMO), deforestation for charcoal, etc. Second, markets and consumer tastes are evolving in ways that offer opportunities for African farmers to increase their income. Third, almost five decades of rural-urban migration have shown that farmers cannot enhance their livelihood significantly by leaving their communities.

African farmers can strengthen their economic security by adopting sustainable agricultural systems, and targeting their production to take advantage of new demands and consumption patterns. One simply example is when organic farmers in an African village establish a restaurant in which only organic meals and products are served.

The agro-entrepreneurial approach to sustainability consists of four major components: "sustainable farmers" within a given village, "sustainable extension officers," "green entrepreneurship experts," and an "agro-entrepreneurial bank" (Figure 4). Each of these components is explained below.

Sustainable Farmers: A major goal of the agro-entrepreneurial model is to encourage the emergence of a coterie of farmers who can combine sustainable farming systems with entrepreneurial initiatives that add value to their agricultural production.

Sustainable Extension Officers: A preponderance of extension officers in Africa are trained to transmit conventional (and in most cases unsustainable) agricultural practices to farmers. A

precondition for the successful implementation of the agro-entrepreneurial model is availability, within village communities, of extension officers knowledgeable in sustainable agriculture.

Green Entrepreneurship Experts: the agro-entrepreneurial model is premised on the idea that markets are evolving in ways that provide income-generating opportunities for African farmers. Experts with knowledge in green entrepreneurship must be available to assist farmers to identify and take advantage of those opportunities.

Agro-Entrepreneurial Financial Institutions: sustainable farmers will need funding in order to undertake agro-entrepreneurial projects, but this funding is unlikely to be provided by traditional financial institutions. New financial institutions that have the skills, expertise, and interest to identify and support agro-entrepreneurial projects will be needed for the successful implementation of the agro-entrepreneurial model. The agro-entrepreneurial approach to sustainability that we propose is exemplified by a farm we visited while in Ghana in June 2008.

Nash K. Omari, owner and manager of the Eden Turon Ebenezer Farms in Nkawkaw, Ghana, is an example of a farmer using largely sustainable economic and agricultural farming practices. He practices water efficiency, wise nutrient management, ecosystem cycling, maintains forest cover, produces diverse sources of protein, and makes a profit.

The Ebenezer Farm is fairly compact (less than five hectares) and located on a main highway in the Kwahu South District in south eastern Ghana. Omari raises grasscutters, porcupines, pigs, goats, chickens, and guinea pigs. He feeds them with waste vegetation from his orchards where he grows oranges, bananas, papaya, mango, and fields with tomatoes and peppers. He returns the animal waste to the fields as fertilizer. In addition, he raises bees for honey that in turn pollinate his crops.

A small stream runs through his property. Omari has diverted the stream into two contiguous cement pools separated by earthen dams. In the pools he was raising multiple species of fish. This practice could be improved upon – and Omari was very open to suggestions – by repeating his technique of nutrient management he was using with his land-based animals. For example, Omari disposes of nutrient rich sludge on unfarmed land when he could be applying it as fertilizer to his fields. Moreover, he could grow hydroponic vegetables in the water exiting his pools thereby removing excess nutrients from the stream and raising another marketable crop.

Omari was constructing a restaurant on his property along the highway. What makes the Ebenezer farm sustainable is the fact that it has succeeded in integrating sustainable farming practices with economic principles and entrepreneurial initiatives that ensure adequate returns on investment. The owner uses mainly family labor, augmented by wage labor, to run the farm. His wife and three of their adult sons work on the farm. One of them studied agricultural sciences at a university in Lome, Togo. Rather than seeking paid employment in the public sector, the usual career path for many university graduates in West Africa, his parents encouraged him to join the family farm. Although Omari and his family own a decent house in Accra (the capital of Ghana), they live in a very modest house on the farm.

Omari is a very astute and shrewd entrepreneur, and he exemplifies the classic "rags-to-riches" image of successful entrepreneurs. After being turned down for a loan from banks, he used his savings from his previous job as a sailor to start the Ebenezer farm. He traveled round the world as a sailor, as far as Miami in the United States. His globetrotting may have exposed him to the basic tenets of entrepreneurship and market economics that are not known to many rural farmers in Ghana. Interestingly, and also quite typical of banks, once his farm started showing profit he was able to obtain loans that enabled him to significantly expand his farm. In summer 2008, he started construction work for a restaurant on his farm that will use ingredients

from the farm ----fish, poultry, vegetables, fruits, etc. It was being conceived as a "green restaurant" based on fresh ingredients, with virtually no processed condiments.

The Ebenezer farm supplies fish, poultry, and fruits (mainly oranges) to high-end supermarkets and restaurants. Recognizing the uniqueness of his farm, Omari seeks to maximize revenue by also pitching the farm as an eco-tourist attraction. The location of the farm along the busy Kumasi-Accra highway, a major hub for tourists, is not fortuitous. Our attention was drawn to the farm on our return journey from northern Ghana to Accra.

Conclusions

Monocausal explanations have offered incomplete, and sometimes misleading, accounts of why agriculture in Africa has become unsustainable. Evidence from Ghana and Nigeria, however, suggests that agricultural sustainability has environmental, economic and equity ramifications. Specifically, the biophysical configuration of both countries has changed over the past five decades in ways that have grave implications for agricultural sustainability. Soil conditions, rainfall patterns, and forest use have all changed for the worst, making farmers in Ghana and Nigeria susceptible to declining productivity and poverty. The perverse biophysical conditions in these countries have also been exacerbated by ineffective economic policies that encourage farmers to use their human and natural resources in unsustainable ways. Despite the increasing use of agricultural and arable land, Ghanaian and Nigerian rural dwellers are no better economically now than they were shortly after independence.

To promote sustainability in the agricultural sector of Ghana and Nigeria, we propose an "agro-entrepreneurial model" of agriculture that embeds sustainable farming within the context market-driven entrepreneurship. The food value chain is evolving in ways that offer new opportunities for farmers to significantly increase their incomes, as well as raise their living

standards. African farmers can no longer afford to continue on the path of unsustainability --a path that has not only been destructive of their natural environment, but also anathema to their economic and physiological well-being.

Table 1: Indicators of Sustainability of Agriculture in Ghana, 1961-2005

Indicator	1961	1962	1963	1964	1965	1966	1967	1968	1969		1987	1988	1997	1998	1999	2000	2001	2002	2003	2004	2005
Arable land, hectares per person	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
Agric. Value added as % of GDP	35	38	36	35	44	43	40	42	46		51	50	36	36	36	35	35	35	37	38	37
GDP per Capita*	268	270	274	273	270	253	256	252	262		199	204	234	239	244	247	251	256	264	272	282

Source: World Development Indicators (World Bank online database)

* At constant 2000$

Table 2: Indicators of Sustainability of Agriculture in Nigeria, 1961-2005

Indicator	1961	1962	1963	1964	1965	1966	1967	1968	1969		1987	1988	1997	1998	1999	2000	2001	2002	2003	2004	2005
Arable land, hectares per person	1	1	1	1	1	1	1	1	1		0	0	0	0	0	0	0	0	0	0	0
Agric. Value added as % of GDP	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	49	43	34	33
GDP per Capita*	297	302	320	328	336	314	258	249	302		317	339	368	365	359	369	370	367	394	426	438

Source: World Development Indicators (World Bank online database)

* At constant 2000$

Figure 1: Agricultural and arable land as a percentage of total land area in Ghana and Nigeria

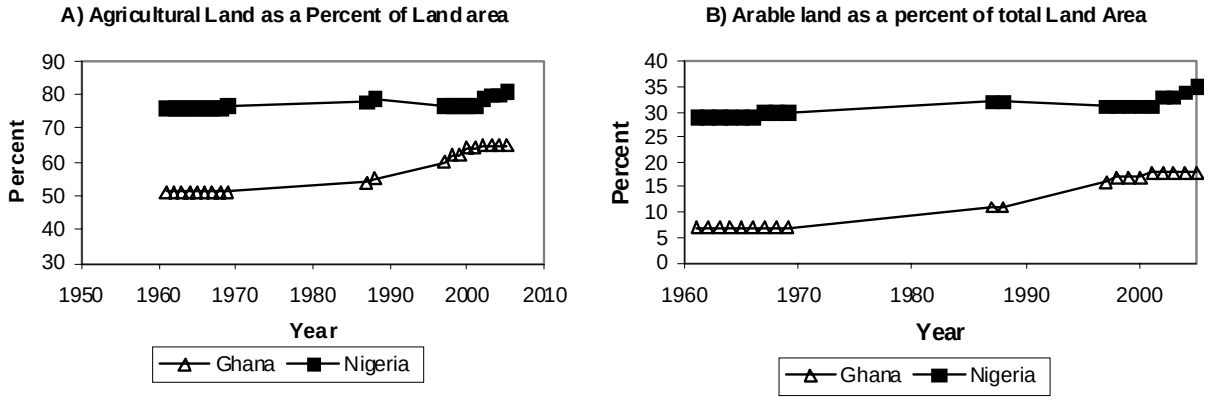


Figure 2: Deforestation in Ghana and Nigeria as compared to other, non-African nations.

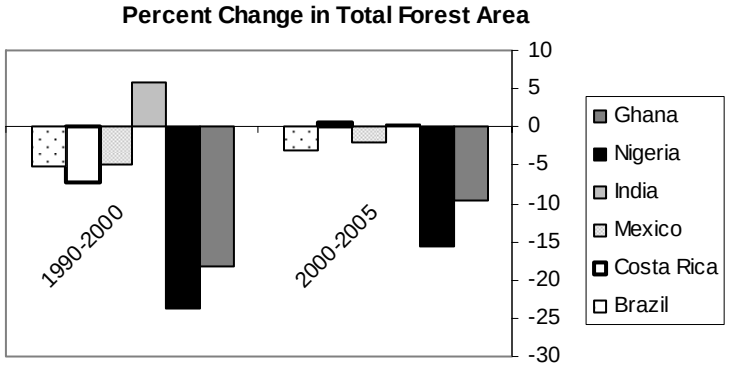


Figure 3: Rural and urban populations as a percentage of the total population in Ghana and Nigeria

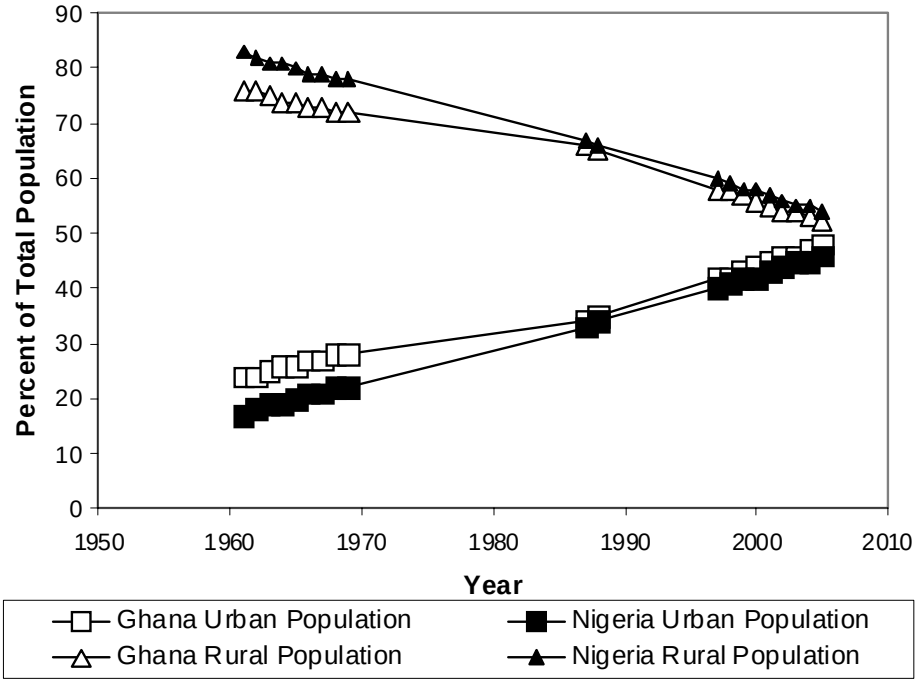


Table 3: Headcount Index for Umuluwe and Africa** (%): 2001 Survey*

	< $1 per day	< $2 per day	< $1 per day (Female)	< $2 per day (Female)	< $1 per day (Male)	< $2 per day (Male)
Non-Migrant	93.0	97.0	98.0	99.2	85.1	94.3
Migrant	69.2	85.0	93.3	100.0	62.8	80.4
Entire Sample	87.2	94.3	97.2	99.3	76.8	89.1
Africa-rural	55.6					
Africa-urban	43.0					
Africa	52.3					

* Own calculations (based on 2000 income)
** Ali and Nwabu (2002, p. 12)

Table 4: Headcount Index for Umuluwe (%): 2007 Survey*

	< $1 per day	< $2 per day	< $1 per day (Female)	< $2 per day (Female)	< $1 per day (Male)	< $2 per day (Male)
Non-Migrant	63.3	76.5	80.5	86.2	44.3	65.8
Migrant	25.5	40.0	42.9	52.4	14.7	32.4
Entire Sample	53.8	67.4	73.1	79.6	35.4	55.8

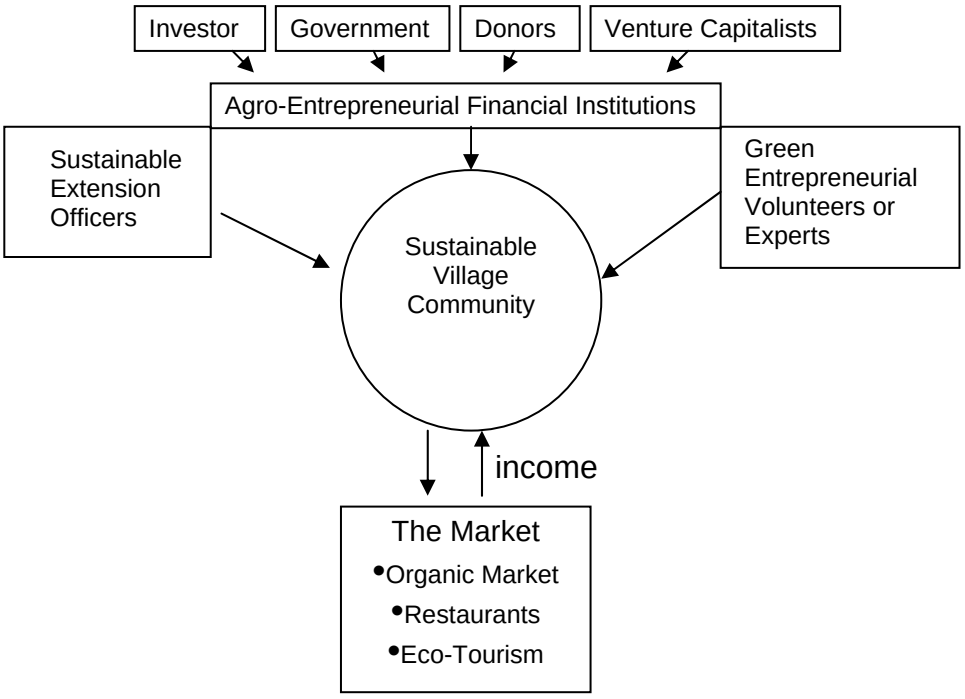
*Own calculations (based on 2006 income)

Table 5: Non-Income Measures of Poverty in Umuluwe, 2007

Indicator	% of Sample	% Men	% Women
Consumes Milk Weekly	33	16	17
Consumes Meat Weekly	24	11	13
Food as Most Important Expenditure	75	36	39
Firewood as Main Mode of Cooking	91	42	49
Owes Money	62	27	36
Has Savings	55	34	21
Owns Land	53	37	16
Owns Goats	25	11	14
Owns Chickens	55	21	34

Source: 2006 Village Survey

Figure 4: Agro-Entrepreneurial Model of Sustainable Agriculture



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