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Full Length Research Paper

Sustainable Agricultural Development Strategies in Increasing Sub-saharan Africa Food Production and Export

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ABSTRACT

Strategies for increasing diversified agricultural productivity on sustainable basis have become imperative because of its role in poverty scale-up and economic development. Agriculture is expected to continue to be the engine of economic growth and other numerous ancillary benefits in sub-Saharan Africa, by being increasingly more productive and more efficient to meet the needs of an increasing population but has often been plagued by climate, ecological, and socio-economic problems; weak institutional policy reforms and poor infrastructure for crop production, handling, and marketing, thus causing fluctuations in food availability (food insecurity),hunger as well as adverse effect on national economies. These are discussed in line with the ecological zones of SS Africa and their major land uses. The technologies and strategies to sustain agricultural development for diversified production and export for economic development are discussed. Comparison was made of agricultural export performance in Africa with Asia. The paper revealed that agricultural export commodities, either primary or processed, are less diversified in SSA as compared to Asia, but that diversification evolves more favorably in Africa compared to Asia for primary, as opposed to processed, agricultural exports. The paper also notes sharp sub-regional differences: CFA economies' agricultural exports been less diversified than those of non-CFA economies. Also, diversification dynamics are found to be less favorable in the CFA zone, but CFA economies appear to shift relatively more rapidly from primary towards processed commodity exports. Factors that favor performance in Asia relative to Africa are better human and physical capital, macroeconomic stability; non-price constraints including industrial countries' trade barriers. Absence of information about international markets and internal institutional failures were responsible for export counter-performance in SS Africa. The paper concludes that agricultural exports can be significantly improved through export-push strategies: access to input imports at world prices; export financing through access to credit; subsidized programs aimed to promote overseas penetration. All these are achievable through favorable policies; liberalizing and deregulating the economy with predictable macroeconomic environments; strong and stable government commitment to export promotion; efficient and relatively honest bureaucracies insulated from daily political pressures; a fair degree of economic equity and national consensus on economic goals; participation of businesses to the design of interventions, and punishment of enterprises that failed to meet their performance criteria.

Key words: *Agriculture, Sustainability, Productivity, Strategies, Export, Africa*

INTRODUCTION

It is estimated that by the year 2025 the population of sub-Saharan Africa (SSA) will double. A major concern is how to feed the population of over 480 million (without South Africa) whose 3 percent rate of annual population increase is about the highest in the world (Ezuma *et al*., 1993). Lal in 2005 states that food production in developing countries estimated at 1223 million metric ton (Mg) must be increased by 778 million Mg or 2.5 per cent between 2000 and 2025 to meet the needs of an increased population and projected change in diet. However, climatic, ecological and socio-economic problems plague Africa. Asadu, Ezeaku and Nnaji (2003) noted major soil groups – Oxisols, Ultisols, Alfisols, Entisols and Inceptisols – in sub-Saharan Africa to be characterized by low inherent soil fertility attributable to dominance of low activity clay, low organic matter content, high rate of nutrient loss through erosion, leaching, inappropriate cultural practices and crop removal (soil mining) to be the common constraints to farming.

In addition, poor infrastructure for crop production, handling, and marketing, compounded by climatic extremes that characterize SS Africa into ecological zones, causes fluctuations in food availability and subsequently hunger. Hence, observed World Bank (1989) that about 100 million inhabitants of sub

-Saharan Africa (or 25 per cent) consume less than 80 per cent of the requirements recommended by the Food and Agricultural Organization (FAO), including the proportion filled by food imports. Because the food security of the majority of the SSA population that is dependent upon farming is directly influenced by agriculture, emphasis on agricultural productivity and related activities will most likely alleviate the food deficits of the most vulnerable poor. Therefore, production not only must increase but should be sustained in the long-term.

The concern for sustainable development is reflected in the growing literature and policy initiatives on the issue. Theoretical definitions range from those that base sustainable development on ecological balance to those that combine ecological to socio-economic concepts. Conway (1985) views sustainability as the ability of a system to maintain its level of productivity in spite of a major disturbance such as caused by an "intense or large perturbation." On the other hand Dover and Talbot (1987) emphasize sustainable production system as one whose productivity continues indefinitely with no noticeable degradation of the ecosystem. However, these definitions do not give the degree, boundaries or level of production to be maintained and at what pressure on the environment. Hence, Okigbo (1989) incorporated biophysical, socio-economic and cultural concepts in the explanation of sustainability and this appears to be more encompassing.

Okigbo defines a sustainable agricultural production system as " one which maintains an acceptable and increasing level of productivity that satisfies prevailing needs and is continuously adapted to meet the future needs for increasing the carrying capacity of the resource base and other worthwhile human needs" (1989:3). Thus a production system leads to the development of people if it results in advancement from the current position. Development attains a sustainable level when its processes are controlled and perpetuated by resources within the reach of, and/or controlled by, the system such that any external influences do not upset the equilibrium attained (Okigbo, 1989; Hildebrand, 1990). Highly developed societies attain a high quality of life using resources that they control or that are accessible to them to "own, maintain or hire".

Agriculture is expected to continue to be the engine of economic growth and other numerous ancillary benefits in sub Saharan Africa, and for this to be realized, it will have to be increasingly more productive and more efficient to meet the needs of an increasing population. Emphasis on agriculture supposes to shift from maximizing production to optimizing resource use and sustaining productivity for as long as possible. In other wards, production not only must increase but should be sustained in the long term. Lack of sustainable agricultural development in sub-Saharan Africa are blamed on plagues of climate, ecological, and socio-economic problems; weak institutional policy reforms and poor infrastructure for crop production, handling, and marketing, thus causing fluctuations in food availability (food insecurity) and subsequently hunger as well as adverse effect on national economies. In addition, government subsidies and implementation of Common Agricultural Policy (CAP)-regarded as free trade compatible- have not positively advanced agricultural sector to a point of production sufficiency and diversification for export orientation. All these create concern on how to feed Africa's ever increasing population growth and re-engineering its economic growth.

The objective of this paper is to examine how agricultural development can be oriented to be highly productive and sustainable for diversified production to alleviate food deficits of the most vulnerable sector, and export for economic development in sub-Saharan Africa.

Consequently, this paper is structured into seven parts with part one being introduction. Part two briefly examines the ecological zones of Sub-Saharan Africa along with their major crops and production constraints. Part three examines general crop production constraints and the potential for over coming them. Part four looks at some aspects of technologies with potential for sustained resource management, while part five explains the strategies and the factors of agricultural export performance in Africa compared with other regions, especially Asia**.** Part six suggests approaches for sustainable crop production and agricultural export diversification to enhance performance in sub-Saharan Africa. Part seven concludes the discussion

Note: *This paper uses the terms Africa and sub-Saharan Africa interchangeably.*

II. The ecological zones in Sub-Saharan Africa (SSA)

Sub-Saharan Africa has over 23 million km^2 of land with a potential arable area estimated at 643 million hectares and forest at 700 million hectares, which is being cleared at the rate of 3.7 million hectares per year (World Bank, 1989). According to World Bank only 174 million hectares of the land are currently under cultivation. In terms of ecological zonation, Sub-Saharan Africa is demarcated into five based mainly on rainfall and relief.

i) The humid forest of West and Central Africa

This zone is characterized by 7-9 (+) humid months, 1400-4000 (+) means annual rainfall and mostly unimodal. The number of growing periods (days) are 270-365, while the soils are mostly acidic e.g. Ultisols and Oxisols, and non- acidic such as Inceptisols, Entisols, Vertisols, Alfisols, etc. (Papadakis, 1966; FAO, 1978).

Tree crops such as oil-palm (*Elaeis guinensis*), cacoa (*Theobroma cacao*), rubber (*Hevea braziliences*), and protected economic woody plants, perennial herbaceous plants, including plantains and bananas are grown in plantations or in multistory associations with root and tuber crops, vegetables and spices. Rice and raffia are grown in swamps and uplands.

The most important plant production constraints of this zone are soil fertility and structural instability. Kang and Juo, (1981) and Lal (1989) reported that luxurious forest growth soon gives way to eroded land when clearing is followed by intensive cropping. Soil acidity is common, and weeds, which flourish during heavy

rains to compete with trees and other food crops. High forest cover reduces crop production. IITA in 1983 reported reduced maize yield in this zone due to cloudy sky and reduced insolation.

ii) The Southern Guinea Savanna (SGS) and Derived Savanna

This zone is called the sub-humid zone of West Africa. Derived Savanna has 6-7 humid months. Some areas have 1300-1500 mean annual rainfall (bimodal) and 240-270 growing periods (days). The soils are mostly Alfisol and some Ultisols. The Southern Guinea savanna, on the other hand, has 5-6 humid zones; 1200-1500 (partially bimodal) mean annual rainfall and 190-240 days growing period. Mainly alfisols and related soils, acidic ultisols and oxisols in some wetter areas, and also entisols and vertisols in some other areas (Kowal and Kassam, 1978; Lawson, 1979).

Land use of the area is mainly cereals (sorghum and maize) production, and root crops (cassava and yams). Yields are often high, especially, in the Derived Savanna because of slightly higher rainfall.

Major constraint to agricultural production is lack of labor at the peak of growing season due to high infestation of tse-tse fly that debars the use of oxen as sources of farm power. Weeds, especially the parasitic Striga, attack the dominant cereal crops. Even though the soils are relatively rich and are structurally more stable than humid forest soils, they are frequently deficient in some major nutrient, whose efficiency may be reduced by negative interaction with minor elements such as phosphorus (P) and zinc (Zn).

iii) Northern Guinea Savanna (NGS)

This zone is also called the sorghum-millet belt of West Africa. The number of humid months is 4-5 with 880-1300 (unimodal) mean annual months. Crops growing period are 140-200 days. The soils resemble that of SGS but **w**ith greater proportion of non-acid Alfisols.

Maize, sorghum and legumes are important crops grown and yields are high because the soil is more favorable for cropping and responds to N, P, and S applications. From this zone IITA (1984) reported excellent maize growth and highest yields in West Africa. Parasitic weed Striga attack on cereal and grain legumes, drought, high soil temperatures, high evaporation rates, soil erosion caused by wind, and soil crusting and capping are major constraints (Hullugale, 1989).

iv) The Sudan Savanna

Sudan Savanna is located in the north of NGS with mean annual rainfall of 90-140 mm (unimodal). The main soils are Alfisols and drier Aridisols, etc. Millet and cowpea are major food crops grown. Malton (1987) reported that cereals are grown on about 70 per cent of the total cultivated area of this zone. Also, cotton and groundnut are the major crops and sometime grown for export. Uncertainty of rainfall result to crop failures.

v) The Eastern and Southern African highlands

The zone is demarcated into two. The first has 7-12 months of humidity with 750 to 1000 mm of mean annual rainfall being unimodal nature and 270-365 days of growing period. The soils are mainly ultisols, oxisols and vertisols. The second has 5-6 humid months with 750-1000 mm mean annual rainfall (bimodal) and 190-240 growing days. Alfisols, Ultisols and Oxisols are the main soils (Kowal and Kassam, 1978; FAO, 1978; Lawson, 1979).

Maize, banana, groundnuts, coffee and tea are crops grown. Rainfall (unimodal) limits these crop productions in the first zone. Limitations to crop production in the second zone result from short duration of the rainfall which requires very intensive labor in land preparation and planting that oftenly resulted to frequent crop losses. Also, high population pressure on the soils of both highlands, with only 5-7 months rainfall, causes low productivity. Soil loss is high. E.g. Collins (1987) reported soil loss of 50 tons/ha/year in the communal lands of Zimbabwe and resulted in reduced yields of crops.

III. General crop production constraints and potential for overcoming them.

i) Constraints

Cereals (wheat, maize, sorghum, millet, rice) constitute 54 per cent by calories of the food crops grown in SSA, while root (cassava, yams, potatoes, and taros) make up 27 per cent of calories (Bruijin and Fresco, 1989). All other crops (plantains and bananas, grain legumes, fruits and vegetables, etc) make up the balance of 19 per cent. Many traditional varieties of these crops are low yielding and the improved varieties released do not seem to have impact in sub-Saharan Africa (SSA) region. The report by Bruijin *et al*., show relative small increases in cassava yield (23 per cent) compared with maize (55 per cent) in developing countries during 1984-1986 compared with 1961-1965. The yield increases are small compared with the population increase, which stood at 71 per cent in Africa during the same period. The small increases in production and yields are a reflection of the small average effect of introducing improved crop varieties into Africa. Similarly increases in other major crops such as yams, rice, wheat, sorghum, and millet were low in comparison with human population increases.

Insufficient and excess rains as well as management and socio-economic factors also result in reduced productivity. Across the ecological regions of SSA constraints are related to the amount and distribution of rains and to poor soil conditions for plant growth. Rainfall in SSA is highly variable, ranging from excessive in places such as Debunscha, Cameroun, with 10,000 mm average annual rainfall to about 200-300 mm in some areas in West Africa. Drought-induced crop losses in the drier areas of SSA occur frequently. In the tropical zone, drought-induced crop losses may occur during years in which the rains are poorly distributed (IITA, 1980). The incidence of diseases and pests is enhanced by rainfall and soil condition. An example is the noxious weed spear grass (*Imperata cylindrica*l), which thrives in areas where forest vegetation is replaced grass. Many diseases such as *Pythium* and *Phizoctnium* rots occur mainly in high-rainfall areas, as does cassava bacterial blight, *Xanthomonas manihot*, which requires high humidity to survive (Lawson and

Terry, 1984, while the cassava mealybug (*Phenacccus manihoti* MF) is very serious during dry seasons (Herren,1989). Multiple soil nutrient deficiencies, especially in areas with very high cropping intensity, low inherent soil fertility characterized by low cation exchange capacity (CEC), high acidity, rapid organic matter decomposition, high P fixation, high erodibility, and leaching – all compounded by a dominance of low activity clay (Kang and Juo, 1981) – render most of soils in SSA unsuitable for intensive crop production using available technologies.

Farmers with limited resources, a large proportion of who are women, dominate in Sub-Saharan Africa. They may manage efficiently at their resource level, which, unfortunately, is low in productivity. High resource inputs require more efficient and demanding managerial skills, which should be demonstrated by profit margins in competitive markets and not by ability to survive. Women who dominate in farming have very limited access to production resources.

The most vulnerable of the urbanization process in Sub-Saharan Africa are the womenfolk, especially widows and the heads of single parent households. The migrated labor system has left women to maintain households and the farms. Example, in Nigeria most women, especially older single women, were often employed as fuel wood dealers, a forced participation in work for wages or in trade and that over 65 percent of women of 15 years of age or more and women constitute 45 percent of the labor force (Ezumah *et al.,* 1993). In others, e.g. Zambia, Kenya, Botswana, and Zimbabwe, Collinson (1978) notes that women constitute only between one-quarter and one-third of the labor force and in some Islamic countries even less.

Institutional and policy constraints have been discussed by Vallaeys *et al.,* (1987), Olayide and Idachaba (1987), etc. They emphasize the undeveloped marketing and input/output infrastructure of the agricultural sector, low investment in research, amounting to about 0.5 per cent of gross agricultural product (Vallaeys *et al.,* 1987), poor research-extension-farmer linkage, which reduce the effectiveness of technology transfer (Collins, 1987), and high dependence of agricultural inputs on imports, which are becoming increasingly costly as foreign exchange becomes scarce. Yet the prices of farm outputs decline.

Further, the issues of overvalued exchange rates discourage agricultural exports. Investment has been discouraged in many countries by the poor prospects for profitability except in a few limited areas of export production and of specialized food production for markets, often in peri-urban zones. Peri-urban and rural production in some cases has also been encouraged by the poor quality of rural roads and transport services. For instance, World Bank (1982:52) observes that in the poorer African countries about 20 per cent of public investment in agriculture is provided by aid.

Collier (1998) states that overvalued exchange rates have been true of some but not all SS African countries to keep the costs of food, fuel, machinery, and technical equipment imports low. They can also be part of an anti-inflation strategy. Attempts to promote industrial development can be protected by selective tariffs. However, imported food can be cheap partly because western countries, particularly those in the European union (EU) , subsidize their food exports, and may thus in certain cases help to undermine African agriculture and indirectly promote African poverty for the benefit of western farmers, while keeping prices down to African consumers. This has far reaching implication of further impoverishment of the poor. More recently, however, food price inflation has occurred in certain cases of food import dependence. There is also the well-known example of the oil boom and "Dutch disease" in Nigeria, which was associated with the decline of non-oil tradable, i.e. export crop agriculture, and appeared to be an equivalent process in Nigeria to deindustrialization in the west.

Structural adjustment programs (SAPs) have been adopted by more than thirty SS African countries, more especially in the 1980s, although African countries were affected by World Bank and IMF policies even in the 1960s, e.g. Zaire, which was one of the first countries to accept such policies. Despite all these programs, real GDP growth in SS African in 1980-1988 averaged only 0.8 percent per annum, compared with 4.8 percent in 1965-1980 and international debt grew at 12 percent per annum (Okigbo, 1989).

The world Bank claimed that the real beneficiaries of the SAPs were the rural poor farmers (World Bank, 1991a: 106) because even in the "short run" they were protected in relation to the urban poor by depreciation of the real exchange rate, which stimulated exports and increased farm incomes, offsetting in part the effects of general decline in wages. But how many of the rural poor farmers are engaged in export crop production, which has declined severely in SS Africa and what is the time–lag on the expected growth of export production? Several years in the case of tree crops. In some countries there is increasing privatization of land and the introduction of herbicides, pesticides, and machinery to reduce labor use, tending to encourage the growth of larger private farms and adding to the numbers of rural landless and urban ward migrants. In some cases the rural areas have been forced to accept people returning to the family farms after being made redundant in the town. It is in any case unsafe to argue on the basis of a rural- urban dichotomy. What, for example, is happening to rural incomes partly dependent on remittances from urban workers?

Sub Saharan Africa in the 1980s experienced far worse levels of shock from deteriorating terms of trade and interest rates than did East or south Asia or Latin America, and these were on top of macroeconomic imbalances and severe structural weaknesses (World Bank 1991) . The report by World Bank shows decline in GNP for SS Africa as a whole since 1980 (For comparison, examples of high {Botswana}, Medium {Kenya}, and low {chad} GNP trends have been provided). SAPs aimed to reduce imports and raise export earnings, but also generally raised the prices of tradable goods relative to non tradable goods. Olayide *et al.* (1987) argued, on the agricultural sector, that many of the poor were more occupied with non-tradable goods than with tradable and were in consequence made worse off. Higher retail prices , where passed on to full–time farmers, have benefited that particular rural group , but those part-time farmers who depend more on the market for their basic goods have gained little. Only the mainly subsistence farmers who could maintain a low level of

dependence on markets have managed to escape the effects of sudden changes in market prices and of changes in the demand for agricultural goods, more especially of any rise in the prices of inputs needed for export production or for commercial food production.

Three examples will illustrate these points.
First, in Uganda the implementation of IMF- World Bank policy packages since 1980 has been claimed to have been followed by reduced food remittances from rural to urban areas, reduced cash remittances from urban to rural, a decline in food production, and a decline in the social services. From 1980 to 1984 overall real wages fell, but agricultural producer prices rose 12-15 times, only to be partly offset by a rise in the consumer price index by 10 times, adversely affecting those families depending on the market for a major part of their domestic consumption (World Bank, 1991b: 550-555). Uganda began an economic recovery program in 1987, but this was followed by inflation, which reached 240 per cent per annum at the end of 1988. More devaluation plus higher interest rates and other measures followed, but inflation still persisted. Conditions were made worse by the collapse of the International Coffee Agreement in 1989.

Secondly, Zambia received an IMF program in 1985, abandoned it in 1987, and returned to the IMF conditions in mid – 1989, when consumer prices were decontrolled and the kwacha was devalued. Inflation rose to more than 120 percent per annum by early 1990 and there was a considerable foreign cash shortage. The agricultural marketing boards were abolished and attempts were made to increase maize production, mainly through subsidies, which contributed significantly to the budget deficit, and unfortunately involving increased marketing costs and serious transport and storage problems. In 1989 maize had to be rationed and maize meal prices rose, followed by riots in Lusaka (FAO, 1991a: 50-53).
Thirdly, in the Sudan in the 1970s economic reform measures included a wage freeze, limits on government employment levels, and limits on government expenditure, but seven years later the Sudan had failed to achieve its economic targets and by 1985, after some help from the US government, the Sudan was deep into economic crisis and the government was swept from office. The debt service ratio climbed to 150 per cent of GDP and the country was forced in part to engage in counter-trade. There is evidence that the economic austerity required in the Sudan imposed severed burdens on the poor, especially the farmers, and Collinson (1987) asked whether the IMF was "the enemy of the poor". By the late 1980s the disposable income of the Sudanese poor was only 30 per cent of what it had been in 1970, and GDP per capita had been markedly reduced. Social services had been cut, wages and salaries frozen, and the purchasing power of the poor had been reduced by devaluation and the removal of price controls. Severe shortages of essential inputs and consumer goods became commonplace. Investment as a proportion of GDP fell together with national and public savings. Budget deficits led to high levels of inflation, jumping by 120 per cent between 1989 and 1990. More economic reforms were introduced in 1991, but unfortunately on an ad hoc and inconsistent basis, which has undermined their effectiveness (World Bank, 1991b:507-512). The Sudan has a harsh environment combined with considerable irrigation potential. It has been severely affected also by civil war and pressure from time to time from Ethiopian refugees. In the complex process of combining several strategies against poverty the Sudan suffers from its limitations, and the Sudanese poor are in consequence amongst the more vulnerable.

Despite the limitations discussed, current SAPs and World Bank programs have claimed an intention to benefit the poor, at least in the longer term, by enhancing the rates of return on the few assets they hold, by increasing their access to the factors of production, by creating employment opportunities, by maintaining their human capital, and by increasing income and consumption transfers (FAO, 1991a:111-113). The FAO report on the state of Food and Agriculture (1991a), much of which was focused on structural adjustment and agriculture (pp.81-152), claimed that SAPs had a negative effect on the chronically poor, while creating a new poor sector with extra burdens on women, very small farmers, and low-income groups (pp.113-114). Attempts have been and are still being made to reduce the social costs of adjustment, such as the PAMSCAD program in Ghana (Program of Actions to Mitigate the Social Costs of Adjustment), but, although " it is true that no social group has lost out massively in Ghana…it is equally true that those who have lost, even if not massively, are those with relatively poor ability to withstand such losses" – particularly the poor northern farmers, the women food farmers in the south, and the petty retail traders (FAO, 1991). All of these point to the effect of SAP policies on agricultural productivity and export in Sub-Saharan Africa.

ii) Potentials for overcoming constraints

In spite of the constraints discussed above, crop production in SSA could increase tremendously if adequate human and institutional resources were available to manage the biophysical resources. Ruttan (1988) buttressed this statement by noting that the achievement of the level of development attained by developed countries will depend upon Africa's commitment in the investment in the institutional and physical infrastructure required to exploit the production potential of the resources with which Africa is endowed. Wit *et al.* (1979) report shows that, whereas the potential arable land in tropical Africa is 643 million ha, the area in use is only 174 million ha, or 27 per cent.

The same report by Wit *et al.* indicate that yield expressed in 1965 grain equivalent for Africa was only 74,000 million out of a potential 9,474,000 million kilocalories, i.e. only 0.8 per cent. Thus the biophysical resources available in Sub-Saharan Africa are grossly underutilized. Because these calculations were based upon biophysical potentials (fertilizer and water are limiting, disease and pest are controlled, and optimal available solar radiation is captured), it was concluded that the main obstacles to increased crop production are socio-economic (capital, institutions, policy, culture). Sub-Saharan Africa can resolve its food deficit problem if even 25 per cent of this estimation are attained. How do we manage the resources of crop production (including human, with emphasis on women farmers) so that resources are sustained. The question calls for re-examination of the technologies available and their usefulness in sustained resource management.

IV. Technologies with potential for sustainable resource management

a) Good technologies with missing links

In SS Africa, considerable efforts have been made on the development of improved cereals, root and tuber crops, and food and fodder legumes by plant breeders, and also on the characterization and identification of the limitations of the soils. Pest control measures have also received attention, particularly from international (IITA, IRI, ICRISAT, WARDA, ILCA, ICP), national, and other research centers and universities in Africa. Agronomists and soil scientists have conducted a lot of research on responses to fertilizer application of various crops in different ecological settings, and breeders and disease and pest control specialists have documented results based on chemical, host plant resistance, biological, and chemical control measures.

Each of these results, introduced into a farmer's system, provides some relief to problems. The ephemeral nature of some of some of the relief is realized when the breeders' variety yields less than expected in the intensive multistory crop association system of small-scale farmers (Ezumah, 1992), and when the expected response to fertilizer is not realized, either because the increased crop pressure requires higher applications, or because the soil physical conditions have deteriorated so much that the effectiveness of fertilizer is reduced in intensive systems (Lal and Greenland,1978). Similarly, the undesirable long-term effects of pest and disease control by a non-integrated approach. A holistic approach to research and extension, which also incorporates the concepts of integrated pest management (IPM), could reduce the dangers of unsustainable crop production in SSA.

Technical innovation in agriculture is generally not designed so as to exploit the contemporary and synergistic effects of the important results for sustained crop production enumerated earlier. Such complementaries are achievable when technologies are developed from current farmers' knowledge base, using multidisciplinary experiences. Ezeaku and Salau (2005) study reveal farmers profound indigenous knowledge of arable soils; experts in soil suitability classification as their systems is based on certain criteria influencing the use and productivity of soils, suggesting that indigenous soil categories have practical validity . The central thesis is that resource poor farmers do not adopt technologies that require costly inputs of labor, cash, and materials or technologies for which inputs are not readily available. These technologies therefore do not fit in the farmers' production environment and frequently break the linkages that enhance resource conservation. Ezeaku and Salau, therefore, opine a need to "peasantize" science so as to make indigenous knowledge and soil categories, not only, become important potentials to advance the productivity frontier, but to act as entry points for future scientific work. In other awards, science should attempt to enter the peasants' world of concepts and representations so as to explore, in full, the dynamic and strategic nature of farmers' knowledge and practices. This will create good synergy between indigenous knowledge and science and then reduce the challenge to conventional positivist science.

b) Mimicking natural ecosystems

Almost all sustainable systems currently available in SSA mimic natural ecosystems. These systems comprise traditional shifting cultivation, which is sustainable at low population pressures, well-managed multiple-cropping systems (which include compound land systems), the alley cropping system, and the fadama or inland systems. These systems may have some or all of the following attributes: extending the duration of growth of the plant community, increasing light-capturing potential via multi-layer interception over a long period, and re-cycling nutrients from deep layer. The systems also integrate many groups of plant species – ephemerals, annuals, and perennials – in the same land area. Guyer (1987) has observed that by mimicking nature, microclimates suitable for growth of many plant species are created and as such enhance diversity. Multiple-cropping (i.e. intercropping and rotation) leads to more efficient resource use and this reflects in yield advantages (Ezumah and Lawson, 1990). Associations that exhibit yield advantage usually are long-duration plants intercropped with short-duration plants or combinations of short-duration crops belonging to the same family, e.g. sorghum and millet or of different species, e.g. sorghum and pigeon pea or maize and cowpea. Asadu, Ezeaku and Nnaji (2003) have reported advantages of multiple-cropping systems to include improved soil physical and chemical conditions for plant growth, reduced soil temperature, reduced soil surface evaporation, increased soil water content, and reduced surface runoff and soil loss. Increased soil biological activity (e.g. earthworm activity) in intercropping compared to monocrop rotations and intercropped situations reduce significantly soil degradation. These reports show the need to focus research on farmers' current systems and to improve on them. They also show the importance of conserving plants and animals in the wild, because their usefulness to humans, apart from the broad concept of ecological balance, is known.

i) Surface mulching

Mulching include the use of translucent white and black plastics as well as organic materials to cover the soil surface. Mulching materials include gravel, organic wastes from plants and animals such as sawdust from wood, foliage and twigs from different plant sources including leguminous and non-leguminous plants. The short-term advantages of mulching relate more to improvement of the soil microclimate for plant growth than to chemical properties, because higher crop yields from the plastic mulches than from the twigs. These effects do not, however, negate the long-term benefits of mulching (Lal, 1989). A major difficulty of mulching is the procurement of materials, which threshold was estimated at 4-6 tons/ha for effective mulching especially for an Alfisol soil (Lal and Greenland, 1978). This quantity is too much for a low resource farmer to carry. Higher maize yield without N fertilization over a five-year period of continuous cropping in association with living legume plants (*psophocarpus palustris* and *Centrosema pubescens*) was reported by Akobundu (1980). Cassava intercropped with maize generates enough mulch to sustain yield. For instance, IITA (1985) reported stable yields of cassava and maize over four years on an Alfisol in southern Nigeria.

ii) Alley cropping

The most recent innovation in mimicking the natural ecosystem is the alley cropping system (IITA, 1990). In alley cropping, the multistory association is arranged to occupy adjacent hedges (hedgerows), about 4m apart. Trees are chosen for certain

characteristics such as deep root (to recycle nutrients), ability to coppice and to produce high biomass (which is pruned for mulching and nutrient release), and, sometimes, rhizobia N-fixing ability. Legume trees in the hedges contribute N in excess of 40 kg/ha. Although the alley system contributes to moisture conservation, organic residue, and structural and chemical improvements to the soil, a reduction in the yields of associated crops due to reduced light of the tree canopy has also been reported by IITA. Despite these contributions, alley cropping is a sustainable system that needs refining. It is amenable to large-scale methods. The labor requirements for pruning, which often coincides with other important farm activities (e.g. weeding and harvesting) are a serious setback, while alley species suitable for acid soils are still being sought.

iii) Inland valleys

Inland valleys or fadama, though small individually, constitute total tens of millions of hectares in west and Central Africa. IITA estimates for West Africa alone gave about 14 million ha (1980). Inland valleys are well watered and have enormous potential for producing food, especially rice. Juo and Lowe (1986) report that inland valleys have been cropped continuously for centuries in China. Otherwise is the case in sub-Saharan Africa due to lack of knowledge about their management, which leads to their infection by vectors of many harmful diseases, such as Schistosomiasis, river blindness, malaria, and guinea worms. In addition to water availability, the inland valleys are sustainable and give higher crop yields because they are relatively higher in fertility as result of inflows of nutrients from the uplands (Ezeaku and Anikwe, 2005). Earlier IITA (1990) note that increased fertility of the inland valleys can be attained by rotating e.g. rice with legumes tolerant of water logging, some of which are Crotolaria spp., soybean (Glycin max), and Sesbanis spp. Thus, exploitation of the potential for sustainable plant production in the inland valleys requires more research.

iv) Diseases and pest control

Chemical and mechanical measures are some of common crop management methods to control diseases and pests. Host plant resistance and biological control measures, though requiring high initial investment at institutional levels, are sustainable and indirectly affordable by the low-resource farmers in Sub-Saharan Africa. Recent examples include the control of cassava bacterial blight (*Xanthomonas manihot*) by resistance breeding (Hahn *et al.*, 1979) and the effective reduction of the cassava mealybug pest (*Phenacoccus manihoti* Mat-Fer) by biological control. A parasitoid, Epidinocarsis lopez, introduced from Latin America and released at strategic sites has contributed to the reduction of the cassava mealybug epidemic in Africa. Furthermore, the claim that diseases and pests (except for weeds, for which it has been demonstrated) are controlled by intercropping need further research because reports have been inconsistence.

c) Women's underexploited potential

One of the causes of the "weak agricultural growth" in Africa is the underutilization of human resource potential (World Bank, 1989: 2). This is particularly manifested in the gender gap in access to production resources. The majority of African food crop producers who are smallholder farmers and women in particular, experience great difficulties in increasing production. To achieve sustainable agricultural production it is imperative to eliminate those factors that hinder the productivity of the majority of food producers.

African women are responsible for about 70 per cent of the labor input in food production. Their activities include hoeing, weeding, transportation of crops and planting materials, food processing, and storage. Men, on the other hand, have been largely responsible for bush clearing, land preparation, staking of crops, and hunting (FAO, 1982). Recent trends characterizing gender roles in African agriculture have been identified (Guyer, 1986: 396-398), namely, that male tasks in agriculture are declining due to: (a) the decrease in forest cover and game reserves; (b) the greater participation of men in out-migration; and (c) male predominance in export crop production. As a corollary, women's agricultural work has been intensified. Factors responsible for this development are that: (a) shorter fallows are now used, resulting in increased weeding; (b) as the distance of farms from homes increases, there is greater need for the transport of crops and planting materials; (c) as the food trade increases, the demand for food processing increases; and (d) the predominance of men in migration leads to an increased workload for women in food production.

Despite the increased responsibility of African women for food production, their productive capacity is deteriorating because they continue to suffer from less access to production resources and inputs, agricultural innovation, and extension services. Some specific constraints that are important for women farmers in SSA concern limited access to resources such as land, capital/credit, labor, and agricultural innovations.

i) Access to land

In most African societies women traditionally had use rights to land. The introduction of the Western concept of land ownerships has been to the detriment of women. Some development programs in Africa have also exacerbated women's restricted access to land. Pankhurst and Jacobs (1988) report women's loss of land through land reforms in Zimbabwe. The marginalization of women in the allocation of irrigated rice fields to men in the Gambia affected rice production and gender relations and also culminated in the failure of the project (Carney, 1988).

ii) *Access to credit*

Smallholder farmers, particularly women, who lack access to credit experience great difficulties in purchasing inputs to increase their production. Access to credit is often based on ownership of collaterals such as land or membership of cooperatives and farmers' associations, which many African rural women lack. Consequently, most agricultural bank loans in the past went to "absentee" or "progressive" farmers (professionals, top bureaucrats, and military personnel) (Okuneye, 1984).

iii) Access to labor

The male predominance in rural-urban migration for wage employment for wage employment has resulted in the intensification of women's work in agriculture and in labor shortages in food production, particularly in female-headed households. Women's lack of access to credit has a concomitant effect on their ability to purchase paid labor. A greater number of women consequently dissipate a lot of energy that could be channeled towards increased productivity on their farms in other enterprises such as working as paid labor on other people's farm or providing exchange labor in return for labor received. Women's cultural obligation to provide labor on their husband's farm also results in limitations on the amount of time they can devote to their own farms.

iv) Access to improved technologies

The dissemination of information about innovations in agriculture as well as training, fertilizers and other inputs, and extension services have been geared mainly to male farmers with adverse effects on women's productivity. Most training in agriculture has been directed to men. The marginalization of women in terms of access to production inputs has often resulted in the deterioration of women's productive capacity (Ezumah, 1992). "Progressive" farmers, usually men, have received preferential allocation of extension visits and services. Some of the adverse consequences of this neglect of women's role in the implementation of agricultural innovations include loss in adaptive efficiency when women's operational knowledge is not taken into consideration and lower adaptation rates owing to women's lack of access to technology and trainings.

V. Bank and Country Factors of Agriculture Thematic Development and Export Performance in Africa

a) Bank factors

- The institution's (World Bank) strategy for the development of the agriculture sector has been part of its rural strategy, and over time the importance of agriculture in the Bank's rural strategy has declined. Both arising from and contributing to this, technical skills to support agricultural development adequately have also declined over time. Data from the Human Resources Department of the World Bank show that there were 17 technical experts mapped to the Agriculture and Rural Development Department in Sub-Saharan Africa in 2006, compared with 40 in 1997.
- The Bank's diagnosis of a country's development status and priorities in the agriculture sector is carried out primarily through analytical work. Until very recently this work has been limited and not readily available. Nor have the findings from analytical work strategically informed Bank client policy dialogue and lending program design.
- Bank policy advice appears to have had far-reaching implications for the direction of agricultural development in African countries; in particular its policy advice associated with the adjustment agenda. However, results have fallen short of expectations because of weak political support and insufficient appreciation of reality on the ground, among other things.
- The Bank's data systems and support for monitoring and evaluation (M&E) have been insufficient to adequately inform the institution's effort to develop agriculture in Africa across a broad front. Current data systems do not allow the institution to track in enough detail how much is being provided for development of specific activities such as seed development and credit. M&E at the project level has been of limited value in answering fundamental questions about outcome, impact, and efficiency, such as who benefited which crops received support and how, what has been the comparative cost effectiveness, and to what can one attribute gains.

b) Country factors

- Although the governance environment in several African countries continues to be weak, political commitment for the development of agriculture in client countries appears stronger than in the past. African governments, many of which were allocating less than 1 percent of their budget to agriculture, agreed in July 2003 at the African Union Summit to allocate at least 10 percent of national budgetary resources for programs to support agricultural growth in the next five years.
- Considerable agricultural research capacity exists, although the sustainability of the activities supported remains uncertain. Overall, government capacity in several countries remains weak, and local agriculture ministries are still relatively ineffective partners in promoting development of the agriculture sector. Though further analysis is needed, the study finding that largely agricultural projects in countries with less favorable agricultural conditions have done better than similar projects in countries with more favorable conditions suggests that other factors such as political economy and country capacity are also a challenge for agricultural development in Africa (http://go.worldbank.org/PPY96H0ES0]).

c) Agricultural Export Performance in Africa

i) Export Diversification and Processing

Comparing different economies in terms of export product diversification requires adopting some degree of aggregation of export commodities with close characteristics, in order to have a classification that is workable and enough detailed to show the main differences among products. Considered as homogenous, each of the clusters of products is assumed to be "equivalent product", even though the homogeneity of its component products is a decreasing function of the degree of aggregation. Much of the analysis in this section relies on the three-digit classification of the International Trade Centre (WTC) and United Nations Statistical Department (UNSD) (2000). According to this classification, 29 "equivalent products" are from the sector dominated by "Fresh Food and Agro-based Products", while 330 "equivalent Products" are from the sector "Processed Food and Agro-based Commodities". These categories were referred respectively, as primary agricultural exports and processed agricultural exports.

While the equivalent number of products is practical to capture the degree of export diversification, another indicator is required to account for the distribution of export sales across equivalent products forming each of these two categories. Indeed, two economies with the same number of equivalent indices of diversification if the export sales of one were concentrated on a smaller number of these equivalent products than the other. Hence, the index of export diversification (WTC and UNSD, 2000) had two underlying assumptions. The first is that an economy exports at least two equivalent products from each category. The second is that the export sales of each category are not equitably distributed among equivalent products. However, all the economies included in table 1 meet these conditions.
Diversification change index was calculated as a country's rank (and group of countries' average rank) with respect to the evolution of the index of diversification from 1996 to 2000. Thus, the economies with relatively more unfavorable dynamics have lower score, while the economies that recorded a relatively more unfavorable evolution over this period have higher scores. Based on these indices, table 1 shows the figures of agricultural export diversification from both static and dynamic perspectives for different groups of countries.

Table 1 show that agricultural export commodities, either primary or processed, are less diversified in SSA compared than Asia. As table 1 shows, primary commodity diversification change is more favorable compared with Latin America, and even less diversified than in Asia. The figures for processed commodity diversification change are the opposite: the increase is higher in Asia followed by Latin America. Finally, the table shows that Africa's strategy relies on primary commodities relatively more than Asia. This may not change at short run: not only do primary agricultural exports represent a large share of the total exports in Africa, but also their growth rate is low compared with that of Asian agricultural exports, either primary or processed.

Some differences between sub-regional groups are also shown in table 1. In Africa, CFA countries' agricultural exports, either primary or processed, are less diversified than in non-CFA economies. Furthermore, diversification change is less favorable in CFA countries compared to non-CFA countries. This suggests that there may be an increasing gap between CFA and non-CFA sub-regions in terms of export diversification performance. However, while processed export represent a larger share of the total exports in non-CFA economies, CFA economies seem to shift relatively more rapidly from primary towards processed commodity exports as the differences between the growth rates suggest. The combination of low diversification change and this high growth rate results in an accelerated move towards more concentration of processed commodity exports in CFA economies. As regards Asian sub-regional differences, they are sharp as well. As table 1 show, highly performing Asian economies (HPAEs) enjoy more diversification in both primary and processed agricultural exports, but the strategic importance of agricultural exports is low and decreases more rapidly in these economies.

As regards the regional and sub-regional difference, Ngaruko (2003) notes that the shift from primary towards processed commodity exports would mean that for an economy to be African, especially CFA economy, is a disadvantage as to the prospects for this economy to have much diversified primary commodity exports. Also, the fact for an economy to be African is a disadvantage as to the prospects to further diversify processed commodity exports. In contrast, taking account of primary commodity diversification, it suggests that African economies on the one hand, and CFA and non-highly performing Asian economies on the other hand, have an advantage as to their probability to have high diversification of processed commodity exports.

ii) Responsive to Commodity Price Incentives

Opinions about agricultural exports responsive to price incentives, especially in Africa, vary among several authors. While part of the literature emphasizes that agricultural products have low price elasticities of supply. Abebayehu (1990) argues that agricultural exports are responsive to price incentives. Deaton (1992) suggests that long-term fluctuations are beneficial for producers in that "they provide the opportunity to supply more when prices are low so that variability around an unchanged mean increases expected revenue".

In terms of the behavior of agricultural export to prices in the long run, Deaton (1992) and Gersovitz and Paxton (1990) observe that the real prices of primary commodities exported by SSA either have been without trend or have declined only gently. According to FAO (2002), coffee prices in particular have been severely depressed, followed by cotton, whose average prices in 2001 were down to 50 per cent of their level in 1995. As regards cocoa prices, after a steady rise over the 1995 to 1998 period, they experienced a marked drop in 1999 and 2000. Tea prices were an exception to this trend: they

Table 1. Agricultural export performance across regions

	Primary Commodities Diversification				Processed Commodities Diversification			
	In 2000	Change 1996-000*	Growth Rate %	Share (%)	In 2000	Change 1996-000*	Growth Rate %	Share (%)
Africa	3.73	74	8.82	41.1	4.02	89	8.0	9.38
CFA Zone	2.98	84	5.08	40.2	3.69	98	11.3	7.67
Non-CFA Zone	4.19	69	9.70	41.5	4.22	84	6.5	10.29
Asia	4.56	78	6.91	19.4	5.03	57	11.9	8.07
HPAEs	5.36	58	-0.40	3.6	5.49	58	2.0	4.60

Non-HPAEs	4.19	83	8.94	23.8	4.82	57	16.9	9.80
LAC	4.44	89	5.04	25.4	5.14	65	14.1	16.89
USA	4.32	32	2	65	12	0	3	

Source: International Trade Centre and United Nations Statistics Department, 2000.
Notes: - The scores are average rankings. The sample includes 168 countries for primary exports, and 141 countries for processed exports.
-'Growth rate' denotes the average annual growth rate of exports expressed in US dollars between 1996 to 2000.
-'Share' denotes the share of export products of the category in total exports.
-Africa includes 39 sub-Saharan African economies; Asia includes 23 economies; HPAE includes Hong Kong, Malaysia, Indonesia, Singapore, South Korea, Thailand, and Taiwan; LAC (Latin America and the Caribbean) includes 28 economies.

Table 2: Responsiveness to price incentive: regional and sub-regional differences.

	Primary Commodities		Processed Commodities	
	RUV in 2000	**RUV annual change**	**RUV in 2000**	**RUV annual change**
Africa	1.61	4.21	1.28	0.44
CFA Zone	1.08	4.40	1.70	2.80
Non-CFA Zone	1.84	4.13	1.12	-0.46
Asia	1.52	7.18	1.05	2.79
HPAEs	1.84	0.80	1.06	0.40
Non-HPAEs	1.43	9.06	1.04	4.11
LAC	1.67	2.92	1.12	0.96
USA	1.2	3	1.2	2

Source: WTC and UNSD, 2002.
Note:- RUV: relative unit value; RUV annual change from 1996 to 2000; Africa includes SSA countries only; HPAE includes Hong Kong, Malaysia, Indonesia, Singapore, South Korea, Thailand, and Taiwan.

remained relatively firm in recent years, but in 2001 they weakened substantially. Sugar prices have risen since 1999, at which they had fallen to less than half their 1995 level. To some degree, these variations reflect the nature of a large of agricultural production: in the long run, the supply may be elastic, but price trends are hardly clear; in the short run, price swings may be discernible, but the supply is hardly adjustable.

Sector price indices for the short to medium term of 5 years – from 1996 – 2000 – for primary and processed agricultural exports for different regions and sub-regions are shown in table 2. For each category and each country, the proxy for the responsiveness to international market price incentives are based on relative unit values of exports (RUV) as calculated by the WTC and the United Nations Statistics Department (2002). The relative unit value is calculated as the ratio of the country's average unit value of exports to the world average unit value, while the average unit value represents values divided by quantities. Thus, the reference point of relative unit value is 1: if the relative unit value is below (above) 1, then the country exports its products at a lower (higher) than the world average unit price. As such, relative unit values give an indication of the quality of export products. On this bases, table 2 shows that SSA economies are specialized in sets of primary agricultural commodities with relatively better price profiles, an indication of best track record relative to Asia. However, Asian agricultural export commodities appear to have the most unfavorable commodity structure but this structure improves the most rapidly. This suggests that the high track record in terms diversification and diversification change responds to price incentive changes in this region.

From a dynamic perspective table 2 contrasts with sub-regional performance differences in terms of diversification: in SSA, CFA countries have the best track record except for primary commodity prices. In Asia, agricultural export structure is more favorable in highly performing economies, especially for primary commodities, but the price profile for the rest of the Asian countries improves relatively more rapidly. In total, highly performing Asian economies seem to be lagging, but together with the decline of primary agricultural exports in these economies, this poor performance likely reflects the little emphasis put on agriculture by the export strategy, given that these economies are highly performing in manufactured exports.

The Factors of Performance in Asia and Their Relevance for Africa

This sub-section surveys the factors of production explaining performance in Asia in the short to medium term, and discusses their relevance for agricultural export performance in Africa.

I. **Factors of Production**

a) *Physical capital*

The contrast between Africa and the HPAEs is striking. Mbaye (2002) observes that Asian exports have developed from massive transfers of capital from industrial countries. They emphasized that the contrast between these flows and the few external resources that Africa has received so far has been one key dimension of the marginality of Africa and that this explains the poor performance of African economies. For instance, regarding foreign direct investment, in 1999 SSA received about 10 times less than Asia and this contrasts with the returns on investment. As Asiedu (2001) points out, these are higher in Africa (25-35 percent) than in other developing countries, including Asia (16 percent), but at the same time, SSA has attracted only 4 percent of the total foreign direct investment flows. On the other hand, while capital flight represented 5-6 percent of private wealth per worker in Asia in 1990, it amounted to 40 percent in Africa (Collier *et al.*, 2001). As Mbaye (2002) shows, in 1991, for instance, capital flight from Africa amounted to US$ 135 billion, 5 times as much as the total investment, 11 times as much as private investment, and 120 times as much as foreign investment. Mbaye estimates that the return of 10 percent of this amount would represent more than twice the private investment in Africa

(excluding South Africa). These show that low investment in physical capital and foreign investment have affected African agricultural export sectors.

In response to why investments reaching African economies fly away, Collins and Bosworth (1996) note that Africa is facing various risks in investment, and even the low amount of physical capital invested in Africa has generally had lower productivity compared with HPAEs. Ngaruko (2003) argues that the limitedness of the internal and external investment and the subsequent poor performance are part of an equilibrium marked by an institutional environment inimical to a high performance, thus hypothesizing that institutions are an important constraint to performance in general, and agricultural export performance in particular, in that it determines the impact of other factors on performance.

b) Human capital

Human capital is emphasized as an explanatory factor of Asian performance. Differences in human capital endowments between Africa and the HPAEs are explained by different specializations. For instance, Lall (2002) notes that the scarcity of skills relative to natural resources is consistent with the African specialization in primary exports, while the relative abundance of education in Asia is found to have boosted processed exports. However, like capital flight, the "brain drain" points to the need to go beyond explanations emphasizing the lack of skilled in Africa.

As Haque and Aziz (1998) show, SSA is the most affected region in terms of "brain drain" expressed as the share of educated people. Also, education has low marginal returns in Africa compared with Asia. Primary education is particularly illustrative of this. Given that about 70 percent of Africans are farmers, primary education may be the most relevant factor of growth, since it affects agricultural productivity the most.

Yet Lau *et al.* (1991) find that an increase of primary education by 10 percent raises agricultural productivity by 1.7 percent in Latin America, 1.3 percent in Eastern Asia, 0.1 percent in North Africa and Middle East, and only 0.3 in Sub-Saharan Africa. Some studies even find a negative relationship in the latter region (Saito *et al.*, 1994).

With respect to agricultural performance, given Lau *et al.*, and Saito *et al.*, figures, they show that lack of education weakens the impact of extension services as well as affect agricultural non-traditional exports and agricultural export diversification in relation with horticultural exports, which have emerged as potentially important for agricultural export diversification.

Higher average levels of education of farmer household members are associated with lower supply of agricultural labor. Educated people are reluctant to engage in agriculture in Africa, and even when they do not find jobs in the modern sector, especially as public servants, they prefer to stay unemployed. Sometimes educated elite members of families and communities are sent to the city to ensure political and economic participation on their behalf, and to collect money from the formal sector and the government. This is counter-intuitive behavior as well as counter-productive strategy, which translates into the deficit of educated people in agriculture. This may impede African economies from diversifying their agricultural exports through the introduction of non-traditional horticultural products. The latter sector is now growing steadfastly in acres, volume, and value over the last 10 years in Africa. This is evidenced by the East African Report (2005), which show that floricultural exports increased from 29,373 tons (worth Ksh 3.643 billion) in 1995 to 81,217 tons (worth Ksh 22,897 billion) in 2005 in Kenya. According to the report (http://www.nationmedia.com/eastafrican/current/index.html) the industry has expanded at annual rate of 200 hectares, and is one of the most rapid expansions in any country in the world. The cut flower industry constitutes more than 60 percent of the country's horticultural sector, contributing about 2.5 percent of the national GDP.

II. **Macroeconomic Environment and Market Imperfections**

a) Macroeconomic environment

Macroeconomic stability, fiscal discipline, real exchange rate alignment, and other policies like aid that affect these generic variables play a central role for the success of export promotion policies (Sekkat and Varoudakis, 2000), even though some microeconomic and sectoral components of the Washington consensus (liberalization, privatization, and market deregulation) are controversial.

The comparison between Africa and Asia in this respect shows that in the latter region, macroeconomic standards were pretty good compared with African figures during the 1970s. But it also shows that since the 1980s, stabilization policies and reforms monitored by the IMF and World Bank have improved the macroeconomic environment in Africa considerably. Yet the impact in terms of export performance was modest, as they mainly consisted in an intensive shift of resources towards export sectors with limited intensification of export production (Ngaruko, 2003a).

To illustrate the limits of macroeconomic stability at improving export performance in Africa, the CFA countries are a case in point. As mentioned earlier, the CFA economies enjoy a special monetary and budgetary status, which includes considerable macroeconomic stability. Virtually no other African economies do. In particular, the monetary and budgetary arrangements between these countries and France virtually exclude any risk of high inflation, high credibility for the monetary policy.

In a model investigating political and economic interactions in policy reform in Africa, Ngaruko (2003b) shows on the basis of the comparison of CFA with non-CFA zones over the 1990 to 2000 period, that the combination of macroeconomic stability, high international liquidity, and institutional decay increases benefits to corruption and capital flight more than to export performance.

As regards liberalization reforms, Helleiner (2002) argues that African governments have typically not developed strong supply-side supports –neither general nor selective – to encourage investment in non-traditional commodities comparable to those used in Asia or Latin America, except in some countries. Even when this was the case, for instance with export processing

zones, these policies largely failed to boost non-traditional exports in Africa. Elucidating decisive factors explaining the differences between Asia and Africa in export performance, Lall (2002) mentions that the weakness and the instability of African governments, the ambiguity and inequity of the policies they enforce, pervasive corruption among public officials, over-centralization of decision-making, and the inability to punish wrong-doing cronies probably account for a major part of the failure of African governments to improve the export performance of their economies, an indication that institutions and governance impact on agricultural export performance.

b) Non-price constraints

Non-price constraints to export performance include two types of factors. The first type includes exogenous constraints, which result from industrial countries' policies and are out of control of Africans. These include the crowding out of the massive subsidies that the governments of industrial economies provide to agriculture in their countries. Agricultural subsidies in rich countries of about $300 billion a year suppress world prices, undermining developing-country exports (World Bank, 2001). Also, World Bank (2002a) found that full elimination of agricultural protection and production subsidies in the rich countries would increase global trade in agriculture by 17 percent, with agricultural and food exports from low and middle-income countries rising by 24 percent.

As regards barriers against agricultural processed exports, escalating tariffs- duties that are lowest on unprocessed raw materials and that rise sharply with each step of processing and value-added- confine African countries to the export of unprocessed commodities. Ghana and Cote D'Ivoire export unprocessed cocoa beans; Uganda and Kenya export raw coffee beans; and Mali and Burkina Faso export raw cotton (World Bank, 2000).

Safety standards and other potentially protectionist anti-dumping actions form the second source of restrictions against African exports (Gersovitz and Paxton, 1990). Tsunehiro (2001) argues with respect to agricultural export diversification that implementation of the European Union's new aflatoxin standards will reduce African exports to Europe of nuts, cereals, and dries fruits. These products are considered as non-traditional and are highly sensitive to aflatoxin standards. The author estimates that the European standards will reduce health risks by only about 1.4 deaths per billion a year but will cut African exports to Europe by 64 percent, worth US$670 million, compared with these products' international standards. These restrictions particularly conflict with other arrangements meant to favor African agricultural exports. This conflicts with other arrangements like the Yaounde-Lome-Cotonou conventions, meant to create incentives to the benefits of African exporters, and depending on the structure of the economy's exports, this may cancel out much of the benefits accruing from these arrangements.

VI. Suggested approaches to sustainable root and tuber crop production and agricultural export performance in Africa

i) Wisdom from Farmers' Production Systems

Systems that have a high potential for sustainability mimic natural ecosystems and ensure continuity in supply of some important resources for plant growth, e.g. vegetation, nutrients, and water, and prevent their losses from soils by erosion. These systems are those practiced by farmers whose habitats scientists are trying to understand. Biological control is one of the benefits of maintaining the ecological diversity of plants and animals.

Therefore, approaches that incorporate farmers' relevant knowledge and experience into designs for improvement will most likely be sustainable, and has been shown in the examples of mimicking natural ecosystems. The Association of farming Systems Research and extension (Hilderbrand, 1990) emphasizes approaches requiring a thorough diagnosis of existing systems and conditions before designing any improvements and experimenting and testing them in farmers' fields. The current research emphasis on multiple cropping, agroforestry, including alley systems, and mulching of various kinds to produce plant cover for the soil represents a refinement of farmers' shifting cultivation to fit emerging situations.

ii) Requirements of New Technologies

To be sustainable, new technologies should address the whole farm and interactions in plant production systems (Hilderbrand, 1990). Donor interest in Farming Systems Research and Extension (FSR/E) may no longer be strong, as was shown by the funding problems of FSR/E and the complete absence of during the international meeting (AFSR/E annual meeting, East Lansing, Michigan, September 1992). Yet sustainability and FSR/E are compatible concepts because whole farm situations and interactions of their components need to be understood. An application is that the days of neatly laid out field experiments with one or two factors and high environmental controls may be over. High levels of variability are to be expected at farm level and more attention to interactions than to the main effects may pay off in understanding farmers' real situations and problems.

iii) Water Management

At optimum water supply and disease and pest control showed that the potential annual grain production in Sub-Saharan Africa was about 10 billion metric tons (Burningh *et al*., 1975). They estimate that the potential agricultural area in Africa in 1965-1973 was 23 per cent of the Africa's total land area. Out of this area, only 6 per cent is cultivated, with a yield of 1,000 kg/ha, i.e. about 10 per cent of the 10,000 kg/ha potential. They concluded that the problem is one more of social and economic than of biophysical potential. Nevertheless, biophysical factors are of great importance if this potential is not exploited in a sustainable manner. Many of improved crop varieties currently in use in SSA do not yield as much as they would if adequate water were available. In the humid zones of West and central Africa, water distribution is such that crops are over supplied for certain months of the year and under supplied in others. A lack of water is also noted in some areas in the humid zone because of poor distribution, which often reduces the duration of crop growth (de Wit *et al.*, 1979). They have shown that moisture stress adversely affects the inflorescence development and grain filling and leads to inefficient use of nutrients. With stress, either fertilization is inhibited or grains that are already fertilized abort. Irrespective of breeders' expected yields, crop yields decline because of reduced duration of growth attributed to the moisture stress of cereal grains or of roots and tubers. An urgent technical input is to

ensure timely water distribution for plant growth. Even for cassava, which is tolerant of moisture stress, storage root yield is decreased during the dry season months of the transitional zone of West Africa.

iv) Implication for Plant Breeding

For most of plant breeders, favorable yields are based on high economic yields and the high harvest indices of improved varieties per unit of space and time. Varieties are usually evaluated in monocropping systems using recommended levels of fertilizer and pest control. Evidence now available suggests that these values need to be reassessed in plant production systems aimed at sustainable development. To conserve soil resources, there is a need to conserve biological life: living organisms can be adversely affected by pesticides and other chemicals; plowing accelerates soil and nutrient losses owing to erosion and leaching; good harvests at the expense of leaves, stems, and other plant parts may be detrimental because the additional vegetative materials needed for mulching the soil are lost. In highly vegetative plants, nutrients that could have been leached off or volatilized from soil may be held in plant parts and later released during decomposition (de Wit *et al.*, 1979).

The age of sustainability calls for a modification of breeding objectives. It may require new approaches in testing improved varieties and a re-examination of selection procedures. A trait lost may be hard to recover at later stages in a breeding cycle. An example is cassava, whose shoot and root yields may be reduced significantly by spraying cowpea intercropped with the cassava as compared with unsprayed cowpea and cassava. Without a systems approach, his interaction may be missed because cowpea protected from insect attack by spraying yielded higher than when unsprayed. Thus the limited objective of increasing cowpea yield is achieved but the broader objectives of ecological balance and of increasing total yield is not attained.

The lack of involvement of users in the development of technologies can lead to non-acceptance of the results. The success of intensive agricultural development in Taiwan is mainly due the farmer pressure on researchers. The high rate of cassava (TMS 30572) and sweet potato (TIBI) adoption in West Africa, particularly in Nigeria and Cameroon, respectively, appears to relate more to their development in unfertilized soil, which may have stimulated the farmers' soil conditions, than to any other factor (IITA Research Highlights, 1985).

Virtually all the crops that generate export income, such as cocoa, coffee, and oil-palm, are declining in importance in the world market. For increased export earnings, SSA may need to produce specialized products in which it commands some advantages. The luxuriant vegetation, fruits, and nuts in African landscapes contain important oils, some protein, lubricants and condiments (Okigbo, 1989). Their potential benefits to SSA and in the world market remain unknown. For example, the cash income derived from some protected isolated stands of trees (*Elaeis guineensis, Irvingia gabonensis, Raphia spp* and *Bytyrospermum paraatoxum*) in southern Nigeria in 1980 was at least 2.3 naira per tree per day or over 10 naira (US$0.5) at 1980 rates (Okafor, 1980). Multiplication and improvement of important plants can be effected by biotechnology, which also has considerable potential in health care (medicine, nutrition) and in the chemical and cosmetic industries. New, improved crops with desirable characteristics, as well as cheap pest and disease control measures, are other potential benefits of biotechnology that SSA may miss out on if action is not taken to utilize existing facilities and create new ones if necessary.

v) Enhancing Women's Productivity

To attain sustainable development arising from the increased agricultural productivity of Sub-Saharan Africa, the human resource potential of both men and women should be developed. Concrete efforts should be geared towards enhancing the productivity of all those involved in food crop production. As women are now responsible for the bulk of the food crops produced on small farm holdings, the emphasis should be on providing them with access to the resources and inputs necessary to increase their productive capacity.

vi) Improvement of Agricultural Export Performance

To significantly improve agricultural export performance, sub-Saharan African countries should apply one or more of the following elements of a successful export-push strategy: a) access to input imports at world prices through free trade zones, export processing zones, bonded warehouses, duty drawbacks, or tariff exemptions; b) export financing through programs aimed at ensuring access to credit, often at subsidized prices; c) subsidized programs aimed to promote overseas market penetration. Particularly, organizations sponsored by governments and involving overseas communities that have invested considerable effort in helping export firms, especially smaller and new ones, to overcome international constraints; and d) policy flexibility. These strategic choices are achievable when governments maintain favorable policies; liberalize and deregulate the economy with predictable macroeconomic environments; efficient labor markets; strong and stable government commitment to export promotion; efficient and relatively honest bureaucracies insulated from daily political pressures; a fair degree of economic equity and national consensus on economic goals; participation of businesses to the design of interventions, and punishment of enterprises that failed to meet their performance criteria.

vii) Sound Land Use Policy for Africa

Land use policy in most developing countries is incomprehensive, e.g. Asadu *et al.* (2004) reported that the Land Use Decree of 1978 in Nigeria dwells more on the demarcation of the nation's land into urban and rural areas, fees to be paid for land development within designated areas and ease of land availability for development purposes. Akamigbo (1999) observes the Land Use Policy of Nigeria to be more concerned with land acquisition rather than land conservation and hence has precipitated a cycle of land degradation and soil erosion as a result of unplanned land conversions. However the policy held the promise of contributing to a reduction of the extent of land "parcellation" and fragmentation in Nigeria.

The objectives of Agricultural Policy should relate to Land Policy in the following ways:

- Improve protection of agricultural land resources from drought, desert encroachment, soil erosion and flood;

- Allocation of land to its most suitable uses, such that land suitable for agriculture is used solely for that purpose, and bad lands are protected against further damage; and
- Utilization of available land in such a way that its quality is conserved so as to enhance its potential for continued productivity.

The following strategies for land use and soil conservation are recommended complementary policy to Agricultural Policy:

1. Establishment of guidelines for land use and soil management, and the necessary framework to implement them;
2. Identification, mapping and assessing the potentials and constraints of soil resources, current land use and the present extent of soil degradation;
3. Development of programs to ensure the rational application of fertilizers and other soil conditioners appropriate to the improvement and sustained use of the soils;
4. Undertaking land capability classification and evolving methods of land evaluation suitable to local conditions;
5. Regulation of agricultural mechanization and other land preparation techniques in order to reduce soil erosion;
6. Increasing public awareness on the danger of soil degradation, its seriousness, causes and remedies; and
7. Provision of guides for traditional grazing systems so as to reduce environmental degradation through overgrazing.

It is important to note that the formulation of laudable programs and policies is often not the problem, but it is their implementation that is an issue. There has often been lack of follow-up strategies for adequate implementation of government programs. The frequent changes in government leadership do not help matter in implementation of land related policies hence evaluation and suggestions for improvement really becomes cumbersome. Another issue also relates to what type of study or strategy needs to be taken to provide relevant data for effecting a land use policy that can be implemented sustainably. Therefore, the objective of a land use policy should be to create a framework for effecting an efficient land use pattern by encouraging efficient allocation and flexibility in transition of land from one category of use to another in response to changes in the economic realities. Furthermore, land policy should specify the role of government and it must form an integral part of the nation's development plan.

SUMMARY

This paper has attempted to discuss the potential for developing sustainable plant production systems as well as agricultural export performance in Africa as compared with Asia.

The paper showed that sub-Saharan Africa (SSA) has more than enough biophysical resources to produce more food and other plants at sustained levels, but only a small fraction of the biophysical potential for crop production is exploited. Although the constraints on plant production are many, they can be reduced to three main focused areas: rainfall, soil related issues, and human resource development.

There is need to develop methods of conserving the available water and to invest in water storage, particularly for those semi-arid areas of SSA where there is a serious lack of water. This requires investment, but approaches currently used by farmers (stone and plant barriers, surface catchments, tied ridges) need to be improved and inland valleys should be exploited. We should bear in mind that some parts of California, Nevada, and Israel, for example, which produces surplus food, are in deserts. Agro-forestry species tolerant to acid soils and adapted to the semi-arid zones should be identified and evaluated for their usefulness in alley or related systems. Also, multiple-cropping systems, and surface mulching using appropriate live mulch species need to be studied further. In other wards, research should be directed to exploiting existing biological complementarities in a holistic manner. Inorganic inputs should be used to complement, not to replace, biological inputs.

Holistic approaches to technological developments pay off in terms of their ease of adoption. Step-wise approaches to technology development, using farmers' current systems as the base, appear to have merits for the small-scale farmers of SSA. Research into whole farm systems requires a revision of the operational approach. Farm-level research is very complex and involves many interactions; it therefore requires multidisciplinary team efforts. Less rigorous but useful analytic approaches should be devised for interpreting data. Most of the farmers in SSA are women. Their neglect in resource allocation should be readdressed by gearing efforts towards enhancing their productivity.

Biotechnology may be the cheapest hope if it is applied to resolving some of the constraints, for example through multiplication of improved varieties, particularly clonal materials, conservation of wild and exotic species, and breeding for disease and pest resistance and much other gene-related research (Ezeaku *et al.,* 2004). Regional laboratories to handle this specialized work need to be created, management procedures devised, staffed, and funded for the mutual benefit of the countries of sub-Saharan Africa.

In addressing the issue of agricultural export performance in Africa as compared with Asia, the paper showed that agricultural exports – either primary or processed – are less diversified in SSA compared with Asia, but that Africa tended to catch up between 1996 and 2000, especially in non-processed exports. However, important differences exist in CFA economies, where agricultural exports are less diversified and grow more slowly, even though the CFA zone records a faster shift from primary toward processed agricultural commodities. As regards to the response to commodity price changes, Asia seems to enjoy the best adjustment velocity, except for highly performing economies, where agricultural exports play a minor role as a developmental strategy. In sub-Saharan Africa, CFA economies appeared to compare particularly favorably with non-CFA economies for processed commodity price changes.

Possible explanations for low performance of agricultural exports in Africa were attributed to gaps in human and capital, macroeconomic stability, non-price constraints including industrial countries' trade barriers, and absence of information about international markets. As Helleiner (2002) and Ngaruko (2003) emphasize, internal institutional failures in sub-Saharan Africa is also responsible for export counter-performance when compared with Asia.

FURTHER RECOMMENDATIONS

To effectively support the implementation of appropriate African agricultural development as a key priority, the paper recommends that the World Bank and SS African governments:

1. Focus attention to achieve improvements in agricultural productivity: -*Establish realistic goals for expansion of irrigation and recognize the need to increase productivity of rain-fed agriculture through improvements in land quality, as well as water and drought management.

*Help design efficient mechanisms, including public-private partnerships, to provide farmers with critical inputs, including fertilizers, water, credit, and seeds.

*Support the development of marketing and transport infrastructure.

2. Improve its work on agriculture:

*Increase the quantity and quality of analytical work on agriculture and ensure that policy advice and lending are grounded in its findings. *Support public expenditure analyses to assess resource availability for agriculture and to help set Bank priorities.

*Rebuild its technical skills, based on a comprehensive assessment of current gaps.

3. Establish benchmarks for measuring progress:

*Improve data systems to better track activities supported by the Bank. *Strengthen M&E to report on project activities in various agro-ecological zones and for different crops and farmer categories, including women.

*Develop a system to coordinate agricultural activities in a country-wide basis with road access, market proximity, and soil condition.

4. Given the diverse constraints to agricultural development in Africa, the strategy for the development of the sector needs to be multifaceted, with coordinated interventions across a range of activities. Also, since Agricultural development in Africa is a complex technical, economic, social, and political challenge it has to be overcome if the Region is to reduce extreme poverty and hunger to meet the first Millennium Development Goal.

5. Also, for Africa to meet the MDGs, it will be necessary to realize the potential of the agriculture sector, to provide the support needed for it to contribute to growth and poverty reduction. It is believed that for the poor SS African countries and people, GDP growth originating in agriculture is about four times more effective in reducing poverty than GDP originating outside the sector.

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