

FOOD SECURITY IN AFRICA : CHALLENGES AND PROSPECTS

Emmanuel K. Boon

*Management and Environmental Management, Free University of Brussels, Belgium,
and University of Ghana, Legon-Accra, Ghana.*

Keywords : Biotechnology, Coping strategies, Food security, Genetic diversity, Genetically Modified Organisms, Globalisation, Good governance, Livelihoods, Malnutrition, Poverty, Sustainable agriculture

Contents

1. Introduction
 2. The Concept of Food Security
 3. Principal Agricultural Systems and Impact on Food Security
 4. Agricultural Systems, Poverty, Food Security and Hunger
 5. Food Security Critical Factors in Africa
 6. Conclusion
- Glossary
Bibliography
Biographical Sketch

Summary

Food insecurity and hunger are widespread in sub-Saharan Africa (SSA). *Food security* implies the provision of safe, nutritious, and quantitatively and qualitatively adequate food, as well as access to it by all people. The chronic food insecurity in SSA is largely due to the fact that 85-90 per cent of agriculture is rain-fed and accounts for 35 percent of the region's gross national product (GNP), 40 percent of exports and 70 percent of employment (World bank 2000). Domestic food production accounts for about 80 percent of the region's consumption (UNEP 2002:289). The yield of roots and tubers in Africa is the lowest in comparison to the other regions of the world (McGranahm et al 1999:104). However, an estimated 40 percent of people in SSA live below the poverty line, and both income and human poverty are increasing (UNEP 2002: 16). This paper examines these complex sustainable development problems and suggests appropriate measures for reducing poverty, ensuring food security, fighting hunger and promoting a sustainable management of natural resources. The paper argues that the principles of *sustainable agriculture* and rural development (SARD) enunciated in the den Bosch Declaration (FAO 1996:39) constitute the foundation for achieving food security in Africa.

1. Introduction

Africa faces a number of critical challenges. According to Klaus Topfer (UNEP 2002 : XV), the environment continues to deteriorate ; social and economic inequality is increasing ; and *globalisation* is sweeping across the world, largely leaving Africa behind. Rapid changes in the global economy, in consumption patterns and in population and demographics are having a negative impact on the environment. In spite of the introduction of economic reforms in many Sub-Saharan African (SSA) countries,

economic growth continues to be sluggish or negative, impacting heavily on the welfare of the people, especially the rural population. In addition, major environmental disasters in the continent such as recurrent drought and floods have serious devastating socio-economic and ecological impacts. Poor land policies and management practices, which lead to land degradation and deforestation, contribute to increased flood disasters in some risk areas.

A clear outcome of these nefaste processes is a significant decline in agricultural production, *poverty* and *food insecurity*. Agriculture, of which 85-90 per cent is rain-fed in sub-Saharan Africa, accounts for 35 percent of the region's gross national product (GNP), 40 percent of exports and 70 percent of employment (World bank 2000). Year-to-year swings in GDP can be as high as 15-20 percent, largely due to the effects of *fluctuations in rainfall* on agricultural production. About one-third of the region has a mean annual rainfall of less than 700 mm, which is too little to sustainably support *rain-fed crop production*. In SSA, domestic food production accounts for about 80 percent of consumption (UNEP 2002 : 289).

1.1. The Research Problem, Objectives and Premises

An estimated 40 percent of people in SSA live below the poverty line, and both income and human poverty are increasing (UNEP 2002 : 16). Using the Human Development Index (HDI) as a measure of the quality of life, in 2000 there were no African countries in the high HDI group. A number of countries were in the medium HDI group, while the majority were ranked in the low HDI group. Forecasts indicate that human vulnerability in Africa is set to worsen in the future. This will lead to increasing poverty ; less attention being paid to the environment ; women and children will continue to bear the brunt of environmental change ; migration and brain drain will intensify ; and the overexploitation of the environment will be accelerated.

This paper analyses food insecurity and related problems in SSA in general and Ghana in particular and proposes the adoption of strategic measures to mitigate human and environmental vulnerability. It argues that ensuring food security is a key strategy for achieving this objective. Projections on food production estimate that Africa as a whole needs to increase its grain production by almost four times and its animal production by seven times, given a population of 2,200 million in the year 2050 (McGranahm et al 1999:104). Ideas on how to meet this challenge vary enormously; some are optimistic, even complacent, others are darkly pessimistic. Some indicate that not much needs to change; others argue for fundamental reforms to agricultural and food systems. Some indicate that a significant growth in food production will only occur if new land is taken under the plough; others suggest that there are feasible social and technical solutions that would increase yields from existing farmland.

The guiding premise of this paper is that without deliberate changes from the normal course of events, many of the food security problems of today will persist and some will become worse. Action needs to be taken now to promote poverty-reducing growth and agricultural development as well as to put agriculture on to a more sustainable path. A second hypothesis of the paper is that *modern agriculture undermines food security and health by putting the rural poor at a disadvantage, threatening their land tenure, and*

degrading wild resources. Agricultural production in the future therefore needs to take into consideration the issue of sustainability.

2. The Concept of Food Security

According to the World Food Summit organised in Rome in 1996, food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 2001 : 4). Tracking trends in food security requires two interrelated variables (FAO 1996a, Vol 1, Ch2 :3). The first is the *per caput availability of food* for direct human consumption (also called per caput food supplies). It can be used to construct the *pattern of world distribution of food supplies* to show what part of the world's population lives in countries with given levels of per caput food supplies for consumption.

The second variable concerns the *distribution of the food supplies within each country*, i.e. given the national average of the preceding variable, what proportion of a country's population has access to any given level of per caput food supplies. One such relevant level for food security analysis is that of per caput food supplies (Calories/day) equal to 1.55 times the *basal metabolic rate (BMR)*. If a person's access to food is below this level, s/he may be classified as chronically *undernourished*. From 1969 to 1971, 900 million people in the developing countries (35 percent of their total population) were so classified. By 1988-1990, the proportion had fallen to 20 percent, but there were still about 800 million undernourished people, given that the population of the developing countries had in the meantime increased from 2.6 to 4.1 billion.

Food security, therefore, implies the provision of safe, nutritious, and quantitatively and qualitatively adequate food, as well as access to it by all people. Food security has three dimensions (UNEP 2002:288):

- availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports ;
- access by households and individuals to appropriate foods for a nutritious diet ; and
- optimal uptake of nourishment, thanks to a sustaining diet, clean water and adequate sanitation, together with healthcare.

2.1. Access to Food

It is important to emphasise that *more food production does not necessarily mean more food for those who need it*. Most experts would agree that the largest part of the production increase has to come from yield increases. Current levels of agricultural productivity and production say little about potential levels, because they are simply a response to present levels of demand and price/market conditions.

It is however important to note that *food production is not the same as food availability* (production minus exports plus imports), and that *aggregate availability and the ability to acquire food (food entitlements) are very different things*. The yield of roots and

tubers in Africa is the lowest in comparison to the other regions of the world (McGranahm et al 1999 :104). Whilst food production undoubtedly influences food entitlements, the connections are complex and there are also other matters involved.

People's *access to food* depends both on the purchasing power of their income, and on their *non-market entitlements*, such as rights to land for subsistence farming and foraging purposes. Households seeking to preserve *food security levels* may resort to a number of *coping strategies* to gain *access to food*. These include : maintaining normal income generating patterns ; adaptation by means of innovative use of available resources or some divestment of liquid assets ; divestment of productive assets, such as stock or land ; and out-migration and destitution.

However, the *market economy* is not expected to grow rapidly, and many *non-market entitlements* are in danger of decline. *Food entitlements* for *urban dwellers* are most often mediated through the market, whereas for *rural dwellers* in general, and *subsistence farmers* in particular, these *entitlements* tend to depend more on the local production.

Clearly, *food insecurity* is basically a problem of poverty, affecting those social groups with the weakest or most fragile food entitlements, both in terms of access to social networks and safety nets or productive assets (capital, land, agricultural inputs).

Malnutrition can thus be a threat to urban and rural dwellers at different times and for different reasons. *Urban-rural links* are often created in the pursuit of *food security*, and hence urban dwellers will maintain rural contacts, or even land, to provide *food security* in case their purchasing power is disrupted, whilst rural dwellers will maintain urban contacts, in part to ensure against the loss of local food entitlements.

2.2. Adequacy of Food Supply

Agricultural output in Africa has been lagging behind population growth since the 1960's. Between 1965 and 1990, agricultural production grew at an annual rate of 1.7 percent, while there was annual population growth average of 2.8 percent. Food imports including food aid in the African region have increased substantially to offset the deficiencies, and in early 1994 represented about 10 percent of the food consumed. At the current growth rates, the food gap is projected to increase to more than nine times the present gap by 2020 (Agyare-Kwabi P., 2003).

2.3. Acceptability of Food

As a result of its agro-ecology, trade history, and position most African countries have diverse diets in terms of staple foods. This is a great advantage in terms of food security because many consumers will substitute among the five broad categories of staple - cassava, yams and tubers, plantain, millet, maize and rice - according to national and also tribal taste preferences and changing relative prices.

Women have distinctive roles to play in determining the acceptability of food basically because of their traditional role as wives and mothers who cook for their families.

Transforming food from its raw state into processed or cooked food has long been the preserve of women. As prepares of food women can get whole households to accept one menu over the other ensuring that family members accept one available food over the other. An ongoing national programme in Ghana - The Cook Art - which is organised with the primary motive of getting some of the authentic Ghanaian dishes back on the national menu is a step in the right direction. It is a programme that would get Ghanaians, especially the youth to start appreciating their traditional diets.

2.4. Determinants of Food Security

These factors are directly and indirectly interrelated. Available food must be accessible to all members of the populace. What is available must also be adequate and the populace must be willing to eat that is what is available must be accepted as a preferred food.

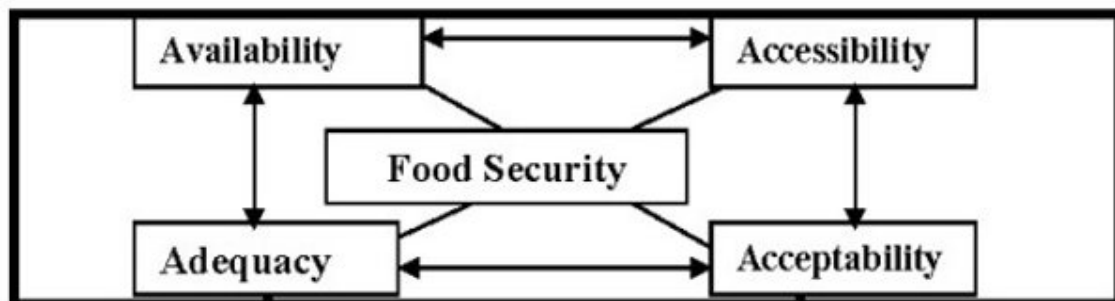


Figure 1: The Intricate Determinants of Food Security

Practically, a food glut in the rural communities may not necessarily be reflected on the market due to problems relating to accessibility – road and transportation networks, more market distributors are not willing to move into the hinterland to cart food to the urban centers. Similarly, a glut of cassava and plantain may not necessarily be that important for example to the Ghanaian non-Akan ethnic groups who do not necessarily accept or prefer to eat “Fufu” or “Ampesi”.

2.5. Monitoring Food Security

The main indicator for *monitoring food security* in the world is *per caput food consumption*, measured at the national level by the *average dietary energy supply* (DES) in Calories on the basis of *national food balance sheets* (FBS) and population data (FAO 1996a :vii). However, there are no internationally comparable comprehensive data for tracking the evolution of access to food for individuals or population groups within countries.

Undernutrition in a given country is determined by its DES in relation to a *minimum threshold* defined as corresponding to the average DES that represents a *minimum level or energy requirements* for individuals, allowing for only light activity. This level ranges from 1,720 to 1,960 Calories/day/person, depending on the country. For countries where the average DES is close to the threshold, the majority of individuals

are undernourished, while experience shows that for countries with DES about a level of say, 2,700 Calories, the proportion of undernourished individuals becomes small, except under conditions of extreme inequalities.

2.6. Agricultural Production Trends in Sub-Saharan Africa

For several developing countries, the 1970s was a decade of improvement in agricultural production faster than that of the 1960s. Rapid progress continued up to about the mid-1980s, and at a slower pace afterwards. But several countries and whole regions failed to make progress and experienced outright reversals, foremost among them many African countries, while South Asia made only meagre progress in the 1970s but more substantial gains in the 1980s. In many developing countries, *per caput food supplies* may remain stubbornly inadequate to allow for significant nutritional progress (FAO 1996a : ix). The dependence of the developing countries on food imports will most likely continue to increase with net imports of cereals growing to cover 160 million tonnes by 2010.

Expansion and intensification of agriculture has often been associated with the buildup of pressures that have led to *resource degradation* and *adverse impacts* on the wider environment. Such pressures will continue to increase in the future and a major issue will be how to minimise the negative effects on the resources, the environment and the sustainability of agriculture. This is particularly important for African countries where the exploitation of agricultural resources is the mainstay of their economies and the deterioration of their resources threatens both their food security and overall economic well-being. At the same time, it is in these countries that continued poverty and further increases in the population and dependence on agriculture intensify pressures that contribute to degradation and unsustainability (see Box 1).

Box 1: Ensuring Food Security in Ethiopia:

In Ethiopia, 14 million and on average 1-5 million are at risk of food insecurity each year. On 28 August 2003 a new coalition of international agencies, donors, civil society, and private sector and the Government was formed to work out strategies to improve Ethiopia's food security by 2006. In the 1990s Ethiopia reduced the percentage of its 67 million people who are undernourished from 59 per cent to 44 per cent. The Government and development partners engaged in consultations on food insecurity issues over the last two years. In a UNDP funded forum, they agreed to form a Coalition for Food Security in Ethiopia, to foster partnerships to take action to lessen the impact of droughts, improve livelihoods and ensure that communities have adequate food supplies. Supported by the UNDP-administered funding pool, the US Agency for International Development and the World Bank, the coalition set up a technical group of Ethiopian and international experts.

The group is focusing on several priorities, including improving livelihoods, agricultural and livestock production, access to food, a safety net and asset protection for rural communities, and marketing agricultural products. They are also working on implementation strategies and budgeting, access to land for voluntary resettlement of families in drought-prone areas, and health and nutrition. So far despite Ethiopia's food needs of 1.5 - 2.2 million metric tonnes the unmet needs amount to 1.5 -2.2 million metric tonnes.

Source: U.S. Agency for International Development (USAID) 2002 *Food Security Crisis in Ethiopia and Eritrea, USAID Fact Sheet Washington, DC November 13, 2002*
<http://www.state.gov/p/af/rls/fs/15208.htm>

Box1 : Ensuring Food security in Ethiopia

3. Principal Agricultural Systems and their Impact on Food Security

3.1. Traditional Agricultural Systems

Farmers of *traditonal* and *low-input agricultural systems* have long favoured crop diversity. Even today, there are still a huge variety of crop combinations cultivated, including cereals, legumes, root crops, vegetables and tree crops. In Africa, more than 80 percent of all cereals are intercropped, producing, in some cases, highly complex patterns, with up to 20 species grown in close proximity.

3.1.1. Genetic Diversity in Traditional Agriculture

In very variable conditions, farmers rarely standardise their practices. They maintain diversity, develop a variety of strategies and so spread risk. Mixtures of crop and varieties clearly provide farmers with a range of outputs, and also represent a logical approach to coping with variable environments. *Mixed crops* can also be less variable in time and space, and combined yields are often greater, particularly if differences in root and shoot geometry allow the crops to use light, nutrients and water more efficiently (McGranaham et al 1999 : 112). *Intercropping* can reduce weed problems, so influence labour requirements, returns to labour can be increased, and erosion and runoff may be reduced because of the greater ground cover given by the mixture.

3.1.2. Importance of Agriculture Genetic Diversity

Crop *genetic diversity* provides security for farmers against pests, disease and unexpected climatic conditions. In the highly variable environments of Africa, crop genetic diversity can help small-scale farmers obtain higher yields than they could with *monocropping*. Higher yields are obtained from a mixture of crops and crop varieties, each one specifically adapted to the microenvironment in which it grows. Genetic diversity also provides farming communities with a range of products with multiple uses and value. Some varieties of a particular crop may be good for immediate consumption, for example, while others are better for long-term storage.

The *mixed farm* can be an almost closed system, making little impact on the outside world : crop residues are fed to livestock or incorporated in the soil ; manure is returned to the land in amounts that can be absorbed and used ; legumes fix nitrogen ; trees and hedges bind the soil and provide valuable fodder and fuelwood, and habitats for predators of pests. The components of the farm are thus complementary in their functions, with little distinction between products and by-products. Both flow from one component to another, only passing off the farm when the household decides they should be marketed.

Small grains, such as sorghum and millet, are more likely to meet these needs than maize hybrids, because they are more drought-tolerant, their seeds can be stored for much longer, and they can be relied upon to germinate after several seasons of storage.

They also require fewer pesticides and fertilizers for cultivation. There is growing evidence to indicate that diversification reduces people's susceptibility to drought and other risks.

3.1.3. Erosion of Genetic Diversity in Agriculture

It is only recently that fields restricted to single species and varieties have become common. The introduction of *modern varieties and breeds* has almost always displaced *traditional varieties and breeds*. The 20th century saw the loss of some 75 percent of the *genetic diversity of agricultural crops*. Only about 150 *plants species* are now cultivated, of which just three supply almost 60 percent of calories derived from plants (McGranaham et al 1999 : 112).

Such *erosion of genetic diversity in agriculture* represents a major threat to the food security of the majority of the world's producers. Modern, *uniform crop varieties* will only reach their potential if the environment is also uniform, which means high quality land where the fertility and water status have been evened out with the use of fertilizers and irrigation. In areas where monocropping is prevalent, diseases and pests can spread quickly and cause devastation. Whilst improved methods of controlling animal and crop diseases are now available, the costs of these services have become increasingly prohibitive for the farmer, largely due to the introduction of *structural adjustment programmes (SAPs)*.

3.2. Modern Agricultural Systems

The process of *agricultural modernisation* has produced three types of agriculture : industrialised, Green Revolution, and all that remains – the *low-external input, traditional* and « *unimproved* » systems.

3.2.1. Industrialised Agriculture and Green Revolution

Industrialised agriculture and *Green Revolution* have been able to respond to the technological packages, producing high-input high-output systems of agriculture . For success, they require conditions that are either like those where the technologies were generated, or else environments that can easily be changed and homogenised to suit the technologies. These tend to be endowed with most of the following attributes :

- access to roads, urban markets, ports, coupled with ready access to inputs : machinery, marketing infrastructure, transport, agroprocessing facilities and credit ;
- good soils ;
- adequate supply of water, either through stable rainfall or irrigation systems ;
- access to modern crop varieties and livestock ; and
- access to petroleum-based products and machinery.

Most *agricultural systems* in industrialised countries are high-external input systems. In developing countries, high-external input systems are found in the large irrigated plains and deltas of South, South-East and East Asia, and parts of Latin America and North

Africa. However, in some sub-Saharan African countries. They tend to be *monocrop* and/or *monoanimal enterprises*, geared for sale of produce, and so include lowland irrigated rice, wheat and cotton ; plantations of bananas, pineapples, oilpalm, sugar cane, market gardening near urban centres, and intensive livestock rearing and ranching.

In the lands of the *Green Revolution*, the success of which lay in its simplicity, agricultural scientists bred new varieties of staple cereals that matured quickly, so permitting two or three crops to be grown each year. They were day-length insensitive, so could be grown by farmers at a wide range of latitudes ; and that produced more grain than straw and were also much more responsive to nitrogen than traditional varieties. These *modern varieties* were distributed to farmers, together with *high-cost inputs*, such as inorganic fertilisers, pesticides, machinery, credit, and water regulation. These *technical innovations* were then implemented in the most favoured agroclimatic regions, and for those classes of farmers with the best means of realising them, the yield increased. Now, some 50 percent of the total wheat, rice and maize acreage is planted with modern varieties, although the uptake varies considerably across continents. As a result, average cereal yields have roughly doubled in 30 years, and this has led to an improvement of about 7 percent in the total food produced per capita over the same period. This average does, however, hide significant regional differences : in South East Asia, food production per capita has increased by about 30 percent, but in Africa it has fallen by 20 percent (McGranaham et al 1999 : 114).

3.2.2. The Burden of Modern Agricultural System

The agricultural production increases brought about by *high-input packages* have brought many benefits. Without them, many people would be worse off than they are now and many others might have died of starvation. But in order to assess the true net benefits of *high input packages*, it is also important to understand some of the *external costs*. It is also important to keep in mind that in some circumstances, *modern agriculture undermines food security and health by putting the rural poor at a disadvantage, threatening their land tenure, and degrading wild resources*.

Many of the *environmental problems associated with agriculture* are a direct result of intensive and specialised farming. *Intensification of agriculture* has meant greater use of *pesticides, fertilisers* and water inputs, and a tendency to specialise operations. The inputs, though, are never used entirely efficiently by the receiving crops or livestock and, as a result, some are lost to the environment. Some 30 to 80 percent of applied nitrogen, and significant, but smaller amounts of applied *pesticides* are lost to the environment where they contaminate water, food and fodder, and the atmosphere (McGranaham et al 1999 : 115). Water is often wasted or used inefficiently, leading to *groundwater depletion*, waterlogging and salinity problems. This is not only wasteful, but costly to those who want to use these resources and expect them to be uncontaminated.

Many *environmental and health-related impacts* have increased in recent years, whilst others have persisted, all efforts to reduce them notwithstanding. Water systems have become increasingly contaminated. *Nitrates* in water can give rise to *methaemoglobinaemia* in infants, *pesticidecontaminated water* can harm wildlife and

pollute drinking water, and nitrate and phosphates from *fertilisers*, together with organic wastes from livestock manure and silage, all contribute to algal growth in surface waters, deoxygenation, fish and coral deaths, and cause a general nuisance. Eroded soil also disrupts watercourses, and runoff from eroded land causes flooding and damage to housing, irrigation systems and natural resources.

Various pollutants also harm farms' and local areas' natural resources. *Pesticides* damage populations of the predators that help keep pest populations under control, as well as other wildlife, whilst inducing resistance in target pests. *Nitrates* from *fertilisers* and *ammonia* from livestock wastes raise the metal content of soils, and *pathogens* in wastes can harm human and livestock health. The atmosphere is contaminated by *ammonia* (which plays a role in acid rain production), *nitrous oxide* derived from *fertilisers* (which plays a role in *ozone layer depletion* and *global warming*) and *methane* from livestock and paddy fields, (which also affects global warming).

The consumer is most likely to be directly affected by eating food contaminated by *pesticides residues*, *nitrates* and *antibiotics*. In industrialised countries, the *levels of pesticides in foods* have been falling steadily since the 1950s, but there are, nonetheless, occasional public scares over particular products, and rare are *incidents of severe poisoning* arising from the spraying of illegal products. In African countries, however, daily intakes are often very high. These may be in cereals or fish, such as those from lakes and rivers of Kenya, Nigeria and Tanzania.

The major hazard, however, lies in *locally marketed food*. Leafy vegetables are often sprayed twice a week and may come to market with a *high degree of contamination*, especially in the dry season. In Africa, vegetables have been found to contain *organophosphates* many times in excess of *human tolerance limits*. Leafy vegetables have also been found to be contaminated with *faecal material*, although this is not confined to high intensity agriculture (McGrath et al 1999 : 116).

The *costs of environmental damage* are growing, and are dispersed throughout many environments and sectors of national economies. Recent analyses, meanwhile, have been characterised by the recognition that farmers themselves are suffering declining incomes or health-related effects as a result of these modern approaches to agriculture.

3.2.2.1. Pesticides and Health

In the past 50 years, the use of *pesticides in agriculture* has increased dramatically, and the value of the global market is now about US \$30 billion (McGrath et al 1999 : 116). *Herbicides* account for nearly half, *insecticides* a quarter, and *fungicides* less than a fifth. The largest individual consumer is the USA, followed by countries of the Far East. On a global level, Africa is a relatively minor consumer of pesticides – about 4 percent of the total world consumption. The consumption is also quite variable, because of intermittent demand (locust eradication campaigns), a recent decline in government pesticide subsidies, and fluctuations in aid.

Pesticides are intended to be *hazardous* – their value lies in their ability to kill unwanted organisms. But they are rarely selective. Most act by interfering with fundamental

biochemical and physiological processes that are common to a wide range of organisms – not only pests and weeds, but to human, too. *Pesticides* affect workers engaged in their manufacture, transport and disposal, operators who apply them in the field, the general public, and wildlife. In the first case, the hazard is common to all industries dealing with toxic chemicals. Of greater concern is the hazard to the field operators because of the high variability in field conditions and frequent lack of protective clothing. Also at risk, however, are the general public and the wider environment, both of which are difficult to protect directly. At very high doses, many pesticides are lethal both to laboratory animals and people, and can cause severe illness at the sub-lethal levels, but the risks differ from pesticide to pesticide.

3.3. Low-External Input Agricultural Systems

The third type of agriculture comprises all the remaining agricultural and livelihood systems, and represents a largely forgotten agriculture. These are the *low-external input systems*, located mainly in drylands, wetlands, uplands, savannas, swamps, near-deserts, mountains and hills, and forests. *Farming systems* in these areas are complex and diverse, and rural livelihoods often depend on wild resources, as well as agricultural produce. They are remote from markets and infrastructure, they are located on fragile or problem soils, and they are less likely to be visited by agricultural scientists and extension workers, or studied in research stations.

These forms of agriculture often have *low productivity*, with cereal yields typically only 0.5 to 1 tonne per hectare. The poorest countries tend to have higher proportions of these agricultural systems, and indeed, most of the food production in Africa comes from these low-external input systems of agriculture. By the mid-1990s, some 30 to 35 percent of the world's population, about 1.9 to 2.1 billion people, were directly supported by this third and « forgotten » agriculture, yet these people are currently excluded from development assistance and agricultural policies that focus on the high potential lands.

Although there has recently been some recognition of what can be achieved by a more sustainable form of agriculture, many institutions still believe in the modernisation paradigm. The high-external input systems and conventional cropland provide the bulk of the world's food, and they are thus assumed to be the only places where further improvements can be made. To some, this implies that activities should concentrate on high potential areas.

The common assumption is that improvements elsewhere will encourage people to migrate from marginal areas to the higher potential ones, where they will have access to jobs and food. This will reduce the population pressure on marginal areas. The implied strategy is to create employment and income opportunities outside of agriculture in the marginal lands, and to boost productivity in the better endowed areas so that populations can leave eventually from the marginal lands. Such an approach ensured that existing low-input and traditional agricultural systems continued to be ignored.

3.3.1. Sustainable Agriculture

The principles of *sustainable agriculture* and rural development (SARD) enunciated in the den Bosch Declaration (FAO 1996 : 39) constitute the foundation for achieving food security in Africa and in deed in the world in general :

« ...the wide diversity of ecological, cultural, social and economic conditions under which agriculture is practised and recognised the primacy for agriculture to ensure first and foremost food security for all, both in terms of quacity and quality of food, to provide employment, and to improve livelihoods and security of income in rural areas ».

UNCED (1992) elaborated on the concept of SARD when in Agenda 21 it called for:

« ...major adjustments in agricultural, environmental and macroeconomic policy at both the national and international levels, in developed as well as developing countries, to create the conditions for sustainable agriculture and rural development (SARD). The major objective is to increase food production in a sustainable way and enhance food security. This is best accomplished through education initiatives, utilisation of economic incentives and the development of appropriate and new technologies, thus ensuring stable supplies of nutritionally adequate food, access to those supplies by vulnerable groups, and production for markets ; employment and income generation to alleviate poverty ; and natural resource management and environmental protection. ...The priority must be on maintaining and improving the capacity of the higher potential agricultural lands to support an expanding population. However, conserving and rehabiliatating the natural resources on lower potential lands in order to maintain sustainable man/land rations is also necessary ».

A recent analysis of 95 agricultural project evaluations revealed a disturbing rate of failure (McGranahan et al 1999 : 194). The cited reasons for failure include an emphasis on external technologies only, no participation by local people, ineffective training of professionals, institutions and no orientation towards the diversity of local conditions and the needs of local people. This evidence suggests four important *principles for sustainability* :

- *imposed technologies are not sustainable* : if coercion or financial incentives are used to encourage people to adopt sustainable agriculture technologies (such as soil conservation, alley cropping, integrated pest management), then they are not likely to be sustaianble ;
- *imposed institutions are not sustainable* : if new institutional structures are imposed, such as cooperatives or other groups at local level, or Project Management Units and other institutions at project level, then these were rarely sustained beyond the project ;
- *expensive technologies are not suitable* : if expensive external inputs, including subsidised inputs, machinery or high technology hardware are introduced with no thought to how they will be paid for, they too will not be sustained beyond the projects ;
- *sustainability does not equal fossilisation or continuation of a thing or a practice forever* : rather it implies an enhanced capacity to adapt in the face of unexpected changes and emerging uncertainties.

A more *sustainable agriculture* that can also serve to reduce malnutrition, systematically pursues the following goals (McGranahan et al 1999 : 193-194) :

- *a thorough integration of natural processes* (such as nutrient cycling, nitrogen fixation, and pest-predator relationships) into agricultural production processes, thereby ensuring profitability and efficient food production ;
- *a minimisation of the use of those external and non-renewable inputs* with the potential to damage the environment or harm the health of farmers and consumers, and a targeted use of the remaining inputs, used with a view to minimising costs ;
- *the full participation of farmers and other rural people* in all processes of problem analysis, and technology development, adaptation and extension, leading to an increase in self-reliance amongst farmers and rural communities ;
- *a greater use of local knowledge and practices*, including innovative approaches not yet fully understood by scientists or widely adopted by farmers ;
- *the enhancement of nature's goods and services*, and other public goods of the countryside.

A recent survey of 74 *rural initiatives* in East and Southern Africa found *dramatic improvements in food production*, with improvements in both *natural and social capital*. These initiatives share important common characteristics. They made use of *resource-conserving technologies* in conjunction with *group or collective approaches to agricultural improvement and natural resource management*. They have put *participatory approaches and farmer-centred activities* at the core of their agenda, which means these activities are on local people's own terms. They have supported the *active involvement of women as key producers and facilitators of change*. And they have emphasised *adding value* to agricultural products through agro-processing, marketing, and other off-farm activities, thus creating employment and income-generating opportunities, whilst retaining the surplus in the rural economy.

Despite the increasing number of successful *sustainable agriculture initiatives* in different parts of the world, including African countries, it is clear that most of these are still only « islands of success ». Finding ways to spread or « scale up » the processes which have brought about these transitions remain a huge challenge.

3.3.2. Organic Agriculture

A second method of low-input agriculture is *organic agriculture*, which will be the subject of a separate paper. Briefly however, organic agriculture represents a deliberate attempt to make the best use of local natural resources. The aim of organic agriculture (also known as ecological or biological agriculture) is to create integrated, humane, environmentally- and economically-viable agriculture systems in which maximum reliance is placed on locally or farm-derived renewable resources, and the management of ecological and biological processes. The use of *external inputs*, whether inorganic or organic, is reduced as far as possible. Organic agriculture represents a system of agriculture rather than simply a set of technologies. The primary aim is to find ways to grow food in harmony with nature. The term organic is « best thought of as referring not to the type of inputs used, but to the concept of the farm as an organism, in which the

component parts – the soil minerals, organic matter, micro-organisms, insects, plants, animals and humans – interact to create a coherent and stable whole (FAO 2002b:141).

The organic agriculture sector is currently the fastest growing food sector. Growth rates in organic food sales have been in the range of 20-25 percent per year for over a decade. Growth rates of organic lands are impressive in Europe, Latin America and the United States. The total area of organic land tripled in Europe and the United States between 1995 and 2000. In the last 5 years, in Argentina, the organic land area increased by 1,280 percent (FAO 2002b:5). Price premiums of between 10-50 percent over prices for *non-organic products* are common. More secure markets for organic commodities, can help counter-balance the loss of preferential trade arrangements, falling food prices and withdrawal of government support to agricultural inputs and other services. Major northern markets offer good prospects for suppliers of organic products not domestically produced. These include coffee, tea, cocoa, spices, sugar cane, tropical fruits and beverages, as well as fresh produce in the off-season. Increasingly, governments in developing countries are creating conditions in support of organic exports (FAO 2002b : 6).

4. Agricultural Systems, Poverty, Food Insecurity and Hunger

In the developing countries, 70 to 75 percent of *the poor and hungry live in rural areas*. Farming is, therefore, at the heart of their *livelihood strategies*. The International Fund for Agricultural Development (IFAD, 2001) and the new World Bank Rural Development Strategy (FAO 2002a : 8) have reiterated the importance of farming as *worsening standards of living in rural areas* drive desperate people to the cities, thereby exacerbating *urban poverty* and a further decline of agriculture and the rural sector.

Many of the *rural poor* are *subsistence farmers* or *landless people* seeking to sell their labour. They depend on agriculture for their earnings, either directly, as producers or hired workers, or indirectly, in sectors that derive from farming. For example, trading, transportation and processing involve large numbers of *small entrepreneurs* and are necessary for agriculture but, at the same time, such entrepreneurs depend on farming activities for their survival. *Food-insecure people* neither consistently produce enough food for themselves nor have the purchasing power to buy food from other producers. During times of famine, food may simply not be available at any price.

4.1. Hunger and Hunger Reduction Strategies

Hunger is the most extreme manifestation of the multi-dimensional phenomenon of *poverty*, and the *eradication of hunger* is therefore instrumental to the eradication of other dimensions of poverty (UNEP 2002 : 287). Persistent *widespread hunger* impedes progress in other aspects of *poverty reduction*, and weakens the foundation for broad-based economic growth. *Hunger* also represents an extreme instance of *market failure*, because the people who are most in need of food are the least able to express this need in terms of demand.

Although the world produces much more food than is required to provide everyone with an adequate diet, yet 800 million people – almost one person in seven – do not have

enough to eat. Most of these people live in South Asia and SSA (FAO 2002a : v). On a global scale, the technology exists to enable farmers to produce an excess of food, and obesity has become one of the fastest rising health problems in both developed and developing countries.

The right to food was first explicitly stated in the 1940s in the Universal Declaration of Human Rights and the Food and Agricultural Organisation (FAO) Constitution (FAO 2002a : 5). However, there has been little progress towards its implementation. The United Nations (UN) Committee on Economic, Social and Cultural Rights has facilitated the task of implementation of this fundamental right by adopting, in 1999, the General Comment on the Right to Food, which specifies how states can meet their obligations to respect, protect and fulfil this right.

Unfortunately, in spite of these comments, too little purposeful action has been taken towards *eradicating hunger*. The number of *hungry people* in the world is not falling fast enough to meet the ambitious but pragmatic goal enshrined in the 1996 WFS Plan of Action. The Plan calls for a reduction in the number of undernourished people from 816 million in 1990-92 (the base period) to 408 million by 2015. The latest figures from FAO show that to meet the target, the number of hungry will have to fall by 22 million every year, compared with the 6 million a year attained on average over the last years of the 1990s. This slow progress increases the difficulty of attaining the goal by 2015. The fact that this slight downward trend in the number of hungry has been driven by a handful of large countries is also a cause of concern. Most developing countries have recorded either an increase or no significant change in the number of undernourished people in their midst.

The lack of action in the fight against hunger may have arisen from a belief that success in *poverty reduction*, resulting from market-driven economic development, would automatically take care of the problem of hunger. However, this thinking does not take into account three points : first, *poverty reduction* takes time, while the hungry need immediate relief ; second, in contrast to many diseases for which cures are either unknown or unaffordable, the means to feed everyone are readily and cheaply available ; and third, hunger is as much a cause as an effect of poverty. Unless hunger is reduced, progress in cutting poverty is bound to be slow.

The existence of *hunger in a world of plenty* is not just a moral outrage, it is also short-sighted from an economic viewpoint : *hungry people* make poor workers, they are bad learners (if they go to school at all), they are prone to sickness and they die young. *Hunger* is also transmitted across generations, as underfed mothers give birth to underweight children whose potential for mental and physical activity is impaired. The productivity of individuals and the growth of entire nations are severely compromised by *widespread hunger*. *Hunger* breeds desparation, and the hungry are easy prey to those who seek to gain power and influence through crime, force or terror, endangering national and global stability. It is, therefore, in everyone's self-interest – rich and poor alike – to fight hunger. A direct attack on hunger will greatly improve the chances of meeting the other Millenium Development Goals, not only for poverty reduction, but also those related to education, child mortality, maternal health and disease (FAO 2002a : 6).

4.1.1. Hunger Reduction Strategies

Given that concerns for the integrity of natural habitats will limit significant further areal expansion of agriculture, other strategies must be found to feed a global population that may exceed seven billion in 2010 (FAO, 1996). A number of alternative scenarios have been suggested by McCalla (1994) which fall into two distinct groups.

4.1.1.1. Scenario 1 : Developing Countries Should Import Food from the North

This scenario assumes a significant development of the global economy in the post-General Agreement on Tariffs and Trade (GATT). In this scenario, continued *growth in world trade* will allow *food-deficient countries* in the South to produce and export industrial goods and services that should enable them to purchase significant quantities of food from *food-surplus countries* of the North. Many of these rich developed countries have considerable unused production potential, given their *technological expertise* and their *marketing infrastructures*. For this food to reach the food-insecure in poor countries, the development of effective *national food security policies* will be required. These must ensure higher *food entitlements* for both the rural and urban poor through wider access to food made possible by income generation and employment. While North-South trade may improve *national food security* in developing countries, it does not directly follow that it will influence household food security for the poor in these countries as a group, or secure greater access to food in remote localities.

4.1.1.2. Scenario 2 : Poor Countries should Increase Own Food Production

The *second scenario*, thought by many analysts to be more realistic, advocates that poor countries of the South must increase their own food production significantly and in such a way that it specifically alleviates *food insecurity*. A number of mechanisms may be required to achieve this goal:

- increased *agricultural research* and development efforts aimed at increasing productivity per hectare of land and unit of labour ;
- improved *extension services*, through governmental and non-governmental channels, that will enable all farmers to use the results of research and reap the benefits from technological advances ; and
- improved *infrastructural and socio-economic arrangements*, including enabling policies (e.g. fiscal policies, land tenure policies, good governance, popular participation, suitable credit schemes and institution-building) that will allow all sections of the community to sustain the increased production.

Rapid progress in cutting the *incidence of chronic hunger* in developing countries is quite possible if *political will* is mobilised. A twin-track approach is required, combining the *promotion of quick-response agricultural growth*, led by small farmers, with targeted programmes to ensure that hungry people who have neither the capacity to produce their own food nor the means to buy it can have access to adequate supplies. Such approaches are mutually reinforcing, since programmes to enhance direct and immediate access to food offer new outlets for expanded production.

Additional *public investment* of an estimated US\$24 billion annually, focused on poor countries with large numbers of undernourished people, would make it possible to attain the World Food Summit goal of halving hunger by 2015 on a sustainable basis. It is estimated that such an investment would yield benefits worth at least US\$120 billion per year as a result of longer and healthier lives for all those who gain from such improvements. (FAO 2002a : vi)

It is suggested that the bulk of the required funding for the *programme for agricultural and rural development* be shared between the *national government budgets* of the countries where hunger is a major problem and *international transfers* in the form of *grants* and *concessional loans*. The implications of the proposed sharing of funds will be a doubling of concessional funding to agricultural and rural development and an overall increase in national expenditures of 20 percent for developing countries.

The creation of a policy environment, both internationally and nationally, that is conducive to poverty and hunger reduction is a fundamental requirement in the countries of SSA. At the international level, this implies measures that contribute to peace, political and economic stability as well as a trading environment for agricultural commodities which, by creating a level playing field, protects the *development and food security interests* of developing countries. Nationally, it implies the adoption of macroeconomic policies that provide the stability required to encourage savings and investment. In most cases, this will call for *increased budget allocations for agricultural and rural development*. Such policies emphasise *broad participation in policy decision-making and implementation*, combined with *institutional decentralisation* in ways that increase the *accountability of governments* to their rural populations and strengthen the capacity of communities and local organisations to place effective demand on service providers. *Policies* that define transparent and secure rights and promote a more equitable access to natural resources, such as land, water and fish stocks, contribute both to their sustainable use and poverty reduction.

There is a need to *share in the benefits of technological progress*. Additionally, all governments need to *develop social security policies* leading to the creation of reliable safety nets for those people who, through no fault of their own, are unable to meet their essential food needs through production, purchase or *traditional coping systems*. Success requires commitment from all branches of society.

5. Critical Food Security Factors in Africa

With regard to food security, the African continent faces special challenges. Figures for 1997-99 show that about 200 million people (28 percent of Africa's population) are chronically hungry, compared to 173 million in 1990-92. While the proportion of the population living in hunger is dropping slightly, the absolute numbers are rising. Most of the *economic opportunities* accessible at both the household and the national level, will have to come from agriculture, since agriculture directly affects the lives of between 70 and 80 percent of Africa's people.

Clearly, *agricultural development* must be at centre of *sustainable development* in Africa in order to bring down the *incidence of hunger and poverty* by a substantial amount. Given the special needs of Africa, especially SSA, a minimum amount of US\$4.6 billion per year will be required for *financing anti-hunger programmes* (FAO 2002 : 11). It is proposed that these additional resources be allocated to sub-Saharan Africa as follows : US\$2.4 billion in *concessional assistance* to agricultural and rural development, another US\$1.6 billion from public domestic sources. It is expected that an additional inflow of US\$0.6 billion per year in *non-concessional loans* will be available. The stated resource requirements for the *Anti-Hunger Programme* in Africa are the minimum amounts required to promote hunger reduction through agricultural development. They exclude the cost of programmes to promote *direct access to food*.

A more ambitious programme has been launched under the *New Partnership for Africa's Development (NEPAD)*. NEPAD's *cross-cutting priorities* are : peace, security, democracy and political, economic and corporate governance. These are complemented by the following sectoral priorities : infrastructure (energy, transport, water and sanitation, information technologies), human resources development (poverty reduction, education, reversing the brain drain, health), agriculture, environment and culture.

NEPAD's framework, which applies to all of Africa, provides a potentially important avenue to attain and even exceed the *world food security goals* in the entire region. In the medium term, action to promote comprehensive and *balanced agricultural development* under NEPAD will focus on three priority areas : increasing food supply and reducing hunger ; extending the area under sustainable land management and reliable water control systems ; and improving rural infrastructure and market access. Resource requirements for these three priority areas are estimated to be approximately US\$13 billion per year between 2003 and 2015. The key critical factors impacting food security in Africa are briefly reviewed in the next sections.

5.1. Rapid Population Growth Rate

Population growth is probably the single most important global factor influencing food security. It took nearly 1 million years for the earth's human population to reach 1 billion people. During the next 10 years, another billion will be added (FAO 1996a : Ch4 p.9). *Africa remains the world's fastest growing region*, at an estimated 2.4 percent per annum. The region will attain an estimated population of 1,406 million by the year 2030 (UNEP 2002 : 312). What is more, structural characteristics of the world's population are changing in ways that affect *food security*. At present, over 800 millions people are chronically undernourished because of lack of food.

Rapid urbanisation is also a main driving force, which is causing stresses in many African economies. With an average growth rate of 3.71 per cent, Africa is the fastest urbanizing region of the world. In 2000, the *urbanisation* level was only 37.9 percent, and it is projected to reach 54.5 percent by 2030. *Urban population* is expected to grow from 297 million in 2000 to 766 million in 2030 the next 30 years, the number of people living in cities in developing countries will quadruple from 1 billion to 4 billion individuals. This imposing shift towards a more urban world calls for a different set of institutions, markets, infrastructure and food policies.

The *population age structure* is heavily skewed towards young people, which generates tremendous demographic momentum. About 43 percent of the population is below the age of 15 years, about 52 percent is between the ages of 15 and 60 years, and 5 percent are aged 60 years or older. The 15-24 age group numbered 149 million in 1998, constituting about 20 percent of the total African population. This *workforce bulge* can be the basis for more investment, greater labour productivity and rapid economic development. With such high population momentum, reflected in the rather *high fertility rates*, and in improving health and medical situations, it can only be expected that the population of African countries will rise to phenomenal heights and will continue to impact the environment in significant ways. Left unattended, these trends lead to great strains and undesirable consequences on the environment.

5.2. Agricultural Policies and Governance

Macro-economic stresses, such as the transition to *cash economies*, and the penetration by *global markets* into local economies and the attendant structural changes, further serve to weaken the efficacy of *traditional coping mechanisms*, and exacerbate *vulnerability to food insecurity*. *Natural hazards and armed conflict* present two of the greatest obstacles to achieving necessary coping objectives; that is increasing agricultural output while seeking additional security through alternative forms of income and stability.

Increasing the supply of food from large-scale commercial agriculture or imports and lowering food prices are more likely to improve food security among urban than rural dwellers, and this is one of a number of issues around which urban and rural interests can come into conflict (McGranaham et al 1999 : 196). Interventions that depress urban prices are not, however, likely to prove an efficient means of improving urban food security. Moreover, some of the most vulnerable urban dwellers rely on rural links to ensure their food supply.

In most African cities, assisting *low-income households* with *urban agriculture* could be an effective means of improving urban food security. More generally, urban food security depends upon wages, employment and informal sector opportunities, and the importance of a health perspective is less evident here. It is, nevertheless, important to keep in mind that measures designed to improve urban food security which undermine the economic opportunities of the more vulnerable urban residents are likely to be counterproductive.

It is impossible to achieve *food security* and *sustainable development* without *good governance*.

Good governance in Africa is challenged by various issues, including the collapse of the state in countries where governments hardly have the capacity to govern and maintain law and order. Narrow political considerations, personalised power and corruption have undermined the process of democracy and responsive governance. *Inequity* in social, economic and political systems, including *gender inequity*, has been a barrier to achieving good governance. As such *poverty alleviation* represents the greatest challenge to good governance. There is also the challenge of how to manage effectively

financial and natural resources, promoting decentralization based on trust, transparency, accountability and capacity.

5.3. Management of Agricultural Land

Stretching 7,680 km north to south and 7,200 km from east to west, *Africa is the second largest region in the world, accounting for 20 percent of the world's land mass : 2, 963, 313,000 hectares (UNEP 2002 : 189)*. Approximately 22 percent of Africa's land area is under forest (650 million ha), 43 percent is characterised as extreme deserts (1,274 million ha), and 21 percent (630 million ha) is suitable for cultivation. By 1999, it was estimated that about 200 million ha (32 percent of the suitable area) had actually been cultivated. At the same time, it was estimated that 30 percent of the total land area (892 million ha) were being used as permanent pasture.

However, Africa's land is suffering from *degradation and reduced productivity*. The causes of *land degradation* in the region are *climatic variability and management practices*, in addition to physical factors, such as the slope of the land and soil structure. As a result of pressures to increase production, *marginal land* is being brought under cultivation or grazing ; *fertilizers and pesticides* are widely used by commercial operations ; and *fallow periods* are being reduced. These activities can result in exhaustion of the *production capacity of the land*, manifested as : declining yields ; vegetation and soil degradation and loss ; and in extreme cases, desertification. *Climatic variability and change, and inappropriate land use or land tenure policies*, add to the pressures and magnify the impacts. The current situation is that approximately 22 percent of vegetated land in the region (494 million ha) has been classified as degraded, and 66 percent of this are classified as moderately, severely or extremely degraded (UNEP 2002 : 192). The effects on *food security* and the anticipated *impacts of climate change* make *land degradation* a priority issue for African leaders.

In Africa, *land tenure and land rights* are highly complex and sensitive social and political issues closely linked with poverty and land degradation. *Traditional land tenure systems* in Africa were developed in accordance with variations in physical conditions and cultures, although they were largely centred on *communal access to resources and sharing of benefits*. Tenure is largely recorded or registered, and land rights were largely allocated through *inheritance or other regulatory and distributive mechanisms*. *Traditional systems* offer more security of tenure than is often recognized by supporters of individual tenure systems, although women generally have lower status than men.

However, *colonial regimes and newly independent governments* perceived *traditional tenure and access systems* to be insecure and poorly suited to commercial, settled agricultural development and conventional economic growth. Many African governments have taken the view that only *Western-style tenure systems and property rights* could stimulate *agricultural intensification* and improve *economic efficiency*. *Indigenous land tenure systems* were inherently considered to be insecure and inefficient, and so acted as a brake on productivity. That thinking has been carried forward into the post independence period, with proponents claiming that when *private land ownership* is clearly established, farmers are more likely to grow *perennial crops*,

invest in land management practices that benefit the *agroecosystem* in the long-term, and improve their overall productivity (McGranahm et al 1999 :108).

Thus, *land has largely become the property of the state*, and is being redistributed with discrimination along lines of wealth, race or gender. Resulting conflicts between *traditional and contemporary tenure and access policies* have frequently led to the *mismanagement of resources and conflicts* between user groups (UNEP 2002 : 192). There has also been a clear shift from *local communal or lineage-based property* towards a combination of *private property and state property*. This shift towards private property, in which *claims to property are legitimated by the state, rather than by the community and/or communal group, holds further risks for the poor* (McGranahm et al 1999 :108). This is especially true for women and pastoralists, who face the prospect of loss of all land rights as a consequence of having few resources to finance the costs of formal land registration. This change of tenure also affects the capacity of local groups to adapt to *their particular environmental circumstances and technological options*. With a few exceptions, *formal land rights* have not been found to be a significant factor in determining *investments in land improvements*, use of inputs, access to credit, or the productivity of the land in Africa. Rather, it is security of tenure that matters most. It is also becoming clear that *indigenous land tenure* in Africa can result in productive systems.

Another key element in the discussion of *land reform processes* is the effect of different tenure systems on investment in resource management and on productivity. Other issues of concern and continued discussion include : the means for developing effective, legitimate institutions for the management of land rights ; the implementation of market-based instruments for the redistribution of land ; the question of land restitution ; and the continuing marginalisation of women, indigenous peoples, and pastoralists or hunters-gatherers. The role of the state in facilitating or administering land reform is also under the spotlight, particularly in Zimbabwe.

5.4. Water Resources Management

In most countries situated in the *arid regions*, *water availability per caput* is already below the level that would allow enough food to be grown locally to feed the population. Between 30 and 40 percent of food production comes from a 250-million-hectares irrigated area worldwide. There are few regional variations in the proportion of agricultural land that receives irrigation : 35 percent is in Asia, 11 percent in Latin America, and 6 percent in sub-Saharan Africa (FAO 1996 : 16). In the developing world, about 18 percent of total *arable land* is irrigated, but irrigation intensity varies widely by individual food crop. Average yield increases in irrigated vis-à-vis rain-fed land in the developing countries are significant, generally ranging from 50 to 200 percent for most crops. In the Near East and North Africa, adverse conditions for rain fed agriculture has focused attention on irrigation. Irrigated land accounts for one-quarter of the region's wheat production, all the food grown in Egypt and more than half of that grown in Iraq and Iran. However, it is in Asia that irrigation makes the greatest contribution to global food security : the irrigated sector contributes about 80 percent of food production in Pakistan, 70 percent in China and over 50 percent of the whole of India and Indonesia.

Water scarcity is a fundamental problem in most SSA countries. The over-dependence on rain-fed agriculture in the continent has led to a decline in agricultural production. Total irrigated land on the African continent is estimated to be about 12.2 million hectares (FAO, 1996 : 18). This figure includes all land where water is supplied for the purpose of crop production (with the exception of water harvesting and spate irrigation). It represents on average 7.5 percent of arable land, but large differences can be observed. As an extreme case, Egypt has 99 percent of its arable land under irrigation, while the corresponding figure in the Democratic Republic of Congo is only 0.2 percent. Six countries (Egypt, Madagascar, Morocco, Nigeria, South Africa and the Sudan) account for nearly 75 percent of the total irrigated land in Africa, while 24 of 53 countries have only 1 percent of the irrigated land. In SSA, water control has in the past played a relatively minor part in agricultural development. This has been limited historically to traditional small-scale irrigation in drought-prone areas, and the reclamation of small swamplands.

Trends in irrigated land expansion over the past 30 years show that, on average, irrigation in Africa increased at a rate of 1.2 percent per year. However, this rate began to fall in the mid-1980s and is now below 1 percent per year. The rate of expansion varies widely from country to country. *Investments in irrigation* in Africa is widely perceived to be a poor investment, and there are innumerable alternatives, notably urban investments, competing for the limited amount of financing. Investment in medium- and small-scale irrigation schemes in SSA is believed to be relatively more attractive than investments in large-scale irrigation for the following reasons :

- small-scale irrigation technology can be based on farmers' existing knowledge ;
- small-scale irrigation technology is more compatible with the existing physical and human environment ;
- local technical, managerial and entrepreneurial skills can be utilised, and migration or resettlement of labour is not usually required ;
- planning and development of small-scale irrigation are more flexible ;
- social infrastructure requirements for small-scale projects are reduced ; external input requirements for small-scale technology are lower.

The scarcity of water calls for the recognition between the links between economic development and protection of *natural ecosystems* and the need for co-operative frameworks in the management water resources in the continent. Future developments will be dictated by a whole set of factors, including political choices, investment capacity, technological improvements, as well as social and environmental requirements.

5.5. Technology and Food Processing

Before colonisation, African economies were able to survive large-scale environmental degradation, for a number of reasons. First, the population was small, and the demands on the economy were small. More importantly, the technology was appropriate and adequate, because the African people had learned over centuries to adapt *systems of extraction of natural resources* to be commensurate with the dictates of the environment

UNEP 2002 : 316). Things have since changed. *Modern economic practices* have introduced increased *demand on human and natural resources*, and so that technology has proved inadequate. For instance, attempts to improve agriculture has resulted in the importation of strange varieties of food crops, and the introduction of chemicals and additives to soils, plants and vegetation.

For a large part of the 20th century, Africa's role in the *development of science and technology* was marginalised. To a large extent, the colonial powers inhibited the development of *indigenous technology* in Africa, and destabilised some of the existing *processes of technical growth*. *Indigenous manufacturing* capability was deliberately undermined in order to facilitate European exports, and captive markets were created. In addition, colonial powers deprived Africa of its historical credit in contributing to *advancement in science and medicine*. Furthermore, Africa has not been only a user of technologies developed in the west, but has also been a dumping ground for *obsolete technologies* abandoned in the west.

5.5.1. Biotechnology and Genetically Modified Organisms

More recently, Africa has become a testing ground for *biotechnology* and *genetically modified* (GM) products (UNEP 2002 : 316). Opinion is sharply divided on whether *biotechnology* and *genetic engineering* are creating opportunities to be seized or a danger to be avoided. These divisions extend to the role of *biotechnology* in addressing *food security problems* (McGranaham et al 1999 : 197). UNEP (2002 : 316) points out that the use of *biotechnology* in agriculture and in related primary production industries has the potential to influence food and fibre production, food security and management. There are both benefits and risks associated with the release of *genetically modified organisms* (GMOs).

Opponents of biotechnology tend to be optimistic about alternative means of improving food security, and pessimistic about both the dangers *biotechnology* brings and the likelihood that it will actually get food to those in need. The *pro-lobby* hopes that protesters will go away, or will be persuaded that *biotechnology* can benefit us all. The *anti-lobby* hopes policy-makers and the public can be persuaded to prevent GMOs from entering the food chain. McGanaham et al (2002 : 199) suggests that the opponents of biotechnology are surely correct in that there are alternative means of improving food security. Emerging empirical data on *sustainable agriculture* suggest that current and future populations can be fed with *low cost and regenerative technologies*. Also, to the extent that *biotechnology is limited to large-scale commercial farming*, it can at best address one side of the food security problem. Increasing food production is not the same as providing food security, especially for the rural poor. Clearly, biotechnology should not be pursued as the solution to food insecurity.

Proponents of biotechnology tend to be pessimistic about the alternative means of improving food security, and optimistic about all aspects of biotechnology, including its ability to solve the world food problems. For example, the search for new pharmaceuticals, based on chemical compounds found in plants, can serve as a stimulus to conserve biodiversity. It also has the potential, albeit possibly a minor one, to serve as a source of income for local people. The proponents may be right to say that biotechnology has the potential to overcome many of the barriers which currently

prevent modern technologies from benefiting small cultivators. However, whether this potential can be realized, efficiently or safely, is open to debate. A major problem facing most African countries is the *insufficient capacity for enforcement of biosafety information relevant for training and biosafety research to address shortage of human resources and fill important information gaps*. It is important to stress that biotechnology does represent a challenge to African countries. How this challenge is met could have important implications for both environmental and health issues.

5.6. Contribution of Women Farmers to Food Security in Africa

Structural changes in the population of Africa tend to modify farm labour supplies and pose important challenges for food security. For example, in SSA, the steady *migration of males to cities* and other areas to look for wages or jobs in the informal sector makes women responsible for *agricultural productivity and output and improving household food security* (see Box 2). Women produce 75 percent of the region's food. Raising *agricultural productivity and output and improving household food security* demands a greater emphasis on women farmers by donors and governments alike, including policy reforms to improve women's access to land and credit, their ability to contract labour and their willingness to adopt technology and utilise technical assistance.

Box 2: Rural Women and Food Security In Ghana: Case Study of the Sefwi Wiawso District in the Westen Region of Ghana

The Sefwi Wiawso District (SWD) is located in the north of the Western Region of Ghana and has a land area of 1,557 sq. km. It is generally undulating with heights between 152 and 610m above sea level. It is bounded on the North by the Brong Ahafo region, South by the Aowin Suaman, West by the Juabeso-Bia district, East by the Bibiani, Anhwiaso-Bekwai district and on the Southeast by Wassa Amenfi. SWD falls within the moist semi-deciduous forest zone of Ghana, which covers most of Ashanti, Western, Brong Ahafo and Eastern Regions.

The economy of SWD is agro-based with cash crops (cocoa and coffee) and food crops (maize, plantain, cassava) being the main crops. The district is predominantly rural in character with 84% of settlements being rural and 16 percent urban. SWD has an average annual population growth rate of 3.2%, with a population of 149,397 in 2000. It is generally underdeveloped because of poor roads, inadequate or low level of health (currently the second highest in maternal mortality in the region), educational, water and sanitation facilities.

The district has an active labour force of 45% that is population between the ages of 16 - 65 years. Between the sexes, men constitute 51.5% of the labour force. Areas of male dominance are cash crop, construction, transport, forestry and mining. Female participation in economic activities is mainly in food cropping, retail trading and home management. The main crops produced in the area include maize, rice, yams, plantain, Cocoyam, cocoa, and coffee.

There is a gender division of labour in terms of cropping with more women cultivating food crops and majority of males concentrating on the cocoa production. However comparing to other parts of Ghana, the Sefwi women form one of the highest in terms of ownership of cocoa farms mainly due to strict adherence to matrilineal inheritance system. But women in the district still form a minority in terms of land ownership.

The contribution that women make to food security in the district is enormous. According to Report from the Ministry of Food and Agriculture the district is one of the major supplier of

plantain to the Western and Ashanti Regions. Women in SWD share actively with men at all levels of food crop production – weeding, planting, pruning, staking, harvesting. However they have additional tasks of ensuring food security - they preserve, process, and market the food and prepare it for feeding their household members. Food security levels are cyclic due to seasonality. As is clear from the graph above, food prices are at their lowest between August and November each year. A bunch of plantain in the lean season would be as much as thrice or four times the normal price.

The constraints facing female crop farmers in the district is not peculiar but similar to that faced generally by women in West Africa. In recent times three major constraints seem to impinge on the performance of female farmers: access to only marginal lands; land degradation, inadequate access to credit and extension services. The problem of converting more marginal lands into cocoa farms following the recent increase in prices and government initiatives towards promoting cash crop production are critical factors influencing food insecurity in the district.

Source: *Agyare-Kwabi P. (2003), Women and Food Security in West Africa, a paper presented at a seminar on Women, Integrated Farming Systems and Food Security in West Africa, held in Accra from 25 – 28 November 2003, pp. 17*

Box 2: Rural Women and Food Security In Ghana: Case Study of the Sefwi Wiawso District in the Western Region of Ghana

5.7. Food Security Early Warning Systems

Another effective instrument for poverty reduction and ensuring food security is the installation of a *Famine Early Warning System* (FEWS). The 1985 famine in Ethiopia galvanised African countries to establish FEWS, with funding from support from the United States Agency for International Development (USAID). The main objective of FEWS is to lower the *incidence of drought-induced famine* by providing timely and accurate information to decision makers regarding *potential famine conditions*. USAID has established FEWS Network (FEWS NET), which is an information system designed to identify problems in the food supply system which can potentially lead to famine, flood or other food-insecure conditions in SSA. FEWS NET is a multi-disciplinary project which collects, analyses and distributes regional, national and sub-national information to decision makers about potential or current famine or flood situations, allowing them to authorize timely measures to prevent food-insecure conditions in these nations.

A second sub-regional *food security early warning programme* was established for Southern Africa was established between 1996 and 1998 with the support of FAO technical assistance. It comprises the following: the Regional Early Warning System (REWS); the Regional Early Warning Unit (REWU); the Regional Remote Sensing Unit (RRSU); and the National Early Warning System (NEWS) (UNEP, 2002).

5.8. Protecting Nature Whilst Ensuring Food Security

From an African perspective, the *environmental aspects of agriculture* are of special relevance to health, because they are closely related to *food security* and *malnutrition* (see Box 3). Lack of access to food is the major cause of malnutrition. There is

abundance of *technical options* to make food production more efficient and higher yielding on approximately the same land area currently in use. Even though all the techniques are not fully researched and ready for extension, people should be able to feed themselves provided that there is a rapid spread and adoption of best working practices and that other enabling conditions for sustainable food production are fulfilled. Three key elements in achieving this are efficiency of resource use, *planning* and *implementation frameworks*, and *good governance*.

Box 3: Environmental Degradation and Food Security in Mali

In the Seno Plain in Mali, the combined effects of drought, demographic growth and desertification over the past ten years created a downward spiral of soil erosion, decreasing agricultural productivity, and overall impoverishment of the population. To reverse this trend, the government adopted a decentralized and participatory approach to food security through a five-year eco-development programme supported by the UN Capital Development Fund (UNCDF) with total of \$10.1 million (\$3.2 million by the Belgian Survival Fund).

The programme focuses on food security and increase household income through environmental protection, development of agricultural production and livestock breeding, diversification of economic activities, and provision of a socio-economic infrastructure. The initiative promotes organization of village associations/groups to be responsible for the management and development of local natural resources. This programme had four major components:

- Village land management component - provides the general framework of implementation under which village land management surveys will be conducted to develop strategies and investment programmes in the context of restoration of soil fertility, management of forest and pastoral resources and flood control and irrigated agriculture.
- Village water supply component - provides 130 equipped boreholes and trains villagers for their maintenance and hygiene; and
- Feeder roads and flood recessions control component - rehabilitates roads and constructs an earthen embankment to regulate the flow of the Sourous River using labour-intensive methods.
- Local public investment component is implemented and managed through a participatory mechanism that empowers communities and strengthens decentralized decision-making processes.

Supported by external assistance, local community-based groups identify, plan, and manage their own development activities, as well as assess priorities for the provision of local infrastructures, mobilize resources for their construction and assume maintenance responsibilities. A micro-credit delivery mechanism is sub-contracted to a specialized NGO. This programme led to the correction of failures of the 1970s Integrated Rural Development Programmes (IRDPs) and supported decentralization. It focused on two factors: i) what is provided is really what is needed; and ii) what is provided is managed and maintained in the long run. The outcome is promising. Food security in 2002 seemed to be under control. According to a recently released update by the US based Famine Early Warning System (FEWS), per capita grain availability in 2002 (230 kg) was up 10 percent from 2000/01 and 13 percent above the official consumption standard of 204 kg per person per year, opening for modest exports of rice and dry grains.

Source: UNCDF (1995), *Poverty Reduction, Participation and Local Governance: The Role of UNCDF - A Fund for Community & Local Development, UNCDF Policy Series, Vol.1, August 1995*
World Food Programme (2002), Country Programme – Mali (2003 –2007), WFP/EB.3/2002/8/1, September 2002, pp27.

Box 3 : Environmental Degradation and Food Security in Mali

5.8.1. Efficiency of Resource Use

Efficiency of resource use is the conversion of scarce resources (natural, social and financial) into products and services in a way that is economically viable but that minimises the impact on the environment. However, the *introduction of more sustainable, environmentally sound agriculture* will not advance evenly; food production will still involve *negative environmental impacts* for the foreseeable future. Thus, future strategies must have a dual objective to accommodate long-term transformation of food production into *sustainable and environmentally sound resource use*; and to mitigate any harmful short-term effects.

Although there is a scientific foundation for the belief that food production can keep pace with projected *population growth* and be environmentally sound, the aggregate picture is clearly misleading. Many areas where marginal land is farmed today are also those where *population pressure, poverty and food insecurity* are intense. These are areas usually difficult to reach and lacking in *infrastructure and investment capital* as well as in *technical expertise*. They are usually not endowed with the necessary resources for the production of *market commodities* and are therefore frequently excluded from food production initiatives. Governments have a special role to play in assisting and promoting rational development in these areas.

5.8.2. Appropriate Planning and Implementation Frameworks

Appropriate *planning and implementation frameworks* are required to facilitate and diffuse *science and technology* and to put policy into action. In some countries this will require *diversification* through creation of employment in other economic sectors, more efficient transportation infrastructure and the removal of obstacles that impede efficient market mechanisms. In other cases, income and employment opportunities should be promoted within the agricultural sector itself, in areas such as processing, marketing and support services.

Environmental conservation and enhancement plans are essential to building a lasting *national food security system*. In addition to the usual elements of conserving land, water and biological diversity and controlling pollution, such plans should be integrated with efforts to reduce the loss of high-potential arable land to other uses, to improve food security and to use integrated planning approaches and processes in order to assess population-supporting capacity, so that planning national investment in food and agriculture can be directed most efficiently.

The *environmental price of food production* is usually found in the loss of natural vegetation and biological diversity, soil erosion and surface and groundwater depletion. Inevitably, there are divergent views about how land should be used, whether for industrial crops, food, nature conservation or industry. These conflicts exist for coastal and inland areas and common property resources (e.g. forests, grazing lands, oceans and seas). Thus, clearly defined procedures are required to resolve different needs and interests in society, not only of current generations but also taking into account future needs. This means involving the stakeholders (farmers, local land managers, NGOs, government, consumers and others) and evaluating the environmental costs of different land-use options.

Democratic structures and public opinion on environmental issues help to identify preferences and set appropriate land-use goals, taking into account the need for access to food and for an adequate diet for a healthy, active life. Transformation of current and future food production system requires a land or resource-use planning approach and the formulation of explicit goals for alternative land uses. Planning is also necessary to define incentives for sustainable use and to promote changes of attitudes and values for improved land-use options. The severe pressure currently on marine fish stocks is an example of how misguided policy and lack of planning can lead to indiscriminate use of a common natural resource. *Market forces* seldom respond well to environmental problems unless encouraged or directed by government policy. The political and administrative framework within which food production can increase without leading to widespread environmental damage should have at least four main elements :

- *initiation of dynamic, participatory land-use planning processes* that identify and mitigate the risks of natural resource degradation and other environmental impacts ;
- *careful crafted social and economic policies* to improve the capacity of food producers in the poorer areas to manage efficiently their soil fertility, soil moisture, pest population and biological diversity through holistic management systems. In many cases, success will depend on first addressing major social or economic constraints such as the equitable distribution of productive resources, access to capital, or unemployment ;
- *greater investment in human capital and rural infrastructure* including the improved use of information and communication technology and training and empowering agricultural advisers to work with farmers to apply *environmentally sound production methods* and to promote private sector development ;
- *ongoing assessment, monitoring and evaluation of environmental impacts* in all segments of the food production chain through information management, decision-support systems, indicators of sustainability and geographic referencing of information (especially by linking AEZ characteristics to district and national planning units).

5.8.3. Good Governance

Experience has shown that countries in which there is *good governance* reap the benefits through more *stable and sustainable economic growth*. *Good governance* involves *promoting dialogue* with diverse interest groups and *sharing decision-making authority and control over allocation of resources* to district and local levels, while simultaneously discouraging *corrupt or inefficient practices*. A more enlightenment role for government also implies working side by side with NGOs, farmers's associations and the private sector. The *marginalisation of women from decisions and resources* also has numerous negative effects on food production. Government is in the best position to assist in sensitising women to environmental concerns by promoting interventions that improve their access to, inter alia, education and training, energy resources and credit.

For economic, political, food security or other reasons, many countries will continue to promote policies that are expedient in the short term but eventually become

environmentally degrading and contribute little to sustainable economic development. Whereas regulatory (command and control) structures often create new problems, fiscal measures to promote environment-friendly techniques and economic incentives have been found to be cost-effective in correcting policy and market failures. These measures include charges for the destructive use of natural resources (e.g. farming on steep slopes, destruction of hedgerows or windbreaks) or for emissions, based on the costs of meeting agreed target concentrations (the polluter pays principle). Change may also be accompanied by carrot-and-stick methods which offer rewards or penalties proportional to the environmental damage avoided or caused.

5.9. Providing Appropriate Support for Pastoralists and Livestock Production

It is widely recognised that *hunter-gatherer communities* depend on *wild resources* for secure *livelihoods*. Collecting, using, selling and managing *wild resources*, coupled with experiments involving their cultivation and domestication, are an inextricable part of many agricultural systems. The term *wild foods* is used here to refer to both plants and animals. Examples of the value of wild resources in terms of rural livelihoods include :

- wild foods are particularly important for the health of women and children.
- the appearance of many wild foods may coincide with the hunger season which precedes harvests ;
- wild foods provide insurance against crop failure, pest attack or drought because they can replace some of the lost crops ;
- many wild foods have an advantage over cultivated crops in that their seeds can germinate and grow under drought conditions ;
- in many pastoral systems, a diet largely based on livestock products is complemented by the collection and consumption of wild foods, especially grains ;
- wild resources are particularly important for the rural poor, women and children, especially at times of stress, such as drought, changing land availability or ecological change. These groups generally have less access to land, labour and capital, and thus need to draw more on the wild resources that are freely available ; and
- wild resources with a market value represent ready sources of income for cash-poor households and may provide a significant proportion of total household income.

Much of the land in Africa is not suitable for *arable production* and so is best used as rangeland. For example, some 87 percent of South Africa's land falls into this category. In these areas, *communally managed livestock systems* are the most productive form of land use and should thus be supported in the interest of food security.

Pastoralists are often better off than settled farmers during normal times. If their flexible strategies are supported, they can move their animals to follow the rains or take them to established seasonal grazing areas. They do, however, need extra help during prolonged periods of environmental stress. For these reasons, *a sustainable approach to agriculture and livestock development* emphasises reducing vulnerability and strengthening local control, which can be achieved by providing support to traditional

pastoralist activities and enhancing productivity through improvements to traditional structures.

6. Conclusion

Africa's existing economic problems, especially rapid declining agricultural production, food insecurity and hunger require objective analysis and appropriate mitigation measures. The critical food security factors that need urgent analysis backed by effective management mechanisms include the rapid rate of population growth rate; agricultural policies and governance; management of agricultural land; water resources management; technological possibilities; the contribution of women; food security early warning systems; protecting the environment whilst ensuring food security; and providing appropriate support for pastoralists and livestock production. The traditional and low-external input agricultural systems have a big potential to contribute positively towards the reduction of poverty and food insecurity in SSA if accorded the right support. Taking into account the fragile and variable environmental conditions of most SSA countries, modern industrialised agriculture should be de-emphasised and the priority accorded sustainable and organic farming systems.

Glossary

Acronyms

BMR :	Basal Metabolic Rate
DES :	Dietary Energy Supply
FAO :	Food and Agricultural Organisation
FBS :	Food Balance Sheet
FEWS :	Famine Early Warning System
GATT :	General Agreement on Tariffs and Trade
GMOs :	Genetically Modified Organisms
GNP :	Gross Domestic Product
HDI :	Human Development Index
IFAD :	International Food Programme
IRDPs :	Integrated Rural Development Programmes
NEPAD :	New Partnership for Africa's Development
NEWS :	National Early Warning System
REWS :	Regional Early Warning System
REWU :	Regional Early Warning Unit
RRSU :	Regional Remote Sensing Unit
SARD :	Sustainable Agriculture and Rural Development
SSS :	Sub-Sahara Africa
UN :	United Nations Organisation
UNCDF :	United Nations Capital Development Fund
UNDP :	United Nations Development Programme
UNEP :	United Nations Environment Programme
USAID :	United Nations Agency for International Development
WFP :	World Food Programme

Bibliography

- Agyare-Kwabi P. (2003), Women and Food Security in West Africa, a paper presented at a seminar on Women, Integrated Farming Systems and Food Security in West Africa, held in Accra from 25 – 28 November 2003, pp. 17
- FAO. (1996a), Food Production : The Critical Role of Water, in World Food Summit, Volume 1 , Technical background documents 6-11, Rome, Italy, pp. 62
- FAO. (1996b), Food Production : The Critical Role of Water, in World Food Summit, Volume 2 , Technical background documents 6-11, Rome, Italy, pp. 62
- FAO (2001), Handbook for Defining and Setting up a Food Security Information and Early Warning System (FSIEWS), Rome, Italy, pp.128
- FAO (2002a), Anti-Hunger Programme : Reducing Hunger through Sustainable Agricultural and Rural Development and Wider Access to Food, Second Draft, Rome, Italy, pp. 36
- FAO (2002b), Organic Agriculture, Environment and Food Security, Rome, Italy, pp. 252.
- McGranaham, G. et al (1999) Environmental Change and Human Health in Countries of Africa, the Caribbean and the Pacific, Stockholm Environment Institute, Stockholm, pp. 214
- UNCDF (1995), Poverty Reduction, Participation and Local Governance: The Role of UNCDF - A Fund for Community & Local Development, UNCDF Policy Series, Vol.1.
- UNEP (2002), Africa Environment Outlook : Past, Present and Future Perspectives, UNEP, Nairobi, pp 422.
- U.S. Agency for International Development (USAID) 2002 Food Security Crisis in Ethiopia and Eritrea, USAID Fact Sheet Washington, DC November 13, 2002
<http://www.state.gov/p/af/rls/fs/15208.htm>
- World Food Programme, 2002 Country Programme—Mali (2003–2007) WFP/EB.3/2002/8/1, 12 September 2002 pp27

Biographical Sketch

Emmanuel Kwesi Boon obtained his B.A. in Economics and Geography at the University of Ghana in 1979. He also has a Master's in Industrial Location and Development from the Free University of Brussels. After obtaining an M.B.A. Degree from the University of Antwerp (UFSIA), he received his Ph.D. in Economic Sciences from the Free University of Brussels (VUB) in 1986. He lectures at the School of Administration of the University of Ghana in Accra and is a visiting professor to several universities and institutions in Africa, Asia, Europe, and South America. Currently, he teaches three courses to the postgraduate students of Human Ecology at the VUB: "Environment and Development," "Communication, Leadership Skills, Multi-media, and GIS," and "Issues on Gender, Youth, Age, Culture, and Ethnic Groups." He is also actively involved in research, consultancy, and extension projects. He is the founder and chairman of the International Centre for Enterprise and Sustainable Development (ICED) based in Accra, Ghana.