Critical Issues on Food Security in the Nile Basin Countries: An Interventionist Trans-boundary Approach

Lydia K. Ndirangu
John M. Omiti
Nicholas N. Waiyaki

Productive Sector Division
Kenya Institute for Public Policy
Research and Analysis

KIPPRA Working Paper No. 17
2010

KIPPRA IN BRIEF

The Kenya Institute for Public Policy Research and Analysis (KIPPRA) is an autonomous institute whose primary mission is to conduct public policy research leading to policy advice. KIPPRA's mission is to produce consistently high-quality analysis of key issues of public policy and to contribute to the achievement of national long-term development objectives by positively influencing the decision-making process. These goals are met through effective dissemination of recommendations resulting from analysis and by training policy analysts in the public sector. KIPPRA therefore produces a body of well-researched and documented information on public policy, and in the process assists in formulating long-term strategic perspectives. KIPPRA serves as a centralized source from which the Government and the private sector may obtain information and advice on public policy issues.

Published 2010

Bishops Garden Towers, Bishops Road
PO Box 56445, Nairobi, Kenya
tel: +254 20 2719933/4; fax: +254 20 2719951
email: **admin@kippra.or.ke**
website: http://www.kippra.org
ISBN 9966 777 47 4

The KIPPRA Working Paper Series disseminates results of on-going research at the Institute. The papers in this series cover specific policy issues in detail and are meant to provide policy makers and researchers with background information that can be used in developing refined discussion and policy papers. The papers are authored and reviewed by KIPPRA researchers and are disseminated to provoke debate and solicit comments. Opinions expressed in the papers are entirely those of the authors and do not necessarily reflect the views of the Institute.

KIPPRA acknowledges generous support from the Government of Kenya, the European Union (EU), the African Capacity Building Foundation (ACBF), and the Think Tank Initiative of IDRC.



Abstract

This study highlights critical issues on food security in the Nile Basin countries and priority investment areas to enhance food security. It presents the main causes of food insecurity at the household, national and regional levels. It outlines the social-cultural, economic and political relationships, processes, and their interaction with the environment in determining people's livelihoods. The study recognizes other related work in the region, especially under the Comprehensive Africa Agriculture Development Programme (CAADP) and brings together previous findings and recommendations relevant to the Nile basin for coordinated action. The study compares the main causes of food insecurity amongst nine Nile Basin countries. The identified problems are ranked according to their severity. Unstable food prices and poor infrastructure are ranked as most severe by eight and seven countries, respectively. This implies that governments in the region need to prioritize policies for improving market access in order to address food availability and affordability in the region. Low agricultural productivity and health issues emerge as most severe sources of food insecurity among six of the nine countries. Suggested eclectic interventions to address issues of food insecurity include increasing food production, expanding regional agricultural trade and devising policy instruments to address price fluctuations. An efficient regional trading system would also help in managing food insecurity issues at the regional level. There is need to carry out an inventory of the available and quality storage and transport in the region. Nile Basin countries need to embrace a regional approach to tackle food insecurity by sharing information and establishing a regional food reserve facility.

Acknowledgments

The Kenya Institute for Public Policy Research and Analysis (KIPPRA) wishes to acknowledge with gratitude the financial support from the Socio-Economic Development and Benefit Sharing (SDBS) project of the Nile Basin Initiative (NBI via UNOPS), under which this study was conducted. The authors are also grateful to other participating institutions in the SDBS project: Institute of Development Research, Addis Ababa University, Ethiopia; Development Studies Research Institute (DSRI) of the University of Khartoum, Sudan; Economic Research Bureau (ERB) of the University of Dar es Salaam, Tanzania; and Institute of National Planning, INP, Egypt for their contribution to this paper. The contribution of two research assistants (Timothy Nyanamba and Afred Nyaga) is greatly appreciated.

The authors wish to gratefully acknowledge comments and suggestions provided by Dr Kavoi Mutuku (Jomo Kenyatta University of Agriculture and Technology, Anne Onyango and Kinyua Kamaru (Ministry of Agriculture), Godfrey Kariuki and and two other anonymous reviewers. Participants in various seminars organized in Dar es Salaam, Entebbe and Nairobi on the same paper are gratefully acknowledged for their insightful suggestions. However, any errors are the responsibility of the authors.

Abbreviations and Acronyms

ADLI	Agricultural Development Led Industrialization
AI	Artificial Insemination
CAADP	Comprehensive African Agricultural Development Programme
CBS	Central Bureau of Statistics
COMESA	Common Market for Eastern and Southern Africa
DES	Daily Energy Supplies
DRC	Democratic Republic of Congo
ECX	Ethiopia Commodity Exchange
FAO	Food Agricultural Organization
GEC	Global Environmental Change
GHI	Global Hunger Index
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IFRI	International Food Policy Research Institute
IRIN	Integrated Regional Information Network
MDGs	Millennium Development Goals
MIS	Market Information Systems
MoU	Memorandum of Understanding
NBI	Nile Basin Initiative
NELSAP	Nile Equatorial Lakes Subsidiary Action Programme
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development
OECD	Organization for Economic Cooperation and Development
PPP	Polluter Pays Principle
SSA	Sub-Saharan Africa

UNEP	United Nations Environment Programme
UNOPS	United Nations Office for Project Services
WFP	World Food Programme
WFS	World Food Summit

Table of Contents

1. Introduction

Sub-Saharan Africa (SSA) is the only region in the world where livelihoods and food security have deteriorated for a long time. The number of chronically malnourished people in SSA was estimated at 250 million between 1997 and 1999. In eastern SSA, food insecurity is a major problem in the Nile Basin countries, which include Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. Food imports are growing annually, while agricultural productivity is stagnating despite huge potential. To advance socio-economic development in the region, the cooperative framework agreement of the Nile Basin countries seeks to promote peace and security through cooperative management and equitable sharing of the Nile Basin and its shared water resources. This study is cast against the background of eliminating the pervasive hunger and malnutrition, while reducing the necessity of food imports as conceived in the Comprehensive African Agricultural Development Programme (CAADP) and the Nile Basin Initiative (NBI).

The Nile Basin countries are endowed with vast land and water suitable for agriculture, livestock production, forestry and fisheries development, among others, with a diverse topography and climate that is suitable for a large variety of economic activities. The economies of most of the Nile Basin countries are characterized by heavy dependence on rain-fed agriculture with low productivity, subsistence farming, and low industrialization, poor socio-economic infrastructure (e.g. roads, energy and telecommunications), gender exclusion, high population growth, low average life expectancy and high poverty levels. Two of the countries (Burundi and Democratic Republic of Congo) are among the five poorest in the world. The total population of the nine countries is about 390 million, with high population densities (250 persons/km) in the Lake Victoria Basin and high annual population growth rates (2.7-3.2%) in Nile Equatorial Lakes region (Table 1.1).

Agriculture plays a significant role in economic development of the Nile Basin countries and accounts for about one quarter of the Gross Domestic Product (GDP). However, this sectoral contribution to GDP varies from country to country and ranges between 15 per cent and 48 per cent in the Nile Basin countries. The agricultural sector is largely dualistic. It is composed of a small but fast-growing sub-sector (essentially private sector-led) that produces high-value crops for the international market. This sector is characterized by modern, high-input, advanced technology

Table 1.1: Socio-economic features of Nile Basin countries

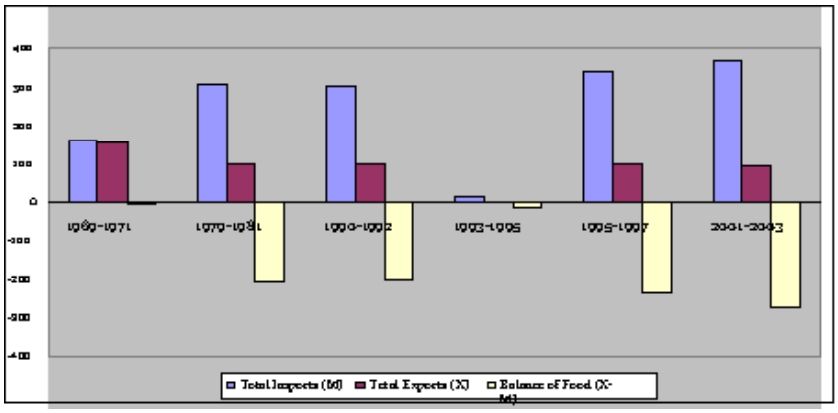
				GDP per capita	GDP	Improved water source
	Population	Population	GDP, PPP	PPP	Growth rate	(% of population
	Million	Growth (annual %)	(constant 2005 $)	(constant 2005 $)	(annual %)	with access, 2006)
Burundi	8.1	3.0	2.9	353.8	4.5	71.0
Congo, Dem. Rep.	64.3	2.7	18.6	289.9	6.2	46.0
Egypt	81.5	1.8	408.5	5010.8	7.2	98.0
Ethiopia	80.7	2.6	64.8	802.4	11.3	42.0
Kenya	38.8	2.6	55.5	1432.3	1.7	57.0
Rwanda	9.7	2.8	9.2	948.7	11.2	65.0
Sudan	41.3	2.2	82.3	1990.3	8.3	70.0
Tanzania	42.5	2.9	49.6	1201.5	7.5	55.0
Uganda	31.4	3.3	34.1	1076.5	9.5	64.0
Total	398.5		725.5	13,106.3		

Source: World Bank Indicators, 2009

with high investments in operations such as flowers, fruits and vegetables, and frozen fish. The agriculture sector is also comprised of a very large sub-sector dominated by traditional small-scale farmers, who account for most of the region's agricultural products such as tea, coffee, cotton, sugar and livestock (NELSAP, 2008).

In 1996, the World Food Summit (WFS) set its objective to halve the number of chronically undernourished people by the year 2015. In 2001, the United Nations reiterated this goal through the Millennium Development Goals (MDGs). Progress towards these goals has been dismal in most of the Nile Basin countries (Sanchez *et al.,* 2005). Per capita average food production has been declining over the last 40 years (Figure 1.1). Regional non-agricultural growth has failed to compensate for sluggish agricultural growth and, consequently, large segments of the population are increasingly at risk of worsening food insecurity (FAO, 2008). This scenario is replicated in the Nile Basin countries, which are characterized by relatively stagnant productivity against a background of increasing population and environmental degradation. The increase in trade has not had a positive bias to food security objective, since the food balance from trade has been negative for a long period. On average, food imports surpass food exports, suggesting that the region is becoming increasingly food-deficient, which is an important policy concern in many Nile Basin countries.

Figure 1.1: Balance of food imports and exports (Kg/person/ year) of Nile Basin countries



Source: FAOSTAT (2008)

With the exception of Egypt and to some extent Uganda, the other Nile Basin countries are classified as food insecure. The 2007/08 food price crisis further threatened any meaningful gains in food security that these countries had painstakingly made. This is in addition to the existing constraints to achieving sustainable food security, such as the demographic growth (estimated at about 2.5% in the Nile Basin); shortage of land and water ; limited capacity to absorb natural shocks such as droughts and floods; and civil conflicts.

However, the Nile Basin region has considerable potential of feeding its population and even beyond. For instance, the Democratic Republic of Congo (DRC) has an agricultural potential that is among the highest in the world, but close to 75 per cent of its population is malnourished– a proportion that is also among the highest in the world (Sanchez *et al.,* 2005). In an attempt to enhance the food security situation in the region, many multilateral agencies such as the Food and Agricultural Organization (FAO), World Bank and World Food Programme (WFP), continue to pump tremendous resources in search of long-term outcomes. In tandem with the increasing resources over time to fight food insecurity, the debate about the causes of food insecurity has also evolved (Devereux, 2001).

Food insecurity is as a result of failure of the livelihood systems to provide sufficient food for all. Close to 52 per cent of food insecurity in Sub-Saharan Africa can be explained by an interaction of chronic drivers such as poverty, environmental stressors, absence of property rights and land access, poor market access, poor human health, unavailability

of employment, and poor infrastructure (Misselhorn, 2005). Sudden drop in regional crop failure acts as shocks in addition to these chronic stressors. Civil conflicts, whose underlying causes are mainly the absence of property rights (especially lack of access to land and water or both) complicate the above factors of food insecurity (Sen, 1981). The coexistence of abundance of production and famines within the same country, such as in Kenya and Sudan, shows that the causes of food insecurity are mainly structural and policy-related. The ensuing climatic change will likely magnify these structural and policy failures unless systems are instituted to enhance the adaptive capacity of households and countries.

The objectives of this study were to scope out[1] critical food insecurity issues in the Nile Basin region and suggest promising interventions to improve food security either by way of productive investments or technology development, especially at regional level.

The next section presents a conceptual framework that shows the characteristics of the livelihood or food systems that promote attainment of food security. Based on this framework, section 3 provides the food security situation in each country. The trans-boundary resources and issues impacting on food security are discussed in Section 4. Section 5 discusses issues pertaining to market access and prices for agricultural products, with an emphasis on smallholder farmers. Section 6 presents the recommendations for investments, and areas requiring more evidence for policy intervention.

[1] Definitions of a scoping study are few and far between. In general, a scoping study may aim to 'map out the key concepts underpinning a research area, the main sources and types of evidence available and can be undertaken as stand-alone projects, especially where a research area has not been reviewed comprehensively before or is complex'. Scoping studies are undertaken to: (i) examine the extent, range and nature of research activity; (ii) determine the value of undertaking a full systematic review; (iii) summarize and disseminate research findings; and (iv) identify research gaps in the existing literature (Mays *et al.,* 2001; and Arksey and O'Malley, 2005).

2. Conceptual Framework

This study adopts the universal concept of food security that assures availability, reliability, sustainability and equity in food access to all people within a specified geographical area such as country or region in terms of quality and quantity to meet nutritional needs and cultural preferences at all times (World Food Summit, 1996). Figure 2.1 shows the components of a food system that offer food security These components include.

(1) Guaranteed food availability

   (a) A capacity to generate sufficient food supply through production, adequate storage and distribution of both domestically produced and imported stocks.

   (b) Long-term sustainability in terms of preservation and improvement of the ecosystems to assure posterity of capability to produce food in future.

(2) Food access

   (a) Economic access–should generate sufficient income to either purchase food and/or have sufficient diversified home production to meet requirements.

   (b) Depends on the composition of the food basket. The more diversified, the better, as it is likely to meet a diversity of calorific needs even from a thin budget.

   (c) It is strongly influenced by the stability or variability of food prices.

   (d) Equity of access of quality food to all social groups as well as expanding their effective demand.

(3) Stability of access

   (a) Consistency of availability is critical to ensuring stability in access. It is important to minimize fluctuations in food production to stabilize access to food. Households may sometimes have plenty of food at harvest time, but these stocks dwindle through the season and they run out of food supplies.

   (b) There also has to be sufficient storage and distribution systems (infrastructure).

   (c) Management of food imports is crucial to stabilize access to food,

which in turn depends on the import capacity.

(d) Food imports depend on availability of foreign exchange reserves to foot the import bill.

(e) This has a bearing on reliability of food systems to deal with risks associated with likely loss due to cyclical variations (such as seasonality, droughts and conflicts).

(4) Food utilization

(a) Food quality

(b) Food safety

(c) Physiological utilization (depending on age, gender and demands for growth, production (e.g. pregnancy or lactation) and maintenance).

The characteristics of food security should also be examined at household, national and regional levels. Corresponding to the three levels are the timeframes for action: short-term, medium-term and long-term, in order to confer a sense of urgency or priority for action.

Food security problems must be solved foremost at the household level, since it is at this level that people must be nourished. This is mainly the short-term perspective. If the issue is reducing the number of under-nourished people, the question of how people access food must be addressed. Gender and age discrepancies in access to and use of food are important at this level as they can easily lay masked or foreshadowed from the public domain.

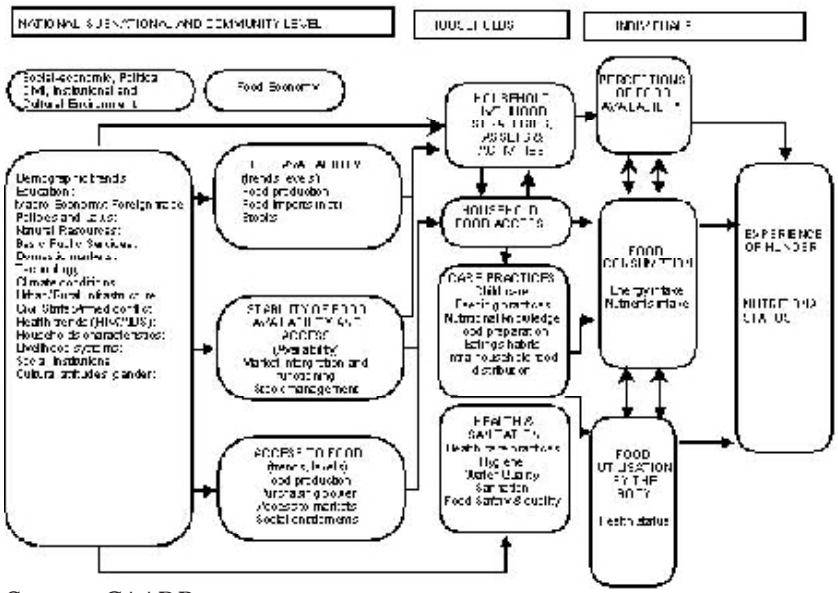
While households may have access to food, there are issues of utilization. Food utilization incorporates issues of food safety and quality, sufficiency of intake at the individual level, and the conversion efficiency of food by the body, which results in sound nutritional status and growth. In the latter instance, the disruption of health infrastructure, lack of nutrition education, and discrimination against women in controlling resources all have a detrimental impact on individual outcomes. The issue of conversion efficiency is of importance in the context of HIV/AIDS and other endemic diseases in the region, such as Malaria.

At the national level, the focus on food security is mainly medium-term to long-term in nature. National policies that ensure food availability, reliability and accessibility of nutritious food to all people at all times must be put in place. In particular, countries must set up institutions

and make deliberate investments that allow broad-based income growth and encourage sustainable food production and marketing systems. Sufficient investments in basic infrastructure (including water and energy) and distribution systems will ensure smooth flow of food commodities between surplus and deficit areas. Such national policies must take cognisance of disparities in livelihood systems in different parts of a country and location (urban/rural), and how this makes it easy or difficult for households/individuals to access food. For instance, households whose livelihoods are dependent on the market, especially the urban poor, are considered most vulnerable to price, production and labour shocks because virtually all their food and non-food needs are purchased from the market.

National policies have a role to play in times of emergencies. Short- to medium-term national safety net and social protection programmes can ensure access to food by the vulnerable people. While the regional or international community can contribute to national and household's food security through trade policies and humanitarian assistance in times of need, household food insecurity cannot be solved by external policies. National food policies must play the greater role, for example through investment in research and development and appropriate trade policies, storage and distribution systems.

Figure 2.1: Food security: A multi-dimensional phenomenon



Source: CAADP, 2009

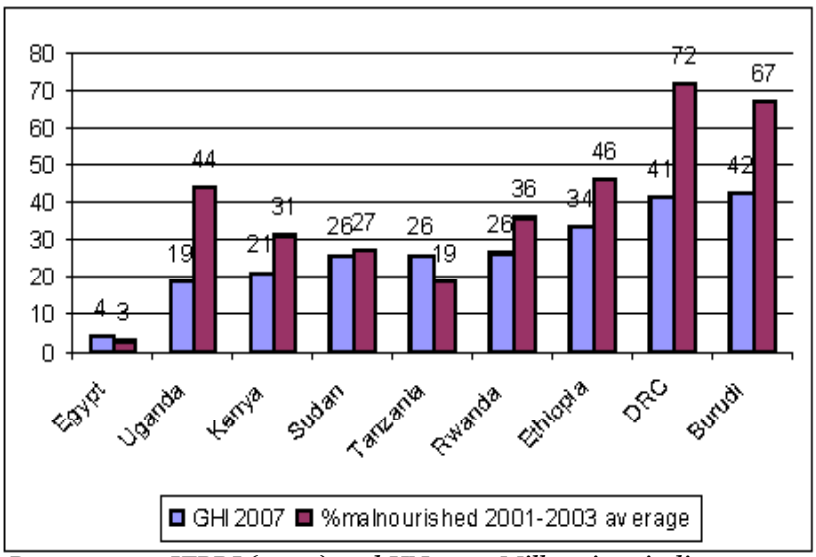
3. Food Insecurity Situation in the Nile Basin Countries

3.1 Food Availability

A national food system should have the capacity to generate sufficient food through production, stocks and imports to meet the needs of its population at all times. At the household level, a livelihood system should have the capacity to produce or acquire adequate nutritious food to feed its members at all times. Most of the food systems in the Nile Basin region fall far short of this. About 60 per cent of the undernourished people in SSA are located in Burundi, the Democratic Republic of Congo, Ethiopia, Kenya, Rwanda and Sudan.

Estimates indicate that close to 35 per cent of the Nile Basin population, or some 135 million people, are chronically undernourished (Figure 3.1). Without underplaying the importance of distributional issues, a major reason for this situation are the low levels of per capita daily dietary energy supplies (DES). Excluding Egypt, the average DES for the Nile Basin countries was 2,150 calories in 2006 compared to 2,265 for all the sub-Saharan countries. Consequently, the levels of hunger are high in the region.

Figure 3.1: Prevalence of malnourishment and the Global Hunger Index



Data source: IFPRI (2007) and UNstats, Millennium indicators[2]

[2] http://mdgs.un.org/unsd/mdg/Data.aspx, downloaded 15 July 2008.

The main cause of insufficiency in food supply in much of the region is associated with insufficiency of agricultural output growth. This is in turn partly due to low levels of labour and land productivity. Figure 3.2 and 3.3 show the low labour productivity and intensification of input use, exemplified by fertilizer use. Only Egypt has recorded a substantial rise in both labour productivity and intensity of fertilizer use. At 371Kg/ha, Egypt fertilizer use is even higher than the world average, approximated at about 92Kg/ha.

Figure 3.2: Agricultural labour productivity in the Nile Basin (tons per worker, 1970-2004)

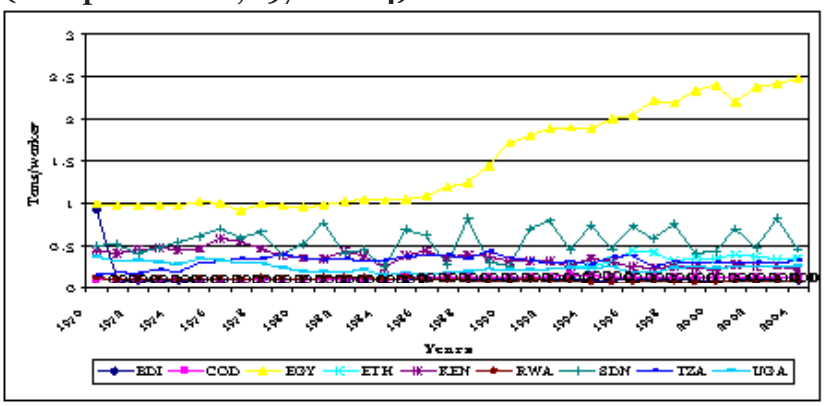
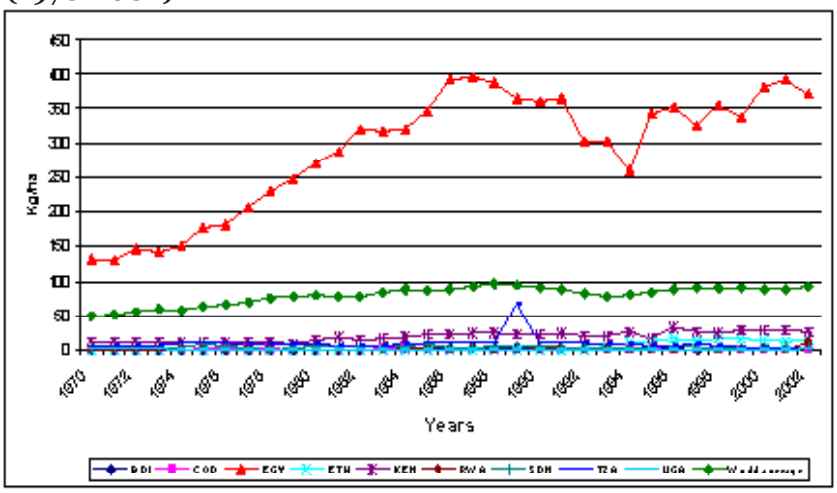


Figure 3.3: Fertilizer use intensity in the Nile Basin region (1970-2002)



3.2 Factors Influencing Food Availability

High dependence on rain-fed agriculture

Most countries in the Nile Basin rely on rain-fed agriculture. Available statistics show that growth in agricultural output is largely driven by the traditional factors of production (land, labour and capital). For example, between 1965 and 2001, 89.7 per cent of the growth in Kenya's agriculture was accounted for by the contribution of land, labour and capital, while total factor productivity growth accounted for the remaining 10.3 per cent. Labour accounted for 48.3 per cent of the total agricultural growth, while capital and labour contributed 27.6 and 13.8 per cent, respectively. Rainfall (climate) and government expenditure were the most important determinants of agricultural productivity growth (Odhiambo *et al.,* 2004). Under rain-fed circumstances, labour shortages during peak season for farm operations such as land cultivation and weeding determine crop yields, hence food security status of many farming households. Furthermore, dependence on rainfall exposes farmers to variable risks of production failure in both crop and livestock systems, which in turn affects levels of consumption profiles and volume of marketable surpluses. With the on-going debate on global climate change, effects of weather variability are likely to pose greater challenges for rain-fed agriculture in many countries. Mechanisms to mitigate, cope or adapt to climate change are generally very weak or non-existent in most Nile Basin countries. The agricultural sector is facing a multitude of problems relating to water resources, which will need to be addressed to promote food security in the Nile Basin countries.

Low soil fertility

In most Nile Basin countries, soils are generally deficient of critical nutrients to sustain high cereal yields. The increasing population has resulted in yield-reducing land use practices, such as more intensive use of land, shortening of fallow periods, and abandoning shifting cultivation among others. Due to widespread dependence on rain-fed agriculture, few farmers use external inputs such as inorganic fertilizer and herbicides because of risk-aversion and financial considerations (Freeman and Omiti, 2003; Mwangi, 1997). In recent years, increasing cost of external inputs, particularly fertilizer, is blamed on its declining application, hence low crop yields. In addition, some of the commonly mentioned causes of declining soil fertility include limited adoption of soil and water conservation measures, encroachment into marginal areas for human settlement and cultivation, lack of knowledge on profitable

soil fertility management practices, and institutional and policy-related bottlenecks (Mwangi, 1997; Rosegrant *et al.,* 2005).

In some countries, there is evidence of conflicting policy intervention to assist farmers increase the use of such external inputs to promote soil fertility. For example, while there is some limited support in accessing fertilizer for maize farming, the same is not extended to other agricultural commodities that could assist in improving household food security. Nonetheless, with limited use of yield-enhancing inputs, many farmers generally obtain low yields and are trapped in chronic poverty. Indeed, cereal yields in the Nile basin countries are among the lowest in the world, estimated at about one (1) ton/ ha/year (FAOSTAT, 2006).

Weak extension and information services

In many countries, agricultural extension and advisory services have undergone a variety of institutional reforms to make them more relevant to farmers needs. Despite low levels of farmer education, extension services still experience many operational and financial challenges. However, there are many promising avenues through public-private partnerships and external funding to improve delivery of extension and information services to farmers and traders.

Limited access to land and credit

Different countries in the Nile Basin have a variety of land tenure regimes that constrain productive and efficient use of land, hence food production capacity. Policies that promote security of land tenure, especially for female farmers, are a pre-requisite for enhancing food production capacity and fostering efficient land markets (UNECA, 2006).

Prevalence of pests and diseases

Pests and diseases cause considerable damage or loss to both crops and livestock during the production or storage stages in the value chains. They account for as much as 90 per cent of the post-harvest losses (Leonard, 2000). If such losses could be avoided or minimized, there is scope of increasing food production levels and improve food security at household, national level as well as at the regional level for the tradable commodities.

However, technologies to minimize pest or disease attack are often expensive and beyond the reach of most small-scale farmers. Public efforts to avail drugs to farmers often face many challenges. For example, communal livestock dips or sprays are poorly managed in many countries (Irungu *et al.*, 2006; Umali *et al.*, 1994).

High post-harvest losses

High production levels cannot be sustained over time without good post-harvest handling practices and well functioning markets. The problem of post harvest losses is relevant for both surplus and deficit food producers. Proper storage, for instance, helps to ensure household food security until the next harvest and helps producers not to sell at low prices during the glut period that often follows a harvest.

Post-harvest losses are a serious problem in the Nile Basin region and Africa in general. Amleson (2004) reports losses in African countries ranging from 10 to 100 per cent. Post-harvest spoilage and wastage for East African dairy sector have been estimated to cost about US$ 90 million (FAO, 2005). Some authorities have put losses of sweet potatoes, plantain, tomatoes, bananas and citrus fruit up to, at times, 50 per cent, and some crops even become completely destroyed (IAC, 2004). In Kenya, farm storage losses for maize have been estimated to be over 30 per cent (Collins, 2005); while mango losses have been estimated to be over 50 per cent (KENFAP, 2006). Part of the agenda for enhancing agricultural productivity and reducing post-harvest losses is through promotion of increased processing of agricultural products.

High cost and poor quality feeds

Cost and quality of feeds are essential in determining livestock productivity. There is great variation within and between countries in their capacity to manufacture animal feeds, which in turn leads to non-trivial differences in livestock performance in such quality-sensitive enterprises as dairy and poultry production. This also influences levels of consumable produce and marketable surpluses.

Collapse of breeding services

Public delivery systems of livestock breeding services in a number of countries have collapsed due to financing hardships on the exchequer. The private sector has not been very successful in replacing the role hitherto played by the public sector. In Eastern Africa, artificial insemination (AI) services have become less reliable and more costly. As such, increasingly many farmers are abandoning the use of AI services, leading to increasing use of natural service, which often results in spread of diseases and poor performance of the dairy herd (Mogoa *et al.,* 2004).

Institutional and governance problems

All the countries in the Nile Basin have different historical backgrounds, political systems and varying levels of commitment to sound governance. Consequently, the requisite legal and institutional frameworks to foster sound governance vary from country to country. There are divergent opinions about the existence and strength of institutions, community participation, and empowerment and accountability systems to promote agricultural development that will kick hunger and poverty out of the region (Rosegrant *et al.,* 2005; and Benson *et al.,* 2008).

3.3 Food Access

A food system's reliability to provide food security is primarily affected by fluctuations in food production, imports, storage and distribution as well as foreign exchange reserves. These are, in turn, affected by a number of factors: climatic variability (mainly rainfall), relative prices, import capacity and export earnings, infrastructure, political stability and the macroeconomic policies. In view of the large share of cereals in the diet (nearly 50% of calorie intake) and the inadequate import capacity of most Nile Basin countries, cereal production variability contributes to instability in available food supplies, leading to consumption instability. Table 3.1 shows instability of Daily Energy Supply (DES) in the Nile Basin. All have a coefficient of variation greater than 10 per cent.

Apart from Egypt, which has enjoyed a relatively stable availability of food, most of the Nile Basin countries have unreliable food systems due to frequency of droughts, floods, conflicts and unstable government policies. Any shortfall in human consumption of more than 5 per cent

Table 3.1: Variability in the Daily Energy Supply (DES) for the Nile Basin countries (1990-2004)

Countries	Coefficient of variation for DES 1990-2004
Burundi	20.03
DR Congo	9.46
Egypt	62.74
Ethiopia	14.05
Kenya	22.91
Rwanda	14.14
Sudan	45.31
Tanzania	47.00
Uganda	33.72

Source: Computed from FAO statistics (2006)

at the national level in terms of aggregate food supplies could have serious nutritional consequences (FAO, 1996). Successive shortfalls of this magnitude are common in the region, especially due to droughts. The 2007-08 food price shocks illustrate the vulnerability of the Nile Basin food systems.

Figures 3.4 (a-i) show the fluctuations in food supply and the contribution of production, commercial and food aid imports to food availability between 1990 and 2004. Sudan has experienced very variable production over the period. All sources of food supply are quite variable for Kenya and, to some extent, Ethiopia. The Rwanda fluctuations were more prominent in mid-1990s during the civil conflict period.

3.4 Factors Influencing Stability of Access to Food

Poor state of transportation

The state of transportation infrastructure is generally poor in most countries, especially during the rainy seasons. This affects the cost of inputs and transportation charges on farm produce (Ruijs *et al.,* 2004). In some cases, transportation costs are so high that many farmers and traders opt not to engage in farming or trading business even if other resources were available. The state of infrastructure and distance to markets significantly influence prices received by farmers and traders, and the volumes of produce that is spoiled or damaged during transportation.

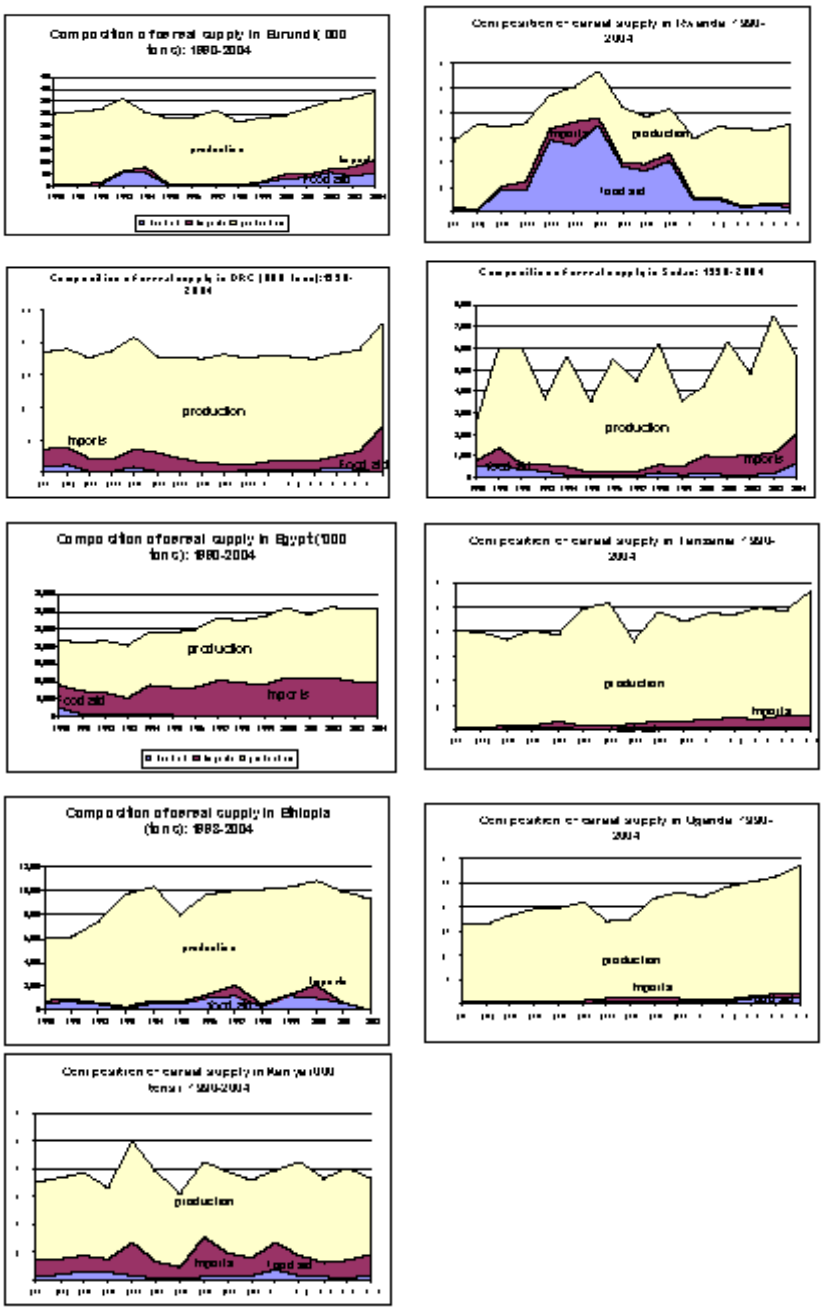
Limited marketing infrastructure

The state of marketing infrastructure (e.g. storage capacity, clean water, sewerage systems, energy and trading space) varies from country to country. This affects the volumes traded, the possibility for rent-seeking in allocation of trading space, and level of competition in the markets. This ultimately influences producer and retail prices. The producer and retail prices have knock-on effects on household disposable incomes, which influence food security.

Limited market information services

The capacity and funding of the different channels (mobile, radio, television, newspaper, etc) of communicating information to the farming and business community varies from one country to another in the Nile Basin, depending on what issues to report and in which format to report (text, pictures, etc). This also varies depending on the extent of

Figure 3.4: Comparison of cereal supply in Nile Basin countries: 1990-2004



geographical coverage, depth of coverage, target audience, intended impact, etc. The effectiveness of different channels is also influenced by the ability of users to access the information delivery channel (Ferris *et al.,* 2006; and Swinnen *et al.*, 2004).

Limited regional agricultural trade

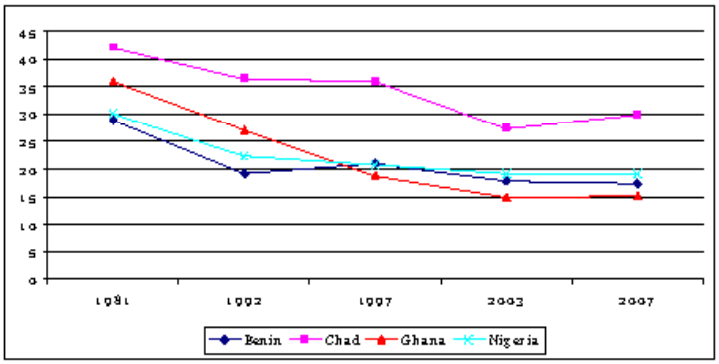
Cross-border trade can increase food availability in the Nile Basin countries, which would go a long way in promoting food security. However, there are several barriers of varying magnitude to cross-border trade between different countries, which impedes movement of tradable commodities. The gap between value of exports and imports of agricultural products has somewhat widened since 2003, with exports growing at a faster rate than imports.

In many instances, agricultural trade has not grown fast enough to compensate for the value of non-agricultural imports (e.g machinery, oil, vehicles). There are some attractive aspects of promoting intra-regional agricultural trade that hinge on: (i) stabilizing producer prices in the exporting country while reducing consumer prices in importing countries, and (ii) promoting regional integration, since there are varying harvesting calendars for different commodities.

3.5 Economic Access to Food

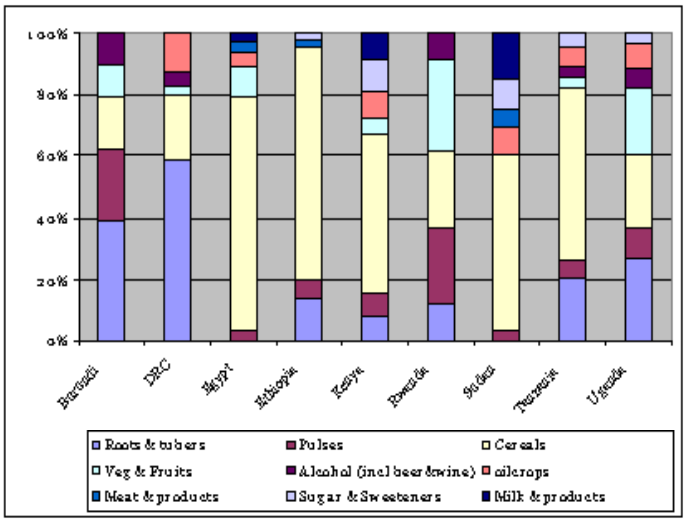
The low levels of income for most Nile Basin countries is a cause and consequence of the state of under-nourishment and hunger. Pinstrup *et al* (1999) projected poverty to remain pervasive in SSA due to slow growth in incomes. However, there is optimism that these negative trends can be reversed. The Nile Basin region could learn from some West African countries (particularly Ghana, Benin, Chad and Nigeria), which have registered substantial declines in both the number and prevalence of undernourished people between 1990 and 2007. Their hunger levels have declined, as shown in Figure 3.5, despite the poverty levels being comparable in the early 1990s to those of the East African countries. Ghana has consistently registered a decline in both poverty and hunger between 1992 and 2007. The proportion of the population living below the poverty line and the Global Hunger Index (GHI) dropped by about 44 per cent. The drop in the hunger index is attributed to, among other things, adoption of new crop varieties (such as yam, maize, rice and cassava) and a 25 per cent increase in crop area (Sanchez *et al.*, 2005).

Figure 3.5: Hunger on the decline in some West African countries



Data Source: IFPRI (2007); and UNstats, Millennium Indicators[3]

Figure 3.6: Food consumption pattern of main food groups



Source: FAO statistics (2005)

The diversity in the sources of calorific needs is also emerging as very important in determining hunger outcomes in a country or region. Countries with a more diversified food basket also correspond to those with lower levels of hunger (Figures 3.5 and 3.6). Such countries also tend to experience relatively stable food prices, a factor that is critical in buffering any likely surges in food prices.

Limited gainful employment

Price and income are major determinants of demand, besides population and taste preferences. However, in many countries of the Nile Basin,

[3] http://mdgs.un.org/unsd/mdg/Data.aspx, downloaded 15th July 2009

unemployment is widespread and has different implications on household income and therefore food security, particularly for the urban poor (Kijima *et al*., 2006; Juvan and Erjavec, 2005; and Mwabu and Mullei, 2000). Social protection measures have been applied to increase access to food by those who are unable to produce sufficient food for their families. These measures include food-for-work programmes, and cash transfers, among others.

Insecurity and human conflicts

Insecurity and/or human conflicts impede farming and trading activities. This significantly affects the food security portfolios of those members of society that cannot access food supplies. Majority of the Nile Basin countries have experienced moments of heightened insecurity and human conflict during the last ten years. However, there are many regional and international efforts to re-establish law and order in these countries.

Equity and gender issues in food access

Almost all the Nile Basin countries are characterized by high inequalities in access to resources among social groups, and therefore incomes, which also implies unequal access to food. Since poor households are likely to spend a great proportion of their income on food, this perpetuates inequalities. High income inequalities would therefore hinder progress towards achieving more equitable food access unless there are sustainable public efforts to support food schemes for the poorer and more vulnerable members of the society. Egypt has a comprehensive programme of food subsidies to the lower income households. It also has the least income Gini coefficient of about 28 per cent (WIDER, 2007) compared to the other countries, all with a Gini coefficient greater than 30 per cent, implying higher inequality level.

Equities in access to factors of production also impact on access to food. Given that food production systems are defined by the elements of land, labour, capital, technology and institutions governing their allocation, equitable food production system involves improving poor people's access to these resources and institutions. In particular, although women may have the prime responsibility of food production, they often have limited rights to land. Their access may shrink further where there are shifts from communal to private ownership of land. For example, the exploitation of communal resources for wood fuel and water for domestic use is particularly important for poor households. Loss of communal resources means that women and children in households with small plots have to spend more time in search of these resources.

Equity in food access between different regions within a country can also be promoted through public investments in infrastructure. This is because most poor households even in rural areas are net buyers of food (KIHBS, 2005/06). An equitable food system would ensure that all people accrue their fair share of benefits from a food value chain, and that the most vulnerable gain access to high value chains.

3.6 Factors Affecting Food Utilization

Access to clean water

In the Nile Basin countries, water is a finite and dwindling resource that is under immense pressure because of increasing demand (Nile Conference, 2002). Water availability patterns in semi-arid regions are extremely variable. Even in basins with a highly developed infrastructure, users are subject to unreliable water supplies, incurring substantial economic losses during periods of scarcity (Calatrava and Garrido, 2005; and Chakravorty *et al.*, 1995).

Access to cooking energy

The cost and availability of cooking energy influences how food is prepared to meet dietary requirements and cultural preferences of households in the Nile Basin. Per capita energy consumption in Africa is the lowest in the world: 0.3 to 0.6 ton/person in sub-Saharan Africa, compared to 7.5 to 9 in North America (a ratio of 1:30). With increasing fuel prices, an increasingly large proportion of households now depends on biomass (charcoal, fuelwood, etc) for preparing their meals. Africa's energy profile continues to be dominated by biomass, which, in its various forms, accounts for two-thirds of total domestic energy consumption (Hazell and Pachauri, 2006).

Knowledge on food preparation

Knowledge on diverse ways of food preparation, preservation and consumption is important in promoting utilization of food (NEPAD, 2007). This calls for training on a range of ways to cook and preserve food for different groups and for different occasions. Sharing of recipes between different cultures is another useful tool of promoting food utilization across the region.

Promoting value addition

Due to dependence on rain-fed agriculture, many regions of the Nile Basin are characterized by seasons of gluts and deficits. Promoting simple and

culturally acceptable ways of food preservation and value addition would go a long way in promoting food production and utilization.

Promoting emerging enterprises

With increasing demand from the tourism industry, there are emerging livestock enterprises such as ostriches, guinea fowls, quails, crocodiles and elands which offer income generating opportunities. However, there is need to streamline regulations that govern the domestication, commercialization and utilization of such non-conventional livestock species.

3.7 Critical Sources of Regional Food Insecurity

Table 3.2 provides a summary of the food insecurity problem and the causes. An attempt is made to code the problems as severe, moderate and not serious. These broad areas provide a basis for possible intervention and research. Market access is the most serious problem for the region, as it is ranked most severe by eight of the nine countries and severe in the ninth country (Egypt). Low agricultural productivity and health problems follow with six countries ranking them most severe.

3.8 Long-term Sustainability: Country-level Concerns

A major criterion for assessing long-term sustainability of a food system is the level of preservation and improvement of the ecological base for agriculture. The long-term stability or sustainability of most of the national food systems is undermined by processes of ecological deterioration. Losses in land cover, biodiversity and freshwater supplies increase the uncertainty about agricultural and livestock production (Scholes and Biggs, 2004). The loss of biodiversity further threatens livelihoods dependent upon them. An important general strategy to address this challenge is to integrate environmental concerns into efforts to achieve food security strategies and programmes.

The causes of land or ecological deterioration can be divided into direct and underlying causes. A major direct cause is the inappropriate land use combined with unsuitable land management practices such as cultivation of marginal land, fragile steep slopes and over-grazing. The underlying causes for these inappropriate practices include population growth and saturation of good lands, evidenced by uneconomical sub-division. This often leads to the poor and landless cultivating steep

Table 3.2: Sources of food insecurity in the Nile Basin countries (1990-2007)

Source of food insecurity	Burundi	DRC	Egypt	Ethiopia	Kenya	Rwanda	Sudan	Tanzania	Uganda
Low agricultural productivity	***	***	*	***	***	***	**	***	*
Environmental degradation									
• Soil erosion	***	**	**	***	***	***	**	***	**
• Pollution	**	**		*					
Water			***	**	***	**	***	**	**
Soil			***		***	**	***	**	**
Market access									
• Poor infrastructure	***	***	*	***	***	***	**	***	***
• Unstable food prices	***	***	**	***	***	***	***	***	***
Drought	**	*	*	***	**	*	**	**	*
Conflicts	***	***	*	**	**	***	***	*	**
Health (e.g. malaria, HIV/ AIDS) and nutritional insecurity	***	***	*	***	***	**	**	***	***

***Severe problem ** moderate * Not serious

slopes with inadequate conservation measures, especially if they also lack security of tenure. The consequence has been deforestation, loss of top-soils in much of the region, and declining soil fertility as fallow systems are replaced by continuous cultivation with little application of organic and inorganic fertilizers (Pender *et al.*, 2006). These negative effects of environmental degradation affect the poor more, as they depend on exploitation of common resources for a greater share of their incomes than the better-off households.

Burundi

Burundi faces enormous challenges as it is physically small and has a high population density of about 314 per km^2 (WDI, 2009). It has the highest rate of deforestation in Africa, having lost 5.2 per cent of its forest cover annually between 2000 and 2005 (FAO statistics, 2006). Deforestation is regarded as essentially complete within the Burundi and Northern DRC portions of the Lake Tanganyika watershed (Cohen *et al.,* 1993). Although Lake Tanganyika, the biggest water body in the country is not part of the Nile Basin lakes, reduction of its water level is of concern to the Nile Basin because it has an indirect effect on the other smaller lakes in the country. Soil erosion in Tanganyika's catchment has caused an increase in suspended sediment entering the rivers and lakes. The soil erosion rate in the deforested and steep slopping Ntahangwa River catchments in Northern Burundi is estimated to be between 20-100 tons/ha/year. The other major environmental concern has been the degradation of marshlands and lakes due to the adverse climatic conditions experienced in such areas. As a result, drought and desertification have led to a drastic drop in water levels in the lakes, and the drying-up of marshlands.

The consequence of the environmental degradation has been increased poverty, especially among rural communities; food insecurity arising from poor agricultural practices; diminishing waters resources; a reduction in activities in the agricultural, forest, energy and health sectors.

The Government of Burundi has put in place measures towards containing the deteriorating environment. The country is one of the several African countries that have signed conventions such as the National Plan of Action for Adaptation to Climate Change, and the Framework Convention for National Communication on Climate Change (IRIN, 2008). The former aims to improve seasonal climate forecasts for early warning purposes; rehabilitate degraded agricultural areas; protect natural ecosystems; capacity building in prevention and management of natural disasters due to climate change; and community sensitization.

Democratic Republic of Congo

DR Congo has many natural resources such as water and timber, and many valuable gems and minerals (e.g., cassiterite, coltan, copper, diamonds and tin). Since independence in 1961, there have been many bloody conflicts over the control of these mineral resources by various national and international corporations. The battle over minerals and other resources has affected wildlife and the environment. National parks

that accomodate endangered gorillas and other animals are often over-run to exploit minerals and resources. Increasing poverty and hunger from the war, and more people moving into these areas to exploit the minerals has resulted in hunting of more wildlife such as apes for bush meat.

Egypt

Although sediments from the upper Nile have been beneficial to agriculture in the lower Nile, the long-term impact of sediments on the reservoirs of the Nile Basin have increasingly become a major concern. There are concerns on the extent to which large floods can affect the river beds and thus reduce the usefulness of the reservoirs. There is considerable sedimentation from the Atbara and the Blue Nile, which carry over 90 per cent of the sediment load (El Moushid *et al.,* 1997).

Another issue posing environmental threat to food production in Egypt is the use of chemicals in agriculture. Egyptian irrigation water re-use raises issues regarding contamination through concentration of chemicals. Khouzam (1996) observed mercury levels in some fish in Lake Maryut to have exceeded 1,000 part per million, compared to the WHO standard of 1 ppm.

Ethiopia

Ethiopia is part of the eastern Nile sub-basin parts, which are the most erosion prone areas on earth. The country loses about 400 tons/ha of top soil every year (Shibru and Kifle, 1998) and soil degradation is the severest environmental problem (Paulos, 2001). It is estimated that the amount of grain lost to land degradation alone can feed more than 4 million people (Demel, 2001). Conditions of high absolute poverty induce the poor to become both agents and victims of environmental degradation in Ethiopia. Thus, a major development challenge for Ethiopia is to reduce absolute poverty and food insecurity at acceptable environmental and economic costs.

It is necessary to understand the relationships among natural resource management, technology, agricultural productivity and food insecurity for Ethiopia and other riparian states. Ethiopia offers a big potential to promote food security in the region through biodiversity and careful harnessing of the two major tributaries of the Nile: the Blue Nile and the Atbara.

Ethiopia has been identified as one of the world's unique centres of plant diversity (McNeely *et al.*, 1995; Thrupp, 1997; and Worede, 1992).

This biodiversity can be exploited to cope with drought and rough terrain. In Ethiopia's northwest Gondar region, for example, farmers plant together six or more crops, including maize, faba bean, sweet sorghum, cabbage, tomato, potato, pumpkin, and bottle gourd, and grow wheat, finger millet and barley varieties in specific mixtures to cope with drought and other uncertainties (McNeely *et al.,* 1995).

About 70 per cent of the runoff into Lake Nasser originates from two tributaries in Ethiopian highlands. A lot of the international attention is being concentrated in Ethiopia, given that about 90 million people in Egypt and Sudan are wholly dependent on the runoff from its rivers. Any actual and potential land management changes in the uplands, for example construction of dams and irrigation, would significantly alter the amounts and patterns of runoff downstream. In addition, there are concerns of current and future environmental changes on the runoff.

Kenya

Close to 80 per cent of Kenyan landmass receives less than 500mm of rainfall, and is therefore categorized as arid or semi-arid. The vegetation is highly variable depending on soils and rainfall. Kenya depends almost entirely on its land for rural livelihoods and economic development. Agriculture is concentrated in the high rainfall areas, which also supply water to urban centres and for hydro-electric power and irrigation. Land degradation problems such as soil erosion, nutrient depletion, and poor vegetative cover are not only widespread, but they are also increasing. Studies show that much of the land degradation in the Kenyan highlands is due to poor land management practices (Pender *et al.*, 2006). In addition, more than 70 per cent of all energy requirements are generated from wood, further driving deforestation. The consequences have been increased soil erosion and nutrient depletion, salinity, water scarcity, pollution and loss of biodiversity.

Watershed degradation is another concern for Kenya. Although watersheds especially around lake Victoria are a valuable cradle of agriculture and settlements in Western Kenya and offer a livelihood far and beyond in terms of a thriving fishing industry, land and water resources in the lake watershed have been degraded and depleted. Problems arise mainly from sedimentation, contamination, and serious disruption of water flow. Deforestation around the watershed aggravates these problems, and fisheries in the lake are also becoming depleted from over-exploitation by fishing industries and rising populations in these regions. The expansion of towns and cities in the watershed has

also greatly increased the dumping of sewage and industrial wastewater (Thrupp and Megateli, 1999).

Over time, the quantity and quality of fisheries in the lakes have declined. Consequently, growing numbers of people may suffer from food insecurity. The area also suffers from an increase in exotic species (water hyacinth and other weeds), illegal fishing techniques, inadequate land use management, and the public health and ecosystem effects of water pollution (Akatch, 1996). Since 1994, the Lake Victoria Environment Management Programme has been handling regional sustainable management issues of the shared lake. However, over the years, difficulties have been experienced in operationalization of its ideas of promoting fisheries development and pollution prevention in the riparian states.

Rwanda

Rwanda's high population density and a large number of internally displaced refugees in late 1990s pushed a large number of people onto ecologically sensitive areas. Degradation of Rwanda's forests results from demand for its products such as fuel-wood, building posts, browse for livestock, wildlife and other products valued by local populations and the international community (Mitchell, 1997).

Demographic pressure has induced utilization of marginal lands, thus shortening fallow periods. The fragmentation of family holdings through generational transfers has led to a severe decline in agricultural production, resulting in decreased levels of caloric intake and soil exhaustion. The demand to convert more land to agriculture has led to destruction of Rwanda's wetlands (*marais*), resulting in stream flow changes, increased water evaporation, decreased water tables, flooding, loss of wildlife habitats and sedimentation (Odada *et al*., 2004; UNEP, 2005).

Environmental degradation in Rwanda poses significant loss of biodiversity, and is a serious threat to both national and regional water resources. The Nile River Basin covers 67 per cent of the national territory and drains 90 per cent of the national waters through two major water courses: the Nyabarongo and the Akagera Rivers, both endowed with many tributaries. Waters of the Nile River Basin flow out of the country through the Akagera River into Lake Victoria. It is estimated that Akagera contributes 8 to 10 per cent of the total Nile waters.

Soil and water conservation, and improvements in soil fertility, are high priorities of the government, as reflected in the Rwanda Agricultural Development Strategy, and the Food Security Strategy and Action Plan. In February 2005, the Rwandan parliament passed the Environment Bill, which lays the legal framework for environmental management in Rwanda. The government has also initiated a terracing programme in the hilly arable areas of Rwanda. Other activities such as reforestation and water management are also undertaken as part of the agricultural strategy, with the view that agriculture intensification must be accompanied by environmental actions to manage water flows, control soil erosion and improve structure.

Sudan

Land degradation is generally a critical issue throughout Sudan. Currently, land degradation is recognized as a major cause of poverty, conflict and risks especially in Darfur and the East. Women and children are the main victims of land degradation and the consequential poverty and violence.

According to UNEP (2007b), the conflict in Darfur and the ended civil war in Sudan's south have been exacerbated by land degradation and deforestation. The UN estimates that the northern desert boundary in Sudan has shifted southward 50 to 200km since the 1930s, turning large amounts of previously arable land into desert. Average precipitation levels have dropped by 40 per cent since the early 1980s. The result has been fewer pastures, declining yields, and increased tension between the various ethnic, religious and political groups. The increasing human and livestock population compound these environmental challenges.

The continuing fragility of Sudan's ecosystems and, in turn livelihoods, has been particularly manifested in the wide fluctuations in precipitation patterns. The climatic changes have also caused floods in many areas of the country. The most devastating occur on the Blue Nile as a result of deforestation and overgrazing in the river's upper catchments. One of the main impacts of watershed degradation and associated flooding is severe riverbank erosion in the narrow but fertile Nile riverine strip. This affects availability of water for irrigation.

Plans to expand the agricultural sector for food security are a major source of concern in Sudan. While traditional rain-fed agriculture has proved stable and sustainable under low population density and increasing pressure on land, it has proved unattainable. Expansion of mechanized irrigation offers some hope, but the country will have

to deal with a number of environmental concerns given the existing experience with the system. Mechanized farming in Sudan has shifted over time into a crude form of extensive shifting cultivation, exploiting land to exhaustion as little or no fertilizer is used. There is also water pollution from sugar factories and canal siltation and soil salination. The other option is the continued practice of traditional irrigation, which is concentrated on the floodplains of the main Nile downstream of Khartoum and on substantial areas along the Blue and White Nile. While considered quite sustainable (UNEP, 2007a), there are environmental threats that can substantially reduce yields. Encroachment of sand dunes and erosion of the riverbanks have led to abandonment of entire villages and, together with the invasion of the mesquite, substantial arable land has been lost, thus threatening the food security situation.

Tanzania

Environmental problems related to land use, deforestation and the increasing demand for wood fuel also abound in Tanzania. Deforestation is estimated to be advancing at an annual rate of 3,222km^2 (Mongi, 2008). Much of the deforestation is due to clearing for unsustainable crop production, over-grazing and fuel wood. The UN has estimated that the degraded area is between 33 per cent and 45 per cent of the total land area, and is most severe in areas that hosted refugees, such as Kigoma-Mpanda and Northern Rukwa. Over-grazing is widespread but severe in the Central, Midwestern, Lake Victoria zone and some parts of Northern Tanzania. Slope cultivation is widespread among highland areas, and is a major problem on the slopes of Eastern Arc Mountains. Soil erosion occurs in 61 per cent of the entire land area in Tanzania (Mongi, 2008).

The effects of climate change in Tanzania have consequences on trans-boundary outcomes. IPCC (2007) observed that temperatures in Western Tanzania have increased by 2^{o}C and 1^{o}C in other regions. The effects are the receding glacier on Mt Kilimanjaro (55% of glacier loss between 1962 and 2000), submergence of Maziwe Island in Tanga Region, recurrent drought, contaminated fresh water with saline water and decreasing level of Lake Victoria.

The Tanzanian government has a number of policies and strategies to address land degradation, which include:

(i) National Water Policy (NAWAPO) of 2002

(ii) National Strategy for Growth and Reduction of Poverty (NSGRP, 2005)

(iii) Agricultural Sector Development Strategy (ASDS) of 2003

(iv) Strategy for Urgent Actions on Land Degradation and Water Catchments of 2006.

To effect the policy at farm level, the government has been putting emphasis on farm training for extension personnel and farmers on land management practices.

Uganda

Although Uganda has a large percentage of arable land, land degradation is a substantial problem. In several regions, important signs of soil degradation trends are apparent, including declining yields and a switch to crops that demand fewer nutrients. Generally, it is estimated that 4-12 per cent of GDP is lost from environmental degradation, with 85 per cent of this due to soil erosion, nutrient loss and changes in crops. Some studies on land use change show that fertility has been declining, particularly on fields away from the homestead (Nakileza and Nsubuga, 1999). The worst affected areas are the highlands in the southwest.

The second most fragile ecosystem in Uganda is the dry land areas of livestock production; the "Cattle Corridor", and the rangelands in the Northeast. Much of the Corridor is over-stocked, and gully erosion is especially visible. Desertification is pronounced in Northeast area of Karamoja (NEMA, 2001). Bush burning during the dry season also leads to important wind erosion, especially in the eastern districts. Soil degradation leads to expansion of xerophytes and a decline in forage quality (Zake *et al.,* 1999).

The land tenure of most of the rangelands is communal. Major socio-economic changes occurring in the dry lands have, however, affected this system. These include increasing human population density and in-migration by agricultural settlers. The affected areas include counties in Mbarara and Rakai districts (National Environment Management Authority, 2001).

Watersheds in Uganda are also being degraded. In addition to the loss of land productivity, the siltation of lakes and rivers associated with erosion has led to eutrophication and reductions of fish populations. This problem is severe, where former wetlands adjacent to lakes and rivers have been converted to cropland (NEAP, 1995). Lake Victoria is also experiencing heavy sedimentation along both the Kenyan and Uganda shores.

Uganda has good national environmental plans for intervening in land degradation, especially in the cropped land, but the institutional structures to implement the plans in the most affected areas are poorly developed. In addition, semi-arid areas have received much less attention by researchers and other public investments. In general, although the problem of land use change is documented in various studies (Briggs and Twomlow, 2002; Nkonya *et al.*, 2002), there has been relatively little national level analysis of the cost of land degradation to the national economy.

3.9 Environmental Change and its Interactions with Agri-food Systems

Global environmental change (GEC) includes changes in the physical and biochemical environment caused naturally or influenced by human activities such as deforestation, land reclamation, agricultural and livestock intensification, over-exploitation of fisheries, freshwater extraction and waste production. The effect may manifest itself in vegetative cover, atmospheric composition from the release of greenhouse gases and the consequent rise in temperatures (Walker and Steffen, 1997), and variability in precipitation cycles and magnitude (Conway *et al.*, 2005). The sustainability issues highlighted for each country is evidence of climatic change effects in the region. Land use modification for food production in the region has had significant and widespread impact on the ecosystem and biodiversity. For example, annual flood controls in the lower Nile by Lake Nassar has resulted in declines in marine fisheries in both the Mediterranean and Red Seas, as the breeding grounds have been interfered with (Wood and Ehui, 2005).

The observed changes raise questions about the ability of the region to increase and maintain agricultural productivity, and especially food production. With rise in population in the region, indications are that demand for food will increase especially if per capita income also improves. Despite the concerns reflected in the GEC literature, and the obvious implications on food security and sustainable development, budgets for GEC issues are often not rig-fenced in the region. A preoccupation with short-term emergencies, limited resources and lack of policy-relevant information on the interactive effects of GEC and food security are factors that explain this neglect (Arntzen *et al.,* 2004). Further, food issues have been treated in a fragmented manner by different GEC international research initiatives (Mano *et al.*, 2007).

4. Trans-boundary Resources and Regional Food Security

Rivers, watersheds, grazing lands, energy resources, fisheries, forests, protected areas, and many other resources cross the national boundaries in the Nile Basin. Such trans-boundary resources are often a source of conflict and hostile competition (Hutchinson *et al.,* 1991; Westing, 1991). Many of these resources have been mismanaged, degraded and underused, yet they are valuable shared assets for the region. If carefully and equitably managed regionally, trans-boundary resources offer the potential to alleviate food insecurity and achieve more sustainable development (Westing 1991; Ejigu, 1995).

The seven main river systems and lakes in the region are cradles of important watersheds, groundwater aquifers and riparian ecologies, including a diversity of fish and wildlife, which are key trans-boundary resources. The main shared water systems are Lake Victoria; River Kagera linking Rwanda, Tanzania and Uganda; the Mara River linking Tanzania and Kenya; Omo River between Ethiopia and Kenya; River Baro in Ethiopia, which becomes the Sobat River in Sudan and joins the Blue Nile to feed 75 per cent of the Nile's headwaters in Egypt; the Awash Basin of Ethiopia; the Atbara River and White Niles linking the Ethiopian highlands to southeastern Sudan; and finally, River Nile linking all the Nile Basin countries.

The region's large areas of wetlands and swamplands are also the source of valuable fisheries with seasonal wetland agricultural and pastoral potential. Trans-boundary wetlands include the Awash swamplands, the Rift and Blue Nile valleys of Ethiopia, the Sudd and White Nile wetlands and the Mackar and Kenumuku marshes of Sudan, the Miombo Dumbo wetlands and seasonal salt ponds of Kenya and Tanzania; and Lake Tanganyika (40%, Tanzania; 8%, Burundi; 46%, Democratic Republic of Congo; and 6%, Zambia).

Expansive pasturelands in arid and semi-arid areas are also significant trans-boundary agro-ecosystems that are valuable for food security. Arid plains and grazing grasslands cross national borderlines in nearly all countries in the region. Pastoral communities typically move across these lands, regardless of nationality, to sustain their herds and livelihoods. Particularly important cross-border pastures are the Huad and Ogaden regions between Somalia and Ethiopia, the Awash and Danakil Valleys of Ethiopia and Eritrea, and the commons between Kenya, Somalia and Tanzania.

Additional valuable agro-ecosystems that are shared in several countries are found in highland plateaus and hilly regions that are naturally rain-fed and have fertile (sometimes volcanic) soils good for coffee, horticultural crops, and other crops (e.g. around Mount Kilimanjaro).

Coastal and marine resources along the Indian Ocean coastline, including fisheries, coral reefs, and mangroves, are also important trans-boundary resources. These oceanic and coastal zones harbour a wealth of highly diverse resources, which are biologically and economically important. The main economic activities are fishing and farming of coastal lowlands. The coastal ports of Mombasa, Dar es Salaam and Port Said are also important trans-boundary resources in terms of opening up the hinterlands. The efficiency of their operations has a big impact on food distribution and availability of agricultural inputs within the countries. Other trans-boundary resources include forests, rangelands, and savannas. In such ecosystems, both domestic and wild animals and plants move across boundaries and often provide food sources.

At least half of the region's protected areas cross national borders. For example, three of the well-known shared parks are: Maasai Mara-Kenya/Serengeti, Maswa and Ngorongoro/Tanzania, Tsavo-Kenya/Umba and Mkombazi-Tanzania. The region's substantial mineral resources and energy reserves, including newly discovered oil in Uganda and Tanzania and petroleum resources and geothermal sources in the Rift Valley also transcend boundaries. Such resources have great potential for development, if managed rationally. However, in many areas, resources are being depleted and degraded, and the people suffer from poverty and food insecurity exacerbated by political and ethnic conflict. With the advancement of changes in climate, conflicts over shared resources may increase if appropriate measures are not put in place.

4.1 Expanding Irrigated Agriculture in Nile Basin Countries

Irrigation could play an important role in contributing towards agricultural development, expansion of trade and contribution to socio-economic development in the region. The Nile River thus presents an opportunity for irrigation, which has not yet been fully exploited to intensify agricultural production and consequently increase the marketed surplus. Expanded intra-regional trade could substitute some of the imports from outside the Nile Basin, such as food items and vegetable oils, and contribute to regional cooperation. In the long term, this should

lead to broader agricultural growth and wider access to regional and international markets.

Irrigated agriculture has been important in the Nile Basin countries, contributing significantly to gross domestic growth. In Egypt, for instance, irrigation accounts for 16 per cent of GDP, while in Sudan it covers 10 per cent of the cultivated land and contributes 50 per cent of the agricultural production. In Ethiopia, irrigation is not yet well developed, and its contribution is relatively small and insignificant. However, the Government of Ethiopia considers irrigation as key to economic development and poverty alleviation. In Kenya, irrigation has been operating below capacity in the past decade following collapse, and its full potential is yet to be realized, with only 10 per cent of the irrigable land developed so far.

Productivity in the irrigation schemes is low compared to the estimated potential in different countries of the Nile Basin. In Ethiopia, for instance, potential maize yield per ha (6 tons per ha) are triple the actual obtained yield (2 tons per ha). Similarly, in Sudan, the actual yields are lower than the potential yields. Even under such bleak circumstances, many farmers do not even realize these low yields. In Egypt, yields have increased since early 1980s, indicating that there is still more potential for improvement especially following economic liberalization.

There are concerted efforts in most of the Nile Basin countries to expand irrigation for the purposes of sustaining food security and generating exportable surpluses. Egypt targets to put some 501,900ha (1.2 million feddans) of land under irrigation by the year 2017. The Ethiopian government has targeted to increase land under irrigation by 487,000ha by 2010. Kenya, in its Vision 2030, targets to exploit its irrigation potential with an annual expansion of 32,000ha, which translates to 300,000ha by the year 2012.

Sudan targets to increase land under irrigation by 730,000ha (1.7 million feddans) using Nile water share as per the 1959 agreement. In Tanzania, only 150,000 ha (15%) of 1 million hectares potential land has been irrigated. The country has a potential for attaining sustainable irrigation development to ensure basic food security, improve the national standards of living and also contribute to economic growth of the country. The Democratic Republic of Congo (DRC) practices basically rain-fed farming dominated by food crops. In spite of the great opportunities for irrigation, only 13,500ha of sugar cane and rice are irrigated out of a potential 4 million hectares.

4.2 Status of Irrigation in the Nile Basin

Burundi

Very little information is available on the status of irrigation development in Burundi, although the country has an abundant network of rivers that can be tapped for irrigation. About half of irrigable land lies in the Congo Basin. The irrigation potential is estimated at about 105,000ha in the basin, of which 75,000ha are for controlled irrigation in the plains while the rest consists of valley bottoms.

Democratic Republic of Congo (DRC)

The Congo Basin is the largest river basin in Africa, covering over 12 per cent of the continent and nine countries (Table 4.1). DRC has a very dense hydrographic system. The discharge of the Congo River reaching Kinshasa and Brazzaville is about 1,269km^3/year, which is equal to 32 per cent of the renewable water resources for Africa. The river then continues to the south-west and forms the border between Angola and DRC before flowing into the sea.

It is difficult to find reliable estimates of the irrigation potential of the very humid countries such as DRC. Neither water nor land is a limiting factor to agricultural development. The irrigation potential in DRC under the Congo Basin is estimated at 6,980,000ha, although only about 10,500ha are under irrigation.

Egypt

Egypt has a long history of irrigation dating back over 7,000 years. Table 4.2 presents the dichotomy of irrigation in Egypt. Irrigation development has been guided by elaborate irrigation technologies, supportive policies and institutions. A total of 3.3 million hectares of agricultural land is irrigated, with a cropping intensity of 180 per cent.

Increase of cropping intensity was made possible through improved water management and cultivation of early maturing varieties. Cereals dominate the irrigated crops, occupying 2.7 million ha (45%) of the cultivated area. The main cereals are wheat (1 million ha), rice (650,000ha) and maize (800,000ha). Other cereals grown in Egypt are sorghum (160,000ha) and barley (90,000ha), with fodder occupying 1.6 million hectares and pulses 160,000ha. Industrial crops cover 640,000ha and include cotton, sugar cane, sugar beet, soybeans, sunflower, sesame and groundnuts. Horticultural crops occupy an area of 1.3 million

Table 4.1: Geographical area (km²) of countries in the Congo River Basin

Country	Total area of the country (Km²)	Area of the country within the basin (Km²)	As % of total area of the basin	As % of total area of the country
Rwanda	26,340	6,464	0.2	24.5
Burundi	27,834	14,574	0.4	52.4
Cameroon	475,440	96,395	2.5	20.3
Zambia	752,610	177,735	4.7	23.6
Tanzania	945,090	244,593	6.5	25.9
Congo	342000	246,977	6.5	72.2
Angola	1,246,700	285,395	7.5	22.9
Central Africa	622,980	403,570	10.7	64.8
Zaire	2,344,860	2,313,350	61.1	98.7
Congo basin		3,789,053	100.0	

Source: http://www.fao.org/docrep/W4347E/w4347e0n.htm, accessed 28 October (2008)

Table 4.2 : Extent of irrigated agriculture in Egypt

Name of main canals	Area ('000ha)	Name of main canals	Area ('000ha)
Upper Egypt, Nile Valley		Upstream Delta barrage	
El Ibrahimiya	645	El Raiyah El Monofi	309
Naga hamadi El sharkia	43	El RaiyahEl Bihiri	502
Naga hamadi El Gharbia	179	El Raiyah Al Nasri	32
El Kalabia	72	El Raiyah Al Tawfiki	282
Asfun	29	Ismailiya canal	244
Direct intakes	174	Direct intakes	127
Total upper Egypt	1,142	Domiatta Branch, East Delta	
		El Raiyah El Abasi	329
		El Mansoria	136
		Direct intakes	77
		Rosetta Branch, West Delta	
		Mahmoudia (pumping)	120
		Direct intakes	45
		Total delta	2,204
Total upper Egypt + Delta	3,346		

Source: ENTRO (2008)

hectares and include vegetables, fruit trees, medicinal plants, flowers and spices.

Ethiopia

Irrigation in Ethiopia is in its infant stages, with less than 10 per cent of the 3.7 million ha only developed. In 2006, irrigated area was estimated at only 340,000 ha, which was distributed into traditional irrigation (200,000 ha) systems, modern small-scale irrigation systems (80,000 ha) and large public irrigation systems (60,000 ha). A general picture of irrigation in the country is summarized in Table 4.3. The main crops in the large public schemes include sugar cane, cotton and some horticulture. In the traditional community irrigation schemes, cereals (*teff*, maize and barley), vegetables and fruits are grown with supplementary irrigation.

Kenya

Kenya has an irrigation and drainage potential of 539,000ha and 600,000ha, respectively. Table 4.4 shows the distribution of irrigation potential among the various basins. Only 102,000ha (19%) of the irrigable land has been exploited. Of these, about 47,000ha are smallholder schemes managed by farmers, water user associations and cooperatives. Public irrigation schemes managed by the National Irrigation Board cover 13,000 ha, and private irrigation farms occupy 42,000ha. With improved water harvesting and storage technologies, the irrigation potential can be increased by a further 800,000ha to 1.3 million hectares.

Table 4.3: Status of irrigated agriculture in Ethiopia

Type of schemes	Traditional irrigation	Modern small scale irrigation	Large public estates
Total area in country	200,000ha	80,000ha	60,000ha
Percentage of total irrigated area	58	24	18
Total area in the Nile Basin	60,000ha	24,000ha	8,500ha (Finchaa sugar estate)
Size of individual scheme	10s of ha	10s of ha–3,000ha	More than 3,000ha
Construction by	Communities	Government or NGO	Government*
Management by	Community-based committees	Irrigation cooperative	Public enterprise

Source: ENTRO (2008)

Table 4.4: Irrigation potential in Kenya

Basin	Irrigation potential (ha)
Tana	205,000
Athi	40,000
Lake Victoria	200,000
Kerio Valley	64,000
Ewaso Ngiro	30,000
Total	**539,000**

Source: Ministry of Water Development, National Water Master Plan (1992)

This can be enhanced further with effective exploitation of underground water resources and innovative management of trans-boundary water resources.

Rwanda

About 25 per cent of Rwanda is in the Congo Basin and the irrigation potential is estimated at 9,000ha, mainly consisting of valley bottoms. There are developed investment plans to increase agricultural production and marketing in marshland and hillside areas in an environmentally sustainable manner. This will involve:

(i) Rehabilitation and development of marshlands and hillsides through expanded irrigation and increased use of sustainable land management practices to accelerate the pace of agricultural intensification;

(ii) Strengthening commodity chains by supporting the commercialization of smallholder agriculture by intensifying production, promoting agricultural value-addition, and expanding access to markets; and

(iii) Strengthening project coordination and support to ensure efficient execution of administrative, financial management, and procurement functions; coordination of project activities among the various stakeholders; timely implementation and monitoring of environmental and land-use management frameworks; and establishment and operation of an effective monitoring and evaluation (M&E) system (www.nepad.org/2005/files/caadp/RwandaBrief1IntensificationFinal.pdf, web.worldbank.org/external/projects).

Sudan

Sudan has an irrigation potential of about 4.8 million hectares. Currently, irrigated area is estimated at 1.9 million hectares, of which about 1.1 million ha is cropped area. About 96 per cent of irrigated area derives its water from the River Nile, while the rest is drawn from ground water. The cropping intensity ranges between 50 per cent and 60 per cent. Major irrigated crops are cash crops (cotton, groundnut and sugar), wheat and sorghum. Cereal crops occupy around 532,000ha (50%), where sorghum occupies 355,000ha and is the dominant crop in the irrigation schemes, wheat (104,000ha), maize (58,000ha) and rice (5,000ha). All the schemes involve pumping from the water source, except the three largest schemes. The Gezira Scheme is gravity-fed while in Rahad I and New Halfa schemes, pumping is supplemented by gravity water supply. Table 4.5 shows the current irrigated area in Sudan and its distribution

Table 4.5: Irrigated acreage in the Sudan

Name of scheme	Area ('000 ha)	Water source	Remarks
Gezira and Managil	924	Blue Nile	PLS
Rahad I	126	Blue Nile	PLS
Suki	36	Blue Nile	PLS
North West Sennar (Sugar)	14	Blue Nile	PLS
Guneid	36	Blue Nile	PLS
Abu Nama (jute)	13	Blue Nile	PLS
Blue Nile Pump schemes	153	Blue Nile	PLS + SPS
Assalaya (Sugar)	15	White Nile	PLS
Kenana Sugar Estate	36	White Nile	Public estate
White Nile Pump Schemes	197	White Nile	PLS + SPS
Main Nile Pump Schemes	88	Main Nile	PLS + SPS
New Halfa	180	Atbara	PLS
Total	1,817		

PLS: Public large scale schemes with smallholder farmers, SPS: Small private scheme owned by private owners or cooperatives.
Source: ENTRO (2008)

Table 4.6: Types of irrigation in the Republic of Tanzania

Farm type	Area (ha)
Estates, outgrowers, medium to large commercial farms	2,400
Parastatal/government farms	19,700
Smallholder, small commercial	359,000
Total area under Irrigation	381,000

Source:www.icid.org/v_tanzania.pdf

Tanzania

Tanzania has vast undeveloped land resources. The country has a potential total arable area of about 40 million hectares. Of this total, only some 6.3 million hectares are currently under crop production, 5.2 million hectares by smallholders and the remaining cultivated by parastatals and private sector. The estimated area under irrigation is about 381,000ha (Table 4.6). Several studies have identified a number of constraints affecting irrigation development in Tanzania. These include: lack of well articulated policy and strategy framework, poor understanding of the real natural resource endowment of the country, and financial and technological impediments. Dam construction is largely restricted by hydrological and topographic conditions.

Uganda

The potential irrigable land is estimated at 202,000ha. However, less than 14,418ha of the potential irrigable area is under formal irrigation, while 67,000ha is under informal irrigation, particularly for rice production. Water use for small-scale irrigation schemes is estimated at 10,000m^3/ha/year, while large-scale irrigation and commercial irrigation schemes use about 12,000m^3/ha/year (Table 4.6). With annual total renewable water resources of 66km^3/year, the country has a very high potential of harnessing its water resources to boost its agricultural production.

Table 4.6: Irrigation status in Uganda

Type of irrigation	Area (ha)	Water use(m^3/ha/year)	Total water use(10^6 m^3/year)
Small-scale irrigation	300	10,000	3.00
Government irrigation schemes	2,036	12,000	24.43
Commercial	5,282	12,000	63.38
Commercial, supplemental irrigation (Kakira Sugar Plantation)	6,800	5,000	34.00
Total	14,418		124.01

Source: unesco.org/water/wwap/wwdr/wwdr2/.../pdf/7_water_food_security.pdf

4.3 Preconditions for Successful Irrigation

The preconditions for a successful irrigation system hinge on such critical factors as legal and policy environment, land tenure systems, irrigation technology, functioning markets for inputs and outputs, and institutional and organizational frameworks. These factors offer many challenges to successful irrigation system development in the Nile Basin region.

Proper land tenure systems

Proper land tenure arrangements are important for attracting and sustaining capital investments in the irrigation sector in many countries. In most African countries, irrigation schemes occupy land that is mostly owned by the government and rented (often on lease terms) to farmers or commercial operators (or companies). For such irrigated land, sometimes there are no clearly articulated land tenure policies that govern land use issues, leading to improper land markets (or market failure) and frequent social conflicts over water and land, among others (Bruce and Migot-Adholla, 1994).

Effective legal and regulatory framework

Legal and regulatory framework among the relevant agricultural institutions should be harmonized to avoid conflicts (Biswas *et al.,* 1993). Laws governing irrigation should mitigate against possible negative impacts of irrigation, such as those related to environmental degradation.

Efficient infrastructure

Efficient road and communication infrastructure positively impact on the operations of irrigation schemes. Major and minor water canals require effective maintenance for efficient distribution of water. Similarly, to avert environmental crisis, effluents from irrigation schemes should be well treated using such economic models as the '*polluter pays principle* (PPP)', and other abatement technologies.

Efficient output and credit markets

Irrigation systems often succeed under undistorted market conditions, and functioning credit and land markets. Credit markets are important in determining the working capacity of the producers and traders, while the output and input markets determine the margins in irrigated agriculture. Efficient land markets often influence the allocative efficiency in resource utilization and its productivity.

Efficient technology

Successful irrigation is marked by elaborate technological development especially in water abstraction and distribution systems. A low-cost but efficient technology in water distribution is important to avert high costs associated with irrigation systems. Water-conserving technologies such as drip irrigation are important owing to the increasing water scarcity in different countries, particularly in the Nile Basin (Nile Conference, 2002).

Market driven water user charges

The cost of water abstraction is often the among the highest cost items in irrigation investments. The costs are spread to the farmers, consequently reducing their profit margins. For example, in Egypt, the cost of irrigation water is free, and farmers incur only the pumping cost to their own fields. The issue of appropriate pricing of water often features in high-level discussions amongst Nile Basin countries (Nile Conference, 2002).

Institutional and organizational frameworks

Proper institutional arrangements are a pre-requisite for development of irrigation in the Nile Basin countries. In Egypt, the Ministry of Water Resources and Irrigation (MWRI) undertakes the construction, operation and maintenance of the irrigation and drainage networks. Specifications and permits for groundwater well-drilling are also the responsibility of MWRI. Other institutions involved in irrigation in Egypt include: Water User Associations, the High Dam Authority (responsible for Aswan Dam) and the Drainage Authority (responsible for drainage systems). In Sudan, the Ministry of Water and Irrigation is responsible for maintenance of the main irrigation canals, while agricultural corporations are responsible for maintenance of minor canals. Although Ethiopia has strong institutional set-ups (e.g., Regional Bureaus of Water Resources (BoWR), Regional Bureaus of Agriculture and Rural Development (BoARD), and Regional Cooperative Promotion Agencies (CPA), they have been incoherent and failed to function effectively. Similar institutions exist in different countries, but they need greater coordination and demarcation of functional roles to achieve higher efficacy.

5. Policy Strategies to Promote Stability in Food Access

An important component of a food system that offers food security is the ability to distribute the available food from areas of surplus to deficit areas, when it is needed, at the right price and quality. Adequate and well-functioning distribution and storage infrastructure is essential for these. The Comprehensive African Agricultural Development Programme (CAADP) emphasizes a very important link between infrastructure and agriculture, and in particular food systems. Apart from the distribution and storage infrastructure, the following are also considered important:

(i) Energy infrastructure, which is essential for development of agro-industries and generally post-harvest management;

(ii) Information/communications infrastructure, which is vital for timely technological information to farmers and agro-industrialists, but also between producers and markets; and,

(iii) Water infrastructure, which is a precondition for irrigation, water-based power generation and agro-processing.

Poor infrastructure within the region is largely responsible for poorly developed domestic, regional and international food markets. In international trade, for instance, Otsuki *et al.* (2001) report that while stricter European standards of aflatoxin were approximated to have reduced health risk by only 1.4 deaths per billion per year, they decreased African exports by 64 per cent or US$670 million.

5.1 State of Rural Infrastructure in the Nile Basin

Apart from Egypt, most of the other Nile Basin countries have inadequate rural infrastructure. The Nile Basin people face the longest distances to the nearest large markets, especially for the four landlocked countries (Burundi, Ethiopia, Rwanda and Uganda), constituting about a third of the population, and people of the Southern Sudan. The state of the roads generally compares poorly even with the rest of Africa. The mean road density is about 0.9km/1,000 head of population, while the equivalent density in SSA is 2.8km/1,000 persons, and South Asia is 1.8km/1,000 persons. East Africa has one of the lowest proportion of paved roads at 1 per cent compared to 15.6 per cent for the SSA, which hinders access to markets. The combination of scarce and poor roads results in high transport costs and makes most economies semi-open. Walking is the

principal means of transport for 87 per cent of rural households (Barwell, 1996). The rural network includes the intra-village tracks, and local government networks that link the rural population to the rest of the economy.

Good quality infrastructure is a particularly important contributor to competitiveness and growth in agriculture. Many agricultural commodities are either bulky or perishable (or both), and costs of transporting both inputs and products can account for a high share in the value of final products where infrastructure and physical market access conditions are inadequate. In these cases, markets may remain effectively insulated, even if all trade barriers are lowered or removed.

Diao and Yanoma (2003) compare the quantitative gains accrued by African economies from removal of subsidies within the EU and the US with gains from reducing trade barriers among Africa countries and from improving transportation conditions. Simulation results reveal that while opening the EU increases export opportunities from Africa and the region's total agricultural income increases by 4.5 per cent, reducing Africa countries trade barriers can significantly increase intra-regional agricultural trade by more than 50 per cent and income by 1.5 per cent. Improving the transportation sector's total factor productivity increases agricultural income by 9.5 per cent and total food consumption by 5.1 per cent. The benefits from improvements in transportation are also more equally distributed among countries in the region than those achieved by liberalization of the EU and US markets. The latter accrue to only a few countries. Such improvement in infrastructure would allow countries to exploit competitive advantage offered by liberalized trade, and enhance economic linkages within a region, especially if coupled with removal of institutional and policy barriers. The question is whether there is empirical quantitative evidence of the impact of Kenyan infrastructure on agricultural and food security status of the neighbouring land-locked countries.

Other rural infrastructure elements of significance to food security (e.g. storage, processing and market facilities) have evolved over time in extent, sophistication and modalities of ownership and operation, depending on socio-economic conditions and country policies. For example, Kenya has an extensive grain storage network, which was built in the 1970s and 1980s, but which has been unavailable to the private sector even with market liberalization. Although such facilities are necessary for food security reserves, sometimes the country still

experiences food shortages soon after a bumper harvest. There is need to carry out an inventory of available stores, indicating their status, and seek ways of involving the private sector more in post-harvest activities. The warehouse receipt initiative by the East African Grain Council could be a viable way of managing grain reserve across the region.

With respect to livestock infrastructure, information on the current state, distribution and availability is scarce. There is need to review, at national levels, the state of this stock before proceeding with significant investment programmess in support of the sector in each country.

With regard to the fishery sector, the region is characterized by a dualistic structure, with an industrial sub-sector operating on commercial basis targeting high quality/high value fish to serve European markets, and an artesian subsistence sector. The commercial sub-sector has a high degree of vertical integration from storage, processing and marketing. Most value added is kept by the companies buying the fish, and very little is left for the fishermen who lack post-harvest infrastructure. The artisanal sub-sector is composed of fishermen engaged mainly for subsistence and the local market and use labour-intensive technology. Among the major constraints are access roads, appropriate landing and storage facilities, and lack of adequate gear especially for safety. Future developments in the sector aimed at promoting a locally-owned industrial fleet, and creating conditions for investments in processing infrastructure within the region, would have to include ports suitable to the needs of the small-scale sector, strategically located with respect to the fishing areas and the required handling facilities that would allow value addition.

Markets for artisanal fishery products are quite important for communities whose livelihood strategies are heavily dependent on fisheries. The market is also of importance to inland populations for which fish represents a cheap source of protein and nutrition, compared to other sources. Improvements to market infrastructure, coupled with investments in connecting rural roads, would reduce transaction costs with likely beneficial effects on both producer incomes and increased accessibility to fish and fish products for consumption by the general population.

With respect to other infrastructure linking Nile Basin countries to the rest of the world, the region is generally deficient in terms of efficiency of operations of the ports. The levels of traffic at the regional ports, both marine and air, are low in relation to the heavy investments incurred. Some world class ports are located in Egypt, with lesser ones situated

in East Africa. Ethiopia, for example, has an excellent international airport in Addis Ababa, at least by African standards considering the volume of air-traffic. Since the existing port facilities were built for broad commercial objectives, there is need to enhance the agricultural activities that would make these investments worthwhile. This includes harnessing the large potential of high-value perishables such as fish, livestock and horticultural products.

5.2 Enhancing Capacities for Improved Market Access

For the last 15 years, market access has become a critical determinant of farmers' production systems, as markets are no longer organized by governments. With the rise in uncertainty, prices for selling produce or purchasing inputs are now largely negotiated. New commercial relations must be struck with a myriad of suppliers and buyers, and farmers' negotiation capacity must be enhanced. Evidence shows that farmers living close to better roads have more frequent and direct contact with the market, and are willing to produce more systematically for the market, while those with poor market access have little incentive to produce crops other than those required for domestic consumption (Omiti *et al.*, 2007; Mose, 2007). Put another way, improved market access, whether domestically or within the region, is a prerequisite to increased farmer incomes.

Enhancing access in domestic markets

A strong domestic market is a building block for export markets. However, tapping its potential requires strong institutional capacities and implementation of relevant policies, for instance those that improve competition, financing and market development services, among others. This is especially so for smallholder farmers who are ill-equipped to extract the maximum from the new market relations they face. One study in Kenya estimated fixed transaction costs in access to product markets to be equivalent to a value added tax of about 15 per cent (Renkow *et al.*, 2004).

For effective rural-urban transition to take place, there must be investments in infrastructure (both urban and rural roads to connect producers and traders to rural and urban markets) and general urban growth to provide jobs to those leaving farming (Tiffen, 2003). Ellis (2005) notes that growth in capital cities already offers opportunities for reducing poverty and food insecurity in the region. However, the

failure by governments and development partners to support the urban infrastructure necessary to fuel this growth may further stifle the process. A study by Omiti *et al.* (2007) on commercialization of smallholder farming demonstrates how improved access to a growing urban market can stimulate agriculture. The findings underscore a phenomenon already observed elsewhere in fast-growing economies of South-East Asia and China that rural-urban links that promote growth of both sectors generally exhibit substantial diversification of activities in both on-farm and non-farm (Tacoli, 2004). Good roads and communication networks broaden and deepen trade and exchange between the rural and urban areas to the benefit of both.

Even though investments in infrastructure were to be up-scaled to facilitate this rural-urban transition and therefore transform smallholder farming, other policies must also be conducive to this change. For instance, although Ethiopia has an agriculture optimist growth strategy (Agricultural Development Led Industrialization-ADLI), the current land policy may inhibit the transition of agriculture. The state owns most of the land, and farm families have rent-free access to land and can pass it on to their progeny, but renting is prohibited. There are widespread perceptions in rural Ethiopia that if land is left for more than 3-4 months, it will be reallocated by the local administration and the same also would occur if individuals were thought to have moved unduly into non-farm activities. This policy traps people in agriculture, since the capital or rental value of land cannot be realized, which may be a precursor to moving to off-farm work. With the current rate of urbanization in Ethiopia at 6 per cent, and an annual population growth rate of about 2.3 per cent, the implication is that in 2015, 77 per cent of Ethiopians will still live on the land and about 15 million more people will have been absorbed into the already exhausted rural land (Ellis, 2005). The ADLI strategy must, therefore, be accompanied by a land reform strategy for the desired results to be realized.

Enhance access to regional and world markets

Access to external markets for agricultural products is essential for the regions economic growth, as agriculture plays a major role in the overall economy of the Nile Basin countries. Although intra-regional exports within the Common Market for Eastern and Southern Africa (COMESA) have been growing at an average rate of about 4 per cent per year between 1997 and 2006, the level is still low, representing only 2.6 per cent of total exports from the region. As in the rest of Africa, the share of in world

agricultural exports has dropped steadily from 8 per cent in 1971-1980 to some 3.4 per cent in 1991-2000, and reversing this decline will require increased efforts to alleviate the domestic supply-side constraints.

The constraints include high dependence on a limited number of export commodities, weak technological capacities, inadequate legal and regulatory institutional frameworks, and insufficient transport, storage and marketing infrastructure. There is also the policy-induced constraints resulting from trade and macroeconomic policies, which have biased the structure of incentives against agriculture and exports. The same factors constraining access to domestic markets also constrain external markets. Farmers lack the necessary skills to access markets, and the information on market opportunities and prices.

Another potential constraint to smallholder agriculture in the region is the emerging trends in global marketing chains, where market power is being concentrated in a few hands, especially in supermarkets. The latter require stricter standards for quality, consistency and timeliness of supply, and traceability for phytosanitary checks. Smallholders who have in the past thrived on supplying high-value perishable products to European markets are likely to increasingly find it difficult to meet the quality and timeliness requirements. However, possibilities exist for assisting smallholder farmers overcome these barriers. Also, new opportunities in form of the enlarging regional markets such as COMESA and EAC stand to be exploited. Regional initiatives, together with national governments and donors, can support smallholder farmers to access these regional markets.

Poulton *et al.* (2005) construct a typology of situations that can be used in mapping out investments in support of smallholder farmers (Table 5.1). The thinking is that given the essentially fixed nature of many transaction costs, in a dualistic system of land distribution, agri-business are more likely to work with large farms, since they can get their supplies from a relatively small number of growers. This is opposed to the situation where land distribution is unimodal and agri-business has no choice but to work with small producers. Agri-business' preference for large farms is reinforced where regular investments may be necessary to satisfy evolving quality and safety requirements by buyers. The smallholders may not afford frequent investments.

To increase commercial interest in smallholders, governments and donors would need to invest in enhancing the capacity of smallholders in quality maintenance and organizational skills to gain economies of

scale. Alternatively, incentives can be provided to buyers of produce to invest in smallholders, as already happens with large scale horticultural companies who sub-contract smallholder growers.

It Table 5.1, smallholders tend to be in cell 1 and 2, while opportunities for high value produce tend to be concentrated in cell 3 and 4. Environments that characterize cell 4 are likely to marginalize smallholders. A dualistic system in a competitive environment presents real challenges for small farmer development. There are few studies documenting viable models of intermediation in area 4 (Boselie *et al.,* 2003).

The highest interest for governments and donors in investing in smallholders should be in cell 1, where smallholder farmers have a chance of competing through contract farming arrangements in high value crops. Priority for public sector investments should be lowest in cell 4. In cell 3, there is an opportunity for public sector involvement, since smallholders already have a comparative advantage but may face relatively higher transaction costs compared to large farmers. Such investments can also be justified on equality grounds.

Area 1 and 3 may be of immediate focus with regard to alleviation of food insecurity in the region and poverty reduction in general. At the moment, most smallholders are in cell 1 and agriculture and livestock production, including fisheries, exhibit a dualistic structure. Also, from Table 5.1, it can be deduced that a country's trade policy has an important role to play in mediating links between small farmers to emerging markets. For instance, if a country's policy encourages its processors and retailers to rely heavily on imported supplies, then such investors

Table 5.1 : Commercial interest in sourcing supplies from small farmers

	Demand for output from small farms	
	High	Low
Comparative advantage of small farms	Inequality in farm structure	
	Low (uni-modal land distribution—mainly small)	High (dualistic)
High Low importance of credence attributes in supply chain	1	3
Low High importance of credence attributes in supply chain	2	4

Adopted from Poulton et al. (2005)

have little incentive to invest in domestic production. There is need, for instance, to examine the extent to which regional investors in agri-business and the growing supermarkets chains in the region source from local or regional producers and small-scale food suppliers.

5.3 Managing Agricultural Prices

Although instability of food prices has been of much policy concern since the 1990s, recent trends have been very worrisome and require urgent measures. The issue of concern to policy makers is how to transit from state-dominated markets to private markets without exposing producers and consumers to risks of price collapses and spikes. What emerges from results of several studies on impact of liberalization on price instability is that sources, magnitude and food price risk and instability vary across and within countries (World Bank, 2005). A recent study of food price trends in COMESA countries arrived at the same conclusion (Karugia *et al.*, 2008). The effects depend on a country's specific situation, as well as local and household characteristics. The appropriate policy response also varies between and within countries depending on geography, patterns of production and consumption and institutional capacity to implement alternative policies. For instance, regions or households with a large share of income on limited varieties of food staples are more likely to be highly affected by price shocks. This is because if consumption is concentrated in one or a few staples, large spikes in prices can severely jeopardize the welfare of such households. The extent to which various foods can be substituted also impacts on price stability. Consequently, the food security situation is better in West African countries where there is a higher diversity of staples (sorghum, millet and cassava) than East African countries where maize consumption and production dominates. Uganda is an exception.

The extent to which a country depends on trade is another important factor in determining the importance of price instability in a country. For a consistent importer or exporter, domestic price instability is largely dependent on global price shocks. However, for a country that fluctuates between import and export status, or if a commodity is not tradable, domestic shocks such as climate changes will be the dominant source of instability.

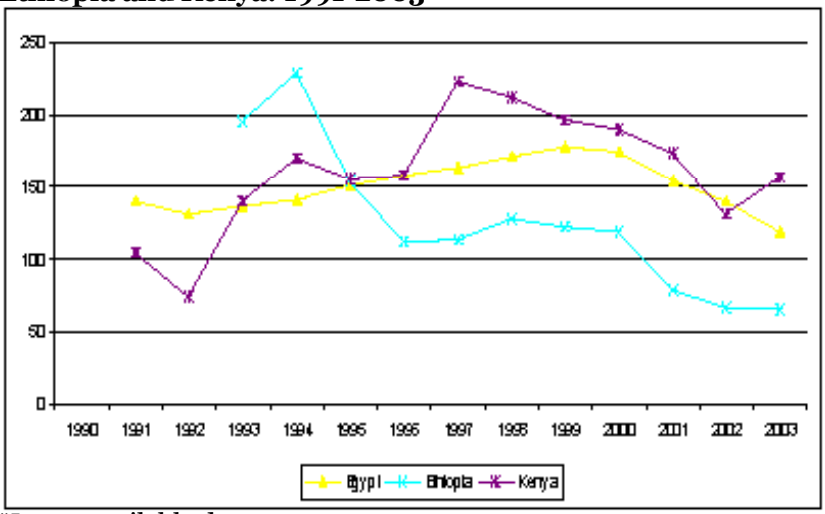
Trade is more important for landlocked countries or large countries with poor infrastructure, since a wide disparity between import and

export parity prices exists (Byerlee and Morris, 1993). Figure 5.1 compares maize producer price fluctuations for Egypt, Ethiopia and Kenya. The fluctuations were higher for Ethiopia and Kenya compared to Egypt, which has relatively developed infrastructure. The coefficient of variation over the 15 years is 12, 26 and 41 per cent for Egypt, Kenya and Ethiopia, respectively.

The transmission of global prices to producers is also poor within Ethiopia. The elasticity of price transmission between global cereal prices and prices in Addis Ababa has been estimated at 0.8, and falls to 0.2 in most of the more remote producing areas (Nicita, 2005). Although this was the case then, the recent food price crisis may yield different results for Ethiopia. Karugia *et al.* (2009) observes that although *teff* is non-tradable, its price is on the rise in tandem with the world cereal prices. The high global prices may be transmitted to domestic markets through speculation behaviour.

Just like for the household, the capacity of a country to import food commercially when it falls short of production is significant in determining the vulnerability to global markets, and therefore domestic price stability. Most of the Nile Basin countries are poor, or are in conflict, and may lack the necessary foreign exchange for food imports. Consequently, there is a high dependence on food aid. This dependence poses problems in the management of food shocks due to:

Figure 5.1: Comparison in maize price fluctuations for Ethiopia and Kenya: 1991-2003*



*Latest available data

(i) Existence of an inverse relationship between food aid supplies with commodity prices (FAO, 2006). High prices signal scarcity and, therefore, less food aid. A country facing deficit would be forced to meet foreign aid shortfalls from commercial imports just when the world prices are high.

(ii) Untimely release of food aid, which may contribute to price instability. In many countries with poor storage facilities or low production, the most severe hunger season is just before the harvest. At this time, prices are also at their highest. Release of food aid very close to harvest time may cause prices to collapse to unacceptable levels (Barrett and Maxwell, 2006).

Absence of storage facilities and good distribution systems for most Nile Basin countries imply that food price fluctuations generate substantial costs, especially for poor households, since staples constitute a big share of their budget.

5.4 Policies that Enhance Food Price Stability

Effective policies in the management of food price instability are likely to be those that address the root causes of price instability without harming market incentives. Where poor infrastructure such as poor road connection and storage facilities are the causes of volatility, public investments in such facilities would go a long way in getting the prices right. In general, such investments would be aimed at creating an enabling environment for private sector development. However, if the private sector is to operate effectively, there is need for an inventory of the state of marketing infrastructure in the Nile Basin countries, and the modalities of releasing or tendering the existing infrastructure to the private sector.

Leasing of existing facilities to the private sector is an important policy tool, especially if combined with a strategic reserve that buys and releases to the market with a purpose of maintaining stable prices for both consumers and producers.

The ability of the countries to manage food reserves effectively is considered to be important in achieving food security in the region. In their Declaration on Agriculture and Food Security in Africa, African Heads of State attending the African Union Summit in Maputo in July 2003 resolved to ensure the establishment of regional food reserve systems, including food stocks linked to Africa's own production. To

some extent, the underlying data in Figure 3.4 (a-i) shown earlier also reveals a growing importance of trade in protecting food availability, since commercial imports are on the increase for almost all the countries. This evidence is supportive of an approach of food reserve policy for the region, which limits the maintenance of physical stocks for purposes of stabilizing supply flows only, while waiting for domestic supplies to be mobilized or imports to arrive.

Another factor that makes a food reserve policy necessary is the increase in frequency of food emergencies due to drought, floods and conflicts in some Nile Basin countries. Most of the countries had slightly higher levels of food aid in the early years of 2000, compared to the mid-1990s.

Ethiopia has a model of an emergency food security reserve (EFSR) which, if well managed, can assist in preventing deprivation. The Ethiopian EFSR was set up in 1982 and has proved its utility over the years. Strategically located stocks with a maximum size of 407,000 tons are maintained by the national authorities. Stocks are released to designated distribution agents for the operation of a national and donor funded safety net programme, and borrowers replenish the reserve when their own supplies arrive. For instance, during the impending famine in 1994, about 94,000 tons were released on loan to NGOs and 52,000 tons in fee drawdown to the government relief agency. This helped mitigate serious food shortages in the northern and southern parts of the country. In 1997, 2000 and again in 2003, EFSR was the only stock on which the government, WFP and NGOs could rely on for emergency relief.

The main challenge in the management of food reserves is the maintenance of a stock size that is just sufficient to meet relief needs. The other challenge is the location of food stocks, where timely delivery cannot be assured due to poorly developed infrastructure. A decentralized system of managing food reserves is therefore preferred.

5.5 Other Market-based Food Price Management Innovations

A number of price risk management instruments exists that could enable markets to provide a high degree of food supply stability. For example, a promising innovation is the use of warehouse receipts. Kenya launched warehouse receipts in March 2008 to make storage facilities available for individuals in other countries. A government wishing to hold strategic

stocks needs to buy warehouse receipts that guarantee quality and quantity of the stocks. Such stocks can be transported when and wherever needed. Ethiopia and South Africa are other countries in Africa that have functional commodity exchanges, complete with warehouses. The Ethiopia Commodity Exchange (ECX) trades in six commodities: coffee, sesame, haricot beans, wheat and maize. ECX provides a marketplace where buyers and sellers can come together to trade and be assured of quality, delivery and payment. The exchange includes a trading floor in Addis Ababa, six warehouse delivery locations, and 20 electronic price tickers in major market towns. However, although commodity exchanges are good institutions in managing price risk, they are are generally complicated.

Other risk management instruments include:

- The World Bank African Trade Insurance Agency, which is meant to ease credit constraint in trading activities. The facility makes it easier for Africa's financial markets to offer credit insurance.
- Barter arrangements involving the direct exchange of specified physical quantities of commodities or goods can be used for food imports. In 2002, the Egyptian Food Industries Holding Company signed an agreement with the Government of Syria for the latter to export 100,000 tons of durum wheat to Egypt in exchange for specified amounts of Egyptian rice and potatoes.
- The recently launched East Africa Grain Council warehouse receipts.
- Islamic finance: The Islamic Development Bank buys food products on behalf of the importer and immediately sells to the importer on deferred payment terms. In 2002, the Bank used this method to finance wheat imports into Egypt.
- Use of market information systems (MIS) in price transmission between market centres. The IGAD region already has a system that supports national MIS in each of its member countries. The IGAD MIS structure is fully operational in Sudan and Uganda. In Kenya, one of the components of the Kenya Agricultural Commodity Exchange (KACE) is a MIS operated through mobile telephones, and is quite successful in relaying price information between different regions in the country.
- Use of donor financing of local or regional purchases. Where the cost of managing local and regional procurement allows, a

proactive policy for local procurement can be pursued to even out prices across surplus and deficit regions. This has the added advantage of raising local incomes for both farmers and local traders, unlike foreign sourced food aid, which is often from subsidized farmers in developed economies. The region can learn from Ethiopia and Uganda, which have had trials with such a programme.

6. Conclusions and Recommendations

Widespread food insecurity and malnutrition is one of the primary development challenges facing the Nile Basin countries. Many of the countries in the Nile Basin experience chronic food shortages and frequent famines despite considerable potential to address this overarching problem. Compared to other regions of the world where the problem of food insecurity has been overcome, it seems that food insecurity is more of a problem of structural and policy failure in the Nile Basin region.

Despite variations across countries and livelihood systems in various aspects of food insecurity, there are some generalisable characteristics that can permit policy makers to re-start the debate on regional food security agenda and prioritize interventions to address food insecurity in the region. These interventions must recognize the location-specific challenges, and the socio-economic and political considerations in order to be successful. There are five broad areas that must receive priority: policies and investments to increase food production; promoting and stabilizing access to food in both domestic and regional markets; strengthening regional policy and institutional framework; improving capacity of future farmers; and regional preparedness and food reserves.

6.1 Increasing Food Production

Increasing the yields in the crops, livestock and fisheries sub-sectors is crucial in increasing food production in many of the Nile Basin countries. For a long time, both research and extension services have decried the huge yield (productivity) gap between what farmers achieve and what has been tried in research stations. Several explanations have been given for this glaring misnomer. There is need to let farmers experiment with new technologies based on their knowledge and expectations, with due regard to the portfolio of resources at their disposal and market opportunities. Encouraging farmers to experiment with market-driven agricultural investments offers significant potential to unlocking the hidden potential in various agro-enterprises in the Nile Basin countries.

Many supply-side constraints impede greater investments by farmers beyond subsistence needs. Water seems to be a top constraint. Guaranteed access to water (from different sources) is one critical bottleneck to intensification and commercialization of agriculture in the Nile Basin countries (Rosegrant *et al.,* 2008; and Omiti *et al.,* 2008).

The governments must provide appropriate institutional and legal frameworks to promote water conservation, and provide policy signals that reflect the inter-temporal and spatial scarcity values of water, including mechanisms of dealing with negative externalities. Rainwater harvesting presents a real opportunity for many upstream governments in the Nile Basin to tap water for different uses without compromising the downstream uses (ENTRO, 2008). The Cooperative Framework of Agreement (CFA) between different Nile Basin governments is attempting to solve the different conflicting interests in the utilization of Nile Basin water resources.

Agricultural technologies can be systematically and coherently tackled through policy and institutional reforms to promote an African green revolution (Diao *et al.*, 2008). For example, there are efforts by various governments and donors to increase funding of the agricultural sector to address these and other supply-side constraints. An important component is to explore how to strengthen public-private partnerships to provide a range of packages to catalyze agricultural productivity growth. One such avenue lies in the provision of financial packages to farmers and traders.

Socio-economic development in the Nile Basin countries considerably depends on the agricultural sector, whose potential is still largely undeveloped. Most of these countries import agricultural products, especially wheat, maize and vegetable oils, which can be produced in the region. While not all land has been cultivated, there is still vast idle land suitable for growing such imported agricultural commodities on a regional basis. Nile Basin countries should invest in programmes that increase agricultural productivity and consequently create surplus for intra-regional trade.

6.2 Enhancing Capacities for Improved Market Access

Little consideration has been given to regional trade as a means to increase the efficiency of both rain-fed and irrigated agriculture (including virtual water trade). Cross-border trade remains mainly informal, and its importance in promoting regional trade corridors has not gained adequate attention in official policy cycles. Poor infrastructure, inadequate risk management and non-tariff barriers have been the major challenges to regional trade. Rural-urban transition will be a pre-requisite to enhance market access on regional basis. To promote

regional agricultural trade and production, it is important to undertake marketing studies, support regional commodity groups, and promote agricultural risk management tools. Supporting regional commodity group(s) would empower the private sector and civil society to participate in policy dialogue to promote trade and strengthen agri-business linkages in the Nile Basin region. Improved capacity to manage agricultural risk would help promote trade and enhance food security, without limiting regional trade.

Promising investments could include:

(i) Agro-processing to increase value-addition in tea, coffee, cotton, sisal, hides and skins, juices, pulp and preserves, as well as bio- and organic products;

(ii) Private sector build-own-operated infrastructure for production, processing, packaging, storage, cold-chain and marketing of agriculture and agri-food products;

(iii) Large-scale agricultural production to promote regional food security and trade;

(iv) Expansion of export horticulture;

(v) Development of fisheries (including aquaculture);

(vi) Regional livestock production and marketing;

(vii) Foreign investments in the region by outsiders who want to grow food for their citizens.

6.3 Strengthening Regional Policy and Institutional Framework

The Nile Basin countries are characterized by inconsistent and overlapping policy, and legal and institutional frameworks (Nicol and Shahin, 2005). These inconsistencies result in poor enforcement of the legal frameworks and inadequate implementation of public policies. There is need to streamline policies, especially those that govern intra-regional trade in agricultural products and services to facilitate increased regional trade.

Reducing the cost of doing business

To enhance intra-trade, the Nile Basin countries need to deliberately pursue concerted policy reforms on several fronts: they must improve

physical infrastructure and create opportunities for market access; and undertake reforms that bring down the costs of doing business, including strengthening the legal and regulatory framework. The focus should be on tackling supply-side constraints and responding to shifting regional and global demand.

Improving customs administration

Nile Basin countries should continue to facilitate trade at customs points, simplify customs procedures, and improve trade logistics. Improving customs administration would also mitigate potential revenue losses from tariff reductions, including in the context of the Economic Partnership Agreements (EPAs). Broadening the tax base by eliminating exemptions would be particularly important. Institutions and organizations that execute policies need to be strengthened in capacity and power to implement their mandates effectively. Such institutions include revenue-collecting organizations that deal with taxes and tariffs, and research institutions that advise on policy formulations and processes in various countries.

6.4 Building Capacity of Farmers

The ability of the region to feed itself depends on the ability to pass on the necessary skills to farmers and conserving resources that are necessary for agricultural production. Building capacity for agriculture entails what is taught in the education system about agriculture, entrepreneurship, innovation and development, conservation and sustainability.

Customizing user-friendly training programmes

Training programmes at all levels should be amended to reflect changing food needs (population dynamics), resource scarcity profiles and market opportunities for the farming population. More emphasis should put on training programmes on efficient sub-sectors and less on water-intensive commodities.

Business development skills

Most young farmers put emphasis on quality production (to get high financial returns), less drudgerious enterprises (i.e. maximize leisure), innovation and development of new products (including services), and development of localized markets (with linkages to global markets). Policy objectives will require greater investments in training and advisory services, availability of investment capital, business management skills

and risk management tools.

Indigenous foods and knowledge: Old solutions for new problems

Besides food production, employment and other economic attributes, the agricultural sector serves many multi-functional roles that are essential to the viability of the rural economy as an entity. It provides for continuity of rural livelihoods, safeguards the environmental landscape, and provides for biodiversity. It holds the secrets for the future of agri-food systems nationally and internationally. Every effort should be made towards providing and inculcating the right leadership, mentorship and entrepreneurial aspirations to future farmers to forestall collapse of agricultural systems in providing future demands for food, among other environmental services.

6.5 Regional Preparedness and Food Reserves

The Nile Basin experiences many inadequacies to reliably provide quality food to its inhabitants. However, working as a region offers some considerable leverage in reducing the extent of hunger and destitution amongst its population. In order to stem food insecurity amongst its people, there is need to promote regional forecasts of supply and demand of major food staples, regional early warning systems and regional strategic food reserves.

Regional commodity outlook

It is important to predict the future supply and demand of key food staples in order to stabilize food availability and minimize emergency responses. This may require various governments to take an inventory of their food production and marketing systems. It will also be necessary to capture the extent of cross-border commodity flows. Governments need to work together to validate their commodity outlook situations. However, this needs to be further worked out so that various government representatives agree on which models to use and what modalities to use in sharing data and other important information.

Regional famine early warning systems

Developing and sustaining a regional famine early warning system is essential to improving preparedness and equipping decision makers with a range of information to make early and effective responses to mitigate food insecurity and hunger. Furthermore, if accompanied with comprehensive analyses, regional famine early warning systems would

equip both decision makers and intervention agents with an assessment of the merits and pitfalls of the range of market and non-market responses that are being considered.

Regional food reserve facility

Low and stagnating agricultural production, high prevalence of HIV/AIDS, erosion of household assets and disasters such as droughts have resulted in high levels of food insecurity and vulnerability. To this end, there is need to elaborate on the legal arrangements and specific roles and responsibilities of each Nile Basin country in the governance and implementation of the regional food reserve facility. This activity could be taken up by the Nile Basin Secretariat or other basin-wide organizations interested in food security or general agricultural development in the region.

References

Akatch S. (Ed). (1996), *Dying Lake Victoria: A Community-based Prevention Programme*. OSIENALA (Friends of Lake Victoria) and Initiatives Publishers, Nairobi, Kenya.

Amleson, S. (2004), Eritrea Country Paper. In Omare, A., and D. Sheikh. (Eds). Study on Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa–Abstracts of presentations and synthesis of discussions. Proceedings of the workshop for Eastern and Central Africa, Nairobi, Kenya: ASARECA/IAC, accessible at www.interacademycouncil.net.

Arksey, H. and L. O'Malley (2005), 'Scoping Studies: Towards a Methodological Framework', *International Journal of Social Research Methodology*, 8(1)19-32.

Arntzen, J., P. Dube, P., M.T. Muchero (2004), 'Global Environmental Change and Food Provision in Southern Africa: Explorations for a Possible GECAFS Research Project in Southern Africa'. http://www.diversitas- international.org/docs/publications/ gecafs, downloaded on 24 August, 2007.

Bai ZG and DL Dent (2006), Global Assessment of Land Degradation and Improvement: Pilot Study in Kenya. Food and Agricultural Organization (FAO) Report 2006/01.

Bakun, A., S. Weeks (2004), 'Greenhouse Gas Build-up, Sardines, Submarine Eruptions and the Possibility of Abrupt Degradation of Intense Marine Upwelling Systems', *Ecology Letters* 7, 1015-1023.

Barrett, C. and D. Maxwell (2006), 'Towards a Global Food Aid Compact.' Food Policy. 31. pp. 105–118.

Barwell, I. (1996), 'Transport and the Village'. World Bank, Discussion Paper No. 344.

Benson T., Minot N., Pender J., Robles M. and J. von Braun (2008), 'Global Food Crises: Monitoring and Assessing Impact to Inform Policy Responses', Food Policy Report, International Food Policy Institute (IFPRI), Washington DC.

Biswas Asit, Jellali Mohammed and Glenn E Stout (1993), W*ater for Sustainable Development in the 21st Century*, New Delhi: Oxford University Press.

Bruce, John W. and Shem E. Migot-Adholla (eds) (1994), Searching for Land Tenure Security in Africa. Dubuque, Iowa: Kendall/Hunt.

Byerlee, D. and M. Morris (1993), 'Calculating the Levels of Protection: Is it Always Appropriate to Use the World Reference Prices Based on Current Trading Patterns?' W*orld Development*, 21(5) 805-15.

Boselie, D., S. Henson, and D. Weatherspoon (2003), "Supermarket Procurement Practices in Developing Countries: Redefining the Roles of the Public and Private Sectors". American Journal of Agricultural Economics 85 (5): 1155-1161.

Boyer, D.C., H.J. Boyer, I. Fossen, A. Kreiner (2001), 'Changes in Abundance of the Northern Benguela Sardine Stock during the Decade 1990 to 2000, with Comments on the Relative Importance of Fishing and the Environment', *South African Journal of Marine Science*, 23: 67- 84.

Briggs L.; S.J. Twomlow (2002), 'Organic Material Flows Within a Smallholder Highland Farming System of South West Uganda'. *Agriculture, Ecosystems and Environment*, May 2002, Vol. 89, No. 3, pp. 191-212(22).

CAAD (2009). Framework for African Food Security (FAFs). Comprehensive African Agricultural Development Programme Pillar III

Calatrava J. and E. Garrido (2005), 'Modelling Water Markets under Uncertain Water Supply', European Review of Agricultural Economics 32(2), 119-142 Collins, S. (2005), 'Competitiveness: Farm to Market Linkages'. Grain Trade Summit ACDI/VOCA (K), 12 October 2005.

Chakravorty Ujjayant, Eithan Hochman and David Zilberman (1995), 'A Spatial Model of Optimal Water Conveyance', Journal of Environmental Economics and Management 29, 25-41

Cohen, A.S., R.B. Bills, C.Z. Cocquyt and A. G. Caljon (1993), "The Impact of Sediment Pollution on Biodiversity in Lake Tanganyika", *Conservation Biology*, Vol. 7, No. 3: pp. 667-677.

Collins, S. (2005), 'Competitiveness: Farm to Market Linkages'. Grain Trade Summit ACDI/VOCA (K), 12th October 2005.

Demel T. (2001), 'Deforestation, Wood Famine and Environmental Degradation in Highlands Ecosystems of Ethiopia: Urgent Need for Actions'. Paper Contributed to *Managing Natural Resources for Sustainable Agriculture in African Highland Ecosystems* Workshop, August 16-18,2001, Western Michigan University, Kalamazoo.

Devereux, S. (2001), 'Famine in the Twenty First Century'. IDS Working Paper No. 105, Institute of Development Studies, Sussex.

Diao, X. and Y. Yanoma (2003), Exploring Regional Dynamics in Sub-Saharan African Agriculture. DSGD Discussion Paper No. 2, IFPRI.

Diao, X., Headey, D. and M. Johnson (2008), 'Toward a Green Revolution in Africa: What Would it Achieve, and What Would it Require', *Agricultural Economics* 39 (2008): 539-550.

Ellis, F. (2005), 'Small-farms, Livelihood Diversification and Rural-urban Transitions: Strategic Issues in Sub-Saharan Africa', Workshop on the Future of Small Farms, IFPRI, June 2005.

Ejigu M. (1995), 'Transboundary Programmes: From Ecology to Policy in Africa. Paper Presented to the Third Annual Conference on Environmentally Sustainable Development', Washington DC, 4-6 October.

El Moushid B.E.F., El Awad O.M.A. and Ahmed S.E. (1997), *Environmental Effect of the Blue Nile Sediment on Reservoirs and Irrigation Canals*, In Fifth Nile 2002 Conference, Addis Ababa.

ENTRO (2008), Eastern Nile Irrigation and Drainage Study ENIDS): Cooperative Regional Assessment and Transboundary Analysis, Eastern Nile Technical Regional Office (ENTRO), Addis Ababa, p140.

EP (*Enquête Prioritaire*) (1998), Etude Nationale sur les Conditions de Vie des Populations, Bujumbura, Burundi.

FAO (2008), Intra-Africa Trade: Issues, Challenges and Implementations for Food Security and Poverty Alleviation, Twenty-Fifth Regional Conference for Africa, 31 March–4 April, Nairobi ARC/08/5

FAO (2006), 'The State of Food Aid and Agriculture: Food Aid Food Security?', Food and Agricultural Organization, Rome.

FAO (2005), Milk and Dairy Products, Post-Harvest Losses and Food Safety in Sub-Saharan Africa and the Near East, available at http://www.fao.org/ag/againfo/projects/en/pfl/home.html.

FAO (1996), World Food Summit: Food Security Situation and Issues in the Africa Region. Nineteenth FAO Regional Conference for Africa, Ouagadougou, Burkina Faso, 16-20 April.

FAOSTAT (2008), Food and Agricultural Organisation of the United Nations data base. Rome.

Fischer G., H. Shah, F.O. van Velthuizen, and F.O. Nachtergaele (2001), 'Global Agro-ecological Assessment for Agriculture in the 21st Century', International Institute for Applied Systems Analysis, Laxenburg, Austria.

Freeman H. Ade and John M. Omiti (2003), 'Fertilizer use in semi-arid areas of Kenya: Analysis of smallholder farmers' adoption behaviour under liberalized markets', Nutrient Cycling in Agroecosystems 66, 23-31.

Gabre-Madhin, E. (2003), 'Why is Ethiopia Facing Another Famine? On Markets and Market Failure', IFPRI.

Hanson B.B., R. Baker and M. Bourdon (1993), 'Comparison of Different Climate Change Scenarios on Rangeland Livestock Production', *Agricultural Systems* 41, 487-502.

Hazell P. and R.K. Pachauri (2006), Bioenergy and Agriculture: Promises and Challenges', International Food Policy Research Institute (IFPRI), Washington.

Headey, D. and S. Fan (2008), 'Anatomy of a Crisis: The Causes and Consequences of Surging Food Prices', *Agricultural Economics* 39 (2008): 375-391.

Hulme M., R. Doherty, T. Ngara, M. New, and D. Lister (2001), 'Africa Climate Change 1900-2100'. *Climate Research* 17 (2), 145-168.

Hutchinson R., B. Spooner and Walsh N. (1991), 'Fighting for Survival: Insecurity, People and the Environment in the Horn of Africa'. IUCN (World Conservation Union), Gland, Switzerland.

IAC (2004), 'Realizing the Promise and Potential of African Agriculture'. InterAcademy Council (IAC). Amsterdam: Royal Netherlands Academy of Arts and Sciences.

IFAD (2001), Rural Poverty Report. International Fund for International Development.

IPCC (2007), 'Climate Change 2007', Intergovernmental Panel on Climate Change, Fourth Assessment Report.

IRIN (2008), 'Burundi: Shrinking Lakes and Denuded Forests. UN Office for the Coordination of Humanitarian Affairs', available at http://www.irinnews.org/report.aspx.

Irungu P., Omiti J.M. and G.L. Mugunieri (2006), 'Determinants of Farmers' Preference for Alternative Animal Health Service Providers in Kenya: A Proportional Hazard Application', Agricultural Economics 35, 11-17.

Jones, P.G., P.K. Thornton (2003), 'The Potential Impacts of Climate Change on Maize Production in Africa and Latin America'. *Global Environmental Change,* 13, 51- 59.

Juvan L. and E. Erjavec (2005), 'Intertemporal Analysis of Employment Decisions on Agricultural Holdings in Slovenia', Agricultural Economics 33(2), 153-161

Karugia, J., M. Waithaka, A. Freeman, R. Prabhu, B. Shiferaw, S. Gbegbelegbe, S. Massawe, M. Kyotalimye, J. Wanjiku and E. Macharia (2009), "Responding to Food Price Crisis in Eastern and Southern Africa: Policy Options for National and Regional

Action", Regional Strategic Analysis and Knowledge Support Systems (ReSAKSS) Working Paper No. 27.

KENFAP (2006), 'Mango Value Chain Analysis', Nairobi: Kenya National Federation of Agricultural Producers.

Khouzam, R.F. (1996), "Economic Incentives to Promote the Abatement of Nile Pollution". Presented at the Sixth Annual Meeting of the International Association for the Study of Common Property Berkeley, California, 5-8 June 5-8.

Kijima Y., Sserunkuuma D. and K. Otsuka (2006), 'How Revolutionary is the "Nerica Revolution": Evidence from Uganda', Developing Economies 44 (2), 252-267

Kurukulasuriya P., R. Mendelsohn, R. Hassan, J. Benhin, T. Deressa, M. Diop, H. M.Eid, K. Y. Fosu, G. Gbetibouo, S. Jain, A. Mahamadou, R. Mano, J. Kabubo-Mariara, S. El-arsafawy, E. Molua, S. Ouda, M. Ouedraogo, I. Se´ne, D. Maddison, S. N. Seo, and A. Dinar (2006), 'Will African Agriculture Survive Climate Change?'. *The World Bank Economic Review*, Vol. 20(3): pp. 367-388.

Mano, R.T., J. Arntzen, S. Drimie, P. Dube, J.S. I. Ingram, C. Mataya, M.T. Muchero, E. Vhurumuku and G. Ziervogel (2007), 'Global Environmental Change and the Dynamic Challenges Facing Food Security Policy in Southern Africa'. GECAFS Working Paper 5.

Mays, N., Roberts, E. and J. Popay (2001), 'Synthesising Research Evidence', in Fulop N., Allen P., Clarke A. and N. Black (eds) S*tudying the Organisation and Delivery of Health Services: Research Methods*, London: Routledge.

McNeely J., M. Gadgil, C. Leveque, C. Padoch and K. Redford (1995), 'Human Influences on Biodiversity', In *Global Biodiversity Assessment,* Nairobi: UNEP and Cambridge: Cambridge University Press, Cambridge, UK.

Misselhorn A. A. (2005), 'What Drives Food Insecurity in Southern Africa? A Meta-analysis of Household Economy Studies'. *Global Environment Change*, 15: 33-43.

Mitchell, T. (1997), "Rwanda and Conflict. ICE Case Studies. Trade and Environment Database.

Mogoa E.G.M., Omiti J.M., Tsuma V.T. and C.O. Bwanga (2004), 'Some Constraints and Opportunities in the Privatisation of Animal Breeding Services in Kenya', Kenya Veterinarian 27, 45-48.

Mongi H. J. (2008), "Addressing Land Degradation in Tanzania: Contemporary Issues Related to Policies and Strategies". CTA Seminar, Ouagadougou, Burkina Faso, 26-31.

Mose. L.O. (2007), 'Who Gains, Who Loses? The Impact of Market Liberalization on Rural Households in Northwestern Kenya', PhD Dissertation, Wageningen University.

Mwabu, G. and A. Mullei (2000), Status of Poverty in Kenya. In The Link between Corruption and Poverty: Lessons from Kenya Case Studies, edited by A. Mullei, The African Centre of Economic Growth (ACEG), Nairobi

Nakileza, B. and E.N.B. Nsubuga (eds) (1999), *Rethinking Natural Resource Degradation in Semi-Arid Sub-Saharan Africa: A Review of Soil and Water Conservation Research and Practice in Uganda, with Particular Emphasis on the Semi-arid Areas*. Kampala: Soil and Water Conservation Society of Uganda (SWCSU), Makerere University; London: Overseas Development Institute.

NEAP (1995), 'The Nation Environmental Action Plan for Uganda', Kampala: Ministry of Natural Resources.

NELSAP (2008), 'Agricultural Productivity, Trade and Investment in the Nile Basin Countries' Consultancy Report, Nile Equatorial Lakes Subsidiary Action Programme (NELSAP), Kigali, Rwanda.

NEMA (2001), 'Uganda State of the Environment Report 2000', Version 2. Kampala: National Environment Management Authority, Ministry of Natural Resources.

Nicita, A. (2005), 'Ethiopia'. Background Paper for the UN Millennium Project's Taskforce on Trade Report: *Trade for Development,* Washington DC: World Bank.

Nicol Alan and Mamdouh Shahin (2005), 'The Nile: Moving Beyond Cooperation, Working Paper No. SC-2003/WS/61, Water Policy Programme, Overseas Development Institute (ODI), London, available at http://Unesdoc.Unesco.Org/Images/.

Nile Conference (2002), Nile 2002 Conference, 26-29 June 2000, Addis Ababa, Ethiopia.

Nkonya, E., J. Pender, D. Sserunkuuma and P. Jagger (2002), 'Development Pathways and Land Management in Uganda'. In *Policies for Sustainable Land Management in the East African Highlands*', by S. Benin, J. Pender and S. Ehui (eds), Washington DC and Nairobi: International Food Policy Research Institute and International Livestock Research Institute.

Odada, E.O., D. Olago, K. Kulindwa, F. Bugenyi., K. West, M. Ntiba, S. Wandiga and J. Karimumuryango (2004), *Global International Water Assessment, Regional Assessment 47.* East African Rift Valley Lakes, Kalmar: University of Kalmar/UNEP, available at http://www.giwa.net/areas/reports.

Odhiambo. W., Nyangito. H.O., and Nzuma. M.J. (2004), "Sources and Determinants of Agricultural Growth and Productivity in Kenya". Kenya Institute of Public Policy Research and Analysis (KIPPRA), Nairobi. Discussion Paper No. 34.

Omiti. J.O., D. Otieno, E. McCullogh and T. Nyanamba (2007), 'Strategies to Promote Market-oriented Smallholder Agriculture in Developing Countries: A Case of Kenya.' A Paper Presented at the 2nd African Association of Agricultural Economists Conference (AAAE), Accra, Ghana, 20-22 August.

Paulos Dubale (2001), " Soil and Water Degradation Factors Affecting their Productivity in the Ethiopian Highland Agro-ecosystems". Paper presented at *Managing Natural Resources for Sustainable Agriculture in African Highland Ecosystems* Workshop, 16-18 August.

Pender, J., F. Place and S. Ehui (2006), *Strategies for Sustainable Land Management in the East African Highlands*, Washington DC: IFPRI.

Pinstrup A., Pandya P.R, Rosegrant M.W. (1999), 'World Food Propects: Critical Issues for the Early Twenty-first Century. 2020 Vision Food Policy Report, Washington DC: International Food Policy Research Institute.

Poulton, C., A. R. Dorward and J. G. Kydd (2005), 'The Future of Small Farms: New Directions for Services, Institutions and Intermediation'. Conference on the Future of Small Farms , June 2005, Wye.

Renkow, M., D.J. Hallstrom, and D. D. Karanja (2004), "Rural Infrastructure, Transitions Costs and Market Participation in Kenya," Journal of Development Economics 73(1): 349-67. Rosegrant M.W., Cline S.A., Weibo L., Susler T.B. and A.V. Rowena (2005), 'Looking Ahead: Long-term Prospects of Africa's Agricultural Development and Food Security', 2020 Discussion Paper No. 41, Washington DC: IFPRI.

Rosegrant M.W.; Cline S.A.; Weibo L.; Susler T.B.; and A.V. Rowena (2005), 'Looking Ahead: Long-term Prospects of Africa's Agricultural Development and Food Security', 2020 Discussion Paper No. 41; International Food Policy Institute (IFPRI), Washington DC.

Ruijs A., C. Schweigman and L. Clemens (2004), "The Impact of Transport- and Transaction-Cost Reductions on Food Markets in Developing Countries: Evidence for Tempered Expectations for Burkina Faso". Agricultural economics, 31 (2-3): 219-228.

Sanchez, P., M.S. Swaminathan, P. Dobie and N. Yuksel (2005), Halving Hunger: It Can be Done. UN Millennium Project. Taskforce on Hunger, 2005.

Sen, A. (1981), *Poverty and Famines*. Oxford: Clarendon Press.

Shibru, T. and L. Kifle (1998), 'Environmental Management in Ethiopia: Have the National Conservation Plans Worked?' Environmental Forum Publication Series No.1 Organization for Social Science Research in Eastern and Southern Africa (OSSREA).

Scholes, R.J. and R. Biggs (2004), 'Ecosystem Services in Southern Africa: A Regional Assessment'. Millennium Ecosystem Assessment, Pretoria, pp. 78.

Tacoli (2004), "Rural-Urban Linkages and Pro-Poor Agricultural Growth: An Overview". Paper Prepared for OECD DAC POVNET Agriculture and Pro-Poor Growth Task Team. Helsinki Workshop, 17-18 June.

Thrupp L.A. and Megateli N. (1999), Critical Links: Food Security and the Environment in the Greater Horn of Africa, Washington DC: World Resources Institute and Nairobi: International Livestock Research Institute.

Tiffen, M. 2003. "Transitions in Sub-Saharan Africa: Agriculture, Urbanization and Income Growth", World Development, Vol. 31, No. 8, pp. 1343-1366.

UNECA (2006), Land Tenure Systems and their Impacts on Food Security and Sustainable Development in Africa. Economic Commission for Africa.

UNCED (1992), 'UN Conference on Environment and Development', Rio de Janeiro.

UNEP (2005), "Connecting Poverty and Ecosystem Services. A Series of Seven Country Scoping Studies: Focus on Rwanda", United Nations Environment Programme and the International Institute for Sustainable Development.

UNEP (2007a), United Nations Framework Convention on Climate Change, United Nations Environmental Programme.

UNEP (2007b), 'Sudan Post-conflict Environmental Assessment', United Nations Environmental Programme.

United Nations Development Programme/Global Environment Fund (1994), *Ethiopia: A Dynamic Farmer-based Approach to Conservation of African Plant Genetic Resources*. GEF Project Document, New York: UNDP.

Walker B.H., Steffen W. (1997), 'An Overview of the Implications of Global Change for Natural and Managed Terrestrial Ecosystems', Conservation Ecology, 1(2): 2.

Westing A. (1991), 'Environmental Security and its Relation to Ethiopia and Sudan', *Ambio* 20 (5):168-171.

WFP (2004), 'Burundi Food Security and Vulnerability Report', World Food Programme (WFP).

WIDER (2007), World Income Inequality Database Version 2.

Wood, S. and S. Ehui (2005). "Food", in Millennium Ecosystem Assessment, Conditions and Trends. Washington, D.C., USA: Island Press.

Worede M. (1992), 'Ethiopia: A Gene Bank Working with Farmers'. In Cooper D., Vellve R. and Hobbelink H. (eds), *Growing Diversity: Genetic Resources and Local Food Security*. London: Intermediate Technology.

Worede M. and H. Mekbib (1993), 'Linking Genetic Resource Conservation to Farmers in Ethiopia', In: Boef W., Amanor K., Wellardf K. and Bebbinton A. (eds), *Cultivating Knowledge: Genetic Diversity, Farmer Experimentation and Crop Research*, Amsterdam: Intermediate Technology, Amsterdam.

WFS (1996), "World Food Summit", 13-17 November 1996. Rome. Italy

WIDER (2007), http://www.wider.unu.edu/wiid/wiid.htm. downloaded 14/08/2007.

Zake, S. Julius, C. Nkwijn and M.K. Magunda (1999), Uganda. 'In Integrated Soil Management for Sustainable Agriculture and Food Security in Southern and East Africa', Proceedings of the Expert Consultation, edited by H. Nabhan, A. M. Mashali and A. R. Mermut, Harare: Food and Agriculture Organization.