SOCIO-ECONOMIC DEVELOPMENT AND BENEFIT SHARING PROJECT [SDBS]

FINAL REPORT 2008

Food-Poverty-Vulnerability Index Analysis for the Nile Basin Region (Ethiopia, Kenya and Sudan)

SUDAN
PROJECT ID Number: P075952

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NILE BASIN INITIATIVE

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List of Acronyms

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ASARECA:	Association for Strengthening Agricultural Research in Eastern and Central Africa
CBA:	Cost Benefit Analysis
CEDF:	Certainty-equivalent Discount Factor
CEDR:	Corresponding Certainty-equivalent Discount Rate Central Africa
CFSVA:	Sudan Comprehensive Food Security and Vulnerability Analysis
CGE:	Computable General Equilibrium models
CRA:	Cooperative Regional Assessment
DDR:	Declining Discount Rate
DPPC:	Disaster Preparedness and Prevention Commission
DSRI:	Development Studies and Research Institute
ENSAP:	Eastern Nile Subsidiary Action Program
ENTRO:	Eastern Nile Technical Regional Office
EU:	European Union
EW:	Early Warning
FFS:	Farmers Field Schools
FGT:	Foster-Greer-Thorbecke
FII:	Food Insecurity Index
FTPs:	Fast Track water management Projects
CSA:	Central Statistics Agency
GAM:	Global Acute Malnutrition
GDP:	Gross Domestic Product
GIS:	Geographical Information System
GNP:	Gross National Product
HEA:	Household Economy Approach
HSF:	Households Food Security
IDPs:	Internally Displaced Persons
IFAD:	International Fund for Agricultural Development

IGAD:	Inter-Governmental Authority for Development
IPM:	Integrated Pest Management
JAM:	Joint Assessment Mission
KIPPRA:	The Kenya Institute for Public Policy Research and Analysis
LDCs:	Least Developed Countries
MoFED:	Ministry of Finance & Economic Development
NARS:	National Agricultural Research Systems
NBI:	Nile Basin Initiative
NGOs:	Non-Governmental Organizations
NPV:	Net Present Value
PASDEP:	Plan for Accelerated and Sustainable Development to End Poverty
PIM:	Project Implementation Unit
SAMs :	Social Accounting Matrices
SDBS:	Socio-economic Development and Benefit Sharing
SIFSIA:	Sudan Institution Food Security Information for Action
SOC:	Social Opportunity of Capital
SPC:	Shadow Price of Capital
SPCRP:	Sudan Productive Capacity Recovery Programme
SPCRP:	Sudan Productive Capacity Recovery Programme
SRTP:	Social Rate of Time Preference
SRTP:	Social Rate of Time Preference
SSARP:	Southern Sudan Agricultural Revitalization Program
UNDP:	United Nation Development Programme
UNECA:	United Nations Economic Commission for Africa
UNFCCC:	United Nations Framework Convention on Climate Change
UNHDR:	United Nations Human Development Resources
VAHW:	Village Animal Health Workers
VAM:	Vulnerability and Mapping
WA:	Water Approach
WMPs:	Watershed Management Projects

Acknowledgement

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Executive Summary

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The Report on Food Vulnerability Index Analysis addresses an important issue of food insecurity in the eastern countries of the Nile Basin Region: Ethiopia, Kenya and Sudan. Particularly, Ethiopia and Sudan have continued to depend on short-term remedies including food-aid by World Food Program of the United Nations (WFP). The main reason for the analysis is the identification of the most poverty vulnerable population/districts with highest food insecurity and poverty index in the three countries. The objective is to set appropriate measures for priority intervention action by policy makers and activists in a trans-boundary context. The study points out lack of commonality and shared vision approaches among NBI countries in dealing with food insecurity problems. While the study is intended to cover the three countries, it uses more information from Sudan to get out proxy indicators and measures that could be extended to the other countries of the Region.

The Food Poverty Vulnerability term has been used in this study to combine different essential elements responsible for the present status of food security in the developing countries in general and the study counties in particular. The vulnerability notion is accommodated within prevailing climatic conditions and human resource endowments and entitlement factors that expose marginal segments of the population in those three countries to risks and hazards of food insecurity. Based on a derived concept from various definitions on the subject-matter, the study interlinks food insecurity with poverty concepts in a coherent context of inherited and acquired endowments and entitlements of the vulnerable households unable to produce or buy basic food needs.

Food insecurity is measured from metric and non-metric angles. The metric one compares household consumption, as a proxy for permanent income/ household income with the food poverty line. If a household's income/ consumption expenditure falls below food poverty line, a household is classified as food poor. Food security situation in this study is evaluated against minimum standard of food nutritional intake (food poverty line) measured in kilocalories,

approximating 2400 kilocalories per person per day. From a non-metric view, food balance sheets of different countries were amassed to incorporate complimentary information on vulnerability status of food insecure peoples' situation in the countries under study. Within this framework the study sets to identify the highest food insecurity and poverty vulnerable geographic and livelihood groups or areas in the three countries. Most vulnerable areas or groups were thus identified and selected for positive food poverty alleviation intervention activities. Obtained findings on food insecurity and poverty vulnerability analyses in the three countries are used to set policy measures for intervention over the Nile Basin Region. Policies integrating development efforts of the three Nile Basin Region countries the Sudan, Ethiopia and Kenya are carved to avail utilization of comparative advantage resources (high potential lands, human and water resources) in an empowered food insecurity and poverty alleviation program. This could quickly help relieve the situation of vulnerable population segments in fragile areas.

The study is divided into four parts: Part A, B, C and D. In part (A) a major study of food insecurity and poverty vulnerability analysis has been undertaken in the three countries using primary data collected from surveys of certain areas. Primary data for Sudan has been obtained from field survey of areas in Khartoum State, the Northern States, Western Sudan State of Northern Kordofan as well as the Blue Nile State on Sudan-Ethiopian borders. Data for Kenya was mainly obtained from Kenya household survey report as well as from KIPPRA's Sister Food productivity study. For Ethiopia the major source of data is Addis Ababa University Institute of Development Research.

On the other hand secondary data sources were the national statistic figures, GDPs, relevant ministries and department's data and information, FAO, WB, WFP:VAM, WTO Statistics, ENTRO Component one Phase One: PHASE ONE: Diagnostic and planning-2008, private information spots, the Internet and other sources.

The methods and approaches of analysis depended on desk work descriptive analyses and statistical calculations of means and coefficient of variations.

Descriptive as well as quantitative analyses have been carried out over Ethiopia, Kenya and Sudan as representative of the Region as far as data and information allow so that the results of the study may be generalized for the whole region. This is to avoid apparent limitation or skewness of the study towards the three countries and to emphasize that it can benefit the whole Nile Basin region as an integral unit.

The main focus of the study is poverty vulnerable population or district with highest food insecurity and poverty index modality under weak groups including gender, children and the elderly. In this regard, the measures for priority intervention action by policymakers and activists in a trans-boundary context can be set rolling.

The major findings of the study indicate the high incidence of food poverty in the three countries. In that context the trans-boundary district area of the Blue Nile region has been signalled by the study as having the most food insecure vulnerable population. Population in this border area depends on tilling land and rearing goats as main source of living. They have no market accessibility apart from accumulating stock on high season and depleting this stock when grain crops fail in low seasons. The main factors affecting agricultural productivity in the Nile Basin Region is low public investment in the sector, recurrent natural hazards such as drought, climate change, and the environment degradation. Accordingly two interventions were advocated by the study: (i) a policy brief advocating the establishment or reactivation of the Early Warning systems for climatic prediction and control over the Nile Basin Region taking the three countries as piloting phase for replication in other countries; and (ii) the establishment of the Trans-boundary investment project for establishment of grain basket production and consumption in district specific areas of Sudan and Ethiopia is propounded also as a pilot phase for replication. The Policy Brief and Investment Project for the two proposed projects are given in section B and C respectively for the completion and rounding up of the study.

The Policy Brief calls for the integration of early warning activities of the three countries since the FAO/IGAD early warning project of the 1990s has

not transpired into a self sustained capacity of national units in the member countries. There is hardly strong technical expertise in remote sensing and market price analysis, with poor proper figuring capacity of seasonality and other threats to rural livelihood in the region to facilitate planning response. There is need for improved climate change analysis, disaster prediction, risk reduction of food and cash crops, financial and technical support since expected cost of obtaining and implementing the facility led to failure of maintaining early warning system in the Nile Basin Region. On implementation, the major expected benefits from the policy brief intervention are seen in advance warning against risks of drought and floods. The system provides and facilitates taking precautionary steps against such incidence and avails canvassing mitigating measures well in advance.

The establishment of the Small Grain Basket Investment Project in border areas of Ethiopia and Sudan hinges on tapping the comparative advantage of the two countries (high potential lands, human and water resources) to enhance food security among vulnerable groups and fragile areas of the two countries. The rationale for the project is based on the fact that the rural people are peasants and agro-pastoralists who suffered from low crops and livestock production levels hardly sufficient to meet their subsistence needs. They are deprived of access to appropriate technology and micro credit that could increase the level of their produce and avail a surplus for marketing. The project aims to define priority development strategies in border areas, provide better agricultural services and technology, strengthen institutional capacity of community based organizations and local government staff for planning, production and marketing on border areas of each country.

On implementation, the proposed project would establish an inter-country commission for agricultural research, extension and management to develop transfer and operate testable technology and husbandry practices for existing agro-ecology. Upon establishment of institutional capacities of responsible agricultural offices on border areas, the project would start with a pilot project to improve agricultural support through group based interventions.

The expected benefits from the grain basket project include enabling small farmers' households to grow food products for self subsistence at minimum costs, and for cash income to buy their other basic needs. In this way farmers or households can contribute directly to self-reliance, alleviation of food poverty and reduced food insecurity.

In response to ENTRO's request the study also included, as a value added exercise, discussion of the rationalization of the use of discount rates in the economic analysis of water resources and related benefits with application to the identified fast track projects for Sudan in section (D) of this study. In this section an evaluation of water projects over a range of discount rates assessing the viability of social-associated projects were undertaken to provide a benchmark for prioritizing areas and intervention strategies of poverty alleviation target groups. It is also worth-mentioning that the results arrived at, could be useful in evaluating the financial, economic and environmental viability of socio-economic projects as proposed above.

The section D gives detailed cost benefit analysis of the Fast Track Projects (FTP) using Lower Attbara River, Dinder area and the Ingassana, in the Sudan as examples. The close Study of these projects revealed that a low rate of 7% DDR – or less-would be quite appropriate for assessing the projects of the sub-region from purely a social point of view.

The idea is to highlight how the rationale of discounting the future could be applied to similar ENSAP projects

Section A

The Main Study
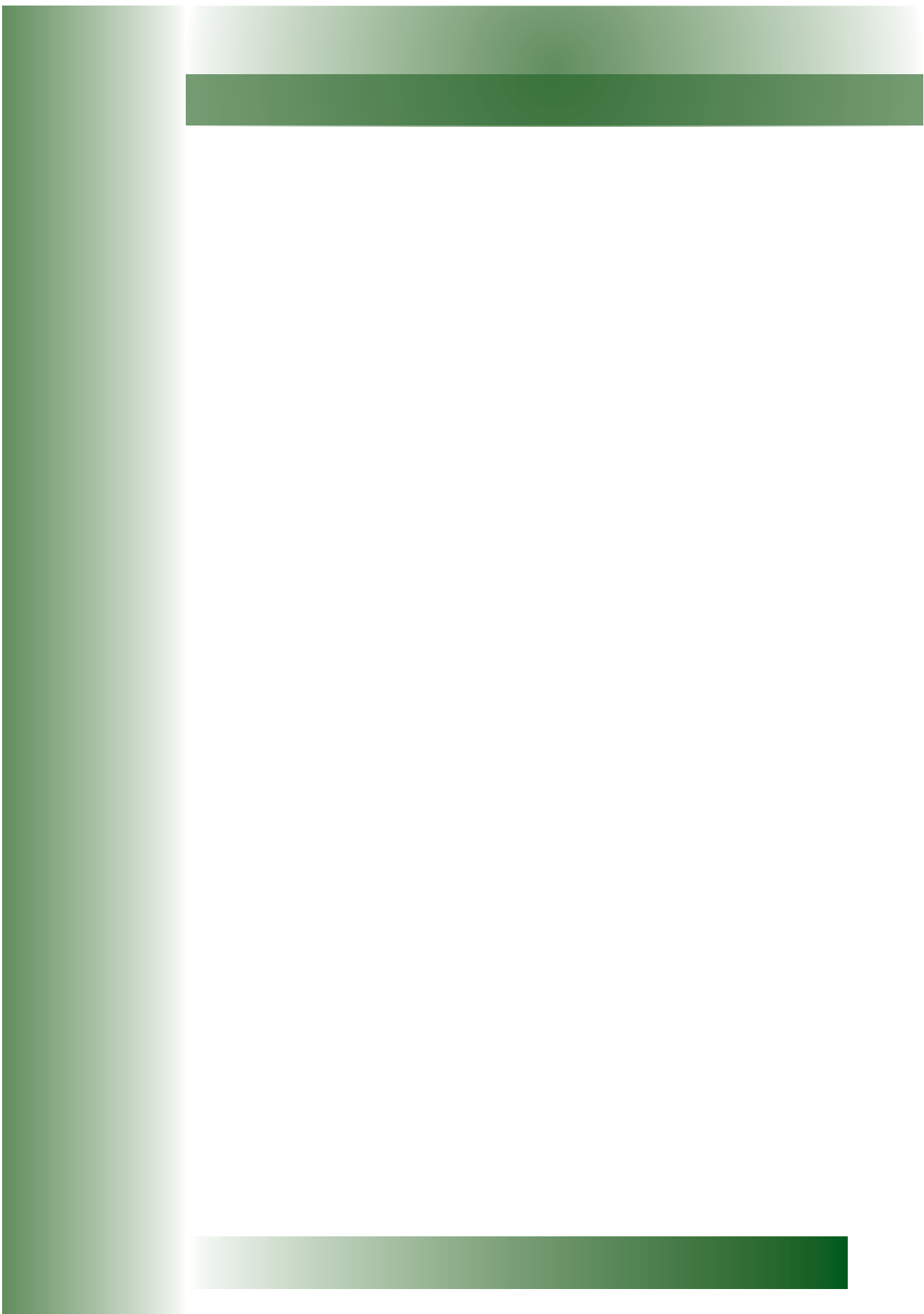
Introduction

Poverty and food insecurity is a common fate in the Nile Basin. However there is marked variations in poverty and food insecurity intensity among these countries ranging between 40% and 90% over the region. Policies to alleviate food insecurity and poverty conditions in these countries have taken many forms and figured out various paces over the last fifty or so years, however, the problem counterfeited all these efforts. This is not to deny that some countries in the region had scored reasonable success in combating food insecurity namely Egypt and Uganda where food insecurity has been considerably reduced. The majority of the other countries failed. Ethiopia and Sudan in particular have had during the last twenty years experienced major accounts of food insecurity conditions and/or outright famine leading to loss of many lives. While there is some improvement in the food security position in general, thanks to a combination of national and international efforts, poverty on the other hand proved much more resilient. Rather than being reduced, in many countries, poverty conditions dug deeper to the contrary.

Food poverty cases in most of the Nile Basin Region countries could be attributed to two major factors: physical and mental. Physically poverty is a result of many factors including low income, unemployment, degradation of the physical environment, unfavourable climatic changes, declining rainfall rates, desertification, poor health conditions, wars and social unrest, inefficient economic methods and practices in addition to corruption and incapable governments. Mental or incapability poverty on the other hand is a result of debility on the part of people to develop methods and means to uplift themselves out of the dismal situation. It is a society failure to accumulate knowledge, experience and capacity to contain poverty.

Efforts to combat poverty in general and/or to create shelter for poverty counteracting endeavours and to effect economic and social development in particular have been partially hampered by colonial and postcolonial

administration development policies. These focused only on modern agricultural and industrial sectors and partially on failure to figure out, from the start, effective poverty combating programs that target poverty condition per se in long term economic planning strategies and policies. On the contrary, traditional sectors where the mass population live and work were largely ignored in these policies and programs. In fact, the generated policies and strategies not only excluded traditional rural sectors from their designed plans but adopted policies and strategies that have had direct negative impact on these sectors.

Large pastoral lands were destroyed or rendered useless upon applying these policies thus forcing massive moves of population into shanty towns around urban centres. These devastating effects of dismal economic plans and policies in the Nile basin Region Countries poor people were further intensified by unfavourable climatic conditions that overshadowed the region for the last forty years. This is not to exclude political instability, wars, wide spread epidemic diseases, fragile economic structures which added more and more to the intense state of poverty in the Region. Over 50% of the population of the rural areas and 30% of the urban centres in the Nile Basin in some way or another till now live below the poverty line.

Unfortunately, various pro-poor policies advocated by national governments and/or supported by international organizations and communities have failed to attain the prescribed goals. One explanation for this failure may relate in one aspect to lack of commonality and shared vision approaches among Nile Basin countries in dealing with the problem. Governments in the Region, international organizations, and other activists in the field may have failed to conceptualize readily the necessity of a common frame work for combating poverty in the Region. Poverty alleviation undertakings proved beyond the fighting capacities of individual countries. Alternatively an orchestrated attacking strategy that extends over the Region may be a better option. Instead, individualistic approaches were followed by individual countries resulting in this continuous failure. The SDBS program of the Nile Basin Initiative is

ostensibly seeking to evolve a common vision and action order to help direct and focus efforts, initialize synergies of common action and substantiate the effectiveness of joint poverty mitigating programmes in addressing the common poverty problem.

While a poverty alleviation programme may take many facets, this study purports to undertake only the analysis of food insecurity and food poverty vulnerability in the three selected countries i.e. Sudan, Ethiopia, and Kenya. The objective is to build a common platform for analysis of food poverty situation in the region identifying common features, causes, spread, direction on one hand, and help identify or propose a common combat strategy for the region in general and in Sudan, Ethiopia and Kenya in particular on the other.

The Concept of Food Poverty Vulnerability

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In addressing the food poverty vulnerability issue in the Nile Basin Region it is imperative to discuss some of the basic definitions and concepts of the two connotative issues; food security and poverty; and then look into their vulnerability element. Food security and poverty are interrelated.

2.1.   The Definition of Food Security

Food Security is a term that evolved in the mid 1980s after realizing the non-applicability of the food self sufficiency approach of the 1970s. The concept of food security explicitly and/or implicitly advocates for both supply and access to food. Access to food could be attained through different forms such as availability in the market in affordable prices (market access) and /or increasing income through employment opportunities generation with improving purchasing power of consumers.

There are more than twenty definitions about food security and they all rotate around benefiting from food for healthy and active life. The World Bank and FAO had almost similar definitions for food security.

As for the World Bank the definition of food security (1986) is: "Access by all people at all times to sufficient food for an active healthy life" (World Bank, 1986:4). This definition indicates that to achieve this goal three conditions have to be met namely:

- Ensuring stability of food supply.
- Ensuring access to food.
- Ensuring adequacy of food supply.

Moreover, Maxwell (1991) criticized the World Bank definition and argued that this definition is incomplete in four respects. Firstly, it subordinates the

concept of food security to that of food consumption; secondly, it pays insufficient attention to people own perception of risk; thirdly, it limits the issues of food security at national level and fails to address questions of differences between poverty and food security.

Maxwell gave an alternative definition based on removal of food insecurity risk. His definition is thus: "A country and people can be said to be food secure when their food system operates in such away as to remove the fear that there will not be enough to eat" (Maxwell, 1991:2).Thus for him, food security will be achieved only when the poor and the vulnerable groups (women, children and people living in marginal areas) have secure access to the food.

The FAO World Food Summit Plan of Action in 1996 – defined food security as "a situation in which all households have both physical and economic access to adequate food for all members and where households are not at a risk of such access" (FAO, 1996:2).

This definition indicated three dimensions:

- Availability of sufficient food,
- Affordability of sufficient food,
- Stability of sufficient food.

2.2.   The Notion of Food Poverty

Given these definitions, FAO identified two main types of food insecurity: the chronic and the transitory (FAO, 1996 and El Maleih. 2003). The chronic food insecurity indicates a continuously inadequate access to food supplies, such as conditions of malnutrition; while the transitory food insecurity refers to a temporary decline in adequate food supplies as in famine situations. The temporary decline in a household's access to enough food may result in instability in food prices, food production, or household incomes. Thus, the types of chronic and transitory food insecurity are co-notated with households that persistently lack the ability to produce or buy enough food. This is in line to Maxwell, and it links with the concept of poverty, for poverty indicates

deprivation of a society or a target group of its basic necessities, one of which is access to food. In this context, if food was not adequate and not accessible by household consumers, non-affordable, many people will go hungry because they are too poor to produce or purchase what they demand.

2.3. The Concept of Vulnerability

Risk is the exposure to the chance of injury or loss and is usually associated with a **hazard[1].**   The literature on disaster enabled the use of risk management and prevention as tools of response. Two distinct disasters are classified based on the kind of factors causing them, the natural disasters caused by environmental factors; and the man-made disasters caused by inappropriate policies, legislation and interventions. However, for both disasters, the reaction of a household remained within the build up of the household (Bolin and Stanford, 1998).

The existing socio-economic factors and milieu, such as ethics, customs, traditions, affects the risk sharing in the household, and determines its coping capacities, which may have a direct influence on its vulnerability[2]. Most of the current research on vulnerability focused on communities coping strategies[3],[4]. Boudreau (1998) confirmed "understanding how families gain access to food in normal years is essential to analyze the effects of external shocks on access to food in bad years." Cannon[5] argued that "there are sets of unequal access to opportunities and unequal exposures to risks, which are a consequence of the socio-economic system". Morrow (1999) indicated that risk could be found among certain categories of individuals and households in the developed nations[6], due to poor human/personal inherent and acquired resources (level

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1   Hazard is the lack of predictability in an event.

2   *The family is defined as "a group of persons of common ancestry: clan; a group of individuals living under one roof and under one head: household; a social group composed of parents and their children; a group of related persons; and group of things having common characteristics." A household is those who dwell as a family under the same roof.*

3   USAID/FEWS Reports.

4   Food Economy Approach

5   Cannon, T. (1994) Vulnerability Analysis and the Explanation of 'Natural' Disaster. In A. Varley (ed.) Disasters, Development and Environment. Wiley, New York.

6   Morrow, B.H. (1999) Identifying and Mapping Community Vulnerability. Disasters 23(1): 1-18.

of education), family and social resources (networks and reciprocity), and political resources (power and autonomy) besides economic and material resources.

To minimize the damage and protect the poor against natural disaster, the early warning system was developed to predict the calamitous events of the climate. Models developed to find correlation between reactions of thermal and moisture regimes on earth and the disaster occurrences. However, most of the systems have the weakness of the primary data collection method. In most cases statisticians and economists collect administrative-wise primary data on ground, while the satellites give a regional/spot dimension.

Thus vulnerability is an important food security and poverty related concept. It can be defined as: The probability of an acute decline in food access, or consumption, often in reference to some critical value that defines minimum levels of human well being.

This understanding of vulnerability can be summarized as follows:

Vulnerability = exposure to risk + risk management

As this equation illustrates, it is largely a function of:

(i)   Exposure to risk: the probability of an event or shock that if it did materialize, would negatively impact the household (i.e. drought);
(ii) Risk management: the ability to mitigate the consequences of a potential shock.

To sum, most definitions on food security emphasized four common elements:

1.   Shift of concern from the national level to the household level.
2.   Shift from adequate levels of food supply towards improving the physical and economic access to household food and improved its standard of living.
3.   Shift of emphasis towards more focus on the vulnerable sector of the society (producing and consuming women, children and the elderly).
4.   Shift from short-term humanitarian to recovery and long term development

household food security perspective; with concerns on sustainability and environment safety.

Therefore, Food poverty vulnerability could be redefined for the sake of this study as: the socio-economic inability (poverty) of vulnerable households to have access to adequate food (food security) despite its abundance in the market.

The following section on methods of analysis and data collection includes the conceptual framework that conjectures the relationship between food security, poverty and vulnerability.

The Conceptual Framework and Method of the Study

This section gives the conceptual framework of food poverty and discusses the methods used in data collection and the different methods of analysis used in this study.

3.1.   Conceptual Framework

It is conjectured that the causes of poverty in the Nile Basin Region in general and the selected countries of Sudan, Ethiopia and Kenya in particular, were partially related to urban-biased development strategies that continually tended to neglect traditional agricultural/rural sector on one hand, and partially to recurrent natural disasters in form of droughts and floods and man-made disasters (civil strife) (see Figure 1 below). The combined effect of the two factors has been gradually eroding the livelihood base of rural communities. Moreover government trade policies that monopolized major export crops grown in rural areas had an apparent effect on deepening poverty thus adversely influencing the livelihoods of those traditional households. Both factors had direct impact on income poverty whereby people lost their main sources of income. Because rural population has no other sources of income to turn to it quickly relegated to state of sticky poverty.

However, poverty is not confined to rural populations only. The last three decades of the last century witness drastic decrease in the income of city and town dwellers especially fixed income groups. Government employees' salaries have gone down by more than seventy percent because of inflation and hyperinflation incident in some of the Nile Basin countries. As a result, what has been encrypted middle class has almost disappeared and its members were reduced to the poverty line. The focus is always based on income-food poverty only. However, poverty has another dimension that is capability

poverty. When people fail to produce a variety when facing change condition, then they are caught in a state of capability poverty. Developing societies are largely so. Their state of development reflects that case. While income-food poverty combat measures are relatively specific and short term, capability poverty is stickier and requires long-term solutions. However, the case of rural and income poverty is more complex in some Nile Basin countries. Where local production sales of systems fail to provide sustenance people fall back on savings, their assets and animals or dependence on food relief and external assistance. They are simply caught in the cycle of impoverishment and deprivation.

Figure 1: Conceptual Framework of Food Poverty Loop
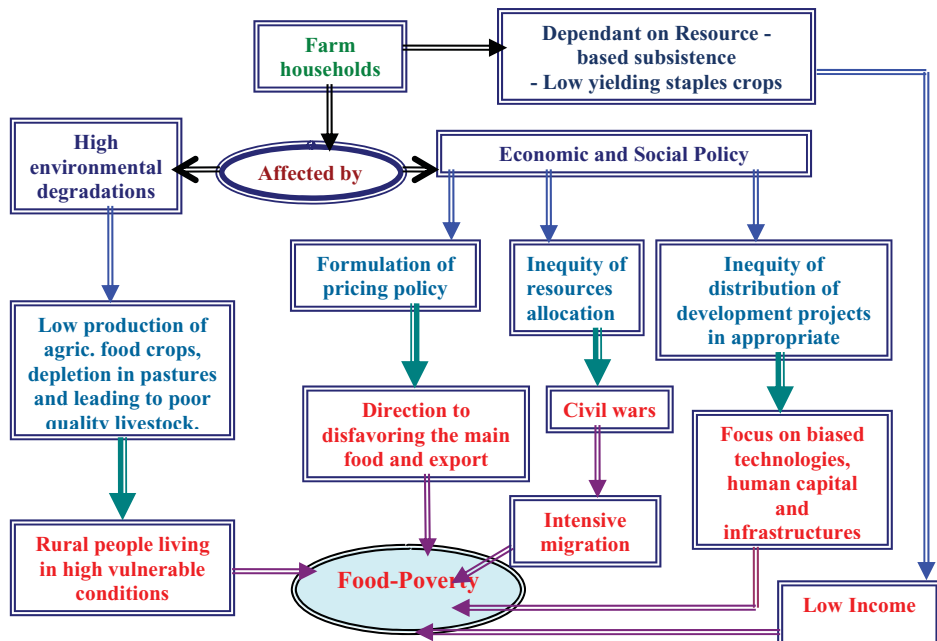
Source: *Zaki, R. 2007.*

3.2.   Data Deduction and Analyses

As for Food Poverty Vulnerability indicators analyse, several approaches were adopted:

1. To identify food poverty vulnerability in the three countries using desk-work analysis,
2. To identify the poverty line index of rural people in the Sudan as a proxy to the Nile Basin Region (Sudan, Ethiopia and Kenya),
3. To analyze the probability of food insecurity index in Sudan as a proxy for food insecurity index in the Nile basin region,
4. To calculate the coefficient of variation of food production in Sudan as a proxy to the Nile basin region.

Given the difficulty of accessing data from other two countries in the Basin, and due to easy access to available data for Sudan, these analyses are developed for Sudan with the understanding that the ensued results could be applied as proxy indicators to the other two countries of Ethiopia and Kenya, and hopefully for the Nile Basin Region.

3.2.1. Desk-work Analysis

Conventional means of measuring economic progress such as GNP/GDP per capita is not comprehensive to express Food Poverty Vulnerability situation in a country, but they remain useful indicators to characterize and compare poverty situation at local and regional levels. Household and sub-regional data may be combined to produce poverty maps showing the geographic location of vulnerable groups. This information, together with a detailed assessment of resources and analysis of the vulnerability processes prevailing in Ethiopia, Kenya, and Sudan, shall determine the areas of interventions and strategy of Food Poverty Vulnerability to be adopted by SDBS/ENSAP to change the situation in the three countries.

3.2.2. Food Poverty Lines Analysis

(a) Measuring Poverty Line

For this study the food poverty line is calculated from the main common food basket used in rural areas of the Sudan. Based on the WHO caloric values, the number of calories for each kilogram of food basket is determined. Then,

the total calories consumed[7] per adult and the required calories per adult per day and the amount of kilogrammes required are calculated based on daily minimum caloric requirement of 2300 kilo calories per person per day (according to the WHO requirements).

The Food-poverty line measures are composed of the measurement of the proportion of poor population (the headcount ratio), the depth (gap ratio) and the severity (squared gap ratio) of poverty following the FGT system based on Foster, Greer and Thorbecke (1984). Poverty line gives the percentage of poor people compared to the total population. The depth of poverty gives the extent of inequity in income distribution or, in this case, nutritional food intake among different income segment of the society. The severity of poverty gives the ratio of the people suffering from inequity in income distribution or access to nutritious food.

P is an indicator that allows the estimation of the poverty measures, which is defined by the following equation[8]:

$$p^\alpha = \frac{1}{n} \sum_1^q \left[\frac{z-y}{z} \right]^\alpha \quad --------------- (1)$$

where n is the total number of individuals under consideration, q is the total number of poor, y is the income of the ith poor individual, z is the poverty line, and α is a parameter characterizing the degree of poverty aversion i.e. the parameter α determines the precise measure of poverty to be used.

(i) The poverty headcount ratio (H) is the proportion of the population whose consumption or income is less than the poverty line z. It is estimated when the parameter α equal zero, and is defined as:

$$H = \frac{q}{n} \quad --------------------------------- (2)$$

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7 Refers to the daily percapita calori consumed by an individual in a typical household.
8 Equation 1.is referred to as the Foster-Greer-Thorbecke (FGT) equation. It defines a family of measures of absolute poverty in any one welfare dimension, which vary according to the choice of poverty line and the choice of the parameterα.

Where:

H = head count ratio, also denoted with P^0.

(ii) Poverty gap ratio gives the depth of poverty, which is the distance separating the population from the poverty line. It is estimated when the parameter α equals one and is defined as:

$$PG = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{z - y_i}{z} \right] \text{--------------------------------(3)}$$

Where:

PG = poverty gap ratio, also denoted with P^1.

y_i is the income of individual (i). often work with household rather than individuals, but the individual still be considered as being equal.

(iii) Poverty severity or squared poverty gap: This is the poverty gap taking into account the distance separating poor from the poverty line. It is estimated by squaring the poverty gap and reflects inequality among the poor. It is estimated when the parameter α equal two, and is defined as:

$$PS = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{z - y_i}{z} \right]^2 \text{---------------------------(4)}$$

Where: PS = poverty severity or squared poverty gap, also denoted with P^2.

(b) Measuring Food Poverty

The food intake of households per person per day is converted into kilocalories and then compared to the Recommended Food Intake (RFI) kilocalories. This RFI is taken as the food poverty line that provides the bench mark for estimating the percentage of people consuming food below the food poverty line.

(c) Data Sources

Data sources for this part was based on the food-poverty field survey data[9] obtained from El Zaki (2005-2006) covering 1000 randomly-selected

9   The survey was carried out to build data base for poverty in Sudan. One of the authors of this NBI study participated in the survey and analysis process.

households (of whom 720 responded) in the rural areas of Sudan under three farming systems namely the irrigated (Gezira state), the commercial mechanized rain-fed (Blue Nile state) and the traditional rain-fed (Kordofan state) farming systems in North Sudan for the season 2005/06.

Vulnerability represents the absence of certain basic capabilities to absorb shocks as a function for successful management of shocks in a society. These involve poor access to education, health, skills, shelter and basic facilities (i.e. clean drinking water and electricity). Therefore, data and information obtained include demography, socio-economic status, expenditures and income levels, food consumption, type and sources of drinking water, health situation, farm and non-farm income sources and levels, housing, assets, land and livestock resources, access to services and social programs as well as risks and threats from external forces.

The survey focused on collecting socioeconomic factors of households and household composition (e.g. age, education, occupation, number of females and males, etc…), on -farm and off- farm income); Assets owned by the rural household (beds, radio, TV, etc…); Food issues including composition of diet; Economic activities in form of crop production, family and hired labour, livestock production; and available basic social services such as drinking water sources and health status.

3.2.3.   Estimation of the Food Insecurity Index (FII)

(a) Calculating the FII

The analysis was based on the UNECA and FAO method of food insecurity index, which measures the stability of food security (UNECA and FAO 1998). The analysis for calculation of the FII was based on secondary data obtained from the Ministry of Agriculture, Sudan. It was composed of production per-capita and trend level production per-capita data.

The FII calculation includes (i) self-sufficiency of main staple food crop production (SS), (ii) food production variability (CV), the log of real gross domestic product per-capita GDP. The food production variability (CV) is used as a proxy to measure the stability in food consumption pattern.

The coefficient of variation of food production per-capita around the long term trend production per-capita is used as a proxy for food consumption variability as follows:

$$CV = (Qta - Qtt / Qtt)) / 100,$$

Where:

Qta = actual production per-capita,

Qtt = trend level production per-capita.

According to the model, the log form of the real GDP per-capita is used to indicate a good indicator of the relative purchasing power of people to buy food and have access to other resources. The log form reflects the diminishing returns to transform income into access to food.

(b) Calculation of food insecurity index FII

1. Calculation of the short fall measure Ii for each of the above mentioned variables according to the following: Ii = (Max Xi–average X)/(Max Xi-Min Xi),

    a. where i= 1, 2, 3,

2. Calculation of the average short fall for the three variables according to:

    a. Ia = Sum Ii, where I = 1, 2, 3,

3. Calculation of the food security index FII according to:

    a. FII = 1 – Ia, where: X1 = food self sufficiency, X2= per capita food production variability, X3 = the log of the real GDP per capita (X3).

Results of the Desk-work Analysis

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In this part, the study describes the situation of food poverty vulnerability in the three countries as deducted from available documents and information. A brief introduction on the population and labour force in the three countries is presented as a preamble.

4.1.   Food Poverty Vulnerability

4.1.1.   GDP Macro-indicators

This is a short term analysis based on limited desk work research utilizing GDP indicators, in Ethiopia, Kenya and Sudan. The per capita GDP is often used as a summary index of the relative economic wellbeing of people in a country. Since this indicator expresses only growth phenomenon rather than equity it is a necessary but not sufficient condition for good measurement indicating poverty situation in a country. Accordingly,   a number of macro indicators including the GDP, per capita GDP, and social indicators were used as proxy for describing poverty situation more comprehensively.

In these countries, the poor tend to cluster around certain social groups, e.g. the landless farmers, the handicapped, the street children, citizens that are on pension, unemployed people, female headed family, ex-soldiers, people dismissed from their jobs, beggers, unskilled and semi-skilled labourers, AIDS orphans and pastoralists in drought affected or arid areas.

Although these countries vary in their potential natural resources wealth, the reported incidents of poverty reached 50% to 90% of the population of the three countries, which indicates incapability of utilization of the vast natural resources of the three countries.

The Gross Domestic Product (GDP) and the per capita GDP are two macro indicators that reveal the level of growth achieved by the specific country in a

certain year. The progress of the GDP and the per capita GDP give the growth pattern performance of the economy as indicated by growth rates measures.

From Table (1) it was indicated that the total GDP of the three countries has been increasing over the period 2003-2005. The total constant GDP for the three countries accounted to about US$ 19.5 billion in 2004 that has increased up to US$ 28.9 billion in 2005, with fluctuating growth rates (Tables 1 and 2). This indicates that fluctuating GDP would result in concomitant instability in per-capita GDP reflecting vulnerability in income levels at the aggregate level for people in the three countries.

Table 1: Constant Gross Domestic Product (GDP) (US$ billion in constant prices) 2003-2005

Country	2003	2004	2005	2006	2007
*Ethiopia	-	9.803	12.644	11.564	11.424
Kenya	2.781	4.615	5.801	6.129	6.997
Sudan	7.145	5.114	6.329	11.289	10.519
Total		19.532	24.774	28.774	28.940

Ministry of Finance and Economic Development (MoFED). (2007). www.cia.gov./library/publications/ the-world-factbook/print/.. (Sudan, Ethiopia and Kenya)

Table 2: Gross Domestic Product growth rate (2003-2007)

Country	2003	2004	2005	2006	2007
Ethiopia	5.5	-3.8	11.6	8.9	10.6
Kenya	0.8	1.5	2.2	5.8	5.7
Sudan	6.1	5.9	6.4	8.0	6.9

www.cia.gov./library/publications/the-world-factbook/print/..

The per capita GDP indicates the estimated share of each citizen from the over all income accrued to the national economy. It does not express the equity of income distribution but an expected share if equally shared among the total population of the country. As indicted in table (3), Ethiopia had the lowest while the other two countries had almost similar levels of the per capita GDP. Given these levels of per capita performance put the three countries

among the low income and food deficit countries classification. However, if the poverty line measure of US$ 1/day spending was applied, then the two countries Kenya and Sudan could escape the poverty syndrome. Similarly, if the US$ 2/day spending rule was applied then all the three countries would fall within the poverty syndrome.

Table 3: Per capita GNI/GDP of Ethiopia, Kenya and Sudan, 2003 and 2007

Country	2003 (US$/person)	2007 (US$/person)
Ethiopia	90	140
Kenya	400	-
Sudan	460	640

Source: *IFAD network with other international organizations*

* Note: Per capita *GDP for Sudan was US$ 493, US$ 617 and US$ 790 in 2003, 2004 and 2005 respectively.*

Though there are high income countries that depend on agriculture, the share of agriculture in the GDP is taken as a measure of low income economy among third world countries. Table 4 gives the share of agriculture in the total GDP of the three countries during the period 2003-2008, with the exception of Kenya, both Ethiopia and Sudan had high involvement of agriculture in the overall economic GDP of the country. As with regard to Sudan, the exploration of oil resources resulted in ignoring the investment in agriculture, particularly the traditional/subsistence sector, for a long time. Now in fear of the Dutch-disease, the government of Sudan is coming back to investment in agriculture again. As regards Kenya, it seemed that there are sectors that contribute more to the economy than agriculture despite the high concentration of its labour force in agriculture. With Ethiopia, the agriculture share in the GDP seemed normal and in conformity with expected assumptions of the development concepts and jargon. Therefore, given the high dependence on agriculture for livelihood in Ethiopia and Sudan, it puts the economies of these two countries within the low income group. Based on this criterion, the classification of Kenya within the low-medium countries groups warrants additional information and analysis.

Table 4: The Share of Agriculture in the Total GDP of Ethiopia, Kenya and Sudan (2003 and 2008).

Country	Share of agriculture (%) 2003	Share of agriculture (%) 2008
Ethiopia	41.8	47.0
Kenya	15.8	23.0
Sudan	39.0	32.0

Source: *IFAD network with other international organizations*

4.1.2.   Role of Infrastructural Services and Food Security

4.1.2.1. Sudan infrastructure

The transport sector in Sudan is the backbone of economic and social development as it links remote production and consumption areas within country and neighbouring countries (roads to Egypt, Ethiopia and Kenya and port links to all countries). However, still large parts of the country in the west and south are unconnected. To meet strategic connectivity objectives the Ministry of Roads and Bridges formulated plans to make full use of a combination of different modes of transport to avail economic utilization of available resources. Transport and communication sector play a great role in the social and economic development, and integration of the vast stretch of lands for great political benefits.

Roads In Sudan, the roads extend over 50,000 km (31,080 miles) covering agricultural production areas and major consuming areas within the country, with links to Ethiopia, Egypt and Kenya.

Railways despite obsolescence, the railways of Sudan still provide services over a distance of 7 thousand kilometres. There are plans in the pipeline to rehabilitate this important transport mode and extending to neighbouring countries. Plans are underway for a railway project to connect Sudan and Egypt over a distance of 502 km.

Shipping Lines Sudan has 10 ships, each with a carrying capacity of 12.5 thousand tons, operating over seas in exports and imports of traded goods and services. Ships operate in Red Sea-North West Europe line and in the Red Sea-Mediterranean line.

Airways Sudan-Airways is the national carrier, with other private airline companies operate on local and international routes. Sudan has nine international airports located in Khartoum, Port Sudan, Dongola, El Obeid, El Fashir , Nyala, Malakal, Merawee and Juba. A new international airport is under construction in Omdurman town, one of the triple towns of the capital state of Khartoum.

Water Resources Sudan water resources are estimated as 31.5 billion cubic meters, most of which is coming from the River Nile and its tributaries. Based on the 1959 Nile Waters Agreement between Sudan and Egypt, the river Nile provides about 20.5 billion cubic meters. The rest comes from other seasonal rivers originating in Ethiopia and Eritrea and within the boundaries of the Country

4.2.   Social indicators

4.2.1   Population and labour force of Sudan, Ethiopia and Kenya

Available data and information show that population in the three countries amount to 160 million, with Ethiopia having about 50 percent of the population, and Kenya and Sudan sharing the remaining 50 percent (table 5).

Table 5: The population of Ethiopia, Kenya and Sudan for selected years (in million)

Country	Population/2003	Population/2004	Population/2007
Ethiopia	68.6	70.0	82
Kenya	31.9	32.4	38
Sudan	34.9	35.5	40
Total	135.4	137.9	160

Source: *IFAD network with other international organizations*

The estimated total labour force was about 60 million in 2003, of which 40 percent were women. The agricultural labour force constituted about 75 percent of the total labour force in the three countries. By contrast, Ethiopia had the largest labour force accounting to almost half of the total labour force among the three countries. Ethiopia and Kenya also, have higher women

participation in the workforce. Low participation of women in the labour force in Sudan may be a result of cultural barriers, mass movement into urban areas and limited opportunities for employment of women compared to the other two countries (Table 6). Rural agricultural activities dominate the livelihood and household income sustenance in the Eastern Nile Basin Countries.

Table 6: The distribution of the labour force in Ethiopia, Kenya and Sudan in 2003

Country	Total labour force[1] (million)	Women percentage in labour force (%)[2]	Agricultural labour[3] force (%)
Ethiopia	30.1	41.4	81
Kenya	16.6	46.2	74
Sudan	13.4	30.2	58
Total	60.1	40.0	75

Source: *IFAD network with other international organizations*

4.2.2. Poverty Social Indicators

To assess the poverty situation level other social indicators at the macro level are also used. Table 7 gives such social indicators. While the infant mortality rates gives a dismal performance in Ethiopia whereby its infant mortality rate reaches 112 per one thousand live birth, which improved by 2008; the percentage of children less than 5 years old suffering from under weight indicated that both Ethiopia and Sudan had almost similar children nutritional status. The life expectancy age also differed among the three countries.

When considering the education as one factor for increasing poverty in countries, table (7) shows that illiteracy rate was higher in Ethiopia and Sudan than in Kenya. Moreover, the basic school enrolment indicates higher levels in Kenya compared to Ethiopia and Sudan despite the latter efforts in improving its educational program and increasing school enrolment in the last decade.

Table 7: Social indicators for Ethiopia, Kenya and Sudan

Social indicator	Ethiopia	Kenya	Sudan
Infant mortality rate (per 1000 live births)	112 (2003) - 82 (2008)	79 (2003) – 56 (2008)	63 (2003) – 86 (2008)
Percentage of children less than 5 years underweight (%)	47. 2 (2002)	19.9 (2003)	40.7 (2000)
Life expectancy at birth (years)	42.0 (2003) - 55 (2008)	53.4 (2006) - 56 (2008)	58.6 (2004) 50 (2008)
Adult literacy rate (%)	41.5 (2002)	84.3 (2002)	60 (2002)
Basic school enrolment (%)	66 (2002)	92.4 (2002)	60 (2002)
Percentage of people with access to improved water services (%)	11 rural (2002)	46 rural (2002)	69 (2002)
Percentage of undernourished people (%)	46 (2002)	33 (2002)	27 (2002)
Daily calorie supply per capita	1940 (2000-2002)	2110 (2000-2004)	2260 (2000-2004)
Unemployment rate	-	40% (2001)	18% (2002)

Source: *IFAD network with other international organizations*

4.2.3.   Population Living Below Poverty Line

Using the scanty secondary data about the level of poverty in the three countries, it was observed that the people living under the national poverty line range between 40 percent to a little bit over 50 percent of the total population of the respective countries (table 8).

Table 8: Percentage of the population living below the national poverty line in Ethiopia, Kenya and Sudan for selected period

Country	Percentage of poor (%)
Ethiopia	45.4 (1999-2000)
Kenya	52.0 (1997)
Sudan	40 (2004)

Source: *IFAD network with other international organizations*

This aggregate indicator can be disaggregated further more into the poor who spend less than US$ 1 per day and poor who spend less than US$ 2 per day (Table 9). It was indicated that the percentage of the poor increases when applying the US$ 2 per day measure. The percentage of those poor who spend less than US$ 2 a day increases up to 80 of the total population in Ethiopia, and to a relatively les percentage of about 58 percent of the total population in Kenya. In Sudan, unofficial reports indicated that more than 80 percent of the population of the country lives under the US$ 2 a day. However, these results raised controversy about the use of the US$ 2 spending in low income countries like those of Sudan and Ethiopia and Kenya.

Table 9: Percentage of population living below US$ 1 and US$ 2 a day in Ethiopia, Kenya and Sudan for certain periods

Country	Percentage of less than US$ 1/day (%)	Percentage of less than US$ 2/day (%)
Ethiopia	26.3 (1990-2002)	80.7 (1990-2002)
Kenya	22.8 (1997)	58.3 (1997)
Sudan	NA	NA

NA: not available

Source: *IFAD network with other international organizations*

4.3.   Household Food Security in Sudan, Ethiopia and Kenya

Food security status is determined by the combination of household food availability, access and utilization. In Sudan, given climate extremes and insecurity, food availability is a crucial component for a household food security status. Although the majority of agricultural output in Sudan comes from small subsistence farms, crop production in the north tends increasingly to depend on larger mechanized and irrigated farms. Nonetheless, household crop production is the main food supply both in southern and Northern Sudan.

The primary staple food crops are sorghum and millet, as both grow well in arid climates. Overall, 70 percent of households reported cultivating sorghum while 39 percent of households cultivate millet respectively. The importance of sorghum and millet varied from one area to another with maize and cassava more important in certain areas of Sudan. As for Ethiopia, the main staple food crops grown are sorghum and teff, while for Kenya maize takes the lead.

Access to enough food to meet dietary energy needs for the household is also a formidable obstacle in parts of the three countries determined primarily by land productivity, security and market access. In the drier seasons, often in desertified areas, households purchase amount as close as to 90 percent of their food needs. In rural areas of the three countries, households generally live a subsistence lifestyle of which 40 percent comes from own production and 10 percent from hunting, gathering and fishing. While food purchase remains an important source of food (with 39 percent of food accessed in this way as in Sudan), limited market access and security problems force most households to rely on own production.

Food security can only be achieved if all household members have access to safe and nutritious food and if their health status allows them to adequately absorb the nutrients ingested. The best proxy indicators of utilization are child health and nutritional status.

Nutritional situation of children in Sudan is characterized by unusually high wasting (or global acute malnutrition- GAM) prevalence, often above the 15 percent level due to interaction of poverty, poor access to water and sanitation, and high disease prevalence (diarrhea, malaria, etc.) factors (CFSVA[10], 2007).

4.3.   Household Food Security in Sudan, Ethiopia and Kenya

A.4.3.1. Food Balance

Food balance situation in the Region as an indicator of food security situation depicts high dependence on commercial food imports as in the case of Sudan

10 WFP-Sudan Comprehensive Food Security and Vulnerability Analysis.

and Kenya, and on food aid for the three countries all together. Per capita consumption of cereals in Sudan ranged between 120 kg/year/person and 150 kg/year.

It can be observed from Table 10 that grain consumption has been steadily increasing during 1999-2004. While imports almost doubled between 1999/2000 and 2000/2001 it remained stable after that period. The use of food grain balance in Sudan indicates self-sufficiency in production of sorghum and millet but import two thirds of wheat consumption in normal years. Food-self sufficiency had not exceeded 60% in most of the years concealing wide variation among different regions/states in Sudan. North Darfur, North Kordofan, Red Sea States are common food deficient producing areas throughout. The situation is becoming more serious in all Darfur States due to civil conflict.

During droughts and other disasters, such as civil conflicts, the country depends on food aid from the WFP and other donors. Table 11 shows large imports of wheat accounting to 1.2 million tons for the year 2006/2007 and all most self sufficiency of sorghum and millet, the main stable crops for traditional households in the Sudan.

Food insecurity in Sudan is fundamentally a rural problem. However, food insecurity situations also prevail in the peripheries of large towns among urban poor and IDPs. About 8.4 million people (30% of the total population) are estimated to have low food intake.

Table 10: Sudan Food Grain Balance (1999-2004) in 000 tons

Item	1999/00	2000/01	2001/02	2003/04
Domestic available	4471	3393	4916	6478
Production	3899	3331	4810	6328
Opening stocks	572	62	106	150
Total utilization	5189	4835	6099	7707
Food use	4204	4371	4460	4795
Feed use	240	200	400	513
Other uses	409	264	348	729
Exports	0	0	100	300
Closing stocks	336	0	791	1370
Imports	718	1442	1183	1229
Food aid pledged	-	55	-	-
Uncovered deficit	-	157	-	-
Total consumption	6243	6277	7973	10006
Self-sufficiency (%)	62	53	60	63

Source: *FAO/WFP crop and food supply assessment missions to Sudan, 2004/05*

Table 11: Sudan cereal balance (000 tons) in 2006/2007

Item	Total	sorghum	millet	wheat	maize	rice
Availability	7237	5548	792	742	120	35
Opening stocks	600	500	0	100	0	0
Production	6637	5048	792	642	120	35
Utilization	8467	5548	792	1942	120	65
Food	5387	3060	536	1649	80	62
Feed	595	500	70	0	25	0
Seeds	106	64	13	26	2	0.5
Post harvest losses	662	505	79	64	12	2
Exports	350	300	50	0	12	2
Closing stocks	137	1120	44	203	0	0
Imports	1230	0	0	1200	0	30

Source: *WFP VAM (2007)*

4.3.2. Kenya National Food Balance

Kenya is a net importer of food coarse grains, which are the leading staple in the country (Table 12). The increased import requirements are mainly due to drought effects experienced since 1998.

Table 12: National Food Balance for Kenya (in '000 Tonnes)

	Wheat	Rice	Coarse grains	Total
Previous five years average production	456	222	745	1423
Previous five years average imports	180	33	1986	2199
2000/2001 Domestic Availability	780	233	3350	4363
2000/2001 Utilization	600	200	1364	2164
2000/2001 Import Requirement				
Estimated per cap. Consumption (kg/year)	25	7	98	130

Source: *FAO/GIEWS – December 2000; a includes maize and other edible grains*

The lack of self-sufficiency in national food production equates to a serious indicator of food insecurity given the importance of subsistence agriculture and pastoralism as a proportion of rural household livelihoods and the minimal purchasing power of such households.

4.3.3. Food Security Hazards in the Three Countries

Food security hazards in the Nile Basin Region result from exposure to recurrent events such as droughts, floods, and epidemics. The occurrences of other disasters in form of earth quakes are also recorded but insignificant, while man-made civil conflicts, are frequently considered as results of natural hazards and poor unimaginative development policies.

Epidemics[11] with frequency of 30 occurrences are the most serious causes of causality in Sudan, though it is not recognized. Floods with 22 events come second and droughts with 7 events come third. Notable floods occurred in 1988, 1998, 1999 and 2003 while, droughts were reported in 1983, 1987, 1990, 1991, 1996 and 2000 respectively.

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11 Epidemics could be sources and results of natural hazards working in a vicious circle. For example , poor signatory places, evolved naturally or created by man, may result in build up of infectious pests and diseases which again multiply and deteriorates the bio-signatory situation

The ramifications of these hazards continue for a long time, sometimes almost persist. Thus the effects of the 1983/1984 droughts that struck western Sudan are still evident in the economy and social life in these areas where many drought affected IDPs tribes from north Kordofan upon losing animals and assets are caged in marginal areas of west Omdurman, living a very poor life. In terms of number of people affected, drought is the most significant factor that contributes to the number of lost lives. About 150,000 people were left dead by the incidence while more than 23 million people were dislocated. Floods are also having a high toll and have claimed more than 1.2 million people displaced and more than 5 million affected.

4.3.4.   Food Insecure Population: Sudan

The percentages of food insecurity and number of food insecure people by state are given in (table 13), for Sudan for 2006/2007. The table clearly indicates that conflict areas have the highest percentage of food insecurity among all states of northern Sudan. These include drought- stricken and conflict areas, and, other fragile states such as north Darfur, north Kordofan, the Red Sea and the Butana region on the borders between the River Nile, Kassala, Khartoum and the Gezira States.

These areas are considered chronically food insecure because of deficiency in natural resources i.e. insufficient rainfall rates, low land fertility and/or lack of moderate climate as in other regions. Nonetheless, these pocket-food-deficit areas have some localized rich agricultural resources with reasonable potentialities, if rationally tapped, significant crop production areas could be acquired that may reduce the agony of food insecurity for the inhabitants.

Considering the overall number of food insecure people, it seems that all states in Sudan have large numbers of citizens who suffer from food insecurity. That could be explained by the premises that food security is defined and measured in context of food availability and accessibility. Khartoum State, for example, is receiving increasing numbers of IDPs who are poor and can not afford buying food even if they have access to marginal jobs. Other states have high

incidences of poverty that constrict the purchasing power of their people of buying food from the market, given their high prices.

From Table 13, it can be seen that Jongolei, Warab and north Bahr El Gazal were the most food insecure states in the South in 2006/2007. Similar to northern Sudan, almost all parts of the Southern states suffer from varying degrees of food insecurity situation in terms of both availability and accessibility. Southern Sudan has just come out from a long civil war and most of its people have migrated to neighbouring countries or are IDPs in Khartoum and other capital cities of northern Sudan. Their ordeal reflects high food insecurity and poverty.

Table 13: Food Security Status in Sudan by State for 2006/2007

State	Food insecurity (%) out of total population in states	Number of food insecure people	No. of total population by state (million)
Northern	1.0	6393	63.93
River Nile	2.6	25272	97.20
Red Sea	12.8	94571	73.88
Kassala	10.8	186037	172.26
Gedarif	9.2	159363	173.22
Khartoum	4.2	241357	574.66
Gezira	1.5	58210	388.07
Sinnar	5.8	76774	132.37
Blue Nile	14.2	238336	167.84
White Nile	9.8	72689	74.17
North Kordofan	13.2	211857	160.50
South Kordofan	31.9	380370	119.24
West Darfur	40.2	713357	177.45
North Darfur	33.0	563645	170.80
South Darfur	13.0	427796	329.07
Jongolei	40.2	606891	150.97
Upper Nile	36.6	380933	104.08
Unity	26.1	153870	58.95
Warab	41.8	630143	150.75
North Bahr-el Gazal	40.5	573087	141.50
West Bahr-el Gazal	27.6	115301	41.77
Lakes	31.7	303388	95.70
Western Equatoria	21.8	148486	68.11
Central Equatoria	15.4	164675	106.93
East Equatoria	31.0	282923	91.26

Source: *WFP VAM, 2007*

4.3.5. Food Insecure Population: Ethiopia

Table 14 provides food insecurity data for Amhara, Oromia and Tigrai Regions in Ethiopia. It indicates that these three regions have the highest rates of food insecurity with figures around 39.3% in the Tigrai Region, 22% in Amhara, and 12.6% in Oromia Region. For more information and discussion refer to Institute of Development Research, 2008.

Table 14: Food Security Data for Amhara, Oromia and Taigrai Regions (2007)

	No. of food insecure population	% of food insecure population	No. of PSNP beneficiaries	% of PNSP beneficiaries	% of cultivated area	Cultivated land per capita (ha)	Agricultural produce (quintals)	Per capita grain production (kgs)
Amhara	2,519,829	22.1	2,519,829	22.0	99.9	0.21	49,220,816	279.3
Oromia	757,397	4.8	1,364,251	12.6	99.9	0.21	73,839,283.25	332.8
Taigrai	456,260	11.7	1,453,698	39.3	100.0	0.40	13,728,896.26	485.5

Source: Institute of Development Research, 2008

Note: For further details and discussion see Institute of Development Research, 2008 (PIs, Ethiopia)

4.3.6.   Food Insecure Population: Kenya

Kenya Food Security Steering Group, et al (2008) report indicated that about 1.38 million people in rural areas of Kenya are highly food insecure and ostensibly unable to meet minimum food requirements without external support. The worst affected areas are found in the pastoral livelihoods of Turkana, Mandera, Samburu, Baringo, Marsabit, Wajir, Moyale and Garissa; significant areas in the agro-pastoral and the marginal agricultural livelihoods in Kitui, Mwingi, Makueni, Mbeere, Malindi, Kilifi, Kwale; and Tana River. The number of affected people amount to 300,000 former and current IDPs included. However there were improvements in household food security in some parts of the eastern pastoral areas, localized areas along the coastal belt and most of the food secure Rift Valley, Western and Nyanza highlands

Food security condition of the urban populations is precarious as depicted by low food purchases owing to the soaring food prices and non food items. The estimated number of highly food insecure in urban slums falls in the range of 3.5 million to 4.1 million up from about 3 million persons in 2007. For more and detailed information on food security status in Kenya refer to KIPPRA, 2008.

Table 15: The Districts and Population with Highest level of Vulnerability in Kenya, 1999

District	Population	Level of vulnerability
Turkana	447,000	Very high
Marabit	122,000	Very high
Samburu	142,000	Very high
Isiolo	101,000	Very high
Moyale	54,000	Very high
Mandera	250,000	Very high
Wajir	321,000	Very high
Garissa	390,000	Very high
Tana River	183,000	Very high
Total Population	2,010,000	

The Variance in Livelihood Strategies

 In Kenya and within the twelve districts there is evidence of wide variation in livelihoods. The CFSP created three livelihood zones (LZ):

(i) The Northern LZ: mostly pastoral with drought (high risk on the relative index) and civil insecurity as main hazards,

(ii) The Southern LZ, much more agricultural, with some communities having a heavy reliance on cash crops; drought risk is relatively low,

(iii) The South Eastern, pastoral based, similar to the northern one but with a much lower drought risk.

The main hazards throughout the most vulnerable districts i.e. throughout the North and

Northeast are drought, civil insecurity, and in some places floods during El Nino events. Drought occurred in: 1984, 1992-93, 1996, 1997, 1999, and 2000. There is variation within the Northern Districts, in addition to the more obvious differences between the Marsabit plateau and surrounding areas, Wajir, for example, has higher drought risk in the Southern LZs than in the North. Mwingi also has variation in drought risk, with greater risk in the Northern LZ than in the South. Kajiado is indicated as having moderate drought risk. Kwale, Siaya, and Migori have variation, but all are low risk areas. During high rainfall years floods are a significant hazard, especially in the Northeast. In Wajir and Mandera, for example, the floods of the previous El Nino event (including rain flowing from the Mt. Kenya area), wrecked significant damage to camels and goats in particular. This event was followed in succeeding years by drought, which particularly affected the cattle. The combined affect has been devastating for the pastoral communities in Wajir.

Food Poverty Vulnerability Results

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5.1.   General

Food poverty including incidents of famine are wide spread in the Nile Basin. A combination of drought, floods, tribal conflict, civil wars, epidemic diseases, political instability in addition to fragile socio-economic structure intensifies the state of poverty in this region. Despite the various pro-poor policies designed for alleviation of the impact of poverty adopted by various governments in the region and received backup from international organizations, and communities, still the Nile Basin region suffers from existence of poverty. Poverty, varying between 40% and 90% in the region, is experiencing a widening social and economic gap between citizens in rural and urban areas. The government programs for poverty alleviation in Sudan, for example, (Zakat Fund, Takaful Fund, Student Support Fund, Sudanese Social Development Corporation Fund) have limited success. Among the factors that count for lack of success are the poor production levels, weak supporting institutions and infrastructure, shortage of finance, and lack of coordination among different actors and players on the scene, with poor information and/ or in-depth analysis of poverty profiles.

The majority of the people in Sudan, and in the Nile Basin region, gain living from the traditional agricultural sector, which is highly vulnerable to rainfall shortages, pests, and suffers from high cost and limited private sector investments. In case of favourable production conditions, marketing becomes a problem as producers do not find markets to sell their products either because local demand is too weak, or because of inability to export due to strong competition in the international markets. An inter-country agricultural policy to increase production and improve marketing opportunities would have far-reaching influence on poverty situation of the people of the region. This study aims to propagate commonality of action among Nile Basin countries. The

objective of risk analysis is to identify populations that are likely to experience a decline in their future food security status due to the effects of a particular hazard/shock. Risk analysis and scenarios can identify geographic areas and populations at risk enabling decision makers to define proper interventions, highlight key factors contributing to increased vulnerability among households and estimate the potential effects of these factors on households.

The analysis has 3 main stages: First, the occurrence of various hazards, their geographical and temporal extent and their historical impact is studied. Second, the analysis puts the emphasis on households' vulnerability to a particular type of shock. Thirdly, those vulnerable households who live in areas exposed to a particular hazard are at risk. Whenever there is a shock (such as drought), prior knowledge of household vulnerability in the affected areas is invaluable and helps to devise estimates of how many people will become food insecure. Vulnerability, as calculated below, depends on several subjective assumptions and is useful in the comparison of different regions and population groups. However, it is hard to estimate the exact impact of shocks on populations and their livelihoods. In case of any shock, a specific follow-up assessment is always needed and the analysis presented below remains indicative.

5.2. Vulnerability Analysis

Food poverty vulnerability among small traditional farmers and households results from cyclical exposure to natural hazards in form of drought and floods in the Nile Basin Region. Table 16 gives the number of natural hazards including epidemics and earthquakes as risk factors that struck Sudan during the period 1940-2006. The impact of these hazards is reflected in the large numbers of drought and epidemic victims (killing about 160000 people), while the impact of floods is felt more in the form of destruction of the livelihood of 150000 people and driving about 1.26 million people out of their homes with the total damage estimated at US$ 220 millions within this period.

Table 16: Hazards in Sudan (1940-2006)

Item	No. events	Killed	injured	homeless	Total affected	Damage (US$000)
Drought	7	150000	0	0	23210000	0
Earth quake	2	3	15	0	8015	0
Epidemics	30	10718	0	0	203995	0
Flood	22	415	1556	1265480	6942742	220180
Total	61	161136	1571	126580	30364752	220180

Source: *WFP VAM (2007)*

5.2.1.   Diversification of Households' Income Generation Activities

Farmers/households attempt to cope with surrounding fragile situation of recurrent droughts and floods with diversifying their lively hood activities. Table 17 gives the different livelihood activities in the Nile basin region as exemplified by the Sudan case. From the table it can be shown that agriculture constitutes the major activities for these vulnerable groups ranging from 30% in case of the north to about 70% in the south of total farmers/agro-pastoralists occupation; livestock ranged from 19% in north to 50% in the south, while petty trade, which is a departure from agricultural occupation, has increased in most drought prone areas of the country due to the increased vagaries of climatic variability. It constituted about 19% nationwide, about 13% for the north and 17% for Darfur. The south, on the other hand, reflects equitable distribution of household occupation in the area of agriculture including crop production livestock raising collection of forest production, hunting of game animals and fishing. It seems that the situation in the south is different, despite variable drought risks among its states, the abundance of still existing natural resources and green coverage allows for more dependence on agriculture (Table 18).

Table 17: Livelihood activities in Sudan

Item	1st	2nd	3rd	4th	5th
Nation	Agric (40%)	Other (20%)	Livestock (19%)	Petty trade (19%)	Employed work (18%)
North	Other (30%)	Agric (27%)	Employed (23%)	Petty trade (13%)	Unskilled labour (12%)
Darfur	Agric (42%)	Food aid (22%)	Petty trade (19%)	Unskilled labour (17%)	Employed (15%)
South	Agric (70%)	Collecting wild food (5.5%)	Hunting (5.1%)	Livestock (15%)	Fishing (4.2%)

Source: *WFP VAM (2007)*

Table 18 gives the percentage of households vulnerable to drought in Southern Sudan though it is not considered a dry area by geographical classification. This gives a clear message of how drought could be a potential risk under climatic conditions, and that land use management is critical in exposing such areas to the risks of drought.

Table 18: Percentage of households vulnerable to drought in Southern Sudan

States	% of households susceptible to drought
Jongolei	27%
Upper Nile	28%
Unity	21%
Warab	39%
North Bahr el Gazal	30%
West Bahr el Gazal	22%
Lakes	41%
West Equatoria	43%
Central Equatoria	17%
East Equatoria	36%

Source: *WFP VAM (2007)*

5.2.2.   Hunger Season

Due to dependence on rainfall, agriculture in most regions like States of Sudan even those endowed with river irrigation, households undergo several months of hunger seasons. Table 19 indicates that food supply lasts for 3 months as the minimum for the Red Sea to 8 months as the maximum for the Blue Nile States, while the hunger season extends from nil for the Northern and Kassala States as minimum to 6 for the Red Sea State.

The Blue Nile State to Kordofan State experience hunger season of 3 to 4 months, and the majority of the Southern states have hunger seasons extended to 5 months. Khartoum is a especial case as it receives incoming food supplies from surplus states/regions and from imports despite its 5 months reported; noting that the farming occupation in Khartoum State is insignificant.

Even though growing home gardens is practiced with the anticipation of supplementing food shortage during hunger season and providing nutritional elements such as vitamins and minerals the practice seemed to be minimal in compensating for food shortages in the different States in contrast to what is experienced in the south Sudan.

Table 19: Length of hunger season and maintenance of vegetable gardens in Sudan

States	Months food last	Hunger seasons	Household vegetable gardens
Northern	6	0	13%
River Nile	4	1	6%
Rd Sea	3	6	2%
Kassala	6	0	2%
Gadarif	6	1	6%
Khartoum	5	0	1%
Gezira	8	3	3%
Sinnar	8	2	3%
Blue Nile	6	4	8%
White Nile	6	3	4%
North Kordofan	5	3	2%
South Kordofan	5	2	3%
North Sudan	6	2	3%
Jongolei	4	5	16%
Upper Nile	4	5	29%
Unity	4	4	25%
Warab	5	5	22%
North Bahr el Gazal	5	5	20%
West Bahr el Gazal	6	5	24%
Lakes	4	5	47%
West Equatoria	6	3	47%
Central Equatoria	5	4	57%
East Equatoria	6	4	50%

Source: *WFP VAM (2007)*

5.3   Poverty Status

Based on the field survey conducted in the three farming systems of Sudan, namely the irrigated, the commercial mechanized rain-fed and the traditional

rain-fed farming systems, the following sub-sections give the results and conclusions with respect to poverty situation, poverty causes in the three farming systems (irrigated, commercial mechanized rain-fed and natural rain-fed).

(i) General Poverty Status in Sudan by Farming System

Table 20 indicates that the traditional farming system has the highest prevalence of poverty among the crop producers of the Sudan. The head count index goes up to 98%, the poverty depth up to 94% and the poverty gap up to 90%. The commercial mechanized rain-fed sector reflects high poverty incidence compared to the irrigated farming system households. This is because the commercial farming systems includes large numbers of seasonal labour that actually emerge from the traditional rain-fed farming system of western Sudan, and of recent, out of the Southern IDPs settled in Khartoum, the capital city of Sudan. This seasonal labour constituted a large portion of the responding specimen in the field survey, and though they received wages, they exhibited high poverty incidents.

(ii) Poverty Status by Occupation

When considering the vulnerability of those households by occupation in the three farming systems, the results were almost similar to what has been determined elsewhere. Farming occupation is a source of vulnerability to poverty and food insecurity in Sudan, given the present situation of agricultural business and development efforts paid by the government. The vulnerability of households to poverty and hence to food insecurity is higher among those who indulge in crop production in the traditional sector of Sudan (table 20). Those who are engaged in crop production in the irrigated sector are not much better off, since almost 60% of the total farmers in this category are considered as poor It seemed that the situation is a little better off in the case of the commercial mechanized farming systems, as the percentage of those depending on agriculture alone are almost of equivalent economic status as those who distribute their sources of income between on farm and off-farm occupation.

(iii) Poverty Status by Livestock Ownership

Livestock ownership is a social and cultural undertaking in most of the developing countries of Africa, and the Nile Basin region. They provide prestige and express wealth. However, they can be good sources of assets in coping with natural hazards and disasters. Livestock owners, especially if they have cropping lands, are supposed to be in a better shape compared to those who grow crops only. Taking the results of Table 20, it is clear that livestock owners in the traditional areas are more vulnerable to poverty and food insecurity than in the irrigated and the commercial mechanized rain-fed farming systems. It appears that the livestock owners in the irrigated and the commercialized farming systems have the capacity of providing an assured source of water and feed compared to the traditional livestock owners.

(iv) Poverty Status by Gender

Community culture and knowledge level determine the degree of involvement by its members. Members of a household participate in the development of mitigation opportunities, as a risk preparedness tool. Such culture is built through different magnitude of interactions within a context of community perceptive definition of hazards and underlying causes of occurrence. Therefore, ritual norms and believing formulated in a form of custom or religions determine the traditions, culture and social knowledge of the individuals.

Perception of moral values and ethics bound a community strength and weaknesses in social setups. Such perceptions constitute the basis for roles that may be undertaken by members of the household. By and large, in many societies the division of labour within the household takes into consideration physiological needs of the family, besides the pros and cons of the optimal use of its human resources. This optimal use depended on the level of reliability on that individual to fulfil the assigned role. In rural settings, divisions are very clear, with the male population fulfilling the work loads of masculine nature and provide physical and social protection.

In general the men are responsible for land preparation, shrubs clearing, family market transactions, settling family external disputes, taking major decisions regarding family movement, and physical protection. Female member of the family, due to physiological and symbolic nature in the community, take up the soft part of protection, that is, the hygiene, together with the physical and psychological build up of their dependents, beside, stocking firewood for cooking, water for drinking and cleaning, food production and processing, children and men care, and many times future security against hazards in form of reserves and family assets.

Human dimension in agricultural production includes engagement of both the male and female. In Africa, specifically countries participating in the Nile Basin Initiative, rural women produce significant proportions of the agricultural food products. Approximately 60-80 % of all the household requirements. This is achieved through participation in planting seeds and in removing weeds in the family farms and/or growing own food crops in small plots around the house, inside compounds or nearby kitchen-gardens easily accessed from the house. Women also take care of small ruminants such as sheep and goats, feeding and milking them for home consumption. These animals are usually kept in the household compound.

Although the evidently impressive contribution of rural women is not calculated and/or evaluated objectively in economic terms, women's role is not, however, denied by men but highly acknowledged. Women carry out major but physically less demanding tasks in the field during cropping seasons and preparing food for the family 2-3 times daily. Men perform the heavy chores such as tree-cutting, ploughing land, harvesting crops and keeping for themselves, the income from any surplus products if sold.

This historical, traditional and social marginalization of rural women in agricultural production is gradually changing as a result of the new "Gender" emphasis introduced through the Technical Assistance projects donated and/or financed by loans. There is also the impact of the accelerated and increased female education in agriculture, animal production and forestry, which

considerably improved rural women status as agricultural producing in equal terms and rights with the men. Enrolment of females in agricultural colleges and institutes recently reached 70-80% per year with similar percentages of graduates working as active researchers and extension service staff. Female advisors have ready acceptance and can operate in confidence with rural women farmers or producers for social and religious reasons. This guarantees more involvement of the rural women farmers in food production and in taking the decisions about how to produce which crops for food or which for cash and in rationalizing food utilization in quantities and qualities.

The newly growing tendency to up-grade and empower women involvement prove a valuable addition to productive man-power in rural areas. Any cooperative programmes and projects that may be initiated in the context of the Nile Basin Initiative, shall find a valuable input of trained and involved rural women in Sudan.

In the case of the vulnerability to food poverty situation, the gender issue does not seem to have determining effect in classifying the poor and the non poor among farming male and female headed households in the irrigated and the traditional farming systems. The situation is highly contrasted in the case of the commercial farmers, where the percentage of the poor female headed families reaches almost 80% of the total mechanized farmers in the surveyed area (Table20).

Table 20: Poverty Index, Depth and Severity in Rural Sudan by Farm (%)

Poverty measures	Farming systems					
	Mechanized		**Irrigated**		**Traditional**	
Poverty index (H)	85.4		74.1		97.8	
Poverty depth (PG)	65.1		54.9		93.7	
Poverty square (PS)	49.6		40.6		89.7	
Occupation	No. of poor	%	No. of poor	%	No. of poor	%
On farm	78.4	171	60.6	97	49.7	102
On and Off farm	21.6	47	39.4	63	50.3	103
Total	100	218	100	160	100	205
Livestock ownership	No. of poor	%	No. of poor	%	No. of poor	%
Yes	62.4	136	31.9	51	43.9	90
No	37.6	82	68.1	109	56.1	115
Total	100	218	100	160	100	205
Farm						
Sex of the household head	Female	Male	Female	Male	Female	Male
Number of poor (%)	108 (49.5)	110 (50.5)	75 (47)	85 (53)	45 (21.9)	160 (78.1)
Total	118		160		205	

Source: *Field survey, 2005-2006*

5.3.1. Poverty Status in Ethiopia

For Ethiopia, Table 21 indicates an improvement in the poverty situation between 1996-2005 and 2007; and Table 22 shows the different sources of shocks that affect households in national, rural and urban cases of Ethiopia. Food shortage, illness and drought were the main shocking factors at the three levels.

Table 21: Poverty situation for Ethiopia between 1996, 2005 and 2007

Poverty measures	Poverty status		
	1996	2005	2007
Poverty index (**H**)	45.0	38.7	34.6
Poverty depth (**PG**)	13.0	8.3	-
Poverty square (**PS**)	5.1	2.7	-

Source: *Mersha, G. (2008).*

Table 22: Profile of Shocks and symptoms Affecting Household by Rural and Urban Sectors

Type of shocks and symptoms	National	Rural households	Urban households
Illness of household member	23.2	23.8	19.8
Drought	10.6	12.3	1.5
Loss or death of livestock	7.8	8.9	2.1
Crop damage	8.1	9.5	0.8
Death of household member	7.5	7.4	8.1
Food	3.0	3.4	0.5
Price shock	2.0	2.0	1.6
Loss of job	1.2	0.7	3.6
Food shortage	24.3	26.9	10.0

Source: *Disaster Prevention and Preparedness Commission (2005)*

5.3.2. Conclusions

The results displayed portray that households with large number of individuals may increase the probability of poverty in rural areas since the large family

requires more spending on social services, such as health, education and transportation. Infection with water borne-diseases, or becoming sick for any other reason, could have a negative effect on the family poverty situation, as they require higher spending on inelastic items such as medicine and transportation to capital cities in search for health treatment in public and private clinics and hospitals.

A secondary occupation is considered important in reducing the probability of being poor. Furthermore, a household headed by a male would be better than a female-headed on. More security is provided by hard working males in and outside their farming quarters. Households with aging members are threatened by higher probability of poverty as they are not fit for hard-labour and are more dependant on younger household heads. Young households have lower probability of being poor compared to the elder households in the traditional farming societies. Education and vocational training were also found to be critical in reducing the likelihood of being poor among small traditional farmers.

5.4.   Results of Food Insecurity Index (FII)

Food insecurity is a result of fluctuation in food crops production, food consumption, and household income. Despite the almost full self sufficiency in staple crops (sorghum and millet) the high variability in domestic production and consumption and the low incomes were responsible for such a high level of food insecurity during the period 1970-1996. Table 23 indicates the extent of the vulnerability of farmers growing the basic staple crops and the main cash crops in the Sudan during the last three decades of the 20th century[12]. Due to lack of continuous time series in some of the data needed to carry out the analysis of the food insecurity index up to 2004, another crop variability analysis has been conducted in the next paragraph to give a better picture up to 2004.

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12. Based on secondary data obtained from the Ministry of Agriculture and Forestry, Sudan

Table 23: Food security index (FII) for cereals and individual staple crops in Sudan (1970-1996)

Crops	Food security index (FII		
	1970-1981	**1982-1996**	**1970-1996**
Cereals	0.5	0.38	0.34
Sorghum	0.48	0.35	0.33
Wheat	0.56	0.43	0.35
Millet	0.54	0.31	0.34

Source: *Ministry of Agriculture and Forestry, Sudan*

5.5.   Crop Production Vulnerability to Climatic Variation

Crop production in Sudan is subjected to climatic variation in temperature and rainfall. The recent long winter season was helpful in producing bumper wheat crop in areas outside the wheat belt in Sudan (Gezira, White Nile and Blue Nile States) sending misleading signals for the succeeding season. Large areas were put under wheat crop production which turned out to be a failed season. Rain fall varies by intensity and duration among and within regions and even among and within specific locations. All these lead to fluctuations in harvested areas and crop yields.

Table 24 gives the variability factor for major staple food crop areas and production grown in north Sudan during the period 1990-2004. The variability factor for crop production ranges from 35 for sorghum to 50 for millet noting that these two crops constitute the main food crops for the small holders in the fragile rainfed production areas. As for wheat the variability is as high as 40% which reflects vulnerability of small producers in the irrigated sector. The variability in areas for sorghum seemed to be more stable since the government is keen to ensure large areas under irrigated production of sorghum to reduce the risk of climatic hazards. The other crops, whether irrigated or rain-fed are subjected to high risks of climatic and policy changes.

Table 24: Crop Area and Production Vulnerability for the Sudan (1990-2004)

Crop	Crop area variability index	Crop production variability index
Sorghum	22	35
Wheat	46	41
Millet	37	50
Sesame	36	44
Groundnut	47	49
Cotton	29	30
Gum Arabic	-	56

Source: *the Ministry of Agriculture and Forestry, Sudan*

6

Mitigating Strategies

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Three key actors contribute to food poverty mitigation. These are: the affected households, the government and national and international NGOs.

6.1.   Households Mitigating Strategies

Even during normal situations, vulnerable people living in fragile areas, with food insecurity threats, are continuously developing survival mechanisms/ strategies in response to changing pressures and opportunities. In case of shocks, households may adopt coping strategies that may result in an entirely different livelihood mix emerging from crises which were experienced before. In Kweji (2006), the new strategies are classified into natural and non-natural resources-based activities.

- The natural-resource based activities include gathering of woodland and forests products, food cultivation, livestock keeping, pastoral activities, and off-farm activities such as brick making, weaving, thatching … etc.
- The non-natural resources-based activities include rural trade, micro processing, remittances from inside and outside country, and from pensions.

All the above activities have potential contributions to the survival portfolio of vulnerable food poor rural households. It should be noted that these livelihood strategies change in situations of displacement and refuge, leading to changes in social structures, cultural behaviour, norms, customs and other practices in the affected populations or receiving end.

The Nile Basin region had and is still experiencing several disasters (natural and/ or man-made), which threaten the survival position of its people especially the food poor vulnerable groups. In events like wars, floods and droughts, the vital functioning of the affected society/societies is disrupted, such as shelter, division of labour, authority, subsistence, cultural norms, communication and

other social and economic activities. Affected people are compelled to flee their homeland to other areas. However, due to mass-population movements caused by disasters, these natural and non-natural based strategies can not be deployed with success. Hence, affected groups face even greater difficulty in surviving on their own.

Women, children and the elderly, for example, are the most vulnerable segments of the population in the process of displacement and refuge. They adopt the following strategies to mitigate their adverse situation:

- Leave home-land.
- In the urban centres, indulge in illegal activities termed as shadow economy (Atif, (1987).
- Offer folklore items
- Sell food, beverages (tea and coffee) in the street.
- Serve in houses against low rate wages.

In Ethiopia the Disaster Prevention and Preparedness Commission (2005) Report indicated *ex ante* mechanism and *ex post* responses for coping with disasters in Ethiopia during 1999-2005. The Report indicated that about 37% of affected people were unable to raise 100 Birr within a week time for unforeseen contingency; of which more urban households (43%) were unable of raising this amount of money compared to rural households (36%) in 2005. At country level, coping strategies included sales of animals (40%), loans from relatives (18%), sales of crop output (14%) were the main sources to raise the 100 Birr. For rural areas, similar responses were given but with a higher percentage of sales of animals (45%).

In Kenya, coping strategies took a broad range depending on the Livelihood Zone. The people in Isiolo District, for example, are increasingly skipping meals and rationing food over time, while access to hunting "Drought is the worst enemy of our recent past, drought wipes out our livestock and we cannot reclaim them back, but when the Toposa take our livestock, we can always reclaim at a later date, but we cannot reclaim from drought" --Elder in Lokichogio.

6.2. Government and the International Community and NGOs Mitigating Strategies

Various studies conducted on the experience of the government and NGOs mitigation strategies in Sudan as an example (i.e. Daoud 2004 and Kewji 2006) revealed their minimal role in food security for vulnerable groups in the IDPs and refugees camps. Therefore, the role of government, international community and NGOs in providing mitigation support to vulnerable food poor segments focused on:

- Provision of resettlement camps
- Provision of food aid and medicine
- Capacity building.
- Income generation activities

Policy Statement and Recommendations

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7.1.   Policy Statement

Based on the above results and outcomes it is plausible to integrate development activities of the three countries (Sudan, Ethiopia and Kenya) to utilize comparative advantage resources (high potential lands, human and water resources) to enhance food security within vulnerable segments of population in fragile areas. In this context a number of potential priority areas are identified by the study for feasible intervention programs.

7.2.   Project Proposals, Policy Briefs and implementation Strategies under ENTRO

By auspice of this study, two proposals are suggested: (1) A project on early warning system for climatic changes prediction and control, and (2) A trans-boundary grain basket project. The second proposal has been largely based on the ASARECA13 proposed program in the Eastern and the Central Region of Africa. These two proposals are presented in section (B) and (C) respectively.

 In section (D) a brief characterization and discussion of the rationalization of the use of discount rates for economic analysis of water resources and related projects with application to the identified fast track projects for Sudan is given. It aimed at demonstrating immediately accruing benefits from these projects focusing on combating poverty under the umbrella of the Integrated Development of the Eastern Nile.
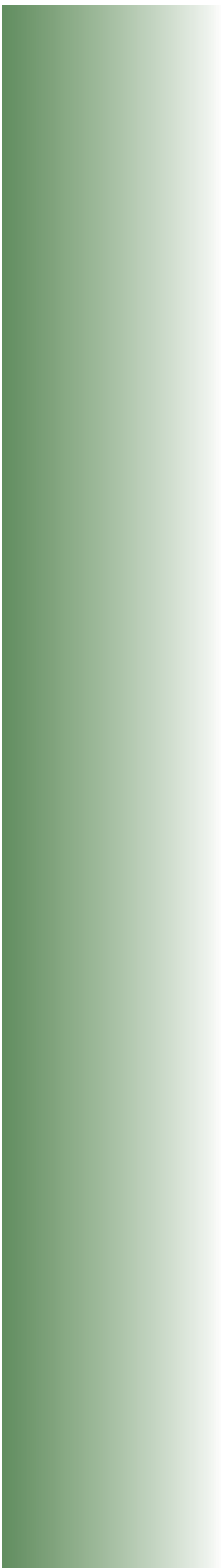
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13 ASARECA website

Section B

Early Warning System (EWS) Proposal

8

Consolidating National and Nile Basin Regional EWS

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The Nile Basin Region, despite endowment with abundant water resources in forms of lakes and flowing rivers, had occurrences of drought and flood hazards over long periods that had serious impacts on livelihood of large numbers of population in countries of Sudan, Ethiopia and Kenya. Although the three countries have been subject to cyclical events of drought and floods, they were unable to mount up capacity to combat it. Several food shortages and famines struck these countries in recent years drawing in massive emergency food aid operations and other international community humanitarian rescue support.

Cynically the vulnerability of these countries to environmental risks and hazards has been identified and well-document by several studies and analysis undertaken in the past and even some early warning systems were established under IGAD Agreement, nonetheless sprats of famines and shortages of food continued to recur in the region. Questions arise as to individual national early warning systems effectiveness in carrying out mandates fully and/or effectively on time. Moreover, questions also arise as to the benefits drawn by these countries from ongoing studies carried out by WFP, USAID and UNEP on food security front and on the effectiveness of climate change prediction and control measures on the Region and in Africa at large.

It is apparent that the current approach/policy options are deficient in one way or another since they failed to produce acceptable relieve level to the problem. Thousands of people are still suffering from effect of drought and floods incidence almost every year either in one or the three countries. The situation calls for in-depth analysis and review.

The proposal given by this study purports to assess the present situation of national early warning systems in the three countries. The objective is to introduce some corrective mechanism to vitalize effectiveness of the system

in providing reliable, viable predictions of expected hazards. The proposal calls for support and coordination of operating international early warning system agencies to make use and draw full benefit of available knowledge and expertise in the area of remote sensing so that policy analysis and poverty mitigation measures are effectively combined in reducing food insecurity in the three countries.

8.1   The Issue

Environmental disasters in the form of drought and floods encounters have historical negative effects on Sudan, Ethiopia and Kenya peoples' livelihood and economic situation. Massive moves from rural to urban centres and population displacement that the three countries had experienced overtime were fundamentally associated with natural resource base deterioration. Given the severity of the impact of these processes, there is a clear and urgent need for improved climate analysis, disaster prediction and risk reduction. The current impact and forecast of natural hazards requires deep understanding of key linkages between natural disasters, food insecurity and poverty situation and the environment. Such understanding should enable governments, organizations and NGOs to consider appropriate coping strategies and measures to mitigate disaster risks and impact.

IGAD early warning project (GCPS/RAF/256/ITA) of 1991 has made significant contribution towards establishing and strengthening national early warning systems for food security in member countries whereby a considerable progress in developing database for agro-meteorology, food prices, nutrition and other socio-economic parameters have been made as well as coordinating training efforts and disseminating information to member countries.

Despite this progress, individual countries still suffer considerable weaknesses and constraints whereby they are neither able to fully utilize generated information effectively nor timely. Inadequate funding for supply of suitable equipment or trained staff threatened sustainability of these units. Furthermore, methodologies, tools and techniques are often inadequate or poorly integrated, seriously bounding reliability and timeliness of food assessments.

Individual countries could neither produce regular early warning newsletters, nor associate them with food security reports and in the same time data acquisition constraint limited geographical coverage. Also there is no evidence of effective utilization of information bulletins by member state governments as there was no feedback.

The rationale of this issue to communities and counties in the respective Nile Basin countries: Sudan, Ethiopia and Kenya emanates from their susceptibility to recurrent spells of droughts, and persistent threat of famine and starvation. Drought is not simply a result of climatic change, but it is a phenomenon in which human activities play a mounting role. Deforestation, inappropriate agricultural and pastoral policies and practices, civil conflicts and physical insecurity, all manmade, exert major threats to food security endeavours in these three countries.

Despite the abundance of technical and humanitarian support to the food insecure areas of the Region, performance in food security is unsatisfactory and reflects wide disparity. Ethiopia, for example, is still experiencing famine in the eastern fringes as well as mass migration within country, an indication that measures are still not effective.

Early Warning Systems for the prediction of the precarious food security situation in Sudan, Ethiopia and Kenya are inadequate owing to the weak capacity of the concerned ministries in the respective governments. With regard to the experience of the early warning system in Sudan, Dr. Amna Hamad[14] reported that the Ministry of Agriculture had first received supporting technical assistance in the area of early warning system and food security information by IGAD/FAO as early as 1990s and more support in the currently ongoing project of SFSIA, sponsored by FAO/ECU. However, past experience indicated failure to sustain the IGAD project once it is completed. The IGAD project did not include technical expertise in remote sensing, or market price information analysis capacity. The system provided only simple capacity for data collection on crops from different parts of the country on a weekly basis and then conveyed to the Minister and senior staff

14 Head of Remote Sensing Division, The National Council For research, Khartoum, Sudan.

of the Ministry with a copy to IGAD. The system analysis of price changes impact component was weak. This serious shortcoming has been somehow corrected in present SIFSIA project where the system is empowered with qualified technical advisors experienced in price analysis, climate change and food security situation analyse. The new system, however, lacks remote sensing component and therefore unable to link ground work studies with the GIS forecast of climate change and risk predictions. The Ministry staff has not been adequately trained to carry out such assignments, a situation which may threaten continuity of the project once it is completed and the subsequent departure of the international experts.

The sequence of events over the past three decades instigated major developments in the field of disaster prediction and risk analysis. It has been proved that natural disasters and human mismanagement of resources are interrelated phenomena. Social development factors are assumed to play a part in drought events. The tendency to maximize herd sizes rather than herd quality in absence of secure adequate water resources (deep boreholes, hafirs, etc) are examples of human interference with nature balance. Considering floods, the increase in Blue Nile flooding rates, for example, has been interpreted to be as a result of partial deforestation and overgrazing in the Ethiopian highlands.

Properly figuring out seasonality and threats to rural livelihoods in Ethiopia, Kenya and Sudan is critical both to interpreting events and indicators and in assessing and planning responses. Rather than designing diversified sporadically spread investment programs which are focused on natural disasters rehabilitation, it is advisable to integrate them into capacity recovery and development programs for food security and income generation in rural and agricultural sectors at national and regional levels within the Nile Basin. This can be gained by developing scientific rural and agricultural development programs associated with early warning system to predict expected events of natural hazards an explore in advance effective preparatory measures for mitigation.

8.2   Findings

In Ethiopia series of early warning system reports together with records of food aid have been useful in preparing and developing vulnerability assessment studies of food insecurity situation in Ethiopia. Coordinated by the Food Security Coordination Bureau and based on different assessments, about 242 districts have been identified as most vulnerable and chronically food insecure areas in Ethiopia. The EFSA-related activities included carrying out crop assessments and nutrition surveillance as well as assessing and studying the impact of the major incidents of famines that struck Ethiopia during the 1970s and the 1980s. In 1993, a National Policy on Disaster Preparedness and Management was developed, and the Relief and Rehabilitation Commission became the Disaster Preparedness and Prevention Commission (DPPC). In 1996, the EWWG was formed in order to harmonize assessments under the DPPC. The following is a summary of the agencies involved in trying to improve the EFSA in Ethiopia in the recent years:

i.   SC UK – development of Risk Mapping program in the mid/late 1990s, based on the Household Economy Approach (HEA).

ii.   UNDP – development of the current early warning and needs assessment system, through a technical support to DPPC, in the mid/late 1990s (with WFP).

iii. WFP – consultant hired to work with the EWWG to improve the EFSA methodology, in 2001/2002.

iv.   SC UK – consultant hired to continue work of previous WFP consultant, through the EWWG, in 2003/2004.

v.   FEWS NET – current and ongoing initiative building on work of previous SC UK consultant, through the DPPC.

In Sudan the UNEP work on climate change and natural disasters was part of the larger investigation of agricultural, forestry and water resource sectors climate-related vulnerability analysis studies. UNEP prepared a detailed and authoritative project on climate on Sudan in 2003, with the assistance of the

UN Framework Convention on Climate Change (UNFCCC). The final reports from this project provided much of the technical basis for the country-specific climate change that can be used for reference.

The UNEP study developed a 'baseline climate' based on rainfall and temperature data during 1961-1990. A range of global warming scenarios were then modelled to predict changes in temperature and rainfall from the baseline to the years 2030 and 2060. These findings were then used to project the scale of potential changes in crop yields for sorghum, millet and gum Arabic. It is worth-noting that there are a number of climate-models for Africa generally that predict similar results despite the existence of some major differences in predicted annual rainfall data. Currently, FAO-EC is carrying out a support project for integrated food security, vulnerability and market information system (SIFSIA). This is aimed at strengthening human physical and organizational capacities, generation and utilization of information for analysis, design, monitoring and evaluation of food security related policies and programs in the Ministry of Agriculture in the North and the South. It is now providing food prices analysis at the macro level and is planning to cover wide areas of food prices analysis at the micro-level in the different states of Sudan in due course.

9

Early Warning Project Description

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For Nile Basin Region countries, early warning system for food security is an imperative policy issue that has to be effectively formulated and implemented. Numerous successful experiences and progress in the past were reported by USAID, WFP, UNEP as well as many NGOs working in the area using such systems. However, revitalization and integration of national early warning systems in Nile Basin Region as represented by Ethiopia, Kenya and Sudan, requires, in the first stage, the establishment of the following facilities in each of the three countries:

- Remote sensing capacity , using geographical information system (GIS) and Global positioning system (GPS) to enhance production of information on food crop production, land use, soil analysis, watershed and vegetative cover mapping of vulnerable areas,
- Conducting field surveys on crop production, marketing and prices in different parts of the region especially dry areas in the three countries,
- Availability of human resources and expertise in areas of :
  i. Crop production
  ii. Soil analysis
  iii. Remote sensing
  iv. Climatic change
  v. Market price analyses
- Establishment of supporting institutions for
  i. Need assessment and policy design for mitigating risk situation
  ii. Building climate-crop related forecasting models
  iii. Dissemination facility for exchange of information
- Market information system
  i. to collect data and information on major staple crops market flows, prices etc.
  ii. building and maintaining storage facilities in the countries
  iii. exports and imports of food protocols

iv.   food aid systems

v.   detecting deficit and surplus food crop production and consumption areas facilities

9.1   Organizational Set Up

Stage One an organization structure to run the Early Warning System needs to be established jointly by the three countries. An early decision by the Ministerial Committee has to be in place to facilitate creation of this new organization, enacting laws and procedures to govern the activities of the new set up in the three countries. A coordinating body is also required to harmonize the function of this new facility in the three countries, and to take the decision about establishing ground stations linking the three countries early warning operations.

Stage Two an the second phase, a program of early warning system is to be established across the rest of the Nile Basin countries building on the experience and knowledge gained in the first stage.

Stage Three the third phase is to link the system to the global early warning system.

Remote sensing and geographical information system technology (GIS) are effective tools for forecasting climate change and of predicting food shortages situations in many parts of the world. When such data and information are associated with truth-ground work verification and effective correlation build up of findings; it shall strengthen the capacity of the Nile Basin Region countries in getting similar quality services. Famine, climate change and food security hazards can be reasonably predicted by applying simulation models to improve understanding of ramification of changes in such critical risk factors in the future. Support to develop and revitalize early warning system for Sudan, Ethiopia and Kenya should be a priority. As has been said before, a quality service of an advanced technology should help reduce risks of climate change and man-made hazards to food security and natural resources of the Nile basin Region. The three countries have had previous experiences in early

warning programs under the IGAD umbrella, but unable to make effective use of them.

Expected costs of obtaining, implementing and running the facility are likely to be high, especially the initial investment cost. Perhaps this is one of the strong factors that led to failure of maintaining such a facility by individual countries in the past. However, given previous food insecurity and poverty ordeals experienced by the three countries as well as inability of an individual country to install and run a system all by itself, the formation of an effective national body for Early Warning System facility in each country and coordination at regional level is the feasible alternative. The system should furnish huge capacity to predict risks and hazards of climate change as well as man-made mismanagement repercussions on natural resources thus exerting great impact on food insecurity and poverty alleviation efforts in the three countries. The other course of action is to continue to depend on costly international donors' humanitarian support for food aid and health services. However, this merely intensifies the ongoing harmful dependency syndrome.

9.2   Policy Recommendation

Current policies in Ethiopia, Sudan, and other similar Nile Basin Region countries, focus ostensibly on cardinal poverty alleviation programs and/or improving food security situation at national and household levels. However, the extensive ramifications of natural hazards in the form of cyclical droughts and floods over the Nile Basin Region in previous periods, and associated malnutrition situations reported, with concomitant migration from marginal into other more resourceful areas and cities proved to be beyond individual country's capacity .The situation calls for quick forging of efforts toward a unified combating strategy for better handling of the dangerous situation. Urgent need justifies planning and support of early warning system jointly installed and maintained by the three countries as high priority tool for natural resources risk prediction and mitigation measures.

In the short run, foreseen possibility is to strengthen local governments and communities capacities to cope with current food insecurity situation. However, from medium and long term perspectives, it is recommended that a comprehensive program for strengthening early warning system in the Nile Basin Region be carried out. The view is to avail these countries with strength and ability to predict expected risks well in advance and be better equipped to cope with advancing drought or flood events and food insecurity situations.

Data collection, analysis and cooperative action in disaster-risk-reduction, and acquisition of adaptive climate change capability should be of great benefit to the three countries. The system generates awareness raising mechanism. Alarming conclusions such as those expressed in climate change reports, can be validated and widely communicated for quick regional and national response. It is unlikely that such specialized services can be readily rendered by international assistance. This in spite of the strong role that the international weather forecast systems play in the fields of climate change adaptation and disaster risk reduction This is an expensive alternative for which extensive expertise and financial resources are not readily available for needy countries.

Therefore, it is recommended that national weather forecast and drought prediction system be installed and strengthen in each individual country of the Region together with mechanisms for disseminating data and information services among participating countries as well as tying it to international early warning and forecasting programs (IGAD, US-based Famine Early Warning System, etc..) to get the full benefits of the integrated systems. Strengthening early warning systems shall augment existing efforts to improve food security situations and availability of food market prices information.

9.3   Implementation Modalities

1. Assessment of present situation of the existing early warning system in the Nile Basin Region to identify deficiencies.
2. Propose intervention measures to reform these systems taking into

consideration all early warning systems cooperating/coordinating protocols in the region (UNEP, IGAD, as well as USAID, Canada and others).

3. Develop, install, and test early warning systems (methodologies, tools and techniques, including computerized data systems and personnel training) at both national and regional levels.

4. Provide financial support for all Nile Basin Region countries to:
   - Verify food security situations;
   - Develop contingency plans;
   - Conduct market and prices analysis; and
   - Forecast patterns.

9.4   Monitoring and Evaluation

Appropriate data for monitoring the performance of the reformed Early Warning System would be used to compare amount of aid delivered before and after recommendations of the proposed policy measures
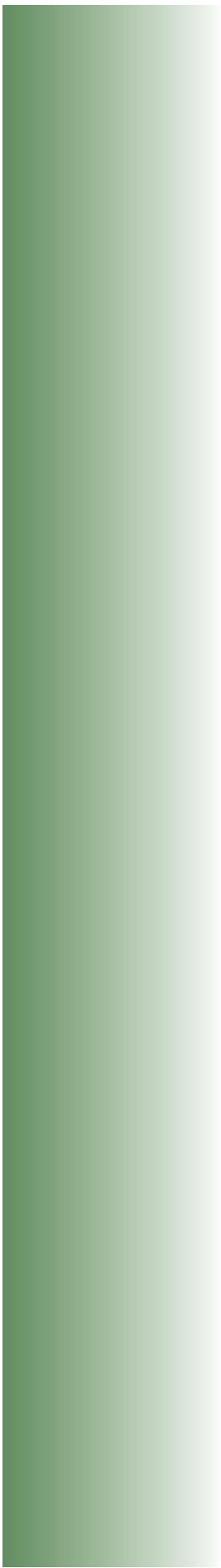
Section C

**Investment small Grain Baskets
Project in Trans-boundary areas
of Ethiopia and Sudan**

Investment small Grain Baskets Project in Trans-boundary areas of Ethiopia and Sudan

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10.1   Background

Ethiopia and Sudan are two major countries of the eastern and central Africa region, having population of more than 117 million people, and covering an area of about 3.8 million square kilometers. About 80% of the population in these two countries live in the rural areas and derive their livelihood from agriculture. According to ASARECA, about 40% of the people of the two countries live in the dry and sub-humid areas where sorghum and millets crop production prevail. Sorghum is one of the basic staple food crops in the Nile basin Region, and ranks 3rd after maize and bean respectively in ASARECA Regional Agricultural Research Priorities. The people of the Nile Basin Region depend on sorghum and millets for bread making in form of Kisra in Sudan, injera in Eritrea and Ethiopia. They are also used for preparing porridge (*asida* in Sudan and *ugali* in Kenya), refreshing beverages (*hulumur*, *abrey* and *huswa* in Sudan) and alcoholic beverages (*busaa* in Kenya, *tela* in Ethiopia and Eritrea, *marisa* and *araqi* in Sudan). The crops also have a great potential for industrial production of starch, beer and animal feeds. The crop residues (stems) are also used for house-construction.

ASARECA indicated that sorghum is grown in an area of 10 million hectares, and millet in about 3 million hectares in the eastern and central African countries, including Ethiopia and Sudan. The crops are mainly cultivated by small-scale resource-poor farmers in the region and yields are generally low. In Sudan large commercial sorghum production under rainfall is also grown on wide scale[15]. The vast bulk of production is used for food in Sudan and

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15 In Sudan, small rain-fed traditional farming grows about 4 million hectares of sorghum, millet, sesame and groundnuts, while commercial mechanized farms under rain-fed grow sorghum with little quantity of sesame in about 4 million hectares.

Ethiopia rural areas. Small quantities are used for animal feed and industrial production. According ASARECA, approximately 60% of sorghum and millet production is consumed at farm level and the remaining 40% is predominantly sold in local markets. However, as the case of Sudan, almost 90% of farm produced sorghum and millet is consumed by the household of the producing farmers. Only one country in the region, Sudan, exports sorghum depending upon good weather and warranting excess surplus output. Drought and climatic variation, especially rainfall fluctuations, in addition to traditional tools and home supplied seeds are among the major constraints limiting increased crop production and utilization, in general, in almost all the countries in the Nile Basin Region. However, these constraints limiting sorghum and millet production and utilization can be alleviated through technology generation and transfer by the NARS, which, unfortunately, is de-capacitated by inadequate financing, shortage in qualified and trained researchers, shortage of germplasm and technologies that can be usefully employed to solve the production and utilization constraints of these two crops.

10.2   Salient Features of Ethiopia

Ethiopia had a population of about 80 million people in 2007 and ranks 169th of 175 countries in the Human Development Index. Per capita gross domestic product (GDP) was about US$140 in 2006/2007, being one of the lowest in the world and less than half the average of sub-Saharan Africa (UN HDR, 2004)[16], with almost 44% of the population being undernourished. Ethiopia is characterized by diversity of its rural livelihoods, with extreme variation altitude-wise, lending to two major weather systems and multiple seasonal cycles in different parts of the country. Despite the efforts exerted to improve agriculture in Ethiopia in the recent years, a number of adverse factors have constrained its capacity to increase food production. These factors include population growth, land fragmentation, traditional agricultural practices and environmental degradation. An estimated 26 million Ethiopians live in food deficit areas. A World Bank study in 2005 indicated that poverty was rising

16 Purchasing power parity is $810, one of the lowest in the world and less than half the average of
   $1,831 for sub-Saharan Africa (UN HDR, 2004).

in urban areas while rural poverty remained almost stagnant largely due to inability of agriculture to keep pace with a fast growing rural population.

Ethiopian agriculture is characterized by smallholder agriculture ranging up to some eight million peasant farmers "who cultivate land using draught animal power and support various combinations of annual staple and cash crop, perennial staple and cash crops and animal production enterprises (Central Statistics Agency's (CSA), Agricultural Sample Enumeration In-depth Analysis, 2005).

The government adopted five-year plans for Accelerated and Sustainable Development to End Poverty (PASDEP). In spite of large volume of expenditures during the last 17 years, there is barely any success in enhancing crop productivity, or agricultural rehabilitation in the rural economy.   In 2006/2007, Ethiopia produced 149.6 million quintals of grain crops (pulses, oilseeds, vegetables, root crops, fruit crops) on an area of 10.6 million hectares. It was indicated that expansion over land for crops production associated with fertilizer application resulted in little increase in crop productivity.

Agricultural production has revealed erratic swings during 1986-2005, period (World Bank). Population growth, declining farm sizes, land degradation, inappropriate use of land such as cultivation of steep slopes, over-cultivation and overgrazing and inappropriate government policies have become the major obstacles to increases in crop production (Measuring the Economic Impact of Climatic Change on Ethiopian Agriculture 2007). There is growing concern within the World Bank and amongst environmentalists that expansion of agriculture into fragile and marginal lands would result in mining of soil nutrients and deforestation (Humbo and Soddo Community-Based Natural Regeneration Project 2006).

Continued dependence of Ethiopia on international food aid, even when there is no drought is serious indicating the bad shape of the agricultural sector in Ethiopia. There are several food deficit pockets in the south, north, east and central parts where structural dependence has become a perpetual phenomenon for over a quarter of the Ethiopian population.

Table 1: Ethiopian Social Indicators

Area, km²	1,133,380
Capital	Addis Ababa
Population 2005, millions	79
Expected population 2015, millions	101
Population growth per annum (per cent)	2.5
Per capita GDP (USD ppp* 2005)	1,055
Per capita GDP/annual growth 1990-2005 (per cent)	-0.2
Total aid from all countries, million USD, 2005	1,937.3
Total aid as proportion of GDP, 2005 (per cent)	17.3
Adult literacy, 2003 (per cent)	35.9
Life expectancy at birth (2005)	51.8
Life expectancy at birth (1970)	40
Under-five mortality rate per 1,000 live births (2005)	164
Under-five mortality rate per 1,000 live births (1970)	239
Doctors (per 100,000 population)	3
Access to adequate sanitation (per cent of population)	13
Access to clean water per cent of population)	22
People with HIV/AIDS in the 15-49 age group (per cent)	0.9-3.5
Ranking in Human Development Report 2007 (out of 177 countries)	169

Sources: *Human Development Report 1998, and 2007.*
   *ppp: purchasing power parity (purchasing power taking into account exchange rates; used to compare living standards in different countries.) Per capita GDP in Sweden (USD ppp 2005)=32,525. Updated 13 Mar 2008

10.2   Sudan

Sudan has a population of 37 million and ranks as 147th out of 177 countries according the Human Development Index (UNDP 2007). The country is covered by diverse climatic and ecological zones, with a multi–cultural, multi-ethnic, multi-lingual and multi-religious people. The majority of the population is poor with annual average per capita income of less than $400 (in 2002) and US$640[17] (in 2005) masking wide regional disparities in economic and social development. The country has been subjected to a series of droughts and

17. Per Capita Gross National Income (GNI) based on Atlas Method, 2005, World Bank

flood cycles during the period 1970-2007. The effect of the climate change has been assumed to be the main causes behind the serious environmental degradation and the southward desert creep estimated at 50 to 200 km since the 1930s in Sudan (UNEP, 2005)[18].

Poverty in Sudan clusters around the landless farmers, the handicapped, the street boys, citizens that are on pension, unemployed people, female-headed households, ex-soldiers, beggars, unskilled and semi-skilled labourers, AIDS orphans and pastoralists in drought affected or arid areas. The number of undernourished people was 8.8 million (27% of total population) in 2002/03[19]. Other indicators of poverty in Sudan also indicated the high percentage of illiteracy (55% against LDCs-49%), life expectancy estimated at 57 years, people not receiving clean drinking water (60%), people not receiving medical services (30%), children less than five years below weight (34%), low calories intake per person per day (1840 against 2115 in the LDCs), widespread of diseases (AIDS, malaria, breathing system, malnutrition, diarrhea).

Table 2: Sudan Social Indicators, 2005 or most recent estimates

Indicator	2005 or Most Recent Estimate
Population (million)	36.2
GNI per capita ($U.S.)	640
Poverty (% below poverty line)	No official data
Urban population (% of total population)	41
Life expectancy at birth (years)	57
Infant mortality (per 1,000 live births)	63
Child malnutrition (% of children under 5)	41
Access to improved water (% of population)	70
Literacy (% of population 15+)	61
Gross Primary Enrolment (% of school-age population) Male Female	64 56

Sources: *Human Development Report 2007*

18. Source: UNEP, Synthesis Report, Sudan Post-Conflict Environment assessment, 2007.
19. FAO (2006), the State of Food Insecurity in the World 2006, Rome, 2006.

10.3   Rationale for the Project

Most of the rural people of Sudan and Ethiopia are primarily peasants and agro-pastoralists, depending on agriculture (crops and livestock) for subsistence and livelihood. For decades, these peasants and agro-pastoralists have been deprived of access to appropriate technology and credit. They practice traditional systems using simple implements and inputs supported by indigenous knowledge. Food and cash crop production of these vulnerable groups are characteristically low and not enough to sustain their household consumption or produce surplus for marketing.

Natural hazards in the form of cyclical droughts and floods struck the two countries with varying degrees. The population pressure over limited and marginal land resulted in deterioration of forest and natural pastures resources, owing to deforestation for selling charcoal and firewood for income to purchase staple food.

Rainfall variability and climate change increased competition for land with continued cultivation without fallow periods to enable soils to regenerate fertility, thus ending into low crop yields. Conflict between crop producers and animal owners are wide spread especially in Sudan and Ethiopia across the borders in the south-eastern parts of the Gedarif (El Fashaga area) and Blue Nile States. Food-aid syndrome crystallized as rural communities increased reliance on isolated packages input supply through donors and NGOs under emergency and humanitarian programmes.

At present, there is virtually no government or private sector capacity for the provision of extension, research, financial services or marketing support for farmers in the border areas of the two countries. The absence of coordinated agricultural support services in rural parts of these areas means that crop producers will continue to be vulnerable to natural hazards and risks. All these considerations justify the introduction and implementation of grain basket project for small producers along the trans-boundaries of Sudan and Ethiopia, and to augment them with financial and technical capacities support

for the existing national agricultural research and extension systems in the two countries.

10.4   Ongoing Programmes

There are a number of international organizations and NGOs activities in the vulnerable areas of the two counties. The World Food Program, UNDP, EU and USAID are playing crucial roles in reducing food insecurity problems in the three countries. Taking the case of Sudan as an example of the on-going activities by the international organizations reveals the following: the implementation of the UNDP-EC Post Conflict Community Based Recovery and Rehabilitation Programme (RRP-Euro 50M), which started in mid-2005. It aimed at building the capacity of local government and rehabilitation of the rural infrastructure for increasing agricultural productivity at the community level in the conflict affected areas of Sudan.

The USAID provided a US$ 22 million for the Southern Sudan Agricultural Revitalization Program (SSARP), which started in 2003 to strengthen the capacity of the community in area of agricultural production and marketing. This included enhancing agri-business skills to entrepreneur farmers through training centres (food crops and forestry at Yei; agricultural technology at Anzara; livestock at Marial Lou; fisheries at Padak; and wildlife at Boma), and provision of financial services to agri-business entrepreneurs.

The FAO-EC provided Euro 20 million in support of the integrated food security, vulnerability and market information system (SIFSIA), which aimed at strengthening human physical and organisational capacities, generation and utilisation of information for analysis, design, monitoring and evaluation of food security related policies and programmes. The FAO-EC also provided Euro 80 million in support of the Sudan Productive Capacity Recovery Programme (SPCRP), which aimed at building human organisational and physical capacities within the Lakes, Leich, Northern Bahr el Ghazal, Western Bahr el Ghazal and Western Equatoria of Southern Sudan. Support would target the state ministries of agriculture and animal Resources, and non-

state actors to deliver better agricultural support and animal health services and to increase crop and livestock production, open new income generation opportunities and marketing activities. It would focus on financing and implementing rural livelihoods projects in the Tambura-Wau Market Access Project and the Aweil Irrigation Rehabilitation project.

The Joint Assessment Mission (JAM) report concluded that "transforming the agriculture sector and promoting private sector development" is central to the challenge of sustainable peace and development in Southern Sudan. The NGOs had food security activities in counties of Juba, Torit, Aweil West and Center, Renk, Gogrial East of South Sudan.

10.5   Proposed Project Design

Peasants produce for self subsistence. This implies both production and consumption of staple grain food and sell the surplus, if any, to buy consumer goods such as sugar, cloths and other basic needs. They only depend on the market for buying food when the cropping season fails. Even in this situation they sell livestock (accumulated capital in surplus season) to be able to buy food. When there is food surplus and good pasture season, they accumulate capital in terms of small remnants to buffer against bad deficit seasons. This behaviour has been well modeled by academics in what is known as 'household models'. See Badawi, 1983/1984 and 1990. Therefore, these people can not depend on market substitute based on cash crop production.

In that context, this proposed investment project, therefore, contemplates the prospect of increasing production of staple food crops and access to food consumption through:

(i)   Increased consumption from self produced crop ,
(ii) Store part of the surplus crop -production at home for next season,
(iii) Selling the remaining surplus crop- production in the market which is to be reformed ,
(iv) Invest in maintaining stock of small ruminant as security buffer for buying food in case of crop failure,

(v)   Introduce and improve accessibility to early warning system information through community based organization and participating government institution to manage crop production , storage , price stability and access to adequate food consumption.

It is envisaged that this project has to be established in selected areas across the boundaries of adjacent countries in the Nile basin having similar food production systems. The detail of the project components will be described below.

10.6   Project Objective

The goal of the proposed project is to improve the livelihood and food security of vulnerable people in the border areas of the two countries. The overall objective of the project is **to provide core agricultural-services based on appropriate technology development to ensure increased production of sorghum, and millet and reduce food poverty vulnerability in the targeted area.**

The project specific objectives are to:

- assist the Governments of Ethiopia and Sudan Ministries of Agriculture to define priority development strategies in border areas,
- improve agricultural support services in border areas,
- introduce improved appropriate technology and transfer through strengthening of already existing inter-country technical forum on agricultural research and extension (such as enhanced focus and support to ASARECA in promoting crop agronomy practices, pro-poor policy actions and marketing systems) in border areas.
- provide the basis for increased crop productivity through capacity support to local communities and local governments in the target areas,
- increase crop production through introduction of water harvesting technology, development and transfer of appropriate technology, supply of inputs.
- improve basic social services in the targeted areas.

10.7 Project Description

The project will provide an integrated development and management of livelihood and production support to the people living in the border areas of the two countries (across the eastern boundaries of Sudan (Blue Nile State and Gedarif State) and the western borders of Ethiopia)

This entail selection of sites/villages endowed with water resources for establishment of water harvesting spots that will act as a core of development and livelihood support. These village community centres will act as nuclei that will provide agricultural and social services to the target groups in selected sites. Such services will include intensification of staple-food-crop production and diversification activities, income generation activities, production and marketing services and extension services. In essence this approach will:

- strengthen the capacity of some of the State Ministries of Agriculture in the targeted area(s) of Gedarif and Blue Nile States, to ensure their supportive role in achieving the objectives of the project,
- enhance the capacity building of Community-Based Organisations to implement agricultural and rural development projects: formation and empowerment of Villages in the selected area(s) of the pilot project.
- reform of land use and land tenure policies with the aim of resolving conflicts over land and water resources in the target area.
- integrate crops, livestock and forests (woods) into one cropping pattern/ rotation in the traditional sector
- introduce and transfer of appropriate technology through strengthened field experiments and demonstration farms and Farmers Field Schools (FFS),
- supply agricultural inputs (seeds, fertilizers, environmentally safe pesticides) on time and by location.
- develop and protect natural resources (forestry, range and pasture, and water resources)
- improve water management resources and encourage utilization of water harvesting technology and establish drinking water and water harvesting reservoirs

10.8   Project Components

The project would be implemented through the following key activities:

i.   Investment in crop production: (a) feasibility studies of project proposals short-listed by County Development Committees; (b) establishment and management of trust funds to finance County Development Funds, distribution of farm inputs (hand tools, fertilisers, etc); (c) support to promote surplus production (post-harvest storage, cleaning and grading equipment, packaging materials, etc), land development (conservation agriculture, water harvesting, micro-irrigation, etc), rural transportation (animal drawn equipment, tractor hire services, etc) and rehabilitation/ construction of rural infrastructure (processing and marketing complexes, village access roads, etc).

ii.   In area of sustainable development, a program of water harvesting, development of wadis and hafirs, marketing centres and feeder roads, mobilization of the local communities, NGO's and government agencies at local level for joint development of natural resources recovery and protection are suggested.

iii. In area of human resources, a program of strengthening community development and skills with associated training activities,

iv.   In area of institution and capacity building a program on improving productive capacity of communities and local government staff with projects on supply of credit to small producers, of seeds to vulnerable small producers and of agricultural services,

v.   In area of information, a data base supporting program including a project on environmental survey,

vi.   In area of poverty alleviation, food security and environment program, a special food security project is envisaged to include establishment of community based organizations (production, credit, marketing and processing supply),

vii. In area of development of appropriate technology and transfer mechanisms, introduction of tested mixed farming approach (crop-

animal and forestry), introduction of animal drawn farming implements, improving indigenous processing technology, establishment of field experiment unit.

viii. In area of Governance and rule of law, a program on reform, revision and enforcement of laws and regulations for food security and rural development law and regulations, country borders trans-boundary and state trans-boundary disease control laws and regulation.

ix. Operational support to Ministries of Agriculture in the two countries in border states through

   (a) Strengthening of the Structural institutions of the respective Ministries of Agriculture;

   (b) procurement of basic applied research and technology transfer equipment and materials,

   c) support agricultural policy development and programme planning border areas.

x. Establishment of an Inter-Country Commission for Agricultural Research and Extension to:

   (a) review present situation in border areas,

   (b) strengthen co-operation and transfer of information between Ministries of Agriculture in border areas

   (c) identify and develop appropriate technologies for existing agro-ecological regions in the area,

   (d) test and develop appropriate methods of disseminating of information generated by research to large numbers of widely dispersed crop producers in the targeted border areas.

xi. Training of public and private service providers: (a) rehabilitation or expansion of training facilities; (b) training needs assessment of public and private sector service providers in border areas in partnership with international institutions.

10.9   Piloting Phase

Upon establishment of institutional capacities of the responsible ministries of agriculture in the three countries then establish a pilot project aiming at 'Improving Agricultural Support Services through Group-based Interventions'. It could comprise the following activities:

i.   **Support to the multiplication of improved seed varieties**

(a) Exchange of good or improved seeds of key crop varieties recommended by Inter-country research and technology transfer commission;

(b) Multiplication of seeds for distribution to selected seed centres and to the private sector for supply to farmers

ii.   **Capacity building of Community-based Organisations to implement agricultural and rural development projects**

(a) Formation and empowerment of Villages in the selected area(s) of the pilot project;

(b) Creation and management of "county development funds" to be managed by County Development Committees; and

(c) Training of Village, and County Development Committees in project cycle management.

iii. **Development of agricultural extension and technology transfer networks** (to be linked to activity (v))

(a) Formation of farmers' learning groups;

(b) Identification (by local communities), recruitment and training of agricultural extension facilitators to support farmers' learning groups;

(c) Operation of farmers learning groups and their experimental plots (on-farm research and technology transfer); and

(d) Transfer of technologies by private and public sector agricultural service providers

iv.   **Investment in crop production**:

(a) Feasibility studies of project proposals short-listed by County Development Committees;

(b) Establishment and management of trust funds to finance County Development Funds, distribution of farm inputs (hand tools, fertilizers, etc);

(c) Support to promote surplus production (post-harvest storage, cleaning and grading equipment, packaging materials, etc), land development (conservation agriculture, water harvesting, micro-irrigation, etc), rural transportation (animal drawn equipment, tractor hire services, etc) and rehabilitation or construction of rural infrastructure (processing and marketing complexes, village access roads, etc).

10.10 Results

Result 1: Demand driven sorghum and millets technologies/innovations generated and promoted

Result 2: Enabling inter-countries policy options for transformation of sorghum and millets system facilitated

Result 3: Inter country capacity for integrated agricultural research for development in sorghum and millets system strengthened

Result 4: Availability of information on sorghum and millets system research and development enhanced

10.11 Preliminary Institutional Arrangements

i.   A Project Implementation Unit (PIU) composed of the related agricultural and other public authorities and financial bodies in border areas will be established to manage this project with support of Donors.

ii. The Project Steering Committee would be chaired by Under-Secretary of Ministries of Agriculture in three countries and comprises heads of agricultural departments, representatives of all implementing partners and stakeholders, including farmers-associations, private sector service providers, women's organizations, etc).

iii. Procurement: The inputs required would be procured by Ministries of

Agriculture joint committees following national government procedures in each country and procurement procedures of donors.

10.12 Project Costs

The total project cost will depend on the project formulation. However, expected preliminary cost estimate is about US$ 91 million. Expenditure items can be summarized as follows:

Table 3: Proposed Project Cost

Component	Contributions (US$M)		
	Governments of Ethiopia and Sudan	**Donors**	**Total**
Operational support to Ministries of Agriculture in three countries	18	12	30
Agricultural policy development	1.0	5.0	6
Support to a "inter country Commission for Agricultural Research and technology transfer	6	12	18
Institutional Strengthening of Public and Private Service Providers	6	12	18
Agricultural support services through group-based interventions and pilot project approaches	14	1	15
Contingencies	3.0	1.0	4.0
Grand total	48	43	91

10.13 Potential Risks during Preparation and Appraisal

i. High costs: The cost of conducting studies and business in border areas would be high due to weak facilities, long transportation distances, and poor living conditions. The turnover of personnel is expected to be high and perhaps affects the smooth continuity in the project.

ii. Lack of experience with project implementation: The PIU will play a key role in co-coordinating the various components and implementing partners under this project. Although Ministries of Agriculture have

strong capacities in dealing with national agricultural project, it may have little experience with joint inter country project implementation. Early and effective attention needs to be paid to creating and strengthening PIU, including material capacity, training and technical assistance.

10.14   Monitoring and evaluation

A special monitoring and evaluation unit should be established to carry out M&E mandate and issue regular reports for reform. The Steering Committee shall undertake midterm and final evaluation of the project for further improvement.
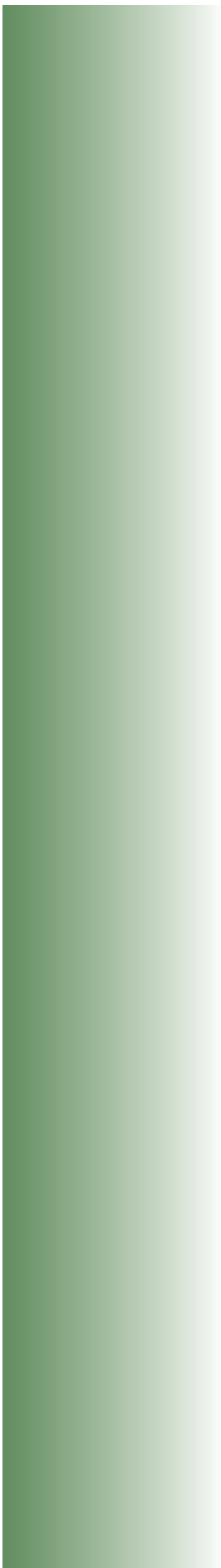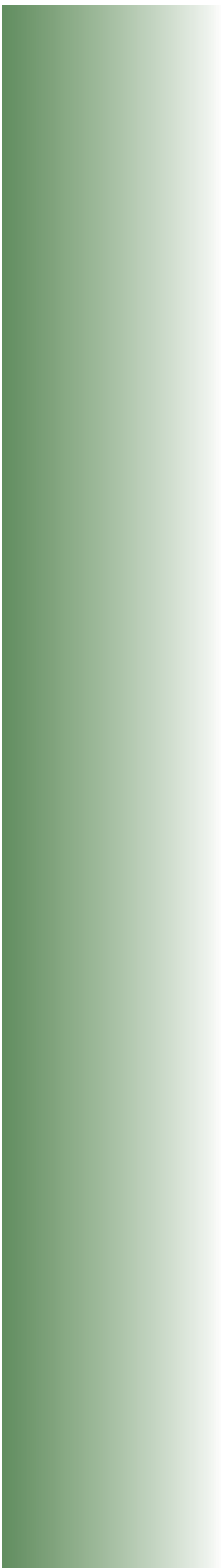
Section D

The Rationalization of Discount Rates for Economic Analysis of Water Resources and Related Benefits in Eastern Nile Subsidiary Action Programme (ENSAP)

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The Rationalization of Discount Rates for Economic Analysis of Water Resources and Related Benefits in ENSAP

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11.1　Objective of the Section

The main objective of this section is to report on the rationalization of discount rates for socio-economic analysis of water resources and related benefits in ENSAP. The reporting shall be based on the review of relevant theoretical and empirical literature as well as on the experience of other countries. The main idea is to highlight how discounting the future works in the case of investment projects to enhance food security in the sub-region. Sudan's identified Fast Track Projects shall be used as an example for the application of the motivated rate(s) of discount.

11. 2　Nile Basin Resources

The Nile River, arguably the world longest river, flows about 6,677 km (4,150 ml) through eastern Africa from its most remote sources in Burundi to a delta on the Mediterranean Sea in northeast Egypt. Ten countries share the basin of the Nile: Burundi, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda, and the Democratic Republic of the Congo. The basin covers about three million square km, which about 10 percent of the African continent.

The Nile basin embodies unique ecosystems, which include high mountains, tropical forests, wetlands, woodlands, savannas, arid lands, deserts and delta lands below the sea level. Nearly 160 million people depend on the Nile River for their livelihood, and about 300 million people live within the 10 basin countries. It is expected that within the next 25 years, the region's population

will double, adding to the demand for water, which is already exacerbated by the growth of the region's industries and agriculture. The threat of the recurrent droughts increases the urgency of the problem, and the pollution is on rise affecting downstream water quality. Almost all of the basin countries are among the world's 50 poorest nations, and are the most vulnerable to famine and disease.

11.3   The Nile Basin Initiative and the Strategic Action Plan

The Nile Basin Initiative (NBI), launched in 1999, is a regional agreed-basin-wide framework to fight poverty and promote sustainable development through improved integrated water resources management at the basin level. The Eastern Nile Subsidiary Acton Program (ENSAP), which includes Egypt, Sudan and Ethiopia, is an investment oriented sub-basin level program.

Two programs under the umbrella of ENSAP, the Eastern Nile Technical Regional Office and NBI were launched. These were; a) The Cooperative Regional Assessment (CRA) for Watershed Management and b) The Fast Track Water Management Projects (FTPs). The former program is an effort for identifying long-term opportunities for cooperative action, while the latter program aims at demonstrating early results of domestically improved watershed management.

11.4   The Strategic Objectives of the ENSAP at Country Level

The long term project development goal of each country member is the same as stated in the Project Identification Document for ENSAP regional cooperation on watershed management and approved by the Eastern Council of Ministers, namely,

(i)   ensure efficient water management and optimal use of the resources through the equitable utilization and no significant harm,

(ii)   ensure cooperation and joint action between the Eastern Nile Countries seeking win-win goals,

(iii) target poverty eradication and promote economic development and

(iv) ensure that ENSAP results in a move from planning to action.

11.5   Current Cooperative Inter-Country and ENSAP Projects

Five categories of joint projects identified by the Integrated Development of the Eastern Nile were put under the FTPs in order to demonstrate early results of cooperation. There were:

(a) the Ethiopia-Sudan inter-connector;

(b) the flood preparedness and early warning project;

(c) watershed management projects in each EN country,

(d) irrigation and drainage projects in each country, and

(e) the Eastern Nile planning model.

Beside the FTPs, a 'multipurpose track' is being pursued to identify opportunities for more complex, longer-term, multi-country, multi-sectored development. This includes a series of cooperative regional assessments in power (referred to as the Eastern Nile Power Trade Investment study), watershed management, and irrigation and drainage, as well as additional strategic studies and consultations to identify a major program of joint multipurpose development and management (the Joint Multipurpose Program).

The Ethiopia/Nile Basin Imitative Power Export Project Ethiopia-Sudan interconnect is in implantation or under implementation. Also at the EN country level, Sudan identified three areas under watershed management. The selection was based on a variety of criteria including community interest and prior experience, impact on poverty, chances for demonstrating early results of improved land and water management and government support. The identified watershed management sub-projects (WMPs) are: a) Lower Atbara, ii) Dindir National Park and surroundings and iii) the Bau Locality (Ingessana). The three areas have different characteristics and needs and are located within different ecological zones.

The rest of this section is devoted to the discussion of the rationale for the uses of discount rate for economic analysis and its application in water resources related projects in ENSAP, using the Sudan's FTPs as an example.

11.6   Basic Concept of Cost-Benefit Analysis

The basic theoretical concepts and techniques related to the socio-economics of water and water resources project evaluation will be highlighted in brief. Such water and water-based projects requires a broader vision of investment and there are usually multiple, sometimes conflicting, objectives to be achieved.

In principle several economic analytical tools are available to assess the impact of projects working through secondary and tertiary market effects on the economy of a country or region. These come under the wider category of "general equilibrium models". Three general equilibrium approaches for assessing the macroeconomic effects are often in use namely:

(a) Input-Output models (I-O): these models focus on the interdependence of sectors within an economy by generating data on multipliers and linkages which help in assessing the impact of a particular project/sector on the national or regional economy.

(b) The Social Accounting Matrices (SAM), the SAMs use a mathematically based matrix presentation to present the flow of funds linked to demand, production and income within a national or regional economy.

(c) Computable General Equilibrium models; the (CGE) models incorporate more realistic description of consumer and producer behavior than do I-O models and the SAMs by accounting for reactions to changes in market conditions. Multi-Criteria Decision Analysis is also used in project impact assessment. This technique aims to take into account multiple criteria to arrive to a scientific conclusion on the impact of the proposed project or program on various aspects of the society.

The common practice in the case of Sudan in appraising public projects is based on the social cost benefit analysis (CBA), and Environmental Assessment Impact. This is not to imply that the above mentioned tools are not important,

but the practice is imposed by the lack of detailed data bases often required for the implementation of these tools.

The basic concept of cost-benefit analysis involves weighing the cost to do or acquire something and benefit that it would return from the process. The concept arose out of a need to quantitatively assess whether a person, business or society at large would experience a net benefit or net loss from a given project. This approach is also adopted for a more complex cases with projects having varied and intermingling inputs and outputs that the net result of a decision is not readily discernable. Protocols of this analysis have evolved over time, notably in response to a more active involvement of governments in economic affairs, and changed in response to different applications. Over the last six decades the tools of CBA were documented in a series of very influential manuals for project evaluation. Examples of these were found in (OECD: Little and Mirlees 1968), World Bank: Adler (1987), ONUDI: Dasgupta *et al* (1972).

It is difficult to give a complete the account of the vast and growing literature on CBA, which has its roots in welfare economics. However, a hint will be given on why CBA is used and why it prices out every impact of the project, i.e. markets are assumed to exist as instrument of social coordination, and what are the basic approaches for determining discount rates and how to estimate them.

11.6.1. The Rationale for CBA and Project Impact Quantification

Assume a project is to be assessed over T time periods of equal length and let $b(t)$ and $c(t)$ represent the benefits and costs generated by the project for the tth period. The net impact of the project at time t will be $a(t) = b(t) - c(t)$ and over the life cycle of the project the evaluation vector will have T+1 components; $(a(0)\ a(1),..........a(T))$ with $a(0)$ usually being negative. All components are expressed in identical monetary units, but the (algebraic) sum given by $a(0)$ is incurred today while $a(1)$ will only be received one period ahead, hence the two numbers are not comparable. Discounting by a

factor that takes change in values over time provides a base for comparison. The question is how to motivate the determinants of this factor. A simple answer could be though of by assuming a perfectly competitive capital market where money can be borrowed or lent at a fixed return rate *r*. Hence, in this market, receiving one monetary unit in period one corresponds to receiving an amount of $1(1+r)$ monetary unit(s) now. Taking into account compound returns, receiving one monetary unit in period *i* corresponds to an amount of $1(1+r)^i$ monetary unit(s) now. This is what called discounting and *r* is the discount rate. Now, the components of the vector $(a(0)\ a(1),...........a(T))$ can be summarized as the sum to be received now that is equal to this cash stream through borrowing and lending operation on the capital market. This sum, known as net present value (NPV) of the project and is given as $NPV = \sum_{i=0}^{T} a(i)(1+r)^i$. If the NPV > 0 the project is worth-full, taking into account the costs and benefits of the project and their dispersion over time.

However, the evaluation of pubic projects is more complex than suggested by the above example from corporate finance, but the social cost-benefit analysis (SCBA) for public project's evaluation could be seen as an extension of the application of CBA in corporate finance. The main extensions include:

a) The quantification of the costs and benefits of the projects from the social point of view.

b) In public projects not all costs and benefits are directly quantifiable in monetary units. In such cases relevant "prices" need to be identified and used to express all magnitudes into monetary units.

c) The discount rate *r* needs to be determined from the social point of view.

Points B and C are most challenging and a subject of an entrenched debate. The concerns related to the estimation of the social discount rate, point (C), will be highlighted in the next sub-section. However, the complication regarding point (B) is that markets for some public "goods" may not exist. In such cases alternative non-market valuation methods are proposed, these methods can be categorized as revealed and stated preference methods depending on whether they are based on

existing markets or constructed hypothesized markets. The contingent valuation and choice modelling related to the latter methods and are widely in use (see Mitchell and Carson 1989 and Bennett and Blamey 2001 for further discussion).

The rationale for quantifying all effects of the project can be highlighted by a simple example. Assume a one period economy with *m* individuals having completely ordered preferences for consuming *n* goods that are exchanged on markets. These preferences can be represented by the following utility function $U_j(c_{j1}, c_{j2}, ... c_{jn})$, where, c_{ji} denotes the quantities of good *i* consumed by individual *j*. The social preferences -or the social planner's preferences- (*W*) are supposed to be well-defined in terms of such utility, i.e. $W(U_1, U_2, ... U_n)$. The impact of a "project" on the margin can be given by differentiating this function as $\partial W = \sum_{j=1}^{m} \sum_{i=1}^{n} w_j U_j \partial c_j$, where $W_j = \partial W_j / \partial U_j$ and $U_j = \partial U_j / \partial c_j$. The social welfare will increase following the implementation of the project if $\partial W > 0$.

If markets exist for all goods and individuals operate in them to maximize utility by ameliorating the impact of the binding constraint, then for individual *j* and for all goods *i* and *k* before the project: $U_{ji} / U_k = p_i / p_j$ where p_i is the price of *ith* good. By setting a good as numeraire, the equilibrium condition can be written as $U_{ji} = \lambda_j p_i$ where λ_j measures the marginal variation of the consumption of the numeraire good for the *jth* individual. Thus, the impact of the project on the margin can be written as $\partial W = \sum_{j=1}^{m} \lambda_j W_j \sum_{i=1}^{n} p_i \partial c_j$. With $\lambda_j W_j$ interpreted as the increase in social welfare due to a marginal increase of the income of the *jth* individual. If income distribution is "optimal" before the project, *W* can be normalized in such a way that $\lambda_j W_j = 1$ for all *j*. Hence, the marginal impact of the project is $\partial W = \sum_{j=1}^{m} \sum_{i=1}^{n} p_i \partial c_j$ that is, the social effect of the project equals the sum over individuals of the variation of their consumption (i.e. the consumer surplus) valued by market prices. Despite the simplicity of the model, it shows the importance of quantifying all effects of a project in order to assess its impact on the social welfare. Dreze and Stern 1987 provided a discussion of the extensions of this model.

11.6.2 Basic Approaches for Social Discount Rates and their Estimation

The preceding section highlighted the rationale for discounting future costs and benefits from a producer (investor) perspective given a competitive corporate finance market. It was shown that, in order to persuade an investor to undertake a project the expected return from the project should be at least as high as the opportunity cost of funding, which is the expected return from the next best alternative investment. Based on this rationale, the costs and benefits of a project should be discounted using the rate of return on lending and borrowing in the private cooperate finance sector. In the absence of market distortions this rate is equivalent to the marginal *social* rate of return on investment, also known as the marginal social opportunity of capital (SOC), which then gives an estimate of the social rate of discount.

An alternative approach providing an argument for discounting costs and benefits with different time profiles for comparison, is based on the observation that consumers (or savers) prefer to receive the same amount of goods and services sooner than later. Two explanations for this pure time preference are offered in the literature. The first is that agents expect their level of consumption to increase in the future, thus, marginal utility of consumption will diminish. That is, agents would have to be paid more than one unit in the future to compensate for sacrificing (saving) one unit of consumption now. The second is that, agents have positive pure time preference, that is, even if the levels of future consumption are not expected to change, they would still discount the future. Two justifications for this pure time preference are given. First, consumers are generally impatient. The other is that agents perceive the risk of not being alive in the future. According to these arguments future costs and benefits should be discounted from the societal point of view at marginal *social* rate of time preference (SRTP), which is the rate at which society is willing to postpone a marginal unit of current consumption in exchange of future consumption.

It should be noted that if capital markets are perfectly competitive both the SRTP and SOC are equal to the market interest rate which reflects the marginal social opportunity cost of inevitable fund. But markets are often distorted due to various imperfections, example of these include taxes on corporate profits, risks, information asymmetry and externalities. These imperfections create a wedge between SRTP and SOC and both will deviate from the market interest rate. In this case, market interest rate will not reflect the marginal social opportunity cost of public funds. What rate then should be used to discount future costs and benefits is one of the unresolved issues and the debate on it has been ongoing for many decades. However, four approaches have been proposed:

a) SRTP;
b) SOC;
c) weighted approach (WA); and
d) shadow price of capital (SPC), but no consensus on which is most suitable (see Boardman *et al* 2001). The estimation of these rates is also a matter of concern and wide disagreement. A very brief and simple summary of estimating these discounts rates is given here.

First, estimation of SRTP: two alternative approaches for the empirical estimation of the SRTP, as defined above, have been suggested. One is to approximate the SRTP by the after-tax rate of return on government bonds or other low-risk marketable securities. The other is based on Ramsey rule, which is founded on growth model where a representative agent maximizes its life-tine utility (U) subject to intertemporal constraint (Ramsey 1928). That is; Maximize $\int_0^\infty U(c_t)e^{-\rho t}d$ subject to: $\dot{k}_t = f(k_t) - c_t$, where $U(.)$ is time-invariant utility function with the usual properties (i.e. the marginal utility of consumption diminishes); ϱ is the utility discount rate reflecting pure time preference; c_t is consumption at period t; f(.) represents a production function and $\dot{k}_t$ is net investment at period *t*. Maximization requires $\partial U(c_t)\partial k_t + \partial^2 U(c_t)\dot{c}_t - \rho\partial U(c_t) = 0$;or; $r = \partial k_t = \rho + \delta g$ where $\dot{c}_t$ is the change in consumption at period t; r is the rate of return on saving; $\delta = \partial^2 U(c)/\partial U$ is the elasticity of marginal utility of consumption (i.e. the

coefficient of relative risk aversion) and $g = \dot{c}_t / c_t$ is the growth rate of per capita consumption. This last expression is familiar Ramsey model, which states that agents choose consumption so as to equate the return on saving to the rate of pure time preference plus the rate of decrease of the marginal utility of consumption due to growing per capital income. Empirical estimation of the formula is controversial; the choice of g is relatively straightforward while the choice of ϱ and δ is not as it involves normative value judgments. The parameter ϱ relates to agent's impatience and risk of death, and has been drop in many studies due to difficulties of quantifying these components. However setting this variable to zero results in paradoxical results, this why other studies impute a value for it, for example Oxera suggested ϱ range is 0-0.5.

Estimates of δ are also controversial, three methods have been suggested: direct survey, indirect behavioral evidence and revealed social values, from all methods, estimates of δ range from 1% to 2%, (see Evans 2005).

Second, the estimation of the SOC: this discount rate considers the opportunity cost of capital and the crowding out effect of the project and could be approximated by the marginal pre-tax rate of return on risk-less private investments. A good proxy is the real pre-tax rate on top-rated corporate bonds; based on this a rate of 7.3% have been proposed to use as proxy for SOC (see Boardman et al 2001).

Third, the (WA) attempts to adjust the SRTP to take into account the opportunity cost of resources (SOC) and the impact of trade in an open economy context. Hence, the social discount rate should be the weighted average of SRTP, SOC and the cost of foreign borrowing. According to this method a rate of 11.8% have been suggested (Harberger and Jenkins 2002).

Fourth, the SPC also attempts to reconcile the SRTP and SOC and at the same time addresses the difficulty of determining weights to use as suggested in the weighted average method. The SPC decomposes costs and benefits into relevant components and then adjusts each component by the relevant SPC. Lyon (1990) pointed that the value of the SPC could vary from about one to infinity depending

on the different assumptions about the parameter of the consumption equivalents of benefits and costs of the project at different periods.

Irrespective of which discount rate to use there are arguments for applying a declining discount rate (DDR). The DDR increases the discount factor, and hence the weight placed on future values, compared with conventional discounting. There is strong evidence that agents discount rates decline with time following a hyperbolic path (Frederick et al 2002). Weitzman (2001), among other, argued that the appropriate discount rate for the far future is uncertain. Hence, some plausible distribution of discount rates and the relevant time profile of discount factor for each discount rate need to be determined. In this, case a risk adjusted average of these discount factors (the certainty-equivalent discount factor CEDF) needs to be determined. Working backwards from the CEDF the corresponding certainty-equivalent discount rate (CEDR) for each period can be established. Weitzman (2001) pointed that the underlying distribution of discount rates follows a Gamma distribution, and hence the CEDR is given by $R_t = \alpha / \left(1 + (t\beta^2/\alpha) \right)$ where α and β represent the mean and standard deviation of the Gamma distribution. Based on the results of wide surveys Weitzman proposed two round-off average values for the Gamma distribution with $\alpha = 4\%$ and $\beta = 3\%$. Dasgupta (2001) provided a critical appraisal of this approach, the main concern relates to time-inconsistency that could be imparted by such DDR.

11.7   Evaluation of Costs and Benefits of WMPs in Sudan

11.7.1   Choice of Discount Rate

The discussion in sub-section (3) suggests that the SRTP can range from 11.8%, using the weighted average approach, to 3.9% DDR according to Weitzman proposal. Following Evans and Sezer (2004) and setting the value of ϱ in Ramsey formula to 1.5% and δ to 1.3% and using the 3.5% average annual growth rate of per capita real GDP for Sudan from 1970 to 2007, the resulting SRTP for Sudan is 6.1%. It worth noting that, the discount rate applied in the feasibility study of the Ethiopia-Sudan inter-connector is 10% (World Bank

2007). Accordingly such rate will be used to determine the bench mark model for the watershed management projects for the FTPs identified by Sudan namely Lower Atbara, Dindir National Park and surroundings and the Bau Locality. The implementation plan of these proposed projects was prepared by SWECO (2007). Such rates could also be applied to similar projects in the sub-region.

11.7.2   Cash Flow of the Proposed Projects

The determination of the cash flow at the project level entails knowledge of the detailed investment and recurrent costs and the expected benefits as well as the project's time profile. The SWECO's study provided detailed account of the allocation of the costs for the three projects (Table 1D). The economic benefits of the projects include: a) environmental benefits, b) direct economic benefits, c) regional political benefits and c) indirect economic benefits. However, only a qualitative account of these benefits is given in the SWECO report. However, the following assumptions are used to generate the cash flows for each project.

First, the costs allocation of each project is assumed to follow the allocation patterns of costs in terms of expenditure accounts as in SWECO's study over the first years of the projects (reproduced in table 2D). Weighting of the various cost components over the allocation period (2008-2011) at the project level is determined from this table. The share of each project in the central administrative cost is determined in the same way and included with the project cost. The various components of costs are regrouped into investment and operating costs, table (3D) presents the results of this calculation.

Second, economic benefits from all the aspects noted above ultimately affect yields at farm level. Different farming modes exist in the project areas including small family farm, relatively large commercial farm and livestock husbandry. On average the farm size is set at 4201 hectares, the total farm area is determined by number of households per project as in the SWECO report. Estimates of the without project effect of the net farm margin on hectare basis are determined using the ENTRO component 1 (2008, Table 4.5), which

gives such estimates for Ethiopia and Sudan. The projects are assumed to generate benefits in two ways, first, by enabling targeted people to ameliorate the negative effects of the binding constraints; for example through improved credit facility of the community funds and through provision of improved seeds. Secondly by improving the quality of land due to better integrated water resources management and the enhanced environmental awareness. The expected net benefits of the-with-implementation of the pFTPs vin Sudan are set at a very low rate of 6.36 %, 2.99% and 6.72% respectively for Lower Atbara, Dinder National Park and Ingessan Areas. The lower estimates for Dinder National Park assumes that much of the benefits of the park accrue to the government in terms of taxes and the third party in the service sector (hotels, transports etc). Hence, the estimated benefits for the three projects could be through of as after-tax benefits. The with-the-project benefits in the ENTRO (2008) report, for a very similar project areas, were estimated on average at 437.5% of the without option (ENTRO 2008). Table 4D presents some socioeconomic indicators of the WMPs in Sudan along with estimated expected average returns per *ha* for the with and without the project options. Benefits are assumed to accrue in the second year of implementation and progress increasingly over the few first years before maintaining their full growth over the life span of the projects, which set at 35 years. Table 5D describes the main components of cash follows of the selected WMPs.

11.7.3 The Results of the Evaluation

The results of the WMPs evaluation is concentrated on the cash flow basis, and they include; a) the net present value (NPV), the discounted benefit cost ratio and the internal rate of return IRR. Three alternative discount rates of 10% 6.1% and 3.9% DDR, as suggested above, are used. Hence they could be taken to reflect the desired profitability level and the risk of the project. Figures 1 to 3 in the appendix show the time profile of the discounted net benefits for each project. Table 29 presents the results on the selected indicators.

Table 1: Summary of the Economic Analysis for the WMPs in Sudan

	NPV			B/C Ratio			IRR1
	10.0%	6.1%	3.9% DDR	10%	6.1%	3.9% DDR	
Lower Atbara Area	96.25	9856.38	27830.1	1.01	1.58	2.62	10.00%
Dinder National Park Area	156.44	9091.89	25526.83	1.01	1.59	2.63	10.02%
Ingessana Area	173.23	12439.31	35048.21	1.01	1.59	2.567	10.01%

1/. The IRR is obtained by solving for r in following relation:
$$NPV = \sum_{t=0}^{T} \left((\text{net benefit}) \, (1+r)^t \right) = 0 .$$

Source: *Calculation based on table (5A)*

 As seen in the table the various indicators give similar ranking of the projects with the Dinder National Park project topping the list followed by Ingessana. This result obtained despite the fact the investment and recurrent costs as well as the estimated benefits per hectare of the Dinder project are relatively low compared to the other projects. However, the relatively large size of the affected farm area of the project provides an explanation for this ranking. In addition to these financial criterions other socioeconomic indictors support the same ranking, namely the potential of the land area, e.g. the economy wide spillover effects of the Dinder National Park, and the population size Table 34, which is at the heart of combat against poverty as emphasized by NBI in general, and the fast track water management projects (FTPs) in particular.

No consensus on a single correct discount rate or project duration for sustainable activities. Some argue that resources capable of providing for future generations cannot be appropriately analyzed by the NPV and considering only the short run (Hueting 1991). While others argue that all projects must be analyzed with high discount rate (10-12%) and be profitable after only short period (Summers 1992). In this analysis a relatively high discount rate of 10% is used to establish the baseline NPV, then, these baseline analyses were supplemented with two set of sensitivity analyses that examine the effect of changes in the discount rates on the baseline NPV. These rates are estimated

on the basis of SRTP (6.1%) and Gamma discounting (3.9% DDR). The various rates used in the analyses would enable the potential practitioner to assess the potential of the WMPs for Sudan under different discount rate. For example, a rate of 3.9% DDR –or even lower- would be relevant for a government planner interested in assessing the societal value of the integrated water resources management, whereas, individual practitioner might insist on a positive NPV in the range of 6.1-10% in order to adopt such enrichment planning. Thus with the range of discount rates provided here both these and other perspectives can be evaluated. As seen in the table the various indicators give similar ranking of the projects with the Dinder National Park project topping the list followed by Ingessana. This result obtained despite the fact the investment and recurrent costs as well as the estimated benefits per hectare of the Dinder project are relatively low compared to the other projects. However, the relatively large size of the affected farm area of the project provides an explanation for this ranking. In addition to these financial criterions other socioeconomic indictors support the same ranking, namely the potential of the land area, e.g. the economy wide spillover effects of the Dinder National Park, and the population size Table 34, which is at the heart of combat against poverty as emphasized by NBI in general, and the fast track water management projects (FTPs) in particular.

Two points worth noting first, the estimation of the expected benefits per hectare at the project level were determined using a very conservative estimates compared to other comparators' (ENTRO 2008). Also the size of the farm land is estimated at about 3% of the overall land area identified in SWECO report. For example, the farm land used for estimation of aggregate return for all the projects is about 21.3% of the size of the Dinder National Park alone, which is only part of Dinder area. Second, generally, inflation is assumed to be neutral in the terms of its effects on costs and benefits.

11.8   Conclusions

This section discussed the basic concept of the CBA and the rationale for the uses of discount rate for socio-economic analysis, with an example of the application of the so motivated discount rates to the FTPs of Sudan. The cash flows for the selected FTPs are estimated based on the results of the SWECO (2007) and ENTRO (2008) studies

A discount rate of 10%, which usually applied by the World Bank to assess the financial viability of its project-lending program is used to establish the baseline NPV. Two alternative discount rates based on the estimation of SRTP for Sudan and the standard Gamma discounting were applied to examine the sensitivity of the baseline NPVs of WMPs in Sudan to the effect of changes in the discount rates. The idea of applying these discount rates in the analyses is to enable the potential practitioner to assess the potential of the WMPs in the sub-regoin countries under different scenarios. For social interest, a low rate of 3.9% DDR – or less - would be relevant for assessing long term projects (integrated water resources management), while for private interest, a rate of range of 6.1-10% would be relevant for assessing short term projects. On the basis of this, a rate of discount of 7% is recommended for similar FTPs in sub-region because it would ensure the long-run sustainability of the appraised FTPs as well as their financial viability.

It is important that baseline household and community surveys be conducted in the inception year of the each project in order to furnish the basis for a bench mark model for monitoring and evaluation of the projects performance, which in turn provides invaluable records of experience for the other long term track project under ENSAP.

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Annexes

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For Section A

Calorie Intake in Sudan

Table A1: Percentage of people both in the rural and urban areas receiving less than 1910 calories/person/day by state.

Rural (%)	Urban (%)	State
69	39	Red Sea
58	49	River Nile
43	52	Northern
25	35	North Kordofan
64	45	Sennar
48	34	Gezira
40	37	Khartoum

Source: *Ministry of Agriculture and Forestry, 2005.*

Table A2 Energy, protein and sugar and fats daily per-capita intake of Khartoum State

Items	Urban	Rural	State
calories	2219.3	2142.1	2201.6
Sugar (gm)	370.8	366.7	369.9
Total Protein (gm)	61.2	47.9	60.4
Animal protein (gm)	17.4	15.4	16.9
Total fats (gm)	59.3	54.2	58.1
Animal fats (gm)	17.1	13.6	16.3

Source: *Ministry of Agriculture and Forestry, 2005*

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Annex for Section D

Table D1: All Projects Cost in Terms of Expenditure Accounts (in Million US$)

	2008	2009	2010	2011
Investment Costs				
Civil work	1.12	5.63	3.72	1.00
Machines % Equipment	0.54	0.28	0.28	0.21
Seeds and Seeding	0.47	0.67	0.27	0.15
Training	3.50	1.29	0.71	0.37
Technical Assistance	2.35	1.04	0.75	0.36
Community Initiative Fund	0.20	0.27	0.36	0.27
Total Investment Cost	8.18	9.19	6.09	2.36
Recurrent				
Operation & Management Cost	0.95	1.12	1.22	1.23
Price & Physical Contingencies	1.06	1.55	1.35	0.79
Total	**10.19**	**11.85**	**8.67**	**4.39**

Source: *SWECO pp. 96*

Table D2: Costs Allocation by Projects (in Million US$)

	Total	Percentage
A. Lower Atbara Area		
Investment Costs		
Civil work	3.14	8.9
Machines % Equipment	0.69	2.0
TA and Training	5.28	15.1
Credit Lines	0.59	1.7
Operating Costs	0.23	0.7
Subtotal Lower Atbara Area	**9.94**	**28.3**
B. Dinder National Park Area		
Investment Costs		
Civil work	3.39	9.7
Machines % Equipment	0.95	2.7
TA and Training	3.23	9.2
Credit Lines	0.30	0.8
Operating Costs	0.55	1.6
Subtotal Dinder National Park Area	**8.43**	**24.0**
C. Ingessan Area		
Investment Costs		
Civil work	6.59	18.3
Machines % Equipment	0.53	1.5
TA and Training	3.02	8.6
Credit Lines	0.18	0.5
Operating Costs	0.78	2.2
Subtotal Ingessan Area	**11.10**	**31.6**
D. Project Management Unit		
Investment Costs		
Civil work	0.12	0.3
Machines % Equipment	0.99	2.8
TA and Training	0.79	2.3
Operating Costs	3.74	10.7
Subtotal Project Management Unit	**5.64**	**16.1**
Total Project Cost	**35.09**	**100.0**

Source: *SWECO pp. 97*

Table D3: Cost in Terms of Expenditure Accounts (in '000 USA D)

	2008	2009	2010	2011	Total
A. Lower Atbara Area					
Investment Costs	3384	3801	2519	976	**10680**
Operating Costs	48	57	62	63	**230**
B. Dinder National Park Area					
Investment Costs	3117	3502	2321	899	**9840**
Operating Costs	116	136	148	150	**550**
C. Ingessan Area					
Investment Costs	4122	4631	3069	1189	**13010**
Operating Costs	164	193	211	212	**780**

Source: *calculation based on SWECO report*

Table D4: Some Socio-economic Indicators of the WMPs , Sudan

	Lower Atbara Area	Dinder National Park Area	Ingessan Area	Total
Population[1]	80000	160000	100000	340000
Number of households	13000	26000	16000	55000
Farm Area in Hectares[2]	54622	109244	67227	231093
Average without the project returns per hectare[3]	740	740	740	
Average with the project benefits per hectare	787.087	767.152	789.742	

1/. Estimate of population is obtained from SWECO report

2/. The household is assumed composed of about six people

3/. Estimates based on ENTRO (2008) report in Sudanese pounds (Ls.), (one dollar= 2 Ls.)

Table D5: The Main Components of Cash Follows of the WMPs , Sudan (in '000 Sudanese pounds)

	Y1	Y2	Y3	Y4	Y5 to Y30 (Average per Y)
A. Lower Atbara Area					
Investment Costs	-6768	-7602	-5038	-1952	
Operating Costs	96	114	124	126	126
Gross Benefits		814	1304	1946	2446
Net Benefits	-96	700	1180	1820	2320
B. Dinder National Park Area					
Investment Costs	-6234	-7004	-4642	-1798	
Operating Costs	232	272	296	300	300
Gross Benefits		1072	1596	2000	2420
Net Benefits	-232	800	1300	1700	2120
C. Ingessan Area					
Investment Costs	-8244	-9262	-6138	-2378	
Operating Costs	328	386	422	424	424
Gross Benefits		1186	1722	2324	3344
Net Benefits	-328	800	1300	1900	2920

Source: *Calculation based on Table 4A*

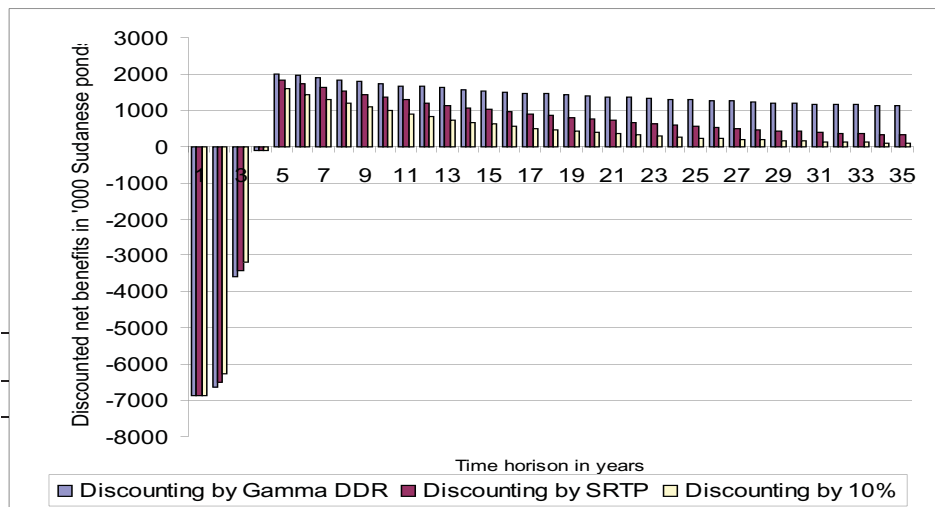**Figure D1: Time series of discounted net benefit of Lower Atbara Area**

Figure D2: Time series of discounted net benefit of Dinder National Park Area
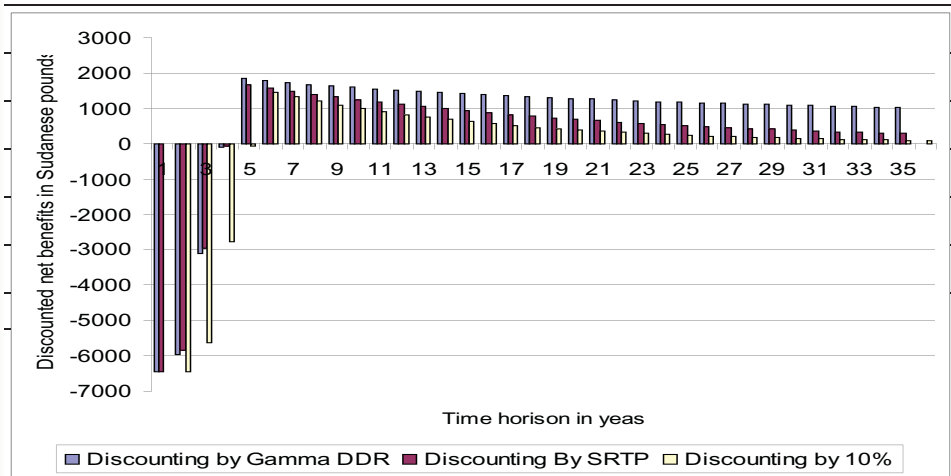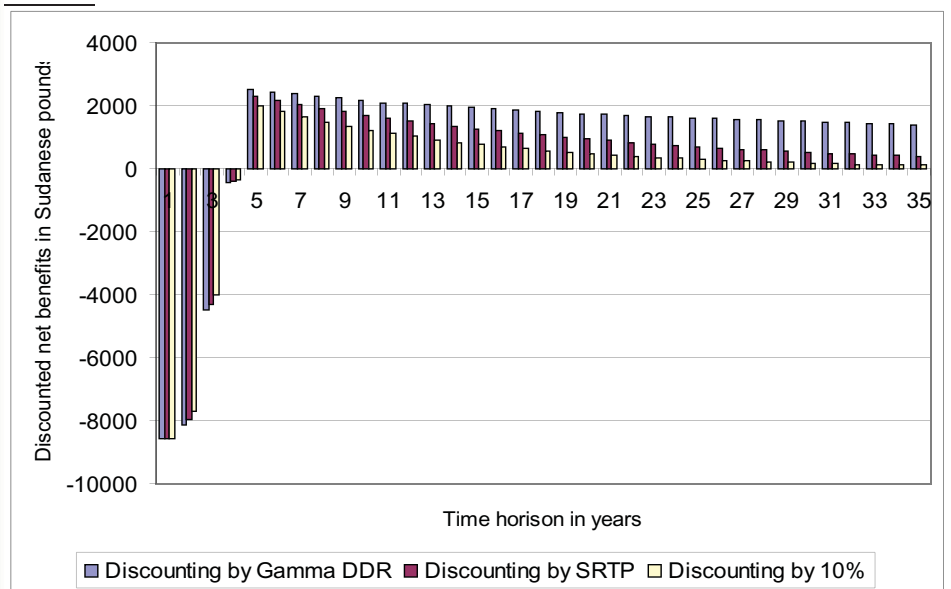

Figure D3: Time series of discounted net benefit of Ingessan Area

Footnotes

1 Labour-force composed of active mails and females recorded officially in the Ministry of Labour.

2 Women labour force composed of active women recorded in the Ministry of Labour

3 Agriculture labour force composed of active men and women estimated by the Central Bureau of Statistics and reported in the Ministry of labour.