The Impact of Poverty on Environmental Degradation
(A Case study of White Nile State)

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A thesis submitted in partial fulfillment of the requirements for
the degree of Masters of Science in Agricultural Economics

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January 2005
To my parents
My beloved mother
My dear father
To my brothers, sisters
To my uncle Abd Elmotaleb
I dedicate this work
With love and respect

Wisal
Acknowledgment

I am deeply grateful to my supervisor, Dr. Kamil Ibrahim Hassan, for constructive criticism and fruitful advice during the research programme.

I am a grateful thanks to Dr. Ali Abdel Aziz Salih for guidance and encouragements.

Special acknowledgements and sincere thanks are to my parents Ahmed and Zakya and my family members for their support and encouragements.

My appreciation extent to my uncle Bushra, and his family for their assistance.

Also, I would like to express my gratitude to Ms. Umsalma and Miss Suad for helping and assistance during the study.

I wish to extend my thanks to the Forest National Corporation (White Nile State) for the cooperation and assistance rendered during the collection of the primary data.
Abstract

Environmental degradation is a serious problem, which continued to attract the attention of the international community. The magnitude of environmental degradation in Sudan, measured in terms of the loss of forest cover in addition to desert creeping and drought, which ultimately lead to desertification, is very serious.

The study was conducted in the White Nile State (WNS). Its main objective is to assess the impact of rural poverty on environmental degradation. To attain this aim the study investigated the socio–economic characteristics of the respondents.

For the collection of primary data multi- stage stratified random sampling was used. The sample size was determined (80 respondents were selected) using questionnaire in addition to secondary data obtained from the relevant sources.

Lorenz curve was applied to estimate the income distribution. In addition to poverty line according to the World Bank definition (one dollar per day for person). The correlation and cross tabulation were used to measure the relationship between variables.

Poverty analysis indicates that the State suffers from wide spread poverty. About 87.5% of the respondents live below poverty line, high income concentrated in the hands of a few number of the respondents, which indicated that inequity exists between the respondents. Most of the respondents use traditional methods for preparing their food. A strong relationship was found between poverty on one hand and environmental degradation on the other hand and this is demonstrated as follows:

a- Using traditional methods for preparing food.
b- Not using healthy water sources.
c- Spread of the diseases (Malaria and Bilharziasis).

For poverty alleviation and environment conservation the study recommends the following:

- Preservation, conservation and improving soil fertility. It is recommended that a green belt be established and make use of agro-forestry systems, techniques, beside the rehabilitation of irrigation systems such as cleaning canals and combating of desertification.
- To establish community forest, which necessitates provision of irrigation water by foresting authorities.
- One of the feasible ways to alleviate poverty is to consider the introduction of income generating activities such as chase cottage industries, raising livestock (goats, sheep and cows) at good quality, and providing micro-financing for the farmers. In addition, improvement of the infrastructure (hospital services, education, road ….etc) is very important.
- Extension is necessary to increase awareness in conservation. Awareness raising about the disastrous results of the misuse of the natural resources, not only for the present but also for future generations, is important.
- : تُحَدِّثُهُمْ يَوْمَ الْقِيَامَةِ ۚ أَن يُتَّقُوا الْأَمْوَالَ أَلْوَانَهَا أَن يُذِبُّوا الشَّمْسَ وَالْقُوْزَاءَ أَن يَقُولُوا الْقَدْحَ ۖ}.مَلَكَةُ الْأَرْضِ لِلَّذِينَ كَفَّارٍ.}
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CHAPTER ONE
INTRODUCTION

1.1 Introduction

Poverty is becoming a stunning phenomenon and the denial of opportunities is presenting an obstacle and a challenge to the process of human development and to environmental conservation. As a phenomenon, poverty stems from a complexity of economic physical, social and political factors and has adverse impacts on both the physical and social environments. Its results are more degradation to the physical and social environments and lower population quality. Lower population quality, in turn, implies vulnerability to death at all ages, more ignorance and inability to execute development (El Nayal, 2002).

Poverty is defined, as a level of low income to meet family basic needs often synonymous with inequity. It is a result of deeply embedded differences in the distribution of power and resource in society that prevent certain groups from participating fully in economic, political, social, cultural and spiritual life of their community (UNDP, 1996).

Poverty, hunger and diseases are interrelated enemies of mankind that need to be alleviated if not completely eradicated. In fact, poverty has become the primary concern of developing countries during the last decades. It becomes a serious problem, which has affected political-stability, prospects for social and economic improvement and environment. There are more than one billion people in developing countries living below international poverty line (UNDP, 1996).

The majority of the population in Africa suffers from low living standards due to low economic growth caused by poverty and environmental deterioration. The malnutrition level in 1995 doubled
compared to that in 1960s, from 100 to 200 million, nearly 500 million hectares of land were subjected to erosion during the second half of the 20th century, 65% of which was agricultural land. Between 1980 and 1995 Africa lost 49 million hectares of forests. As present 14 African countries experience water deficit and the number is expected to increase by 2025. What applies to Africa is also applicable to Sudan (Hassan, 2002).

Sudan like other developing countries has been seriously affected by environmental degradation during the last decade, mainly in the form of deforestation, drought and desert encroachment. The major environmental degradation stems out from the virtual neglect of environmental consideration on policies, strategies and plans for development of the country. There is no adequate consideration for the simplest environmental principles pertaining to the proper utilization of the available resource for development purposes. As a result the country has undergone tremendous environmental degradation during the last four decades (Ahmed, 2004).

Major environmental problems in Sudan are depletion and misuse of natural resources through over cultivation, overgrazing, deforestation, desertification and drought, environmental refugees and displacement, misuse of agricultural chemical and wildlife destruction (Yagoub, 2003).

1.2 Problem Statement

"In many parts in the world it is the poor people who suffer most from environmental degradation, climatic change, deforestation, drought, disease, and from widespread of desertification. These environmental conditions can even threaten their very survival. Environmental impacts are inevitably global, and what happen in one
part of the globe has inescapable effects elsewhere, and one or common future, no society can afford environmental degradation." (Reed, 2001).

Sudan's economy is characterized by its dependency on agriculture. About 70% of economic active population works in agriculture and about 90% of these lives in rural areas (Hassan, 2002).

IFAD (2001) reported that, about 75% of the poor people in the world live and work in rural areas; this will still be the case for over 60% of the poor in year 2025.

It is evident that poverty might generally be considered a typical rural phenomenon in the world. Rural poverty is seen as a cause and consequence of environmental degradation in most developing countries.

During the last two decades Sudan has experienced several epochs of drought. As a result, many people lost their means of livelihoods and access to essential services, for instance, million of the rural population were forced to move to other areas with the different climatic condition and capabilities and hardly equipped to absorb these large numbers of displaced population, the displaced persons too were neither equipped with the basic skills that enable them to earn decent living in the new environment not trained enough to compete in the urban labor market (El Nayal, 2002).

Poverty is a cause and consequence of environmental degradation. It exacerbates environmental degradation by forcing poor people to utilize marginal land or over-harvest depleted resources in order to survive .In Sudan; the causes of the widespread poverty are the economic weaknesses and environmental deterioration. Poor economic performance and distortions brought by drought and desertification combined with high internal migration and civil strife have perpetuated the poverty situation.
Environmental degradation in the White Nile State influenced crop area, productivity and income of the people in the affected area.

1.3 Main objective

The main objective of this study is to assess the impact of rural poverty on environmental degradation. That is because it is believed that there is strong relationship between poverty and environmental degradation. To achieve the main objective, the following specific objectives should be dealt with.

1.3.1 Specific objectives

1/ To investigate the relationship between poverty and land degradation in the rural environment through measuring the impact of:
   a/ drought                        b/ desertification

2/ To assess the standard of living of the farmers in the study area in relation to natural resources degradation.

3/ To assess the pattern of consumption such as food, education, health, cloth and other items.

4/ To suggest means for poverty alleviation and a working program for the control of environmental degradation if not the improvement of the natural resources.

1.4 Justification

i. The relation between poverty and environmental degradation in its many forms is a serious problem, which continued to attract the attention of the international community.
Environmental conservation, far from being a luxury is an essential ingredient for maintaining the natural resources based upon which most nations depend for their future economic development.

Most of the previous studies, which dealt with the issue of poverty and environmental degradation suffer from a lack of integration. This study is conducted to fill some of the gaps in the area. The study was confined to specific rural areas where poverty and environment problems were expected to be at their worst.

The study provides a broad picture on poverty and environmental degradation and its magnitude. Its findings may hopefully be used by interested decision makers and socio-economic researchers in designing anti-poverty projects, environmental conservation strategies and programs which will be integrated with social community development plans.

1.5 Hypotheses

i. Many factors lead to degradation of natural resources. These factors could be divided into two groups: those caused by human misuse and those resulting from natural causes; mainly drought and desertification. It is our intention to assess the impact on rural areas.

ii. Low incomes of rural people are found to be caused by environmental degradation. This is always followed by their migration to nearby cities or urban centers. This explains that poverty is the main factor for migration from stricken area to other areas.

iii. Environmental deterioration leads to declining economic activities in the rural areas and this is reflected in decreased individual income and indicate that most of rural people suffer from low income.
iv. Unavailable of primitiveness of the basic infrastructure and the marginalization of rural people increase the hazards resulting from poverty and environmental degradation.

1.6 Research methodology
1.6.1 Methods of data collection

For data source both primary and secondary data were used. Secondary data were obtained from text books, published papers, reports, Ph.D, M.Sc. Thesis and from governmental administration, research institutions and organization.

For primary data, questionnaires were designed, to give abroad view of the living standards, poverty and environment degradation for the target population in the selected area.

1.6.1.1 Sampling techniques

For improving the precision of estimates and to avoid bias in selection, a multi-stage stratified random sampling technique was used for the target population (White Nile farmers). The population was divided in four strata, El Gableen, Kosti, El-Duiem and Getena localities. From El Gableen locality four villages were selected as follows: Alhedib, Nayfer, Sharta and Islah, from Kosti locality two villages Alrawat and Alnaim were selected From El-Duiem locality two villages were selected Alrhawat and Elkhanger. Finally, from Getena locality the villages selected were Alsada and Algmalab. From each of these villages the numbers of farmer respondents were selected randomly, the use of stratification is justified by the difference between the strata since each stratum is relatively more or less homogenous.

1.6.1.2 Sample size
The sample size was determined according to the level of precision demanded, financial cost and other facilities. According to Bhattacharya and Johnson (1977) the following formula was used to determine the sample size.

\[ n = \frac{KV}{D} \]

Where:

\( K = \text{Z value (the normal score at 0.9 probability)} = 1.654 \)
\( V = \text{the estimated standard deviation of output in the area of the study, which assumes the value 2.39} \)
\( D = \text{the magnitude of the difference to be detected (.05).} \)

According to the formula above the sample size was:

\[ n = \frac{1.654 (2.39)}{0.05} = 79.0612 \approx 80 \text{ respondents} \]

1.6.2 Methods of Analysis

The following methods for data analysis:

1/ Descriptive statistical analysis was used to investigate the socio-economic characteristics of respondents, poverty status and environmental situation.

2/ Descriptive statistics was applied to present the main characteristics data about the respondents. This includes the mean, standard deviation, percentage and frequency distribution tables.

3/ Correlations techniques were used to measure the significance of differences between the variables.

4/ Lorenz curve were applied to demonstrate the poverty situation.

1.7 Organization of the study

The study consists of five chapters divided as follows:

Chapter one: introductory part, problem statement, objectives, justification, hypotheses, methodology and organization of the study.
Chapter two: deals with the relevant literature that is concerned with poverty concept and environmental degradation.

Chapter three: Descriptive chapter deals with descriptive procedures to assess the main characteristics of parameters and presents causes and consequences of environmental degradation and poverty.

Chapter four: results and discussion of the main findings.

Chapter five: summary, conclusions and recommendations.

CHAPTER TWO
LITERATURE REVIEW

This chapter presents the available and relevant literature. It includes the definitions of the following concepts: Desertification, drought, land degradation and poverty, their discussion with a critical approach and then the ones to be used in the study.

2.1 Introduction

Desertification and drought are serious problems of global dimension. Their effect being of global nature i.e. they affect all regions of the world, therefore, joint action of international community is needed to combat desertification and/or mitigate the effect of drought. Desertification and drought have negative effect on sustainable development programs. That is because the interrelationships between the different factors hampering development such as poverty, poor health, malnutrition and lack of food security are inseparable. Some of these problems arise from migration, displacement of persons and demographic dynamics besides other
factors like climate change. The importance of these problems explains the significant efforts exerted by different states and international organizations in mitigating drought effects and combating desertification in trial to mitigate their negative effects. Implementing the Plan of Action to combat desertification which was adopted at the United Nation Conference on Combating desertification in 1977 could be mentioned as a good example. Various studies proved that the strategies to combat desertification and mitigate the effects of drought will be most effective if they are based on sound systematic observation and rigorous scientific knowledge and if they are continuously reevaluated. (ref: www.unccd.int/convention,2004).

In the recent years, the notion of desertification has become a major issue in the international debate on environmental degradation in both developed and developing countries. The terms of desertification, drought and land degradation have been given various definitions. The widely used ones which, will be adopted in this study are the definitions that are indicated by United Nation Convention to Combat Desertification (UNCCD).

2.1.1 Definitions

"Desertification means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities". According to this definition the phenomenon started when men shifted activity from subsistence needs to commercial utilization of lands and natural resources especially in arid, semi arid and dry sub-humid areas where the ecological balance is fragile, also the climatic changes due to natural factors has its affect on land degradation which results in desertification.

Drought means the naturally occurring phenomenon that exists when precipitation has been significant below normal recorded levels,
causing serious hydrological imbalances that adversely affect land resource production systems.

Land degradation means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from processes or combination of processes, including processes arising from human activity and habitation patterns, such as:

i) Soil erosion caused by wind and/or water;

ii) Deterioration of physical, chemical and biological or economic properties of soil; and

iii) Long term loss of natural vegetation;

Land degradation encompasses deterioration in some or all of the component parts of land, which would lead to the reduction of biological productivity of ecosystems.

Combating desertification includes activities which are part of the integrated development of land in arid, semi-arid and dry sub-humid areas for sustainable development which are aimed at:

i) Prevention and/or reduction of land degradation;

ii) Rehabilitation of partly degraded land; and

iii) Reclamation of desertified land;

The phenomenon of environmental degradation has been attracting attention world wide because the effect of the problems spared in all countries, for that organizations, writers and researchers take this problems in different concepts, definitions and ideas.

UNCCD, (1977) defines desertification as the creation of desert-like condition; it is a process leading to reduced biological productivity with consequent reduction in plant biomass, land’s carrying capacity for livestock, crop yield and human well-being. The definitions indicate that the direct affect of desertification on reduction of biological
productivity as a result reduction in plant biomass, livestock, crop yield and quality of life for humans.

Dregne, (1986) stated that, "desertification is the impoverishment of terrestrial ecosystems under irrational uses by man".

In this case the process of desertification is a result of human activities rather than climate changes.

2.2 The process of desertification definition and description

FAO, (1989) reported that arid and semi-arid lands, together with their sub-humid margins, constitute what are called “dry reigns, dry zones or dry lands” and cover a global area of about 45 million km². It is in this area that desertification is taking place and endangering the livelihoods of some 850 million inhabitants.

The problem of desertification takes a new understanding that reveals its universal impact and causes, which extend well beyond the dry lands most immediately affected.

Desertification destroys nation’s productive resources base, causes famine and starvation during prolonged dry periods, causes loss of valuable genetic resources, increases atmospheric dust (which could have as yet unknown consequences on the global climate), disruption of natural water recycling process, and loss of market and the disruption of the national economies.

Babiker, (2003) defined desertification as the phenomenon of environmental degradation that convert lands into desert-like conditions unfit for human living.

2.3 Desertification worldwide

The problem of desertification has recently attracted a lot of attention of many people and international organizations. Many
international organizations are involved in designing and implementing projects to solve the problem of desertification in the developing countries where it is of a primary concern (Mohamed, 2002).

Wollers, (1996) mentioned that most important cause of desertification is the overuse of resources due to population growth as a result; desertification is not to be found in the countries affected only. In Africa alone, the area affected is a corridor about 5,500 kilometers long and about 420 kilometers wide from the Atlantic to the Red sea, between the Isohyets of 200 millimeters in the north and 600 millimeters in the South. In 1988 an estimated 44 million people live in this area of around 2.32 million square kilometers.

Environmental changes associated with desertification tend initially to be localized and often expressive of a combination of three factors: Seasonal dryness or drought stress, excessive pressure of land use and naturally vulnerable sites (Kobbail, 1996).

The summary of the factors that lead to desertification is seasonal drought, excessive pressure due to land use and naturally vulnerable sites.

Grainger (1990) concluded that desertification is caused by main types of poor land use namely: over-cultivation, over-grazing, deforestation and poor irrigation practices. The conclusion reflects sociological theory of dry land degradation, which focuses almost exclusively on what people do locally.

Drought is a global problem that affects many parts of the world, including the poor and rich countries as well as developed and developing countries.

According to World Bank, (1985) drought is defined as markedly sub- average amount of rainfall, during a year or years.
Grainger (1990) stated that drought is a result of climatic change, but the desertification is the result of action human being. Drought could trigger rapid desertification rates and could make its effect more keenly felt by those living in the affected area. The major consequences of drought, include widespread crop failures high rates of livestock mortality and human displacement and/or mortality. According to Laban (2004), drought in Africa is a serious natural disaster and has been associated with many socioeconomic miseries. Drought on the continent often causes large-scale water and food deficits, hunger, famine, exodus of people and animals, diseases, deaths, and many other severe, chronic societal problems. Moreover, the economies of most of these African countries rely heavily on the exports of rain-dependent agricultural products, which are often seriously affected during the years of severe droughts. Thus, drought occurrences on the continent generally cause severe reductions in the foreign exchange earnings, which in turn result in the crippling of natural resources and the ability of the individual nations to cope with the negative socioeconomic impacts of such droughts. Drylands in Africa comprise one third of the world total corresponding to 65% of entire continent and inhabited by 400 million people (UNEP, 1991).

The dryland (arid and semi arid) areas with less than 200 mm rainfall cover proximately 60% of the Sudan area (105 million kilometers) consisting the largest area, of dry land in Africa (Mohamed, 2002).

Adam (2002) stated that, large areas of Sudan, in which rainfed crop production and extensive grazing are practiced, were subject to unreliable rainfall. This results in low crop yields and poor pastures which lead to poor human nutrition (that has negative impact on ability
to maximize the potential productivity of the following season) and poor livestock condition. The situation is frequently exacerbated by shortage of drinking water for both the human and the livestock populations. The often-enforced human rise of polluted water resources may lead to human illness a further loss of productivity and increasing food insecurity.

The natural flora and fauna in the drylands are adapted to cope with this recurring environmental hazard. Also the human livelihood. Systems have on element of the safety net built into their economies to cope with this natural disaster when and not if it occurs. Nevertheless extreme drought (either in terms of length or amount of precipitation) can, and does, cause major catastrophes, and income recent years seems to have created more of challenge to survival to both man and the environment. The East Africa drought situation in the early 1980s was publicized as an emergency situation rather than part of a cyclical pattern of drought. Drought causes not only environmental problems but also problems related to economic, social and political life in these regions (Norris, 1985).

Mohamed, (2002) indicated that combined effects of drought and desertification, which are complex interrelated, have led to the reduction of land productivity, food shortage, shifting sand dunes, acute shortage of fuel wood and deterioration of the resource base.

2.4 Land Degradation, Environmental Degradation and Deforestation

Soil, as the basis for crop and livestock production, is one of the most vital natural resources. The conservation and maintained productivity of this elementary production factor is crucially important for sustainable agriculture and rural development, increasingly so in
view of the spread of soil depletion and the make decline in soil fertility. Soil degradation already affects almost fifth of the world’s farmland and a further 6 percent is severely degraded. It is calculated that between five and seven million hectares of farmland are lost every year close to 0.5 percent of the total area. Yet population expansion is set to continue, and with it the need for more food (Haas, 1997).

A sustained agricultural production can be achieved only by a proper use of soil resources, which includes maintenance and enhancement of soil fertility. The term soil fertility is cast here to encompass not only essential plant nutrients but also aspects of soil structure, including water holding capacity, soil organic matter content and biological activity that influence both the efficiency of use and sustainability the resources. All these attributes are interrelated and contribute together to soil potential productivity or fertility. (Pieri, et al. 1997).

Mohamed, (2002) pointed out that environmental degradation is a change that negatively effects human life and is commonly categorized in two types: environmental degradation related to land and natural resources and environmental problems related to pollution. Environmental degradation is of primary concern in the developing countries. Land degradation, is the most serious and chronic environmental problem in Africa, particularly in the drylands because it undermines food production.

With the increase in the demand of fuel wood and the rising prices of energy, collecting fire wood has become more than a daily work for female members of the household it become commercially, some times illegal, activity for conversion to charcoal and consequent consumption in the urban areas (Norris, 1985).
At the present time there is a large number of land trees being cut due to human activity and climatic factors also help land degradation.

According to Abdel Galeel (2003), the arable land constitutes about 1/3 (84 million hectares) of the total areas of Sudan (250.5 million hectare) of which only 21% (17.47 million hectares) is actually cultivated. Over 40% (102 million hectare) of the total area of Sudan consists of pasture and forests. Annual forest harvest (allowable cut) is estimated at 11 million m$^3$. For example, the 1994 forest product demand was estimated at 16 million m$^3$, which indicates the annual loss in the forest capital. Thus, forests are exposed to continuous removal and clearance either for agricultural expansion or for wood consumption.

Table (2.1) summarizes the pattern of wood products consumption for the whole country. During 1994, total consumption was estimated as 15.77 million m$^3$, for all wood products. The distribution among different sectors was 89.4% for households, 6.8% for industry, 2.5 for commercial and services sector and 1.3% for quranic schools. By product analysis, wood fuel (fire wood, charcoal) consumption accounted for 87.5% while construction, maintenance and furniture wood accounted for 7.2%, 3.8% and 1.5% respectively.

Table 2.1 Total wood consumption in Sudan (c.m)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Wood fuel</th>
<th>Poles and saw logs</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firewood</td>
<td>Charcoal</td>
<td>Construc</td>
<td>Maintenanc</td>
</tr>
<tr>
<td>Household</td>
<td>6148380</td>
<td>6070207</td>
<td>1113172</td>
<td>573002</td>
</tr>
</tbody>
</table>


Abdel Galeel (2003) stated that annual forest harvest (allowable cut) is estimated at 11 million m$^3$. While at 1994 total consumption was estimated as 15.77 million m$^3$, which exceeded the allowable cut.

Table (2.2) shows the consumption of forest product by households sector both urban and rural. Urban households consumed 35.6 % (5.02 million m$^3$) of wood consumed by the sector, while rural household consumed the remaining 64.4 % (9.08 million m$^3$). The table explains clearly that rural people are the majority consuming forest products such as firewood, furniture more than the urban people.

**Table 2.2 Rural-Urban household consumption of forest products (c.m)**

<table>
<thead>
<tr>
<th>House Hold</th>
<th>Firewood</th>
<th>Charcoal</th>
<th>Construction</th>
<th>Maintenance</th>
<th>Furniture</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>976515</td>
<td>3619601</td>
<td>202645</td>
<td>153159</td>
<td>72053</td>
<td>5023973</td>
<td>35.6</td>
</tr>
<tr>
<td>Rural</td>
<td>517186</td>
<td>2450606</td>
<td>910526</td>
<td>419842</td>
<td>129715</td>
<td>9082554</td>
<td>64.4</td>
</tr>
<tr>
<td>Total</td>
<td>614838</td>
<td>6070207</td>
<td>1113171</td>
<td>573001</td>
<td>201768</td>
<td>1410652</td>
<td>100</td>
</tr>
</tbody>
</table>
Deforestation has significant negative impact on land productivity. Deforestation exposes the soil to accelerated water and wind erosion and ultimately causes soil deterioration. As a result of soil deterioration its productivity will definitely decline (i.e. productivity per unit of land) for cash crops and/or lower productivity of rangeland in terms of its animal carrying capacity. The deforestation of land and its low productivity has serious implications on the performance of the economies of most developing countries since they are agriculturally based. (Mustafa, 1993).

2.5 Sudan environment situation

Nearly one third of the land area between 10 – 18° N is affected by desertification. The general consensus is that desertification is the main environmental problem of Sudan, as regards natural forests which suffer from deforestation due to regular harvesting without planting for replacements of cut stands and to replenish the available wood volume. Estimates show that annual wood consumption has removed an area of some three million feddans of standing forest while the size of annual planning is a very humble figure. Forest productivity is the second Sudan environmental concern, charcoal species and those preformed for furniture and other specified uses under continuous pressure. The annual expansion of mechanized cultivation, that began since 1942, has resulted in removal of forest, birds and wildlife habitats, large mammals have disappeared, wildlife in the northern Sudan is now limited to the Dinder Park and although under protection it faces many threats, the environment in war stricken zones of southern Sudan...

<table>
<thead>
<tr>
<th>%</th>
<th>43.6</th>
<th>43.0</th>
<th>7.9</th>
<th>4.1</th>
<th>1.4</th>
<th>100</th>
</tr>
</thead>
</table>

Source: (FNC, Forest National Corporation, 1995).
and Blue Nile faces many threats (Sudan Country Study on Biodiversity, 2001).

The present situation of all the components of the natural resource base seems to be unpleasant and if the rate of exploitation of these resources continues as it is happening now, the future of these resources will be very gloomy and welfare of the rural population will be severely damaged. The rate of deforestation is on the increase and on the other hand the pacing of rehabilitation of forests is very slow. At (the time of independence), the forests covered about 38% of total area of country. At present the percentage has decreased to only about 8% (Elhassan and Bakhiet, 2003).

2.6 Poverty concepts and definitions

Poverty is a complex multidimensional problem. In Africa, poverty is one of the drivers of environmental degradation, largely because the poor have limited choices and depend heavily on the natural resource base. There is no uniform solution to the problem of poverty. The country-specific programs to tackle poverty, and sub-regional, regional and international efforts supporting national efforts are needed. At national level, a specific anti-poverty strategy is, therefore, one of the basic conditions for ensuring sustainable development (UNEP, 2004).

El Nayal, (2002) mentioned that poverty inflicts a negative impact on both the environment and process of human development. Due to the diverse physical and cultural setups of Sudan, the impacts of poverty on Sudanese population vary from one region to another.

In general poverty is a global phenomenon spread all over the world but it varies from one country to another and in one country it
also varies from one region to the other. For this reason the strategies to alleviate poverty depend on the nature of the treatment in each country.

Abdala, (1996) pointed out that; there is strong evidence that rural poverty is a dominant feature in all regions of the world. It affects the lives of close to one billion people.

The main characteristic situation of the rural poor in the Sudan is the high level of illiteracy rates, high disease incidence, high infant mortality rates, short life expectancy, lack of access to basic services, low per capita income and conflicts over natural resources (water, and grazing land), (El Nayal, 2002).

Most of poor people living in the rural areas depend on agriculture and livestock in their live and two activities (agriculture and livestock) is affected by environmental changes which lead to increased poverty situation all over the world.

Poverty is a complex issue and it can be understood and defined in various ways concerning its place, time position... etc. The following are some definitions of poverty:

IFAD (1995) defines poverty as: "a condition that causes more sickness, suffering and death than diseases on earth. It's a root cause of hunger".

The definition indicates that poverty is the main cause of hunger, sickness and death.

According to FAO (1993): "poverty refers to the inability to attain a minimal standard of living. Criteria for assessing minimum nutritional needs and other basic necessities vary from country to country. Since they reflect country specific conditions, national priorities, concepts of welfare and rights, the minimum acceptable level of consumption, the poverty threshold generally rises as national income increase. Despite the difficulties in selecting a single poverty
threshold, such a threshold is necessary in order to make cross-country comparison”.

Crowley (1999) stated that: "poverty is temporarily variable. The poorest households are locally defined as those who lack the off-farm income to purchase inputs, plant cash crop, and diversify income-earning activities or education for their children. The endowments of people fluctuate over time in accordance with the development cycle of domestic groups”.

2.6.1 UNDP (2000), defined poverty in terms of

a. Income poverty

a.1 Extreme poverty: lack of income necessary to satisfy basic food needs usually define on the basic of minimum calorie requirements (often called absolute poverty).

a.2 Overall poverty: lack of income necessary to satisfy essential clothing, energy and shelter as well as food needs (often called relative poverty).

b. Human poverty

Lack of human capabilities: illiteracy, malnutrition, abbreviated life span, poor maternal health, and illness from preventable diseases. Indirect measures are lack of access to goods, services and infrastructure energy, sanitation, education, communication, drinking water necessary to sustain basic human capabilities.

IFAD (2001): poverty can be seen as abroad multi-dimensional partly subjective, variable over time comprising capabilities as well as welfare, and in part relative to local norms, comparisons and expectation. In practice most poverty measurement focuses on private consumption below an objective poverty line that is both fixed overtime and defined in terms of an absolute norms a narrow aspect of welfare
for example, define poverty as deprivation of sufficient consumption to afford enough calories, or as dollar poverty.

Poverty definition varies over time and over country, due to change in resources, wealth, ability between peoples who live in those countries.

2.6.2 World Bank (2001) definition of poverty:

Relative poverty lines: are defined in relation to the overall distribution of income or consumption in a country. In the relative poverty a person is poor relation to the members of this society.

Absolute poverty lines: These are anchored in some absolute standard of what households should be able to count on in order to meet their basic needs. For monetary measures, these absolute poverty lines are often based on estimates of the cost of basic food needs to which a provision is added for non-food needs. For developing countries, considering the fact that the large shares of the population survive with the bare minimum or less, it is often more relevant to rely on an absolute rather than a relative poverty line.

2.7 The inequality definition

Poverty is often viewed as an issue of inequality because a transfer of income from rich to poor can reduce poverty in most societies. Further, any poverty line is drawn with respect to standards prevailing in community so that poverty may look like an inequality between the poorest groups and the rest of the society (Abdala, 1996).

The poor are especially vulnerable to degradation of natural systems. Both the global and the local consequences of environmental damage directly affect poor people. Global concerns, such as changes
in the earth’s atmosphere are critical to the livelihoods of poor people and their consequences last longer than first assumed. For example, a rate of climate change is likely to cause widespread economic, social and environmental degradation over the next century. Therefore, the poorest people in Africa and other developing regions are certain to suffer the most due to failing harvests, growing water shortages and rising sea levels. (ref: www.unep.org, 2004).

Most African countries fall under the category of high risk and low coping capacity. This is because most countries in Africa over the past 30 years have been at high risk, for example, floods, earthquakes, lava flows, fires, droughts, civil strife, and armed conflicts and wars, which have increased poverty, exacerbated serious health problems and resulted in hunger. These disasters have displaced populations across national borders and internally, contributing to further environmental degradation, and leading to more vulnerability and insecurity. The impacts have mostly affected the poor, who have low coping capacities. Millions of people in most parts of Africa are directly dependent on natural resources of the physical environment. They are, therefore, more vulnerable to environmental change than people in other regions of the world. (ref: www.unep.org, 2004).

According to UNDP (1997), poverty has been and remains a major cause and consequence of environmental degradation and resource depletion. Currently, almost 40 percent of people in Sub-Saharan Africa live below the poverty line, and both Income poverty and human poverty are increasing (ref: www.unep.org, 2004).

According to (UNDP 1998), current projections, Africa is the only continent on which poverty is expected to rise during the next century. (ref: www.unep.org, 2004).
The linkages between development, environment and poverty make it impossible to deal with problems of poverty in isolation of the factors (Nimir, 2002).

Taban, (2002) stated that Poverty and backwardness are sides of the same coin, and if poverty is to be eradicated, ignorance and backwardness have to be fought. The civil society organizations, in form of religious groups, mosques and churches, trade and professional unions, teachers, women and youth bodies being the enlightened groups in society have a big responsibility towards fighting poverty.

2.8 Poverty worldwide

FAO (2003) reported that 842 million people were undernourished in 1999-2001. This includes 10 million in the industrialized countries, 34 million in countries whose economy is in transition and 798 million in developing countries. At the regional level, the numbers of undernourished were reduced in Asia and the Pacific and in Latin America and Caribbean. In contrast, the numbers continue to rise in Sub-Saharan Africa and in the near East and North Africa.

FAO (2000) estimates that the number of hungry people in countries was declining by 8 million a year in the first half of the 1990s, but if we are to fulfill the pledge model at the 1996 world food summit, that number must reach 20 million a year, but hungry people cannot wait another 15 years. The many causes of undernourishment from poverty and conflict to poor infrastructure and limited Investment in agriculture – will require sustained attention everywhere, from the village to the international community. In a world enjoying record wealth, it is a moral imperative to ensure that every person on the planet realizes their right to be free from hunger.
2.9 Poverty in Sudan

In 1998 official figures releases estimated that 94% of Sudan population are under the line of poverty, the change over from a regulated economy to free economy enterprise system is largely responsible, rural population was the hardest hit. The traditional farmers now faced with lack of credit, making difficulties of products, costs of his agricultural and livestock inputs and households goods to secure his food and bridge the gap in his income, which inevitably pushed to reap more land will be grown to offset the risks of production failure, which results from recurrent droughts and pest outbreak before harvest. The other alternative to generate income is the forest products, more harvest from the land either wood or non-wood, both alternatives are threat to his nature endowment of natural resources, this lead to is vicious circle. (Sudan Country Study on Biodiversity, 2001).

2.10 The Effect of Poverty on Natural capital

Nur (2002) stated that, there is an unsettled dispute over the two-way causal relationship between poverty and environmental degradations. The hen-egg type of question: is do poor people degrade environment or does environment degradation cause poverty? Without wishing to give a definite answer to this question, we know that poor are too weak to degrade environment, regardless of which causes which, we know that biodiversity and livelihood activities mutually overlap with linkage in both directions. While biodiversity provides the poor with direct and easy livelihoods, excessive livelihood activities eventually deplete environmental resources and consequently foreclose livelihood options for future generations implying non sustainable development, therefore, poverty, which implies excessive utilization of
environmental resources, and environmental degradation, irrespective of which started which, are two processes that grow together, for the rural poor environmental resources is an important asset perceived to be a gift from God. But the rural poor, ignorant of the fact that environmental degradation in some cause is an irreversible process, unable to conserve environment, unaware of an expected tragedy of the commons and desperate for a living proceed to utilize natural resources excessive.

CHAPTER THREE
THE SOCIO-ECONOMIC CHARACTERISTICS

This chapter presents and discusses the empirical results of the study. It presents the socio-economic characteristics of the respondents, economic activity, nutrition and health, production and environmental situation.

Socio-economic characteristic of farmers in White Nile State

3.1 The age distribution of respondents

Table (3.1), the respondent’s age distribution shows that farmers within the most productive age represent (16.25%) of the total selected sample i.e. (21-40 years old). Respondents with age between (41-60) are the majority (47.5%) and those above 60 years old comes second representing (36.25%). If we compare these percentages we can conclude the following:

Farmers at the productive age are the least. The overwhelming majority are old people. This is due to lack of education, (most the respondents are illiterate) and lack of other professions with better economic rewards. Thus we can say respondents do not choose to be
farmers but are actually forced especially those of advanced age. The small portion of young farmers, within the age of (21-40) most of whom still practice agriculture are at the same time looking for other jobs that could provide better living.

**Table 3.1: The age distribution of the respondents in the White Nile State**

<table>
<thead>
<tr>
<th>Age range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-40</td>
<td>13</td>
<td>16.25</td>
</tr>
<tr>
<td>41-60</td>
<td>38</td>
<td>47.5</td>
</tr>
<tr>
<td>&gt;60</td>
<td>29</td>
<td>36.25</td>
</tr>
</tbody>
</table>


### 3.2 Sex distribution

In some rural areas of Sudan, males are the main supporters of the household and are responsible for the supply of food and most essential requirements of living for the family. Therefore, rural males were interviewed since they are heads of the household and in charge of major land use activities. Table (3.2) indicates that in White Nile State, about (98.75%) of the respondents are males. This figure is high due to the social traditions that head of household is expected to be a man whose responsible to shoulder the household responsibilities and to provide all needs and requirements. The role of women in general in this state, is to take care of the house, supply water, collect fuel wood, cook, take care of the children and carry out others domestic affairs. For these reasons the percentage of female household heads is very small and represents only (1.25% - only one case).

**Table 3.2: Head of household distribution according to Sex**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>79</td>
<td>98.75</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>1.25</td>
</tr>
</tbody>
</table>
3.3 Place of birth of the respondents

Table (3.3) shows the place of respondents birth, about (30%) of the respondents were born in Gableen locality, (20%) in Kosti locality, (25%) in El-Duiem locality and (25 %) in Getena locality. Note that the number of respondents from each locality = 20. That means all farmers included in the sample are from the same locality concerning El- Duiem and El –Getena while 5% of the farmers in El- Gableen are from outside the locality and 5% of respondents of Kosti work out side their locality. It seems that work opportunities create labor movement to or out of the different localities in the White Nile State.

<table>
<thead>
<tr>
<th>Birth Place</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Gableen locality</td>
<td>24</td>
<td>30.0</td>
</tr>
<tr>
<td>Kosti locality</td>
<td>16</td>
<td>20.0</td>
</tr>
<tr>
<td>El-Duiem locality</td>
<td>20</td>
<td>25.0</td>
</tr>
<tr>
<td>Getena locality</td>
<td>20</td>
<td>25.0</td>
</tr>
</tbody>
</table>


3.4 Respondents marital status

From table (3.4) the majority of the respondents are married to one wife about (72.5%), those who are married to two wives are about (20%), married to three wives (5%) and (2.5%) married to four wives. The number of men that are married to one wife is higher comparing with the number of men that married with more than one wife, as the
tradition and the religion in this particular state and in whole Islamic world men allowed to marry more than one wife in the past, but now due to the hardships of life and economic problems men stick one wife and the table indicates that the ones that married to more than one wife are a small percentage this is due to economic reasons and social movement.

Table 3.4: Respondents marital status

<table>
<thead>
<tr>
<th>Number of wife</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married to one wife</td>
<td>58</td>
<td>72.5</td>
</tr>
<tr>
<td>Married to two wives</td>
<td>16</td>
<td>20.0</td>
</tr>
<tr>
<td>Married to three wives</td>
<td>4</td>
<td>5.0</td>
</tr>
<tr>
<td>Married to four wives</td>
<td>2</td>
<td>2.5</td>
</tr>
</tbody>
</table>


3.5 Respondents Education Level

The distributions of the farmers according to education level, from table (3.5) about (51.25%) of them are illiterate, (6.25%) received informal education (khalwa) and (42.5%) received Formal education, ranging, from primary school to university. Primary school (22.5%), intermediate (10%), secondary (6.25%) and university (3.75%).

Generally, about more than half of the respondents are illiterate (51.3%), while about (38.8%) of the respondents with not enough
education to meet the agriculture requirements and improve their quality of their lives.

<table>
<thead>
<tr>
<th>Education level</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literate</td>
<td>41</td>
<td>51.25</td>
</tr>
<tr>
<td>Khalwa</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>Primary</td>
<td>18</td>
<td>22.5</td>
</tr>
<tr>
<td>Intermediate</td>
<td>8</td>
<td>10.0</td>
</tr>
<tr>
<td>Secondary</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>University</td>
<td>3</td>
<td>3.75</td>
</tr>
</tbody>
</table>


### 3.6 Occupation

Agriculture is the main source of income in the study area, but it was observed that the numbers of the farmers that have another economic activity for earning income beside main occupations are shown in table (3.6). The distribution of respondents according to different secondary jobs, such as merchants present about (42.9%), animals rearing (37.2%), free work (14.3%), teachers (5.6%).

<table>
<thead>
<tr>
<th>Secondary job</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merchant</td>
<td>15</td>
<td>42.9</td>
</tr>
<tr>
<td>Animal breeding</td>
<td>13</td>
<td>37.2</td>
</tr>
<tr>
<td>Free work</td>
<td>5</td>
<td>14.3</td>
</tr>
<tr>
<td>Teacher</td>
<td>2</td>
<td>5.6</td>
</tr>
</tbody>
</table>


### 3.7 Reasons for farmers to reside at this particular state

Table (3.7) present the main reasons behind farmers residing in these villages is agriculture. This represents about (66.25%)
of the total respondents. Those who are in agriculture and animals raising are about (17.5 %). (6.25%) of the respondents are attracted to agriculture and trade. Some others hold government jobs (6.25%), (3.75%) are part-time farmers and they migrate when there is drought.

Table 3.7: The reasons for farmers to reside at this particular Village

<table>
<thead>
<tr>
<th>Residence in the village</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attracted by agriculture</td>
<td>53</td>
<td>66.25</td>
</tr>
<tr>
<td>Attracted agriculture and animal raising</td>
<td>14</td>
<td>17.5</td>
</tr>
<tr>
<td>For agriculture and trade</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>Governmental Jobs</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>Agriculture and migration from drought and desertification</td>
<td>3</td>
<td>3.75</td>
</tr>
</tbody>
</table>


3.8 Nutrition status

Table (3.8) considers the numbers of the meals per day. The majority of the respondents in the area (71.25%) had two meals per day and only about (28.75%) of them had three meals per day.

Table 3.8: Numbers of meals per day

<table>
<thead>
<tr>
<th>Number of meals</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two meals</td>
<td>57</td>
<td>71.25</td>
</tr>
<tr>
<td>Three meals</td>
<td>23</td>
<td>28.75</td>
</tr>
</tbody>
</table>


3.9 Meal components

Table (3.9) considers the meal components per day. About (32.5%) uses popular main source of the nutrition in the area
(Lubia,Kisra,Asida), about  (18.75%) of the respondents have little quantity of meat and vegetable with the main source of the nutrition in the area (Lubia,Kisra,Asida), (18.75%) eat meat on daily basis with vegetable and bread, about (12.5%) eat (Vegetable, Lubia,Kisra,Asida), (12.5%) eat little quantity of meat with (Lubia,Kisra,Asida), and (5%) eat vegetables, bread, fruit with (Lubia,Kisra,Asida).

Table 3.9: Meals components

<table>
<thead>
<tr>
<th>Meals component</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubia, Kisra, Asida</td>
<td>26</td>
<td>32.5</td>
</tr>
<tr>
<td>Meat, vegetable (Lubia, Kisra, Asida)</td>
<td>15</td>
<td>18.75</td>
</tr>
<tr>
<td>Meat, vegetable, bread</td>
<td>15</td>
<td>18.75</td>
</tr>
<tr>
<td>Vegetable (Lubia, Kisra, Asida)</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Meat (Lubia, Kisra, Asida)</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Vegetable, bread, fruit (Lubia, Kisra, Asida)</td>
<td>4</td>
<td>5.0</td>
</tr>
</tbody>
</table>


3.10 Common diseases and water sources

Malaria, Bilharsiasis are the most widespread diseases in the area. All the farmers reported that malaria and Bilharsiasis are the main diseases in the area. The third one is typhoid and the last is thyroid gland diseases. Malaria and Bilharsiasis (48.75%), Malaria (20%), (malaria, typhoid, thyroid gland) about (20%), (malaria, typhoid) about (11, 25%). The reason why they are common diseases is because the water sources not treated, for example they use water from canal (tura’a) for drinking and bathing and its good media for mosquito and intermediate host of Schistosoma. Using of the non healthy latrines is the reason for typhoid and the deficiency of iodine in the water causes thyroid gland diseases. Generally, the situation is worsening by the absence and weakness of the health services, provided in the area.
In general, water is essential to people, but the extent to which it can fulfill its functions depends on quantity and quality of available water. There are different types of water sources for respondents. About (41.25%) use canal (tura’a), (23.75%) get water from wells, (21.25%) get their water from the Nile and (13.75%) get their water from reservoirs. This water sources is not good clean water, concerning the respondents, health situation, especially for drinking and cleaning themselves and their animals. This shows the bad health situation in the area and consequently the spread the diseases in that particular area.

Table (3.10), shows Common diseases and Water sources.

**Table 3.10: Common diseases and water sources**

<table>
<thead>
<tr>
<th>Common disease</th>
<th>Frequency</th>
<th>%</th>
<th>Water source</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria and Bilharsiasis</td>
<td>39</td>
<td>48.75</td>
<td>Canal (tura’a)</td>
<td>33</td>
<td>41.25</td>
</tr>
<tr>
<td>Malaria</td>
<td>16</td>
<td>20.0</td>
<td>Well</td>
<td>19</td>
<td>23.75</td>
</tr>
<tr>
<td>Malaria, typhoid, thyroid gland</td>
<td>16</td>
<td>20.0</td>
<td>Nile</td>
<td>17</td>
<td>21.25</td>
</tr>
<tr>
<td>Malaria, typhoid</td>
<td>9</td>
<td>11.25</td>
<td>Reservoir</td>
<td>11</td>
<td>13.75</td>
</tr>
</tbody>
</table>


### 3.11 Home characteristics and type of ownership

Table (3.11) shows housing conditions and type of ownership. About (12.5%) of the respondents have one room in their house, (26.25%) have two rooms, (32.5%) have three rooms, and those who have more than three rooms represent about (28.75%). All these houses are simply built from local material for example mud and wooden roof …etc.

The majority of the farmers staying at their own houses this represent about (96.25 %) of the respondents, only (3.75 %) inherited.

**Table 3.11: Respondents housing conditions and type of ownership**

<table>
<thead>
<tr>
<th>Home characteristics</th>
<th>Frequency</th>
<th>%</th>
<th>House owners</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>One room</td>
<td>10</td>
<td>12.5</td>
<td>Private</td>
<td>77</td>
<td>96.25</td>
</tr>
<tr>
<td>Two rooms</td>
<td>21</td>
<td>26.25</td>
<td>Inherited</td>
<td>3</td>
<td>3.75</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
<td>-------</td>
<td>-----------</td>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>Three rooms</td>
<td>26</td>
<td>32.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than three rooms</td>
<td>23</td>
<td>28.75</td>
<td>Total</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

### 3.12 Place of latrine

According to table (3.12) there is (52.5%) have better places of latrines inside their houses. Those are the ones who live close to the town. When we go far away from the town their percentage is (18.75%) and (28.75%) for the uses of the outside the house and open spaces latrines respectively. The ones who use their latrines outside the house or open space are endangering the environmental health conditions to themselves and to the others.

<table>
<thead>
<tr>
<th>Place of latrine</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the house</td>
<td>42</td>
<td>52.5</td>
</tr>
<tr>
<td>Outside the house</td>
<td>15</td>
<td>18.75</td>
</tr>
<tr>
<td>Open space</td>
<td>23</td>
<td>28.75</td>
</tr>
</tbody>
</table>

### 3.13 Energy and Electricity

Table (3.13) shows that the majority of the respondents suffer from shortage of basic infrastructure. About (12.5%) only use electricity, while (71.25%) use gasoline and (16.25%) use private generators. It was noticed that only a small percentage use electricity due to the absence and weakness of the services available.
Table 3.13: Distribution of the respondents according to energy and electricity

<table>
<thead>
<tr>
<th>Type of lighting</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Gasoline</td>
<td>57</td>
<td>71.25</td>
</tr>
<tr>
<td>Generator</td>
<td>13</td>
<td>16.25</td>
</tr>
</tbody>
</table>


3.14 Energy for food preparation

From table (3.14) the majority of respondents use traditional methods for preparing food (Charcoal and Wood), local stove present (47.5%) of the respondents, (37.5%) using local stove and gas, (7.5%) using local stove and animal dung and finally (7.5%) of the farmers using gas.

The main source of energy for food preparation is local stove which uses charcoal that have been cut from trees that cause the desertification in the long term.

Table 3.14: Type of energy for preparation food

<table>
<thead>
<tr>
<th>Cooking food</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local stove (fuel and charcoal)</td>
<td>38</td>
<td>47.5</td>
</tr>
<tr>
<td>Local stove and gas</td>
<td>30</td>
<td>37.5</td>
</tr>
<tr>
<td>Local stove and animal dung</td>
<td>6</td>
<td>7.5</td>
</tr>
<tr>
<td>Gas</td>
<td>6</td>
<td>7.5</td>
</tr>
</tbody>
</table>


3.15 Source of obtaining (energy) fuel wood

The area under forests is declining more and more towards the far south. This appears clear from the study area where the vegetation cover is being semi removed. From the table (3.15), the high percentage of obtaining fuel wood from purchase this about (37.8%), gathering dead trees and purchase (33.8%), about (5.4%) gather dead trees, cutting
trees and gather dead trees represent about (10.8%), cutting trees and Purchase (9.5%) fuel obtain from cutting trees represent only (2.7%) of the total respondents.

### Table 3.15: Source of obtaining (energy) fuel wood

<table>
<thead>
<tr>
<th>Source of Fuel wood</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>28</td>
<td>37.8</td>
</tr>
<tr>
<td>Gather dead tree and purchase</td>
<td>25</td>
<td>33.8</td>
</tr>
<tr>
<td>Gather dead tree</td>
<td>4</td>
<td>5.4</td>
</tr>
<tr>
<td>Cutting trees and gather dead trees</td>
<td>8</td>
<td>10.8</td>
</tr>
<tr>
<td>Cutting tree and purchase</td>
<td>7</td>
<td>9.5</td>
</tr>
<tr>
<td>Cutting tree</td>
<td>2</td>
<td>2.7</td>
</tr>
</tbody>
</table>


### 3.16 Fuel sales points

According to table (3.16) about (76.7%) buying fuel, from the village market, (23.3%) buying fuel, from out side the village (About 60 respondents from the total purchasing the fuel).

### Table 3.16: Fuel sales points

<table>
<thead>
<tr>
<th>Baying fuel</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the village</td>
<td>46</td>
<td>76.7</td>
</tr>
<tr>
<td>Outside the village</td>
<td>14</td>
<td>23.3</td>
</tr>
</tbody>
</table>


### 3.17 Building material

Table (3.17) shows the type of trees used for building houses in the study area, (31.3%) uses Ban, (28.8 %) uses Saluk, (15%) uses the Kitir, (13.8%) uses (kitir, sahab, talih) and (11.3%) uses Sahab.

### Table 3.17: Types of trees for building respondents houses
### Building trees

<table>
<thead>
<tr>
<th>Building trees</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ban</td>
<td>25</td>
<td>31.25</td>
</tr>
<tr>
<td>Saluk</td>
<td>23</td>
<td>28.75</td>
</tr>
<tr>
<td>Kitir</td>
<td>12</td>
<td>15.0</td>
</tr>
<tr>
<td>Kitir,Sahab,Talih</td>
<td>11</td>
<td>13.75</td>
</tr>
<tr>
<td>Sahab</td>
<td>9</td>
<td>11.25</td>
</tr>
</tbody>
</table>


### 3.18: Forests situation

The field data revealed that most of respondents perceive the scarcity of fuel wood in the area where fuel wood becomes scarce with an increase in the distance, rural household tend to spend more time for fuel wood collection, this affects household's labor in other activities.

From table (3.18) the farmers mentioned that forest situation is inadequate to meet their future need. These presented about (91.25%) respondents who think that it is adequate to meet future needs represent (8.75%) of the respondents.

#### Table 3.18: Forests situation

<table>
<thead>
<tr>
<th>Forest situation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate to meet future needs</td>
<td>73</td>
<td>91.25</td>
</tr>
<tr>
<td>Just adequate to meet future needs</td>
<td>7</td>
<td>8.75</td>
</tr>
</tbody>
</table>


### 3.19: Consumption of charcoal per month, charcoal prices (SD) and the period of time that wood have been used as source of energy:

Table (3.19) shows the monthly consumption by respondents from 1–2 sacks of charcoal represent (75.7%), 3–4 sack
represent (18.9%), 4-6 sack represent about (5.4%). The price of charcoal, ranging from 600 to 2600 (SD), the price reasonable, in the far south compared with the northern part of the State. Also good quality, of wood that is being used.

From 600 to 1200(SD) the percentage is (50%), from1300 to 1900 (SD) the percentage is (33.3%) and from 2000 to 2600 (SD) the percentage is (16.7%).

The period of time that respondents using fuel woods according the table about (5%) of the respondents been using fuel wood for 10-15 years, (16.3%) been using it for 16-20years and finally (78.8%) have been using it for more than 20 years.

The majority of farmers had been using fuel wood for a very long time and depending on it as a main source of energy for cooking and preparation of food.

Table 3.19: Consumption of charcoal per month, charcoal price (SD) and the period of time that wood been used as source for energy

<table>
<thead>
<tr>
<th>Monthly consumption</th>
<th>Frequency</th>
<th>%</th>
<th>Price of charcoal (SD)</th>
<th>Frequency</th>
<th>%</th>
<th>Since when uses fuel wood</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 sack</td>
<td>56</td>
<td>75.7</td>
<td>600-1200</td>
<td>30</td>
<td>50</td>
<td>10-15 year</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3-4 sack</td>
<td>14</td>
<td>18.9</td>
<td>1300-1900</td>
<td>20</td>
<td>33.3</td>
<td>16-20 year</td>
<td>13</td>
<td>16.25</td>
</tr>
<tr>
<td>4-6 sack</td>
<td>4</td>
<td>5.4</td>
<td>2000-2600</td>
<td>10</td>
<td>16.7</td>
<td>&gt;20 year</td>
<td>63</td>
<td>78.75</td>
</tr>
</tbody>
</table>

3.20: Type of land ownership

Table (3.20) indicates that (92.5%) of farmers own their agriculture fields, there are (5%) sharing their field with other individuals. (2.5%) renting the agriculture fields from the owners. Generally speaking, the majority of the farmers own their land.

**Table 3.20 : Types of ownership of land.**

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners</td>
<td>74</td>
<td>92.5</td>
</tr>
<tr>
<td>Sharing with other individual</td>
<td>4</td>
<td>5.0</td>
</tr>
<tr>
<td>Rent</td>
<td>2</td>
<td>2.5</td>
</tr>
</tbody>
</table>


3.21: Land size

From table (3.21) the range of the land size is between 3 and 10 Feddans representing (41.25%), 11-18 feddan represent (45%), from 19 to 26 feddans represent (3.75%), 27 to 34 feddan represent about (6.25%) and above 34 feddans (3.75%).

**Table3.21: Ownership of agricultural land**

<table>
<thead>
<tr>
<th>Land size</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-10 feddan</td>
<td>33</td>
<td>41.25</td>
</tr>
<tr>
<td>11-18 feddan</td>
<td>36</td>
<td>45.0</td>
</tr>
<tr>
<td>19-26 feddan</td>
<td>3</td>
<td>3.75</td>
</tr>
<tr>
<td>27-34 feddan</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>&gt; 34 feddan</td>
<td>3</td>
<td>3.75</td>
</tr>
</tbody>
</table>

3.22 Production situation

According to table (3.22) for the last five years, (90%) of the farmers said that production is low, (6.25%) said the production rate is constant and (3.75%) said the production improved. The majority claims that the production is low because the farmers don’t practice the rotation on the lands this causes the land to lose fertility, the irrigation problems due to lack of maintenance and the high cost of irrigation, improved seeds, chemical fertility (shortage of financial services) for that a number of farmers depending on rainfed face the fluctuation of rainfall and finally desert encroachment in some agricultural lands and covering the canals.

In addition to the study in the area, the total respondents, lack extension services.

Table 3.22: Agricultural products for the last five years

<table>
<thead>
<tr>
<th>Production situation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worsening</td>
<td>72</td>
<td>90.0</td>
</tr>
<tr>
<td>Constant</td>
<td>5</td>
<td>6.25</td>
</tr>
<tr>
<td>Improving</td>
<td>3</td>
<td>3.75</td>
</tr>
</tbody>
</table>


3.23 Crop rotation

Farmers, being poor, are unable to restore the soil fertility or improve their agricultural technology, techniques or practices. As a result of the degradation they cause to environment, they are forced to move to other areas, expanding further the degraded areas and ultimately they move to urban centers: causing more degradation and decay to the urban environment. This confirms the strong linkage between poverty and environmental degradation (El Nayal, 2002).
According to the table (3.23) about (51.23%) of the respondents apply crop rotation and (48.75%) do not to apply the crop rotation this causes loss of land fertility.

The majority of respondents are not integrating their animals into the rotation (92.5%). Only (7.5%) integrate animal in the rotation.

### Table 3.23: Application of the rotation and Integrate animal in Agriculture rotation

<table>
<thead>
<tr>
<th>Crop rotation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>41</td>
<td>51.25</td>
</tr>
<tr>
<td>No</td>
<td>39</td>
<td>48.75</td>
</tr>
<tr>
<td>Integrate animal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>7.5</td>
</tr>
<tr>
<td>No</td>
<td>74</td>
<td>92.5</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

#### 3.24 Land fallow period

Table (3.24) indicates that about (48.75%) don’t apply fallow period on their lands, (37.5%) apply it only for one year, (3.75%) apply it for two years, and (10%) apply it for three years. Not being practicing the rotation system on their lands due to farmer's poverty.

Lack of a rotation system, indicates farmers poverty because the high cost of the agricultural input and high cost of irrigation they prefer using the land near the irrigation sources and the expansion to other land after the land loses its fertility.

### Table 3.24: Different space of frequencies of follow period

<table>
<thead>
<tr>
<th>Land fallow period</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero year</td>
<td>39</td>
<td>48.75</td>
</tr>
<tr>
<td>One year</td>
<td>30</td>
<td>37.5</td>
</tr>
<tr>
<td>Two year</td>
<td>3</td>
<td>3.75</td>
</tr>
<tr>
<td>Three year</td>
<td>8</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004
3. 25: Type of livestock owned and changes of animal numbers for the last five years

Table (3.25) the higher number of respondents lost their livestock wealth, through selling to meet their live requirements, this represents about (40%), and (60.0%) owned different types of animals (Cattle, goats, sheep).

The change of the animal numbers owned by the respondents. The increase of the animal numbers, represent (13.75%), decrease represent (46.25%) (The decrease due to selling, slaughter and death) finally about (40%) Lost their animals.

<table>
<thead>
<tr>
<th>Type of livestock</th>
<th>Frequency</th>
<th>Percent</th>
<th>Livestock-change</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost their animals</td>
<td>32</td>
<td>40.0</td>
<td>Increased</td>
<td>11</td>
<td>13.75</td>
</tr>
<tr>
<td>Cattle</td>
<td>27</td>
<td>33.7</td>
<td>Decreased</td>
<td>37</td>
<td>46.25</td>
</tr>
<tr>
<td>Goats</td>
<td>13</td>
<td>16.3</td>
<td>Lost their animals</td>
<td>32</td>
<td>40.0</td>
</tr>
<tr>
<td>Sheep</td>
<td>8</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

3.26: Sources of feeding and addional fodder for animals

Table (3.26) shows animals feed, about (33.25%) of the respondents feed their animals from (natural pastures, crop residue), (25.0%) feed their animals from crop residues, (16.7%) feed natural pasture, (12.5%) feed them from their farm and finally (12.5%) feed their animals from (natural pastures, crop residue, purchase).

There are additional different types of supplements given to their animals, (16.7%) crop residues, (45.8%) sorghum, (2.1%) seeds,
(12.5%) Cake, (14.6%) Sorghum with seeds and (8.3%) feed with (Crop resides, Sorghum, seeds, cake).

**Table 3.26: Sources of feeding animals and additional fodder**

<table>
<thead>
<tr>
<th>Sources of food for animals</th>
<th>Frequency</th>
<th>%</th>
<th>Additional feed</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural pastures, crop residue</td>
<td>16</td>
<td>33.3</td>
<td>Crop residues</td>
<td>8</td>
<td>16.7</td>
</tr>
<tr>
<td>Crop residues</td>
<td>12</td>
<td>25.0</td>
<td>Sorghum</td>
<td>22</td>
<td>45.8</td>
</tr>
<tr>
<td>Natural pasture</td>
<td>8</td>
<td>16.7</td>
<td>Seeds</td>
<td>1</td>
<td>2.1</td>
</tr>
<tr>
<td>From their farm</td>
<td>6</td>
<td>12.5</td>
<td>Cake</td>
<td>6</td>
<td>12.5</td>
</tr>
<tr>
<td>Natural pastures, crop residue, purchase</td>
<td>6</td>
<td>12.5</td>
<td>Sorghum, seeds, Crop resides, Sorghum, seeds, cake</td>
<td>7</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

**3.27 Trees condition and trees plantation**

All respondents in the area perceive the decline of the natural forest around their villages. Most of the people in the areas still remember the times where they used to have thick forest around the villages. The cases of environmental degradation seem to be well understood by the villagers.

From table (3.27) about (42.5%) of the respondents say that at the present there are no trees around the area, (52.5%) say that the vegetations has decreased around the area, only (5%) say that the vegetations increased around the area. Those who claim that there are trees they refer to the increase of mesquite trees in the area.
About (92.5%) of the respondents have not planted any type of trees in their farm, only about (7.5 %) have planted trees.

Table 3.27: Trees condition and plantation

<table>
<thead>
<tr>
<th>Trees condition</th>
<th>Frequency</th>
<th>%</th>
<th>Trees in the farm</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete depletion</td>
<td>34</td>
<td>42.5</td>
<td>Yes</td>
<td>6</td>
<td>7.5</td>
</tr>
<tr>
<td>Decreased</td>
<td>42</td>
<td>52.5</td>
<td>No</td>
<td>74</td>
<td>92.5</td>
</tr>
<tr>
<td>Increased</td>
<td>4</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

3.28 Type of agriculture

Table (3.28) shows that (66.25%) of the respondents use irrigation pumps, (12.5%) using mechanized rainfed and about (21.3 %) use both pump and mechanized rainfed system.

Table 3.28: type of agriculture

<table>
<thead>
<tr>
<th>Type agriculture</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>53</td>
<td>66.25</td>
</tr>
<tr>
<td>Mechanized rainfed</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Pump, mechanized rainfed</td>
<td>17</td>
<td>21.25</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004
CHAPTER FOUR
RESULTS AND DISCUSSION

This chapter is a review of the results. It consists of the poverty analysis (consumption patterns and income distribution by using Lorenz curve). The correlation technique is applied to seek the relationship between the variables (migration and income, water sources and common diseases, income and common diseases, income and adoption of crop rotation), cross tabulation is used to explain the relations between income and energy sources and descriptive tables are used to assess the environmental degradation.

4.1 Poverty analysis
4.1.1 Type of crops grown in the area

IFAD (2001) reported that most of the poor people in the African rural areas and the other social low-income layers depend on cereal crops such as sorghum, millet besides cassava and yam as their main food.

From table (4.1) the majority of respondents (82.5%) at the study area grow their crops just to get food for the household consumption (sorghum crop). Some of them grow it for both cash and food supplies. This group represents about (15%), while (2.5%) of the farmers grow cash crops only.

Generally, the cash crops production is avoided due to the high cost and small returns (farmers suffer from low income to meet the agricultural production requirements), and also deterioration on land fertility, therefore most of respondents are shifting their production to food crop.
Table 4.1: Type of crop grown at the study area

<table>
<thead>
<tr>
<th>Type of Crop</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food crop</td>
<td>66</td>
<td>82.5</td>
</tr>
<tr>
<td>Food crop, cash crop</td>
<td>12</td>
<td>15.0</td>
</tr>
<tr>
<td>Cash crop</td>
<td>2</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

4.1.2 Table (4.2) shows the respondents annual income in Sudanese Dinar (SD).

Table 4.2: Respondents annual income

<table>
<thead>
<tr>
<th>Income (000) (SD)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>24</td>
<td>30.0</td>
</tr>
<tr>
<td>200-300</td>
<td>24</td>
<td>30.0</td>
</tr>
<tr>
<td>300-400</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>400-500</td>
<td>9</td>
<td>11.25</td>
</tr>
<tr>
<td>500-600</td>
<td>6</td>
<td>7.5</td>
</tr>
<tr>
<td>600-700</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>700-800</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>800-900</td>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>900-1000</td>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

4.1.3 Total and average income by Sudanese Dinar (SD):

Table (4.3) shows that the sources of total income at the study area. Total income 26675568 (SD), the average total income is found to be 333444.6 (SD). The average farm income represented 281444.6 (SD) and none farm income is about 52000 (SD), the percentage of farm
income and none farm income represent (84.4%), (15.6%) from the total income respectively.

**Table 4.3: Average annual incomes of the respondents in White Nile State in Sudanese Dinar (SD)**

<table>
<thead>
<tr>
<th>Income sources</th>
<th>Average income (SD)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm income</td>
<td>281444.6</td>
<td>84.4</td>
</tr>
<tr>
<td>None farm income</td>
<td>52000</td>
<td>15.6</td>
</tr>
<tr>
<td>Total</td>
<td>333444.6</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

4.1.4 **Family size and poverty line:**

The average family size is (8) persons. Most of the respondents lie under the poverty line according to the indicator by the World Bank (one dollar day per person). This is found to be about (87.5%) of the total respondents, and only a small percentage lies above the poverty line (12.5%).

IFAD (2002) reported that about 1.2 billion people in the world are estimated to consume less than standard dollar a day and are therefore in (dollar poverty).

Table (4.4) shows the average income, Std. deviation and average family size we notice that Std. deviation is very high due to low agricultural income which leads farmers to seek another source of income which varies from one to the other while the Std. deviation of family size is very low.

**Table 4.4: Average income and family size**

<table>
<thead>
<tr>
<th>Average income (SD)</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>333444.6</td>
</tr>
<tr>
<td>Family size</td>
<td>7.98</td>
</tr>
</tbody>
</table>

4.1.5 Consumption pattern:

Data on respondents expenditure have been collected to provide information on standard of living. The selected individuals in the sample have been asked to answer in detail the questions about their allocation of their incomes on different items such as food, education, health, housing, clothing and others.

Table (4.5) shows that the annual average consumption, which is about 328473.75 (SD) per year and around 114 (SD) daily per capita expenditure for the main food consumption which represent (73.9 %) of total food expenditure, expenditure on education represents about (9%), (7.6%) for health, (6.6%) for clothing, other family members is (2.1%) and zero consumption on housing that is because about (96.25%) of the respondents stay in their own houses and about (3.75%) inherited their houses.

It was noticed that most of consumption is on food, while education represents the second item at the expenditure due to high cost of education (increase in the level of school fees and stationeries) but it is still small percentage with respect to all consumption as some respondents, children drop out from their schools, expenditure for health represent a small percentage due to respondents poverty, they most of the time use traditional medicine (local medicine) except for serious diseases they go to the hospitals around their villages or to the nearest town. Clothes expenditure also represents a small percentage because some of the respondent’s clothes come as gifts from their relatives or buying from local markets due to their cheap selling prices.
Nur (1996) mentioned that in developing countries food is the major welfare components of the budget, other components like education, health and housing are now gaining importance.

Table 4.5: Consumption items

<table>
<thead>
<tr>
<th>Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>73.78</td>
</tr>
<tr>
<td>Education</td>
<td>9.03</td>
</tr>
<tr>
<td>Health</td>
<td>7.63</td>
</tr>
<tr>
<td>Cloth</td>
<td>6.56</td>
</tr>
<tr>
<td>Others Family Members</td>
<td>2.99</td>
</tr>
<tr>
<td>Housing</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

These results confirm the rule that poor people spend more money on food and less on health and clothing, figure (4.1) shows a typical example of White Nile State farmers or rural people's consumption pattern.
Figure 4.1 The Consumption Items

Consumption Items

- 73% food
- 9% education
- 8% health
- 7% cloth
- 3% Others family members
- 0% Housing
4.1.6 Lorenz curve and inequality:

Gini coefficient is the most commonly used measure of inequality, the coefficient varies between 0, which reflect complete equality and 1, which indicates complete inequality (i.e. one person has all the income or consumption and all others have none).

If each individual had the same income (total equality) the income distributaries curve would be straight line in the graph –the line of total equality. If the income is distributed completely equally, the Lorenz curve and the line of total equality are merged and the Gini coefficient is zero. Graphically the Gini coefficient represents the area between the Lorenz curve and the line of equality (World Bank 2001).

To calculate Lorenz curve and equality line, all respondents were arranged in ascending incomes, the whole population in the sample has been divided into deciles (tenth) according to ascending income level and then, the proportion of income received by each decile was determined.

The ratio of income obtained, by dividing any income group over the total income. The Lorenz curve was calculated as cumulative income. (Ministry of Agriculture, 2004, In Arabic Version).

Table (4.6) explains the calculated Lorenz curve and Gini coefficient at the study area.
Table 4.6: The calculated Lorenz curve and Gini coefficient for the respondent's income at White Nile State

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Annual income in (SD)</th>
<th>Income (%)</th>
<th>Lorenz</th>
<th>Equality</th>
<th>Absolute value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1030500</td>
<td>3.86</td>
<td>3.9</td>
<td>10</td>
<td>6.14</td>
</tr>
<tr>
<td>10</td>
<td>1280800</td>
<td>4.8</td>
<td>8.7</td>
<td>20</td>
<td>5.2</td>
</tr>
<tr>
<td>10</td>
<td>1474100</td>
<td>5.53</td>
<td>14.2</td>
<td>30</td>
<td>4.47</td>
</tr>
<tr>
<td>10</td>
<td>1671160</td>
<td>6.27</td>
<td>20.5</td>
<td>40</td>
<td>3.73</td>
</tr>
<tr>
<td>10</td>
<td>1993588</td>
<td>7.47</td>
<td>27.9</td>
<td>50</td>
<td>2.53</td>
</tr>
<tr>
<td>10</td>
<td>2285000</td>
<td>8.57</td>
<td>36.5</td>
<td>60</td>
<td>1.43</td>
</tr>
<tr>
<td>10</td>
<td>2757000</td>
<td>10.34</td>
<td>46.8</td>
<td>70</td>
<td>0.34</td>
</tr>
<tr>
<td>10</td>
<td>3472420</td>
<td>13.02</td>
<td>59.9</td>
<td>80</td>
<td>3.02</td>
</tr>
<tr>
<td>10</td>
<td>4256000</td>
<td>15.95</td>
<td>75.8</td>
<td>90</td>
<td>5.95</td>
</tr>
<tr>
<td>10</td>
<td>6455000</td>
<td>24.19</td>
<td>100.0</td>
<td>100</td>
<td>14.19</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004
4.1.7 Gini-coefficient:

The Gini coefficient explains the size of the area between the equality line and Lorenz curve, the increase in the area of Gini coefficient mean (far from equity line) high inequality.

Gini coefficient at respondents in the study area was calculated by the flowing formula:

\[
\text{Gini coefficient} = 0.5 \times \frac{\sum |\text{income } \% -10|}{100}
\]

\[
\text{Gini coefficient} = \frac{(0.5 \times 47.5)}{100} = 0.235
\]

The Gini coefficient at respondents in the area of study is approximately found to be 0.24.

Figure (4.2) shows the Lorenz curve, maps the cumulative income share on the vertical axis against the distribution of respondents on the horizontal axis (income group).

The results reflect, the degree of inequality between the respondents (between the very poor and the very rich), it indicates that money concentrated in few hands and majority are very poor (for example 40 percent of the population obtains around 20 percent of the total income while 90 percentage obtains around 75 percent of the total income).
Figure 4.2. The respondents income distribution at White Nile State
4.2 Environmental degradation:

There has been a clear complex interaction between environment and poverty. Environmental degradation has an important impact on poverty. The deterioration of country natural resources due to over consumption of trees for firewood and mismanagement of land for expansion by mechanized crop production schemes and traditional sectors over marginal lands could be prime causes of poverty and vice versa. For instance; the depletion of soil can decimate farmers income and lower nutrition status of the population. Similarly, those who live in extreme poverty chop down any remaining trees of firewood, even at the expense of further environmental degradation. In Sudan people are impoverished by drought, desertification, floods, and the depletion of common resources affect poor families. Therefore poverty is a cause and an effect. For example, poverty fuels environmental degradation, which in turn fuels poverty in a downward spiral of deprivation. (Mohamed, 2003).

Fuel wood used by most of rural people for preparing their food, (see table 3.14) explains that high percentage of respondents depending on fuel woods and charcoal as traditional methods of the obtained energy in the rural area, the percentage is (47.5%), about (37.5%) using local stove and gas, (7.5%) using local stove and animal dung and finally (7.5%) of the farmers use gas.

Table (4.7) shows the relationship between the income and energy consumption. The table indicates that most of the respondents with low income depend on fuel wood (local stove) as a sources for
preparing their food, this represents (47.5%), (33.75%) use local stove and gas only about (5%) use gas this for the income ranging (under 200000 to 700000 SD), for the income ranging between (700001- above 1000000 SD), (3.75%) uses local stove and gas and (2.5%) uses gas.

At the end the main source for energy for food preparation is the local stove, which uses charcoal and fuel wood that has been cut from trees. Thus it is proved that the human intensive use is the main cause behind the degradation of natural resources.

Table 4.7: Annual income and Energy consumption

<table>
<thead>
<tr>
<th>Income (000) (SD)</th>
<th>Local stove and animal dung</th>
<th>Local stove and gas</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq</td>
<td>%</td>
<td>Freq</td>
</tr>
<tr>
<td>&lt;200</td>
<td>6</td>
<td>7.5</td>
<td>12</td>
</tr>
<tr>
<td>200-300</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>300-400</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>400-500</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>500-600</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>600-700</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>700-800</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>800-900</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>900-1000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

4.2.1 The shrinkage of trees cover:

Tree cover status is indicative of state of the ecology and natural recourses base. Whether the trees increased or decreased, could be
assessed in a subjective way from respondents answers. The result is given in table (4.8) showing that, (42.5%) of the respondents believed that there is complete depletion of tree cover, most of the respondents agreed that there is shrinkage in trees cover this represents about (52.5%) from the total respondents and small percentage (5%) mentioned that there is an increase in the number of trees the respondents who said that, they possibly meant mesquite trees which grow at irrigation area to combat the desertification problem. The tree cover at the southern part of the State is threatened because the efforts of rehabilitation of the forest are very small compared to accelerated degradation.

Table 4.8: The trees condition at the present time

<table>
<thead>
<tr>
<th>Trees condition (Number of trees)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete depletion</td>
<td>34</td>
<td>42.5</td>
</tr>
<tr>
<td>Decreased</td>
<td>42</td>
<td>52.5</td>
</tr>
<tr>
<td>Increased</td>
<td>4</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

Annual rainfall distribution is skewed indicating that mean rainfall is biased by a short heavy annual rain fall years, followed by along succession of below average rainfall years. In the study area, respondents were asked about the precipitation and drought frequencies at the last five years. Table (4.9) indicates that about (25%) suffer from drought, (37.5%) said that the rain quantity is little, not enough to their agriculture requirement, (37.5%) said that the rains rate is on average about normal.
Finally, rainfall is unpredictable and variable from one year to another, which increases the risk in agricultural crop production and affects farmer’s income thus leads to a vicious circle.

Table 4.9: Rainfall situation

<table>
<thead>
<tr>
<th>Rainfall situation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No rainfall</td>
<td>20</td>
<td>25.0</td>
</tr>
<tr>
<td>Little</td>
<td>30</td>
<td>37.5</td>
</tr>
<tr>
<td>Average</td>
<td>30</td>
<td>37.5</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

4.2.2 Respondent’s situation at dry season

Human and climate influence environment and production of crops affects the availability of food for households. That is because the net primary productivity, potential productivity and also biomass increase with the increase of the amount of rainfall.

Table (4.10) shows that at dry season, about (22.5%) from the respondent's migrate to other areas seeking secondary jobs in the city in the big irrigation scheme like (Gizera scheme). And (77.5%) use the natural resource in their current areas.

Table 4.10: Respondent’s situation at dry season

<table>
<thead>
<tr>
<th>At dry season</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>18</td>
<td>22.5</td>
</tr>
</tbody>
</table>
Rainfall in the study area is the most crucial climatic factor, failure in rainfall may bring large scale suffering. There is strong relationship, between poverty and migration. Migration every year is associated with the dry seasons from the affected area to good areas, table (4.11) explained the significant positive relationship between income and migration, higher income indicates that people settle in their villages and low income is always associated with migration.

It was noticed that in the dry season in spite of hard conditions most people prefer to stay at the area and use natural resources (forest, fish). This applicable also if we take in to consideration the income i.e. (respondents with the high income prefer to stay).

**Table 4.11: Correlations between the migrations of respondents at dry season and income**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pearson’s Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration of the respondents at dry season and low income</td>
<td>.262*</td>
<td>.019</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

**4.2.3 Water source and common diseases:**

In general water is essential to people, but the extent to which it can fulfill its functions depends on quantity and quality of available water. Table (4.12) indicates the different types of water sources for respondents in the relation to common diseases. About (20%) suffer from Malaria, (48.75%) from (malaria, Bilharsiasis), (11.25%) from (malaria, typhoid), (20%) suffer from (malaria, typhoid, thyroid gland).
The water sources in the study area are not good purified water, concerning the respondent's health situation, especially water for drinking and other services for human being and animals. This shows bad health situation in the area and spread the disease in that particular area like Bilharziasis Malaria and typhoid diseases.

**Table .4.12: Water sources and common diseases Cross tabulation**

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Reservoir Freq</th>
<th>%</th>
<th>Well Freq</th>
<th>%</th>
<th>(Canal) turua Freq</th>
<th>%</th>
<th>White Nile Freq</th>
<th>%</th>
<th>Total Freq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>12.5</td>
<td>1</td>
<td>1.25</td>
<td>1</td>
<td>1.25</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Malaria, Bilharziasis</td>
<td>7</td>
<td>8.75</td>
<td>2</td>
<td>2.5</td>
<td>18</td>
<td>22.5</td>
<td>12</td>
<td>15.0</td>
<td>39</td>
<td>48.75</td>
</tr>
<tr>
<td>Malaria, typhoid</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3.75</td>
<td>5</td>
<td>6.25</td>
<td>1</td>
<td>1.25</td>
<td>9</td>
<td>11.25</td>
</tr>
<tr>
<td>Malaria, typhoid, thyroid gland</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>11.25</td>
<td>3</td>
<td>3.75</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>13.75</td>
<td>19</td>
<td>23.75</td>
<td>33</td>
<td>41.25</td>
<td>17</td>
<td>21.25</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Field survey, 2004

Most of respondents at the study area suffer from lack of essential needs, such as water sanitation, hospitals and electricity. Table (4.13) shows that the relationship between the common diseases and type of water sources, whether this water is used for drinking or cleaning. Positive relationship (at level .01) indicates that with the increase of uses this type of water is the increase of the diseases.

**Table 4.13 Correlations between types of water sources and Common diseases**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of water sources and common diseases</td>
<td>.476**</td>
<td>.000</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
Table (4.14) explains negative relationship between incomes and spread of disease (at the level 0.01), the negative significant relationship between the income and common diseases, this indicates that low income associated with increased spread diseases at the study area.

Table 4.14 Correlations between common diseases and income

<table>
<thead>
<tr>
<th>Category</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common diseases and low income</td>
<td>-.306**</td>
<td>.006</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).

Table (4.15) shows the significant and positive relationship between the adoption of crop rotation and income, (at the level of significant 0.01).

The positive relationship indicates that, the increase of the income leads to increase in adoption of crop rotation while decrease of income leads to decrease in crop rotation.

Table 4.15 correlation between crop rotation and income

<table>
<thead>
<tr>
<th>Category</th>
<th>Pearson correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop rotation and income</td>
<td>.658</td>
<td>.000</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary:

The study was conducted in the White Nile State to assess the environmental situation in relation to poverty in rural area. The study relies basically on the primary data, which was collected using questionnaires and direct interviewing. The study field survey was carried in the year 2004.

A three-stage stratified random sample of 80 respondents was selected. The first stage the population was divided in four strata, El
Gableen, Kosti, El-Duiem and Getena localities. The second stage was from El Gableen locality four villages were selected as follows:

Alhedib, Nayfer, Shart and Islah. From Kosti locality two villages were selected Alrawat and Alnaim. From El-Duiem locality two villages were selected Alrhawat and Elkhanger. Finally, Getena locality the villages that have been selected are Alsada and Algmalab. The last stage, from any of these villages the number of farmer's respondents were selected randomly. The secondary data were used in relevant field.

Descriptive statistics has been used to draw the main features of the socio-economic characteristics of the respondents. The results indicated that, about (16.25%) at the active group (21 to 40), while (47.5%) are in the age (41 to 60) and more than 60 present (36.25%), all the respondents were married, (72.5%) married to one wife while (27.5%) married to more than one wife, more than half of the respondents are illiterate (51.25%), informal education khalwa represent (6.25%), (32.5%) attended primary and intermediate schools, secondary schools present (6.25%) and university is (3.75%).

The average family size was 8 persons, average annual income was found to be 333444.6 SD and 114 SD daily per capita expenditure. The average on food consumption was the most dominant expenditure and represents about (73.8%), while education was (9%), health about (7.6%), cloth about (6.6%) and other family members (2.1%) from total expenditure, respectively.

High percentage of respondents grow food crops this is due to the high cost of input and small returns from cash crop, (60%) of the respondents have animals and (40%) lost their animal.

All the respondents suffer lack of extension services and most of them use traditional methods of preparing food and building their
houses by used wood (forest production). Very small percentage of them grows forest trees in their farm. All the respondents drink water without any filtration, the area is characterized by the lack of basic infrastructure and medical services, thus that majority of them suffer from tropical diseases such as (Malaria and Bilharsiasis, Typhoid). During the dry season (77.5) of respondents use the natural resources and (22.5%) whose income is low migrate to other areas.

Around (87.5%) from respondents live under poverty line, which indicates that poverty is very widely spread in this State. The Lorenz curve analysis revealed that the distribution of the respondent's income. A strong relationship between low income and environmental degradation was tested through the correlation technique and descriptive table.

5.2 Conclusions
The main conclusion is that poverty has negative effects on natural resources and poor peoples are a cause and consequence of the environmental degradation. The effects are clearly shown by the following indicators:
- Most of the natural forests have deteriorated and the plant cover removed is now moving south.
- Productivity of crops declined.
• Most of the farmers changed the crop pattern and have concentrated on food crop production rather than cash crop.
• A great number of farmers depend on rainfall in their production so they with face the risk of fluctuation in rainfall (drought season).
• Many of the schemes suffer from desert creep at their canals, which affected the irrigated sector.

5.3 Recommendations
• To preserve, conserve and improve soil fertility, through establishing a green and make use of agro-forestry systems and technique. Besides, the rehabilitation of irrigation systems such as cleaning canals.
• To establish community forest, which necessities provision of irrigation water by foresting authorities.
• Expanding uses of alternative energy sources such as improved stove and gas.
• One of the feasible ways to alleviate poverty is to consider the introduction of income generating activities such as cottage industries, breeding livestock (goats, sheep and cows) at good quality, also providing micro finance for the farmers. In addition the improvement of the infrastructure (hospital services, education, road ….etc) is very important.
• To improve the level of income the diversifications of field crop production with vegetable growing since it generate fast return.
• New policies for marketing cash crop (cotton), which keep high return for the farmers without a risk.
• Provision of technical package to improve the production, which, lead to increase income.

• Extension is necessary to increase awareness in conservation, about the disastrous results of the misuse of the natural resources, not only for the present but also for future generations.

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Appendices
Plate 1: Sand movement towards agriculture land

Plate 2: Sand dune movement at degraded area
Plate 3: The domination of *Panicum turgidum* and *Colcynthis vulgaris* (Tomam and Hanthl trees) in the degraded area

Plate 4: Local method for sand dune stabilization (By using Leptadenia branch)
Plate 5: *Leptadenia pyrotechnica* potentiality in stabilizing sand dune movement

Plate 6: Sand movement stabilizing by the *Panicum turgidum* (Tomam grass)
Plate 7: The canals cover by the sand dune movement

Plate 8: The adverse effect of grazing on planted trees (Eucalyptus SP)
Plate 9: Polluted water sources