Socio-economic Impacts of Drought and Desertification on the livelihood on farmers and pastoralists in El Duiem Locality, White Nile State, Sudan

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DEDICATION

I dedicate this work to my

Mother and father and all family

And for my wife Nada

With love.

ACKNOWLEDGMENT

First of all I would like to thank Allah, the bountiful for the gift of health and strength which He has granted upon me, and with which I could have carried out this work. Secondly, I would like to thank Dr. El wasila Mukhtar for his helpful, invaluable criticism, and kind patience throughout this work, as well as I would like to thank the natives of the White Nile for their generous hospitality that made all the interviews smooth and possible .Finally, I would like to express my thank to the staff and members of Desertification and Desert Cultivation Studies Institute.

ABSTRACT

The White Nile State is one of the states, which were severely affected by drought and desertification, and El Duiem Locality is among those areas. This study focused on the socio-economics impacts of drought and desertification on the livelihood of farmers and pastoralists in that area. The main data of the study was obtained through direct interviews using questionnaire in May 2008. A multi-stratified random sampling procedure was used to select 8 villages from 4 units in both the less and the more affected areas by drought and desertification, and then quota sampling was adopted to select the farmers and the pastoralists from each village to have a total sample size of 100 farmers and 73 pastoralists, in addition to collect secondary data from related sources. The research had come to a conclusion that drought and desertification had resulted in migration and some conflicts between farmers and pastoralists, lack of food and water. The prevalence of poverty made the farmers and pastoralists practice a number of occupations, and selling their animals to cope with the state of income insufficiency. The occurrence of migration among the farmers was more than among the pastoralists. There were significant differences in income among farmers in the less and more affected villages, but there were no significant differences in the other socio-economic characteristics under consideration. Also there were significant differences among pastoralists in secondary occupation and income, but there were no significant differences in the rest of socio-economic criteria considered in the less and the more affected villages. The desertification and drought in the study area lead to decline in

productivity of the main crops. Desertification and drought also lead to deterioration in the rangelands productivity and species compositions, which led to decrease of animals numbers. There were significant differences in the number of animals per household before the drought of 1983/84 and in 2007. The study recommended rehabilitation programme, awareness about environment problems, establishment of shelter belts, improves basic services and the need to conduct further studies of the problem to face these deteriorated situations.

الخلاصة

ولاية النيل الأبيض من أكثر الولايات تأثرا بالجفاف والتصحر وتعتبر محلية الدويم ضمن هذه المناطق المتأثرة بالجفاف والتصحر. هذه الدراسة أجريت لتحديد الآثار الاقتصادية والاجتماعية للجفاف والتصحر علي معيشة للمزارعين و الرعاة في المنطقة. البيانات الرئيسية تم الحصول عليها من الحوار بواسطة الاستبيانات التي ملئت في مايو 2008م باستخدام العينة العشوائية الطبقية المتعددة المراحل لاختيار 8 قري من 4 وحدات في المناطق الأقل والأكثر تأثرا بالجفاف والتصحر، ثم العينة المتيسرة لاختيار للمزارعين و الرعاة من كل قرية ليكون العدد الكلي لحجم العينة 100 مزارع و 73 راعي ، إضافة للبيانات الثانوية التي جمعت من المصادر ذات الصلة. وخلص البحث ألي أن الجفاف والتصحر أدي إلي الهجرة و النزاعات بين المزارعين و الرعاة و نقص الغذاء وشح المياه و انتشار الفقر و جعل المزارعين و الرعاة يما رسون عدد من الوظائف الثانوية و يقومون ببيع حيواناتهم للتأقلم مع عدم كفاية الدخل. حدوث الهجرة وسط المزارعين أكثر من الهجرة بين الرعاة. هنالك فروق معنوية في الدخل بين المزارعين في القرى الأقل والأكثر تأثرا بالجفاف والتصحر ولا توجد فروق معنوية في باقي الخصائص الاقتصادية والاجتماعية تحت الدراسة، هنالك فروق معنوية بين الرعاة في الوظائف الثانوية و الدخل وليس هنالك فروق معنوية في باقي الخصائص الاقتصادية والاجتماعية تحت الدراسة في القرى الأقل تأثرا والأكثر بالجفاف والتصحر. ايضا هنالك فروق معنوية المزارعين و الرعاة في الهجرة ، نقص الغذاء ، الدخل ، كفاية الدخل و الوظائف الثانوية . أدي الجفاف والتصحر في منطقة الدراسة ألي انخفاض إنتاجية المحاصيل الرئيسية. أدي الجفاف والتصحر إلي تدهور إنتاجية المراعي ونوعية النباتات الموجودة في المراعي و أدي هذا إلي نقص في عداد الحيوانات لكل اسر المزارعين و الرعاة، عند مقارنة أعداد حيوانات الرعاة قبل و بعد جفاف عام 84/ 1983 نلاحظ أن هنالك اختلاف معنوي بين أعداد الحيوانات لدي ألاسرة في القرى الأقل والأكثر تأثرا بالجفاف والتصحر.

أوصت الدراسة ببرامج إعادة التعمير، التوعية بمشاكل البيئة، إقامة الأحزمة الشجرية، تحسين الخدمات الأساسية للمواطنين، مزيد من الدراسات للمشكلة لمواجهة تلك المتردية.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The phenomenon of desertification, as a process of land degradation in arid, semi-arid and dry sub-humid areas, had attracted considerable global attention from international and national bodies during the past three decades. It became an international issue only in the 1970s, largely because of the global concern about the devastating effect of the prolonged spells of drought that hit the Sahel region of Africa during the 1960s and the early 1970s and their associated famine (Saeed and Salih, 2004).

Desertification is a major environmental problem with adverse socio-economic impact, particularly in the arid and dry sub-humid land of developing countries (Odingo, 1990).

Desertification in Africa, as elsewhere, reduces the productivity of land and deprived people from biological resources that are important for sustenance. Their impacts , in turn , lower income (and subsistence levels) of hundreds of millions of already poor , dry land's peasants , herdsmen and urban people who form a part of the same economy , prolonged periods of drought under these circumstances lead to hunger , malnutrition and starvation, high infant mortality and accelerated migration (IPED ,1994).

Desertification and resource-scarcity can provoke social unrest and political and armed conflict. With continuing degradation and increasing scarcity of natural resources, the remaining resources are likely to become a potent source of conflict among communities and countries in the African dry-lands (Ghai, 1992).

Desert encroachment is a serious problem for economic future of the Sudan. An area of nearly 650,000 Km^2 is affected by several forms of desertification includes moving dunes , depletion of soil fertility declining of agricultural yield , reducing rangeland and shrinkage of fuel wood resources . Affected areas includes Nile irrigated schemes, gum Arabic production, a wide range of live stocks and vast area of wood lands, population in the affected areas is more greater than 4.5 millions, essentially traditional farmers and nomadic pastoralists. Immigration on either a permanent or seasonal basis is already taking place as an out-come of drought and desertification, causing deterioration of the infrastructure of abandoned areas (Ahamed , 1991) .

1.2 Problem Statement

El Duiem Locality suffered from desertification process like sand encroachment and wind erosion which led to loss of soil fertility and accumulation of sand over fields in irrigation canals in the farm not far away from the Nile .These processes led to reduction of crop yield , shortages of food and economic losses . The result of shortage of food and cash has made the population of the area search for supplementary income-earning opportunities through part-time jobs in the area or migrate to other part of Sudan.

Drought and desertification endangered rain-fed agricultural production, grazing land, led to decrease in the animals numbers, and made the pastoralist migrate away to search for drinking water and pasture in dry seasons. The scarcity of water and pasture in the area as a result of drought and desertification led to clashes and conflict between farmers and pastoralists.

1.3 Justification of the study

This study contributes to understand the socio-economic impacts of drought and desertification in the west White Nile, which is considered among the most affected areas, the area suffered from frequent drought such as that of 1983/84. Desertification in the area is not unique and remains as a complicated problem similar to many other areas in the country or in the world as a whole. Desertification is regarded as the first environmental threat that poses a real constraint to achieving sustainable agricultural development. Most population live in the White Nile, depending on agriculture to make living , and when drought comes agriculture collapses , people migrate, and those who stay face food shortage, conflict over rangeland and water. The farmers and the pastoralists are most affected people than the other population

The complexity of the problem in general, and it's significant consequences on the environmental, social, ecological aspects altogether linked with undefined research strategy, raised the need for research plan action to address this topic . Desertification related research in the White Nile state is rather poor and limited if compared with Kordofan to Darfur states.

1.4 Objectives of the study

The main objectives of this study is to assess the socio-economic impacts of drought and desertification on the farmers and the pastoralists in El Duiem locality in the west White Nile State, however the specific objectives of the study were :

1- To assess the effects of drought and desertification on the agricultural productivity, rangeland productivity and animals production.

2- To assess impacts of the drought and desertification on conflict, migration, education, water shortages and food security that took place in the area.

3- To develop some policy recommendations that can help in combating the negative impacts of drought and desertification in the area.

CHAPTER TWO

LITERATURE REVIEW

2.1. Definition of desertification

Environment department of the World Bank quoted by Mustafa (2007) defined desertification as : " the process of sustained land (soil and vegetation) degradation in arid, semi-arid and sub-humid areas caused of at least partly man it reduces the productive potential to extent that it can neither be readily reversed by removing the cause nor easily reclaimed with out substantial investment " . It was also defined as: “land degradation in arid, semi-arid and sub-humid areas resulting mainly from adverse human impact " (Dregne et al ., 1991). The most widely accepted definition is "land degradation in arid, semi-arid and sub-humid areas resulting from various factors, including climatic variations and human activities" (UNCED, 1992). The latest definition by UNEP (1997) stated that "Desertification is a consequence of people's efforts to use natural resources in environments that are highly susceptible to natural variability"

2.2. Definition of Drought

Drought means the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded level, causing serious hydrological imbalances that adversely affect land resources production systems (Salih, 2007).

The severity of drought depends on the degree of moisture deficiency and its duration, and the size of the affected area. Successive droughts eventually

evolve into wide spread desert encroachment in certain localities and over large land expanses. Specifically, there are four ways to define or sort droughts:

1-Meteorological: this is a measure of departure of precipitation from the normal due to climatic differences .What considers drought in one location may not be drought in another location .

2-Agricltural: this refers to the situation when the amount of moisture in soil is no longer meeting the needs of particular crop.

3- Hydrological: This occurs when the surface and sub-surface water supplies are below normal.

4- Socio-economical: This refers to the situation that occurs when physical water shortage begins to affect the standard of living of people (Saeed and salih, 2004).

2.3 Food Insecurity

Food insecurity is uncertain ability to meet immediate food needs. Food security is defined by the world bank as " An access by all people at all time to enough food needed for an active and healthy life " and by the FAO as "ensuring that all people at all time have both physical and economic access to food they need " (Nur and Salih ,2007)

The types of food insecurity are the following**:**

a. Chronic food insecurity: permanent inability of individuals to maintain adequate food supply . This occurs in marginal land among small crop producers, small herders and the land-less.

b. Temporary food insecurity: This type result as a sequence of climate and price variability. Recurrent drought is among the main factors leading to temporary reduction in food supplies. Temporal food insecurity may develop into famine in extreme cases.

c. National food insecurity: inability of the whole society to supply its adequate food needs at the aggregate level.

d. Individual / Household food insecurity: inability of individual or household to have access to their adequate food need despite it's availability at the national level (Nur and Salih, 2007).

2.4 Conflict

Definitions of conflict may include the following

- A clash of interest, values, actions or directions often spark a conflict. Conflict refers to the existence of clash.

- It is a battle between two or more parties in specific area for specific period of time, on the other hand civil war or war is a battle between two or more groups of people in larger area and longer interval of time. One of the causes of conflict is competition for utilization of natural resources, e.g between farmers and range managers /pastoralists or between a group of settled people and intruders, or between the originally settled people and displaced persons (Nur, 2007).

Conflict research indicates that ecological degradation is unlikely to trigger an escalation of violent conflicts in its own right (Bauer, 2007).

2.5 Migration

According to the international organization for migration (IOM, 1996) (persons who are displaced within their own country of habitual residence or who have crossed an international borders and whose environmental degradation , deterioration or destruction is a major cause of their displacement , although not sole one).

The intricate linkage of soil degradation, agricultural production, food security and poverty, many household members may as a consequence of desertification leave their homes and seek to supplement the income of their families through cash remittances. Other may even be uprooted with their whole families and decide to migrate in order to survive. In fact, it is one of the key findings of the Millennium Assessment that recurring drought and land degradation are predominant factors in the movement of people from dry-land to other area (Bauer, 2007).

2.6 Link between Drought, Desertification and Climate Change

Drought often triggers desertification, but human activities are usually the significant factors causing desertification on vulnerable land (UNEP, 1997).

Desertification is often confused with drought, although they are both prevalent in dry lands and appear to cause similar sorts of damage, they are both entirely distinct phenomena. Desertification is a process of ecological degradation of dry land resources systems that is slow and insidious. It is caused by a combination of the inherent ecological fragility of the land and water resources that for the life-support systems of dry land societies, and subsequent pressure put on these resources through overuse by societies.

Recurrent drought is one of the causes of the inherent fragility of the resources system. But drought is natural hazard caused by rainfall failure which is itself a characteristic of dry land climate .Incidences of drought are irregular and unpredictable and damage caused is sudden and often dramatic.(Kassas,et al ,1991)

Climate variation is natural variation in main elements of the climate that characterizes the arid, semi-arid and sub-humid land such as drought periods, winds speeds, rainfall amount, frequency and intensity. While climate change is permanent change in these elements resulting in an increase or decrease in areas of the climatic zone. The link between climatic change and desertification are recognized by United Nation Framework convention on climate change , The convention stated that arid and semi-arid zones , which are liable to desertification , are particularly vulnerable to the adverse effects of climate change .Desertification is cause and consequent of climate change . (Mustafa, 2007).

2.7 Causes of desertification:

There are three main causes of desertification, namely, adverse climatic variations, human activities, and climate change (Mustufa, 2007).

According to the FAO (1983), some human activities that causes desertification are:

- Cultivation of fragile lands.
- Reduction in the fallow period of soils.
- Overgrazing in rangeland which consume vegetation.

- Over exploitation of woody resources.
- Uncontrolled use of fire for regenerating pasture and agriculture clearing.
- Agricultural practices that destroy soil structure. (use machine)
- Agricultural practices that in net export of soil nutrients.
- Diversion of rivers to create irrigation scheme ; or
- Irrigation of poorly drained soils that are prone to salinization, alkalinization or even water logging.

All these activities derive from two root causes .The first five activities are typical of poverty and under development , while the rest result from "modern " development that disregards the impact of technologies used on land sustainability (Mubarak , et al ,2007).

2.8 Desertification in the world

About 43 million of irrigated land or 30% of their total area in dry lands in the world's dry lands (145 million ha) are affected by various processes of degradation, mainly water logging, salinization and alkalinization. irrigated lands in dry lands constitute nearly 62% of the total irrigated area of the world (240 million ha).soil scientist have established that the world is now losing annually ,about 1.5 million ha of irrigated land due to various processes of soil degradation , and this is mainly in dry land . Nearly 216 million ha of rain-fed crop lands or about 47% of their total area in the world dry lands (457 million ha) are affected by various processes of degradation, mainly water and wind erosion of the soil, depletion of nutrients and physical deterioration. Rain-fed crop lands in dry land constitute nearly 36% of the total area of rain-fed crop

land in the world. About 3,333 million ha of rangeland or nearly 73% of its the total area in the world dry lands (4556 million ha) are affected by degradation, mainly degradation of vegetation which on some 777 million ha is accompanied by soil degradation mainly erosion. The annual losses of the rangeland within the dry land are around 4.5 – 5.8 million ha and even more if so far unaccounted sand encroachment , urbanization , etc , is to be considered . (Dregne et al., 1991).

Like all major ecological changes desertification may have impacts at three levels; on- site, off -site and global.

On-site impact related to change in:

- Plant growth (reduction of primary production).
- Animal life (reduction of livestock, wild animal).
- Surface deposits (soil erosion, loss organic matter).

Off-site impacts are many and varied including:

- Surface deposits that are transported through water and wind erosion and pile sediment on downstream site of productive lands ,road and water reservoirs
- Suspended particulates (dust) that affect the health of livestock and people reduce visibility.
- Salinized surfaces of deserted irrigated fields become sources of salt particles and may be wind –carried to other productive lands.

- Forced movement people who have to leave the land because their life – support system has deteriorated. These environmental refugees bring menacing pressure to their host sites.

  On global scale the impact of desertification relate to its effects on world food producing capacity, world biodiversity and world climate. (Kassas et al., 1991).

2.9 Drought and Desertification in Africa

According to the UNEP's assessment (1992) 1.9 million ha of irrigated crop land (or 18% of the total area), 48.86 million ha of rain-fed crop lands (or 61% of the total area). and 995.08 million ha of rangeland (or 74% of the total area) in Africa are affected by desertification at moderate or higher level .Three distinct areas of continent are at most-risk like the Mediterranean Africa, the sudano-sahelian region and Kalahari-Namibian region in the southern Africa, one third of Africa is affected by desertification and 73% of the total agriculturally used dry land are degraded. Recurrents drought are a fact of life throughout dry land of Africa ; virtually every year there is drought in some part of the continent, with major drought , regularly affecting large portions of dry land , such disasters occurred in 1968-73,1982-85 and 1990-91 ,causing many countries of Africa to experience substantial food shortage . With each drought cycle, desertification increase (Darkoh, 1998).

The sahel desertification has brought an alarming drop in agricultural production: millet, sorghum and ground-nut harvests have been critically low in Mali since 1970 drought. Production has dropped by 50 -80 % compared to the situation in 1930 and loss per year in income is estimated at US$ 5.7 million .In Senegal, ground-nut production has fallen to 800 kg per hectare since 1991,

having reached 1100 kg per hectare, quarter of a century ago, and the “Groundnut basin “ has moved south wards to less degraded soils. The great drought in the sudano-sahel region of the early 1970s, claimed about 250,000 lives .Millions more were reduced to destitution, provoking mass migration to urban areas in search of work and relief .The 1982-85 drought affected the entire sub-Saharan region. The worst affected country was Ethiopia where an estimated one million people starved to death from the combined effect of drought and civil war, drought has accelerated the migration of farmers from the countryside to cities, putting additional pressure on basic city services such as water and sanitation. (Dorkoh, 1998).

Desertification translates into a spiral of declining production, increasing poverty and diminished potential productivity. Desertification and resources scarcity can provoke social unrest and political and armed conflict .Several governments, have been swept from power by the suffering and unrest associated with drought and famine. (Darkoh, 1998).

In eastern Africa , some 13 million people still rely on food assistance because of the lingering effects of last year drought , coupled with conflict in some parts , the situation is particularly severe in Eritrea , Ethiopia , Kenya and Sudan , where drought have sharply reduced food production and killed large number of livestock . (FAO, 2001).

2.10 Agriculture and Rangeland in the Sudan

The Sudan economy depends largely on agriculture , about 70% of the country's economically active population work in agriculture and about 90% of them live in rural areas .(Hassan ,2007).

The Sudan has an area of 2.5 million km square, includes 200 million feddans suitable for agricultural production and raising animal. Animal wealth is 103 million heads of cattle , goat, sheep and camels .contribution of agriculture in the total out put is about 48% .(Nur and Salih , 2007).

The agriculture depends on two main sources of water –rains and irrigation. The performance of Sudan agriculture has depended very heavily on weather condition .Between 1985 and 1989 average of annual growth rate of agriculture was 5.5% with a decrease of 0.7 % annually in the GDP during the same period. (Gore, 1991).

In the Sudan , the area devoted for range and forestry is about 61.3% of the total area of the country .The total rangeland is about 187 million feddans ,which contribute to about 78 million ton of dry matter compared to 4 million tons by irrigated forages . Rangelands are the main source of food for domestic and wild animals. Most of the meat consumed locally and for export is produced from range animal. Moreover, other animal products such as cheese, milk and ghee are produced from range animals, and assist in meeting pastorals living expenses. It is estimated that 30 to 40% of population in the Sudan are herders who depend totally on an animal to cover living expenses and 90% of livestock in the country is owned by these people .(Abu Suwar,2007) .

2.11 Population growth in Sudan

Population was grown from 10.26 million in 1956 to an estimated 25.6 million in 1993. The annual growth rate has been increased from 1.9% to 2.6 - 2.8. Rural urban migration has been steady and high with urban population growth of 4% in 1983 /1995 and 1.6% in rural areas, with urban population growth from less than I million (854.000) in1956 to 7.5 million in 1993. The nomadic population decreased from 13.7 % to 2.7%. The rural sector constitutes 59%, where as rural nomads and the urban settlers are 11% and 20% respectively. The average of annual growth rate is 2.8% .This trend of high rural /urban migration is due mainly to the reoccurring drought, the frequency of which is becoming shorter, civil conflict and declining development investment and budget cuts in the rural areas. (Salih, 2007).

2.12 Drought and Desertification in the Sudan

The Sudan is one of the most seriously affected counties in south of Sahara by desertification and recurrent droughts. (Goda, 2007).

The dry land of Sudan are about 234.4 million ha constituting about 94% of the total area of the country. Out of this area 77.6 million ha are hyper-arid leaving 156.8 million ha for the arid, semi-arid and dry sub-humid or 63% of total area of the Sudan which is prone to different degree of desertification. (Ayoub, 1998).

According to Salih (2007) the area prone to drought risk and desertification are confined to five ecological zones between latitude 10-18 N and there are :Desert , semi-desert , low rainfall savannah , high rainfall savannah and

mountain .The total area prone to desertification hazard is amounting to 1,259.8 million sq.km ^{2} and represent 50.4% of the total area of the Sudan .

An estimated 50 to 100 km southward shift of the boundary between semi-arid and desert since rainfall and vegetation records were first held in the 1930 .This boundary is expected to continue to move south-ward due to declining precipitation .The remaining semi-desert and low rainfall savannah on sand , which represent some 25% of Sudan agricultural land , and at considerable risk of further desertification . This forecast led to a significant drop (approximately 20%) in food production. (UNEP, 2007).

Major causes of soil degradation are overgrazing (47%), improper agricultural practices and mechanized rain-fed agriculture (23%) , deforestation for fire wood and over exploitation of vegetation for domestic use (12%). (Ayoub, 1998).

2.12.1 Impacts of Drought and Desertification in the Sudan

Most of the Sudan falls within the Sahelian Belt which is periodically affected by droughts. These droughts have become severe during the past two decades. The first drought started in 1969 and it reached the peak in 1973 .The second one started during 1982/83 period. During 1982 /83 , 1983/85 and 1986/1987 periods of agricultural production was very low , the most severely affected regions being Darfur ,Kordafan and the Red sea province In Eastern region . These regions are already characterized by chronic malnutrition, through it is common everywhere in Sudan .These droughts also contributed to accelerate in process of the desertification, to large reduction and losses of livestock in addition drought creates lack of employment opportunities in the

affected area, with result that large movement of people takes place. (Gore, 1991).

The drought that covered the whole country in 1984 led to the death of lots of trees and removal of some by the wind in semi-desert belt and the low rainfall savannah , soil exposed to erosion , people have adapted to this situation by expanding their agriculture land in the area used as pastures to increase production to face families' need for food and cereals .some of them , especially the poor one cut trees to have fuel wood and charcoal as resources of income that influence the increasing ratio of vegetation removal and exposed more area to erosion .(AOAD, 2002) .

The crisis of 1984-85 uprooted large segments of rural population and result in depletion of their assets and in stress migration into urban area , future food price explosions (in the context of another drought) will hit these people even more earners without degrees of freedom to cope . (Teklu,etal , 1991).

Poor grazing and health condition , which worsened in 1984 , resulted in large livestock losses .The period of 1984/85 witnessed a sharp decline in growth rates of herds due to high mortality rates , distress sales , and low birth rates .(Teklu ,etal , 1991).

Recent surveys have revealed that most of the rain-fed agricultural land between latitudes 17 and 15 degree north is lost to desertification , due to movement of sand from Libyan desert (FAO Mission report 1976) .The length of the Nile between Dongola and Kariema is also affected by sand dune encroachment and sand drift which are engulfing productive agricultural land and human settlements(UNEP ,2007).

The Gezira scheme is now almost completely surrounded by bare, flat soil , and encroaching sand threatens the scheme , sand encroachment affects the Gezira scheme in the following ways :

- Soil : Desertification has changed the chemical and physical characteristic , chemically by adding nutrient –poor silicon material (sand) to fertile clay top soil and physically , by altering the top soil , it clay texture and structure , towards those of sandy soils.

- Irrigation : Deposited soils has changed the level of irrigated lands .

- Filling of the irrigation canals with sand by severe windblown sand (Ahamed ,2000).

Food production has declined and is continuing to decline because of soil deterioration associated with desert encroachment and because of the loss of land, especially the land buried by sand. Production data of kordafan province indicates that the acreage needed to product 73,000 ton of groundnut in 1973 was almost five time that needed in 1961 , and the decrease of sesame production was approximately in proportion of 20 to 1 during the same period . In terms of productivity sesame producers have lost , during twelve , 19 feddans out of 20 and groundnut producers have lost 4 out 5. Dura (sorghum) production has declined from 424 kg / feddan in 1961 to 191 kg / feddan in 1973 and maize and dukhan (millet) yield have declined from 333 kg and 542 kg to 154 kg and 71 kg /feddan respectively during the same period. Meat and milk production are only a fraction of the area’s potential . Annual off take for cattle is 6-8% compared with 38-40% in U.S. , and that for sheep is 15-20 % . This is due to inadequate nutrition caused by overgrazing and desertised rangeland. (DECARP, 1976).

The yield of groundnut decrease from over 1000 kg / ha in early 1960 to around 600 kg /ha in the early 1990s. Sorghum yield decrease from about 900 kg /ha to about 50 kg /ha , millet decreased from 600 kg /ha to 250 kg /ha and sesame decrease from about 400 kg /ha to 200 kg /ha during the same period . The decrease in yield were greatest for millet and sesame (50%) . The correlations between yield and season were highly significant at the one percent level .Sesame and millet yield had the highest negative correlation with the years of cropping namely -0.906 and –o.831, respectively. These yields reductions were attributed to land degradation and desertification processes. Ayoub (1999) attributed food insecurity in North Kordofan, North Darfur, West Kordofan and West Darfur states to wind erosion and nutrient depletion. Severe food insecurity in the red Sea Hill area was attributed to water and wind erosion. (Mustafa, 2007).

Drought has caused large movement of people into major towns, large movement had also taken place to irrigated areas such as Gezira and Rahad , where hundred of thousands have left their home in western Sudan and migrated in search of living. Those left behind survive on subsistence agriculture which is barely able to meet their needs, and are therefore susceptible to recurrence drought . The livestock owners in drought affected areas had also suffered seriously. It is estimated that in Darfur and Kordofan over half of livestock population was lost and 90% in Red Sea provinces. (Gore, 1991).

The main response of the nomads to drought hazard is migration to where water and grass are available, the adversity of drought had forced the nomads in the mid-1980s to migrate further south to humid and hostile environment to their animals. Some nomads have started to grow some crops for their own

consumption, after losing sizeable number of their animals, they also work as agricultural laborers in agricultural schemes (Ibrahim, 1991).

In certain areas the drought produced change in the mode of life, for example in Red Sea province it observed the growth rates in the province were different for the urban, rural nomadic population grow at 4.5% and 8.8% respectively. The rural settled population had an annual rate of -4.2% in the inter periods 1973-1983. The major factor in reduction of rural settled population was the drought which occurred just before 1983, which continued until 1985. This partially explains the high rate of growth of the nomads and negative rate growth of rural settled population. (Gore, 1991).

The nomads had their suffer from desert encroachment .They had to adapt more quickly than cultivators to the changes of physical environment. It is the usually practice among nomadic groups for migration cycles to change from year to year because of rainfall and pasture failures .This often bring them into cultivation and grazing territories of other population groups , resulting in confrontation , blood –shed and loss of human life and livestock (DECARP, 1976).

The UNEP's analysis indicates that there is a very strong link between land degradation, desertification and conflict in Darfur, Northern Darfur, where exponential population growth and related environmental stress had created the condition for conflict to be triggered and sustained by political, tribal or ethnical differences can be considered a tragic example for the social breakdown that can result in ecological collapse. (UNEP, 2007).

Local clash over rangeland and rain-fed agricultural land had occurred throughout the Sudan recorded history. Conflict, displacement and food

insecurity are three most issues facing the Sudan. Natural and partly manmade disasters such as drought; desertification and floods are major contributing causes to these problems (UNEP, 2007).

A drastic decline in food availability in rural area and the related movement of people into urban area have probably led to major decline in real wages and employment for those who where already urban residents and dependent on employment in services jobs at lowest income brackets .This is to say that the food production crisis has probably been transmitted into urban areas not only via its widespread price effects on urban labor markets. Certainly the massive influx of drought victims into the urban and peri-urban areas should have contributed to increased inequality of income in the 1980. (Teklu etal ,1991).

While the Sudan traditionally faces a problem of extreme fluctuation in stocks, there also seems to have increase in these fluctuation in the 1980 s. Food availability per capita declined notably between 1970 and 1986 . The annual growth rate was significant – 1.4 precent, largely reflecting the low growth in production relative to population, the trend diminished (-0.7 per cent) when the effect of the 1984 drought is controlled for, which evidences the story adversity of the drought-production effect on cereal consumption. Average per capita cereal consumption dropped from a high of 100 kilograms in 1976 to 78 kilograms in 1983 and to 51 kilograms in1984 .The years 1985 and 1986 witnessed marked recovery but not to the magnitude of the per famine level . (Teklu et al, 1991).

The main factor causing food insecurity in Sudan are climatic and manmade factors as the following :

- The Sudan is characterized largely as a dry or semi- dry country. In 6 out 15 year production levels fell below consumption needs. So far, the country experienced cyclical droughts, three floods, and several out-breaks of migratory pests such as desert locust and Quela birds eating the staple food crops.

- Policies and programs neglect the traditional agriculture and traditional farming areas.

- The different conflict in the Sudan.

- Mass displacement of the population.

- Weak institutions providing social and economic services. (Nur and Salih, 2007).

In the Sudan drought is the main reason causing the breakdown of the primary production system , in addition to pest , fires and other hazards , the breakdown of primary production system (especially farming or livestock systems) , result in major loss of output .It may also imply a loss of productive capital and recovery capability (e.g breeding livestock , seed or trees stock , tools , perhaps , soil fertility). (Hassan, 2002).

2.13 Desertification and Drought in the White Nile:-

The White Nile State is considered among the most affected area in the arid and semi-arid zones. It seems that the climate condition in addition to the pattern of the resources utilization is greatly linked to these problems. The domination of the open grazing system of livestock raising traditional agricultural practices and traditional water distribution contributed greatly to

these problems. Desertification in general is not unique and may not differ greatly from other affected area in the Sudan, but it seems to be more severe here due to the above mentioned reasons. (Gaiballa and Farah , 2004).

The successive drought periods , which occurred in the White Nile during last three decades , resulted in repeated crop failure , deterioration of rangeland , dried up surface water great loss of livestock , and after that families were forced to migrated to the urban area in the states , irrigated agricultural scheme in Gezira , or Khartoum . Desertification as associated with drought is considered as real problem in the state , interferring with livelihood , mainly social stability and food security of local communities . (Gaiballa and Farah , 2004).

2.14 Drought and Desertification in El Duiem Locality:

The White Nile State is among the states, which are mostly affected by wind erosion, particularly the northern part of El Duiem, El Geteina and the western part of Kosti localities (Alwia, 2000).

FAO (1986) reported that during the last few years moving sand reaching the White Nile pumps schemes, covered villages clogged canals and made irrigated agriculture difficult or impossible in some areas. Desertification in White Nile state led to sedimentation of canals and coverage of fields with sand, reduction in crop area and low productivity, which reduced tenant income and hence resulted in food deficiency and non -sustainable development in the area.

The West of White Nile is a region with a very high risk of desertification and drought and experienced a great deal of rural change over the last five decades. El Duiem area had faced severe droughts in recent years, and this has

had fundamental impact on agriculture. Farmers at Arashkol who grow just sorghum and millet claim to have formerly grown other crop such as sesame as well. Drought was said to be a significant factor in the trend towards sorghum and millet. Rain failure can be serious on the irrigation schemes as they are dependent upon rainfall in July when the Jebel Aulia reservoir is usually too low for the pumps to be effective. The effect of drought on livestock has regional variations, drought is considered more serious at Arshkol than at Esh Shuqeiq. In drought years both area widely use ombaz as fodder. However, at Arshkol there are fewer extensive pastures close at hand and so greater movement for grazing required, and this in itself has a deliterous effect on livestock. Increase numbers of cattle in the Arshkol area in recent years, and concentration on them rather than on sheep and goats, exacerbates the situation, as cattle need better pasture, and with pasture deterioration, they suffer more than the hardy sheep and goats. This situation affects livestock kept by irrigation farmers , since cattle are abundant in the south of the White Nile, when necessary they are taken to El baja by the village shepherds, but one mitigating factor there is that schemes herd's tend to be smaller and less important economically than their rain land counterparts . On irrigation scheme desertification is potentially most serious where sand dunes are adjacent to hawashas, where blowing sand change the nature and composition of soil and reduces its fertility. Sand cover makes the soil of clay plain more permeable, increasing the demand of water (Tribach, 1986).

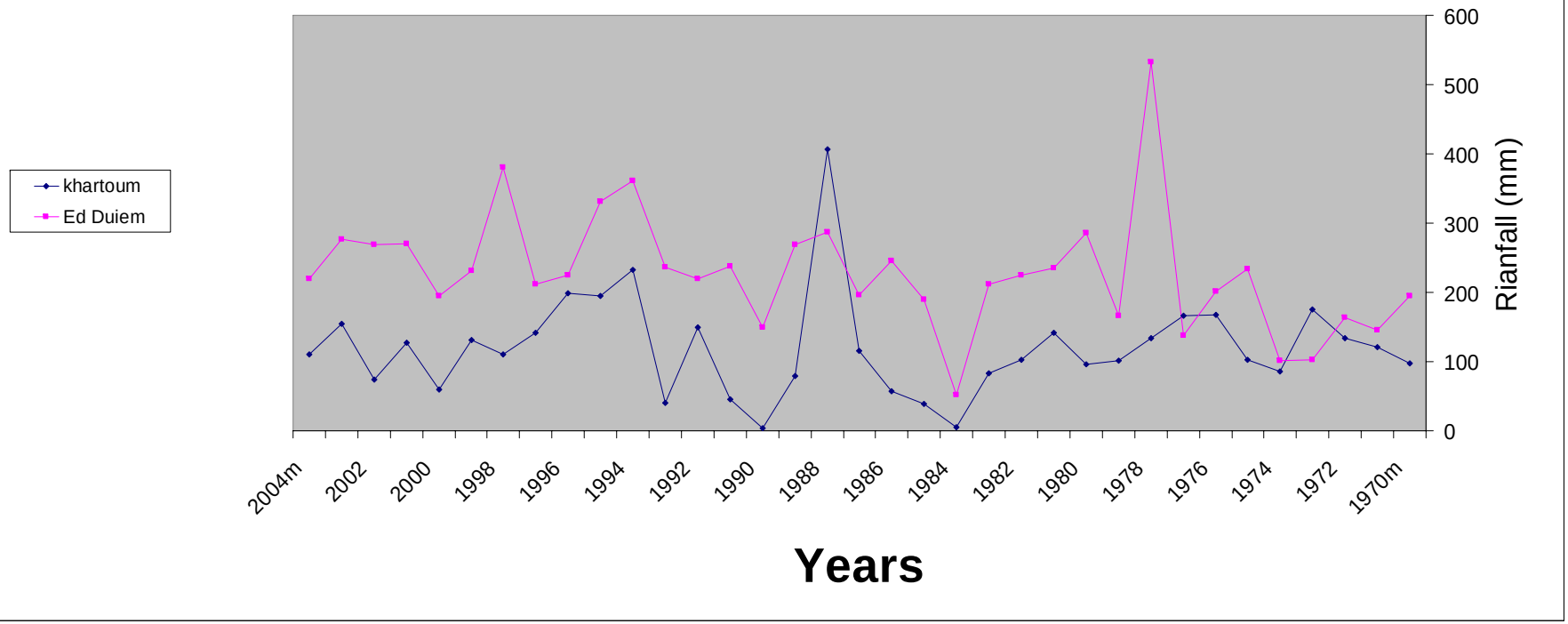
2.14.1 Climate in the El Duiem locality:

The climate of the white Nile falls into the arid to semi-arid. Arid condition prevails in north where annual rainfall is100 mm and insufficient to support significant natural vegetation and rain-fed crop production is not attempted , in south the rainfall approaches 500 mm and vegetation is more visual and rain-fed cropping is an annual features of the landscape (IFAD, 1992).

The dominant climate is semi-arid tropical climate, with short rainy season (June –September) low mean and annual variation. Recent drought has resulted in general decrease of rainfall (figure 1). The average annual rainfall for Ed Dueim had declined from 330mm (1921-1950) to 248 mm (1960-1995) (Plan , 1991).

The wind speeds for most of the year are generally gentle but reach gusty proportions during the hot dry summer season giving rise to haboobs which are severe dust storms, wind during this period cause movement of unstabilized sand dunes causing damage to agricultural land, infrastructure of the villages (Parry, 1986).

Figure (1) : Annual Rainfall in Khartoum and Ed Duiem (1970- 2003) -



(Source: Khartoum Metrological office)

2.14.2 Geology and soil of El Duiem locality :

In only a small portion of the area there are solid rock formations known to crop out and these belong to either the Basement complex or Nubain sand stone series. The more recent superficial deposits in the area fall conveniently into three groups: Um Ruwaba series, the Qoz sand and clay deposits. The main out-crops are the three main hill masses (Jebel Arashkol, and Jebel Tuyus) with their surrounding pediments. Qoz means sand dune or sandy soil found in the area west of clay plain , there are two types of dunes , longitudinal and traverse, both of which to day blow predominantly during the winter months (Musa ,1986). The major landform in White Nile State identified are made up principally of vertisol soil group of alluvial clay plain and fans with smaller area of entisols and aridisol of Aeolian sand (IFAD, 1992).

The soils west of the white Nile have developed on flood plain and recent terraces of former courses of the White Nile , other soils further west includes those formed on stabilized sand dunes and on wadi alluvia . flood plain soils are fine texture with clay sized material forming dominant particles size , slowly permeable cracking soil , the soil generally belong to vertisol group. Qoz soils are mainly associated with stabilized sand dunes but where cultivated are frequently exposed to wind erosion , the physical and chemical properties of these soil indicate infertility , which give them regosol classification ,they are quite suitable for millet and often for ground nut cultivation , even with low amount of precipitation (Musa ,1986).

2.14.3 Rangeland in El Duiem Locality:

Ed Dueim area was almost entirely classified as semi-desert , a part from the area around Ed Dueim , which was classified as woodland savanna

with low rainfall the trees recorded in Ed Dueim area were :Sunt (Acacia Nilotica) , sail (Acacia Tortilis) , Talh (Acacia seyal) , Marakh (leptadenia spp) , Kitir (Acacia mellifra) , heglig (Balanites aegyptiaca) , and sidir (ziziphurs spina –Christi) . The grasses and shrubs such as : Gaw (Aristida spp) , Senna Makka (Cassia acutifolia) , water hyacinth (Eichhorinia crassipes) , haskaneet (cenchrus bifforus) and Tumam (Panicum turgidum). (Alame Din, 1986).

With the increase in the number of the human and animal population over cultivation and overgrazing took place. The situation was aggravated by cutting of trees for wood for domestic energy, construction, and charcoal making. As a result severe degradation of the plant cover has taken place, A marked feature is the disappearance of trees including Acacia Seyal and Acacia tortillis , on which goats and camel like to browse , from all the white Nile area except the beds of some wadis .Also famous species of grass and herbs ,such as Siha (Blepharis spp) and hanted (Ipomea cardiosepala) have disappeared . However where cultivation is not practiced the perennial Gaw (Andropogon gayanus and Aristida funiculata) covers wide areas, which are thus protected from desertification. This is because Gaw is a hardy perennial grass providing good grazing when it is green, but is largely unpalatable and avoided once it has become dry, with the result that it is rarely susceptible to overgrazing . It’s chief enemy is the rainland cultivators. In the area where Gaw or other similar plants are not dominant moving sand may present a real threat to irrigated area (Khogli, 1986).

Because of overcutting and comomitant drought the species like Saha (Maerua crassifolia) was affected, the herb (Siha (Bagil) (Blepharis lineriform) is believed to have disappeared from El Baja . There are some plant species believed to be on decrease as affected by over grazing and seasonal fires such

as (Om asabe) (Dactyloctinium aegyptium) and Difra (Echin ochloa colonum) . On the other hand species that have been observered to be on the increase since they are unpalatable include the following cymbopogon nervatus (Nal), Cymbopogon proximus , Abutilon pannosum (hambank) , xanthium brasilium , Ranmtouk and sonchus cornutus (moleita) (table 2.1) (Balla, 2005).

The number of livestock in El Duiem locality according to 2002 census by animal wealth office in El Duiem locality is 2,922,182 heads of cows, 57,432 head of sheep, 960,947 head of goats and 870,310 of camels. All the animals feed on natural rangeland and crop residues and water melon. the rangeland area estimated 714.288 hectares and there is deficit in rangeland estimated about 499,300 tons of dry matter , 291,800 tons of digestible matter , and 24,000 tons of digestible protein (table 2.2) (AOAD, 1996).

Table (2.1) plant species in Al Baja area

Local Name	Scientific name
Seyal (trees)	Acacia sub radiana
Kitir	Acacia mellifra
Sider	Ziziphus spinachriste
Loat	Acacia nubica
Osher	Calotropis procera
Sunt	Acacia nilotica
Tondob	Capparis decidua
Marekh	Leptadenia pyrotechnica
Hegleag	Balanites aeyypfraca
Sarah	Maerua crassifolia
Hibal	Combretum glutinosum
hashab	Acacia Senegal
Siha (Bagil) (grasses and herbs)	Blepharis spp
Gaw	Aristida mutabilis
Tomam	Panicum turgidum
Haskaneet	Cenchrus ciliaris
Haskaneet khishin	Cenchrus biflrous
Shara	Tragus spp
Gibaish	Areva javonica
Difra	Echinochloa colona
Simsim al gimal	Sesamum alatum
Dahyan	Farsetia longisiliqua
Nal	Cumbopogon nervatus
Om simama	Aristida pallida
Handal	Colocynthus vulagaris
Sana maka	Cassia sama
Tagtaga	Crotalaris spp
Mahreeb	Cumbopogon. proximus
Banu	Eragrostis spp
Abu assabi	Pactyloctenium aegyptium

Source: AOAO.1996

Table (2.2) the budget of fodder in El Baja area (1000 tons)

	Dry matter	Digestible	Digestible Protein
The total animal need	894.0	491.7	34.3
Available feed	394.7	199.9	10.3
deficit	499.3	291.8	24.0
Self sufficient per centage	44.2	40.7	30.0

(Source : AOAO.1996)

2.14.4 Agriculture in El Duiem Locality:

Agriculture is the single most important economic activity in the Sudan. From earliest historical times the banks of the Nile have been cultivated and in the central and southern regions heavy dependence has also been placed upon rain-fed cultivation, this basic pattern remains today, but significant changes have taken place to modify the situation of particular importance has been the introduction of large schemes over the past 60 years especially in the white Nile and the Blue Nile. There are three agricultural zones from east to west, parallel with the White Nile River.

a. Irrigated agriculture in clay plain : which is divided into :

(i) The seasonally flooded the white Nile flood plain (gref) .

(ii) The small private irrigated pumps schemes and large one run by government.

b. Rain-fed agriculture on flood plain: is adjacent to flood plain, traditionally this area used for the rain-fed cultivation of millet and sorghum.

c. Rain-fed agriculture on the qoz : immediately to the west of the plain is the vast expanse of sandy qoz the main crop are dukhn (millet) ,and sesame . The qoz is the main area for livestock rearing , and its large pasture (El Baja) are visited in kharif by numerous nomadsowed herds , as well as by those belonging to farmers on riverain and rain land (Trilsbach ,1986).

Some of the results of the last period of drought and desertification are change that happened to traditional rain-fed agriculture . in this regard ,the area used by the individual family increased , as the properly increased from 14 hectares to 28 hectares. Cropping concentrated on Dukhn and sesame (mainly on sand soil).The changes in areas of cultivation is accounted for by reduced productivity, and the family to produce surplus which can stored to be used in similar periods of drought in places where rainfall is variable (table 2.3). (AOAD, 1996)

Table (2.3) Effect of drought on production of Dukhn and sesame in Ageedat El Tire in El Duiem Locality (Kg/hectares)

	Before drought		After drought	
crop	Good rainfall	Fair rainfall	Good rainfall	Fair rainfall
Dukhn	643.514 (2.7sack/fed)	301 (1.26 sack/fed)	321.129 (1.33 sack/fed)	108 (0.43sack/fed)
Sesame	693.383 (2.9sack/fed)	321 (1.35sack/fed)	335 (1.4 sack/fed)	128 (0.54sack/fed)

Source: AOAD, 1996

Table (2.4) shows the cultivated area and productivity of the main crops in irrigated agriculture in El Duiem locality during 1996- 2001 , when the average productivity was found to be 1.756 guntar / feddan , 3.8 sack / feddan and 2.1 sack / feddan for cotton , sorghum and wheat respectively.

Table (2.4) crops areas and productivity in El Duiem locality

crop	Cotton		sorghum		wheat	
season	Area feddan	Productivity (Quntar/fed)	Area (feddan)	Productivity Sack/fed	Area (feddan)	Productivity (Sack/fed)
1996/97	14,533	2.44	19,645	4	3,372	2
1997/98	14,598	2.01	28,520	4	4,980	2
1998/99	9,691	2.10	12,264	3	6,051	2
1999/20000	2,100	0.42	34,104	2	6,051	2
2000/2001	1,042	1.8	19,490	6	1,246	2.7
Average		1.756		3.8		2.1

Source : El Duiem Agriculture production management (2001)(Mona , 2003**)**

In El Baja area in El Duiem locality the cultivated land average is 34 Mukhamas per family (59.5feddan), Dukhn and dura are food crops grown to meet the family needs and some is stored in traditional stores called (Matamir) to be used in urgent time. Water melon is of many uses and products, water for man and animal, food for animal and seeds which represent cash crop of high price. It has an important role to play in soil protection against wind because of its growing season that extends from the rainy season to the dry season and its covering the soil during this period .see table (2.5).

Table (2.5) Crop production in traditional rain-fed agriculture in El Baja in El Duiem locality (kg/hectare)

Crop. productivity	Dura	Dukhan	Sesame
Lowest	125(0.4)*	105(0.4)*	95(0.3)*
Highest	503(1.75)*	490(1.7)*	440(1.5)*
average	236(0.82)*	208(0.72)*	220(0.7)*

*productivity in (sack/feddan) (source: AOAD 1996)

2.14.5 Conflict in El Duiem Locality

The invasion of rain-land farms by animals is greaterest problem in the agricultural zones. Around Esh Shuqeiq the problem is greatest when abilad lies adjacent to major route used by livestock traveling to and from water points. Often the animals are not supervised sufficiently and they wander in the bilads, both eating and trampling crops. According to local police and farmers , some semi-nomads encourage their animals to invade farm land in drought year as they know that penalties upon them are less than the cost of losing animals .Report to police can lead to fines (100 Sudanese pound) but rarely does this happen , farmers are encouraged by their families to settle dispute privately . Animal invasion at Arshkol is somewhat less significant. (Tribach, 1986).

2.14.6 Coping strategy with drought and desertification in El Duiem:

People are forced to use certain mechanism to combat drought . Traditional producers, coping strategy has several aspects. it often involves a change in farming policy and management with reference to inputs, credit and land tenure systems, animals are either got rid of (by sale or transfer to other persons) or taken to another environmentally richer area sometime people migrate to other areas to compensate for their loss in income and food production caused by the drought .(Ahamed, 1994).

The size and composition of family makes it easier for some members to find alternative form of income in drought years, even if they do not already have jobs else- where. However migration beyond a certain point , particularly of the younger able-bodies member , make the family less able to provide the necessary man power to make the best use of crop and livestock farming possibilities . Large family with good herds of livestock and large area under cultivation find it easier to make adjustments in emphasis between crop-growing and livestock –rearing than smaller family in drought years movable capital has advantage over fix capital .Younger and more enlighten farmers seemed to be able to cope with drought situations better than the others, but often they restart to migration. The three most widely grown drought resistant crops in this area are dukhn , sorghum (feterita) and sesame (Harare) most of the farmers concentrate on dukhn and sesame . Dura (feterita) is mostly cultivated in wet years in the clay pockets or clay area on the fringes of the White Nile irrigated schemes . Dukhn is favored not only because of its suitability to sand soil and it low water requirement , but also because people prefer its taste while birds find it sour , and it easy to prepare as food or drink (table 2.6) (Abu Sin , 1986).

Table (2.6) crop strategy in the western area of the White Nile State

crop	Average (yield per) makhamas In sacks		Crop combination (makhamas)
	Wet year	Dry year	
Millet	10 (4.4)*	6.5(2.9)*	Millet + sesame
Sesame	7.5 (3.3)*	5 (2.2)*	Sorghum + sesame
Sorghum	13 (5.8) *	5 (2.2)*	Millet + sorghum

* Yield per feddan in sacks . Source: Abu Sin (1986)

Popular combination of cattle and goats rather than cattle and sheep rearing by people in area. Although cattle are very vulnerable to drought , they provide a source of ready cash through milk selling , and because goats need a minimum of care , extra effort can normally be directed toward cattle management . People prefer to invest in livestock because they are usually less vulnerable to drought, they can migrate further south of White Nile to alternative grazing areas. There is also the possibility of " internal investment " in livestock-rearing , where by some can be sold to save the other , more flexible and potentially successful readjustment can be made in livestock-rearing than in crop cultivation in time of drought.(Abu Sin , 1986).

CHAPTER THREE

METHODOLOGY

3.1 Area of the study

El Duiem locality of the White Nile is located between the latitude 13 45 – 14 N and longitude 31.45 - 32.5 E (map 1). It covers an area of about 10.000 km ^{2} or 860924 hectares. The locality consists of five units (Wahdat), with population distribution as indicated by table (3.1).

Table (3.1) the population per units

Unit	Population
El Duiem	70.000
El Wahda	111.843
Shabasha	106.612
El Tadamun	50.250
Um Rimta *	165.000
Total	504.240

*Um Rimta became locality after 2007

Source :El Duiem locality office (2007)

The main tribes in the study area were Husseinat , kawhala , Hassaniya, Shuweihat, Kurtan, Megdiya and Shenabla. It is possible to divide the rural

population of this region into three groups according to the degree of involvement of each group in cultivation and animals raising as follows:

(a) People had permanent village, on high land near the White Nile, which were mixed with irrigation schemes, main activities were irrigated cultivation, rearing few animals like goats and cows .the area is not affected directly by desertification.

(b) People had permanent village on the eastern edge of the qoz , people were involved in irrigated cultivation in scheme that lie on the east as well as in rain land agriculture in the west. Animals mainly cattle and a few sheep and goats were also raised. The area is affected by drought and desertification.

(c) People lived in permanent village on qoz and the nomads lived in unfixed dwellings. They engaged in both rain-fed agriculture and raising animals. The animals is more important to them . They more affected by drought and desertification because of encroachment of sand dunes.

3.2 Data collection

Primary data and secondary data were used in this research. Primary data was collected through observation and personal interviews using structured questionnaire (appendix 1). The questionnaire was used to collect qualitative and quantitative data. The survey was conducted during May 2008 .Secondary data was collected from reports, official records, documents, books, Journals, and other relevant sources.

3.3 Sample selection

Face to face interviews were carried with farmers and pastoralists in El Duiem locality. Multi-stratified random sampling, procedure was followed to select the villages in the area of the study. First the villages were categorized into two groups according to the extent of desertification, the more affected villages by desertification which depend mainly on rain-fed agriculture (qoz villages) and the less affected villages which depend mainly on irrigated agriculture. Then two villages of every unit in El Duiem locality were randomly selected (table 3.2). In third step 100 farmers and 73 pastoralists were selected from these villages , 7 -14 farmers and pastoralists from each village involved, using convenient quota sampling (table 3.2), the plan to choose 10-15 farmers and pastoralists of every village and to select 100 pastoralists , but there was a difficulty to find pastoralists in their villages because they were far away from the villages looking for food and water for their animals .The pastoralists' response to the questionnaire was not easy.

3.4 Data Analysis:-

Data collected by questionnaire were first coded, and then analyzed using SPSS. Chi-square test was applied to show if there is significant differences between the farmers, between the pastoralists in less affected and more affected villages and between all the farmers and all the pastoralists. Correlation was used to clarify the relationship between some socioeconomic characteristics. Results are presented in figures and tables.

Table (3.2) Sample of the study

zone	units	villages	Number of farmers	Number of pastoralists
The More affected Village By desertification	Um Rimta	Um Toloh	14	12
		Wad Nowar	15	9
	Shabasha	Helba	12	14
	Al Wahda	Al Ziraga	14	7
		Qoz Al Ahmar	13	7
Sub Total			68	49
The Less affected Village by desertification	Shabasha	Arshkol	10	11
	Al Todamun	Mejega	8	7
		Al Tahara	14	6
Sub total			32	24
Grand Total	4 units	8 villages	100 farmers	73pastoralists

Source: Field survey, May 2008

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter is devoted for presentation of the results of the study and their discussion.

4.1 Some socio-economic characteristics of the respondents:

4.1.1 Age of respondents:-

Table (4.1) shows that the large proportion (59.4%, 57.3 %) of the farmers and (62.5 % , 49 %) of the pastoralists in the less and the more affected villages respectively, were above 50 year of age , and this helped to have good observations and answers about drought and desertification before and after 1983/85.

4.1.2 Education level

The majority (53.1%, 51.5%) of the farmers and (62.5%, 75.5%) of the pastoralists in the less and the more affected villages respectively, were illiterate.

This result indicated that the level of education was very low and there was a high percentage of illiteracy among farmers and pastoralists and especially among pastoralists in the more affected villages (table 4.2).

4.1.3 Family size of respondents

It was found that the average of family size was 8 members (table 4.3). This family size help to create other forms of income, but at the same time it may increases the family's daily expenditures and leads to poverty. "Large families with good herds of livestock and large areas under cultivation find it easier to make adjustment in emphasis between crop-growing and livestock-rearing than smaller families» Abu Sin (1986) .

4.1.4 Secondary occupation

Table (4.4) shows that large proportion (43.7% , 47.1 %) of the farmer in the less and the more affected villages have secondary jobs , while small proportion (4.2 % , 32.7) of the pastoralists in the less and more affected villages had secondary occupation besides agriculture and animal rearing , respectively .

This result indicated that the farmers were forced to do other jobs beside agriculture and animals rearing , because the agriculture was a seasonal work , and of low return , while pastoralists are busy with their animals throughout the year .

Most pastoralists (79.2% ,83.7 %) in the less affected and the more affected villages respectively , practice agriculture beside rearing animals as additional secondary occupations to cope with low income ,and low productivity in animals and crops happens during desertification (table 4.5).

Table (4.1) frequency distribution of respondents according to age

Age	The farmers				The pastoralists			
	The less affected village by desertification		More affected village by desertification		Less affected village by desertification		more affected village by desertification	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
< 30	2	6.2	8	11.8	1	4.2	4	8.2
30-49	11	34.4	21	30.9	8	33.3	21	42.8
>50	19	59.4	39	57.3	15	58.3	24	49
Total	32	100	68	100	24	100	49	100

Source: field survey, May 2008

Table (4.2) Frequency distribution of respondents according to Education level

Education level	Farmers				pastoralists			
	The less affected village by desertification		The more affected village by desertification		The less affected village by desertification		The more affected village by desertification	
	F*	%	F*	%	F*	%	F*	%
illiterate	17	53.1	35	51.5	15	62.5	37	75.5
khalwa	2	6.3	10	4.7	0	0	4	8.2
Primary and intermediate school	8	25.0	20	29.4	7	29.2	8	16.3
Higher secondary School	5	15.6	3	4.4	2	8.3	0	0
Total	32	100	68	100	24	100	49	100

* Frequency
Source: field survey, May 2008

Table (4.3) Frequency distribution of respondents according to family size

Family size	The farmers				The pastoralists			
	The less affected village by desertification		The more affected village by desertification		The less affected village by desertification		The more affected village by desertification	
	F*	%	F*	%	F*	%	F*	%
<3	0	0	0	0	1	4.2	1	2
3-6	10	31.25	17	25	5	20.8	14	28.6
7-9	18	56.25	29	42.6	12	50	20	40.8
> 9	4	12.5	22	32.4	6	25	14	28.6
Total	32	100	68	100	24	100	49	100

* Frequency
(Source: field survey, May 2008)

Table (4.4) Frequency distribution of respondents according to secondary occupation

Had Occup-ation	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
yes	14	43.7	36	47.1	1	4.2	16	32.7
No	18	56.3	32	52.9	23	95.8	14	67.3
Total	32	100	68	100	24	100	49	100

* Frequency

(Source: field survey, May 2008)

Table (4.5) Frequency distribution of pastoralists according to practicing agriculture

Practicing Agriculture	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
No	5	20.8	8	16.3
Yes	19	79.2	41	83.7
total	24	100	49	100

(Source: field survey, May 2008)

4.2 Water in Study Area

The observations and interviews showed that the respondents suffer from water shortage especially during dry season (summer). Table (4.6) shows that the canal, well or haffir were most important sources of water in the less affected villages. In the more affected villages main sources were well and haffir (fill by rain), this mean that the farmers and pastoralists depend directly on rainfall so they were more vulnerable to shortage of water. From the researcher observation the

children ride the donkeys for a long distance and long time to bring the water to their house and this deprived them from education and attending the schools .

Table (4.7) reveals that the most important reason that lead to shortage of water in the more affected villages for both farmers and pastoralists was its remote distance from their villages. In addition to other reasons that affect farmers in less affected villages such as: water contaminations and high prices of water. Also the dryness of wells is considered the main reason of water shortage in more affected villages. All these factors are indicators of drought and its effect.

4.3 Income of respondents in study area

Table (4.8) reveals that most (59.4%, 82.4%) of the farmers in the less and the more affected villages respectively, had an average income less than 2500 SDG per year. Most (63.3%) of the pastoralists in the more affected villages had an average income less than 2500 SDG per year. Also 58.3% of pastoralists in the less affected village had an average income ranging from 2500 – 4500 SDG per year.

This result indicated that the income of the farmers and the pastoralists in the less affected villages was greater than the income of the farmers and the pastoralists in the more affected village, and this means there was a relation between the income and the extent of desertification.

Most (71.9%, 69.1%) of the farmers and (54.2%, 51%) of the pastoralists in the less and the more affected villages respectively, said that their income was not enough. It could be conclude that the income of the farmers and the pastoralists in the more affected villages was more enough than those in the less affected villages (table 4.9). And this is a result attributed to the pastoralists spend little money for education and food or live a simple life than the farmers as Abu Sowar (2007) mentioned.

As mentioned before, the average family size was 8 members, if their share was one dollar per person, the family will need 8 dollars per day, 2922 dollars per year

which equals more than 6720 Sudanese pound (SDG) per year if one dollar equal 2.3 SDG, but from the result the income of most respondents was less than this. According to indicator of World Bank (one dollar a day per person) (IFAD, 2007) most of respondents lie under line of poverty. This result agreed with UNEP (2007) ,"small scale farmers and herders in traditional rain-fed farming and live-stock sector are more prone to poverty than those in irrigated area "

Most (65.6%, 72.1%) of the farmers and (83.3, 77.6%) of pastoralists in both types of the villages spend their money on food, specially the pastoralists (table 4.10). This is also an indicator to poverty among the farmers and pastoralists.

Table (4.6) Frequency distribution of respondents according to Source of water

Source Of water	The Farmers				The pastoralists			
	The Less affected villages by desertification		The More affected villages by desertification		The Less affected villages by desertification		The more affected villages by desertification	
	F**	%	F**	%	F**	%	F**	%
Canal	0	0	0	0	6	25.0	0	0
Well+haffir*	10	31.3	14	20.6	11	45.8	7	14.3
Well+canal	8	25.0	0	0	7	29.2	0	0
Well+haffir	0	0	42	61.8	0		26	57.1
Well+khor	0	0	12	17.6	0	0	14	28.6
Canal+haffir*+well	14	43.8	0	0	0	0	0	0
Total	32	100	68	100	24	100	49	100

* haffir : fill by canal

** Frequency

(Source: field survey, May 2008)

Table (4.7) Frequency distribution of respondents according to Reason for shortage of water

Reason of Shortage Of water	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Shortage of rain	0	0	11	16.2	0	0	8	16.3
Distance of water	8	25.0	21	30.9	6	25.0	17	34.7
Dry of wells	10	31	11	16.2	15	62.5	2	4.1
Shortage of rain + distance of water	0	0	16	23	1	4.2	5	10.2
Distance of water +dry of wells	0	0	0	0	1	4.2	1	2.0
Shortage of rain + dry wells	0	0	0	0	0	0	13	26.5
Other reason	14	43	9	13	1	4.2	3	6.1
Total	32	100	68	100	24	100	49	100

* Frequency
(Source: field survey, May 2008)

Table (4.8) Frequency distribution of respondents according to income

Income	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
<2500	19	59.4	56	82.4	9	37.5	31	63.3
2500-4500	13	40.6	11	16.2	14	58.3	14	28.5
>4500	0	0	1	1.5	1	4.2	4	8.2
Total	32	100	68	100	24	100	49	100

* Frequency
(Source: field survey, May 2008)

Table (4.9) Frequency distribution of respondents according to Income sufficiency

Income enough	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
No	23	71.9	47	69.1	13	54.2	25	51.0
Yes	9	28.1	21	30.9	11	45.8	24	49.0
Total	32	100	68	100	24	100	49	100

* Frequency

(Source: field survey, May 2008)

Table (4.10) Frequency distribution of respondents according to items consumed

Item consumption	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Food	21	65.6	49	72.1	20	83.3	38	77.6
Education	4	12.5	0	0	0	0	0	0
Food + education	7	21.9	17	25.0	4	16.7	9	18.0
Treatment	0	0	2	2.9	0	0	1	2.0
other	0	0	0	0	0	0	1	2.0
Total	32	100	68	100	24	100	49	100

* Frequency

(Source: field survey, May 2008)

4.4 Food security in study area

Table (4.11) indicated that the food shortage in the more affected villages was greater than in the less affected villages. The farmers suffer more than the pastoralists from food shortage, because the later had more animals and live more simple life.

Low production and crop failure are the main reason for food shortage in all the villages. Further more there were other reasons related to pastoralists such as: decline in animals production (table 4.12). Crop failure and low production were result of drought and desertification (table 4. 27).

Table (4.13) shows that the main methods to adjust to food shortage was by selling animals and taking loan from other people. 80.8 % of the pastoralists in the more affected villages are enforced to sell their animals to cope with drought and desertification. It worth mentioning that the pastoralists and the farmers prefer to invest in livestock to cover food shortage by selling them and also the animals are less vulnerable to drought compared to crops.

Table (4.11) Frequency distribution of respondents according to food shortage

The case of Food	The farmers				The pastoralists			
	Less affected villages by desertification		More affected villages by desertification		Less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
No shortage	12	37.5	20	29.4	14	58.3	23	46.9
shortage	20	62.5	48	70.6	10	41.7	26	53.1
Total	32	100	68	100	24	100	49	100

* Frequency

(Source: field survey, May 2008)

Table (4.12) Frequency distribution of respondents according to Reason of food shortage

Reason For food shortage	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Crop failure	2	10	15	31.9	2	20	9	34.6
low production	17	85	22	46.8	8	80	10	38.5
Crop failure + weak production	0	0	8	17	0		1	3.8
Other	1	5	2	4.3	0	0	6	23.1
Total	20	100	47	100	0	0	26	100

* Frequency

(Source: field survey, May 2008)

Table (4.13) Frequency distribution of respondents according to coping strategy with food insecurity

Strategies	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Selling animals	8	40	15	31.9	4	40	21	80.8
Additional jobs	2	10	6	12.8	0	0	1	3.8
Loan	9	45	18	38.3	4	40	3	11.6
Selling animals +loan	1	5	4	8.3	2	20	1	3.8
other	0	0	4	8.3	0	0	0	0
Total	20	100	47	100	10	100	26	100

* Frequency

(Source: field survey, May 2008)

4.5 Migration in study area

About 53.1% and 63.2 % of farmers migrated from the less and more affected villages respectively. While pastoralists who migrated from their less and the more affected were 29.2 % and 36.7 % respectively (table 4.14).

The pastoralists had seasonal migration to short distance and for short time to adapt to their new condition resulted from drought and desertification.

The main reason of the farmers' and pastoralists' migration was low income, they mainly migrate looking for better standards of living (table 4.15). There was a positive relation between migration and income (table 4.47)

Table (4.16) reveals that most of the farmers and the pastoralists did other jobs in migration and desert their original jobs and they may do marginal jobs in cities which didn't suit them and don't serve the Sudan economy.

Table (4.14) Frequency distribution of respondents according to Migration

The Case	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
No migration	15	46.9	25	36.8	17	70.8	31	63.3
Migration	17	53.1	43	63.2	7	29.2	18	36.7
Total	32	100	68	100	24	100	49	100

* Frequency

(Source: field survey, May 2008)

Table (4.15) Frequency distribution of respondents according to Reason for Migration

Reasons of Migration	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Income	15	88.2	37	88.4	7	100	16	88.9
Other	2	11.8	5	11.6	0	0	2	11.1
Total	17	100	43	100	7	100	18	100

* Frequency
(Source: field survey, May 2008)

Table (4.16) Frequency distribution of respondents according to Jobs at Migration

Jobs at Migration	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Work as farmers or pastoralists	4	23.5	8	18.6	1	14.3	7	38.9
Other jobs	13	76.5	35	81.4	6	85.7	11	61.2
Total	17	100	43	100	7	100	18	100

* Frequency
(Source: field survey, May 2008)

4.6 Conflicts in study area

The state of conflict reported by the farmers and the pastoralists in explained that 34.4% and 52.2 % of the farmers, and 37.5% and 46.9% of the pastoralists said there is conflict in the less and more affected villages respectively (table 4.17).

Thus it can be concluded that the level conflicts in more affected village was greater than in the less affected village. This conflicts happen when the pastoralists crossing or invading with their animals the agriculture lands of farmers .

The shortage of rangeland was the main reasons for conflict between farmers and pastoralists in the more and less affected village, but most of the pastoralists (55.5 %) in the less affected villages said that the main cause was grazing beside agricultural lands and careless of the pastoralists, which happens because of lack of rangeland (table 4.18), the shortages of rangeland happen as a result of drought and desertification table (4.32).

Most of the conflicts took place from time to time in all villages. This conflict attributed to shortage in rangeland , which happens in dry years (drought cycle). Some conflicts happen every year because pastoralists in dry season of the year cross the agriculture lands to reach White Nile and to feed their animals on agriculture residues (table 4.19).

The traditional solutions were dominant ones during period of conflicts. These conflicts were solved in most cases through Omads and Sheikhs or among the framers and the pastoralists themselves inside the village without going to police or the court of law (table 4.20). This fits and agree with Trilsbach (1986), who mentioned “reports to police can lead to fines, but rarely does happen, farmers were encouraged by their families to settle a dispute privately ”.

Table (4.17) Frequency distribution of respondents according to availability of Conflicts

conflicts	The Farmers				The Pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Not available	21	65.6	32	47.8	15	62.5	26	53.1
available	11	34.4	35	52.2	9	37.5	23	46.9
Total	32	100	67	100	24	100	49	100

* Frequency
(Source: field survey, May 2008)

Table (4.18) Frequency distribution of respondents according to their view about reason of conflicts between pastoralists and farmers

Reason For conflicts	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Agriculture expansion	2	16.7	1	2.9	3	33.3	2	8.2
Increase animals	2	16.7	1	2.9	0	0	0	0
Shortage of rangeland	6	50	23	65.7	1	11	14	60.9
Careless of pastoralists	2	16.7	9	25.6	5	55.5	7	30.4
other	0	0	1	2.9	0	0	0	0
Total	12	100	35	100	9	100	23	100

* Frequency
(Source: field survey, May 2008)

Table (4.19) Frequency distribution of respondents according to time of Conflicts

Conflicts happen	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F*	%	F*	%	F*	%	F*	%
Every year	5	41.7	15	41.7	3	33.3	8	34.8
periodical	6	50	20	55.6	6	66.7	12	52.2
Rare	1	8.3	1	2.8	0	0	3	13
Total	12	100	36	100	9	100	23	100

* Frequency (Source: field survey, May 2008)

Table (4.20) Frequency distribution of respondents according to means of solving Conflicts

Conflicts Solving By	The farmers				The pastoralists			
	The less affected villages by desertification		The more affected villages by desertification		The less affected villages by desertification		The more affected villages by desertification	
	F	%	F	%	F	%	F	%
Omad and Sheikhs	4	33.3	28	80	7	77.8	18	78.3
Between them	8	66.7	7	20	2	22.2	5	21.7
Court and police	0	0	0	0	0	0	0	0
Total	12	100	35	100	9	100	23	100

* Frequency

(Source: field survey, May 2008)

4.7 Desert creeping in study area

The majority (73.9% , 92.2%)of farmers in the less and the more affected villages respectively , said that their rain-fed lands currently suffer from desert creeping , and most (42.9%) of the farmers in the less affected villages said that their irrigated lands is subjected to desert creeping in the future (table 4.21).

From the result, there was a real problem of desert creeping in rain-fed land in all villages; the more affected villages were more affected by desert creeping than the less affected villages. In the more affected villages also movable sand dune were available which cause desert creeping. The irrigated lands suffered from desert creeping, but it is expected to suffer more in future, because they lie in the margin of sand dune. This agrees with FAO (1986)and Tribach (1986).

71% of the farmers in the less affected villages revealed that there was a problem in irrigation (table 4.22). 84.4 % of farmers said that the reasons of irrigation's problem was sand that blocked the canal (table 4.23), and this happens as a result of desert creeping, causing the problem in irrigation which lead to decline in productivity (table 4.30).

About 81.2% of farmers in the less affected villages revealed that there was no loss in soil fertility, while in the more affected villages most (72.7%) of farmers didn't notice any loss of soil fertility (table 4.24).

from this result it could be concluded that most of the farmers thought there was no loss in soil fertility in the less affected and the more affected villages in spite of desertification and desert creeping in the area (table 4.21). This may be attribute to the lack of real understanding of the phenomenon of desertification , the people understand drought and desertification according to its immediate impacts , and not their future implications .

The sand cover or in other words desert creeping was an important reason for loss of soil fertility in the less and the more affected villages, in particularly in the

more affected villages. Over cultivation was another reason for loss of soil fertility in the less affected villages (table 4.25).

Table (4.21) Frequency distribution of farmers according to their views about desert creeping

Desert creep	The farmers					
	The less affected villages by Desertification (rain-fed land)		The more affected villages by Desertification (rain-fed land)		The less affected villages by desertification (irrigated land)	
	F*	%	F*	%	F*	%
Suffer	17	73.9	59	92.2	7	33.3
Not suffer	5	21.7	3	4.4	5	23.8
In future	0	0	0	0	9	42.9
In past	1	4.4	2	2.9	0	0
Total	23	100	64	100	21	100

* Frequency

(Source: field survey, May 2008)

Table (4.22) Frequency distribution of respondents according to availability of irrigation problem in the less affected villages by desertification

Problem in irrigation	Frequency	%
Not available	9	29
Available	23	71
total	31	100

(Source: field survey, May 2008)

Table (4.23) Frequency distribution of farmers according to their views about reasons of irrigation problems in the less affected villages by desertification

Reasons	Frequency	%
Fill the canal by sand	19	84.4
Problem in pumps	3	13.6
total	22	100

(Source: field survey, May 2008)

Table (4.24) Frequency distribution of farmers according to their views about level of soil fertility in study area

Soil fertility	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Not fertile	26	81.2	48	72.7
Fertile	6	18.8	18	27.3
total	32	100	66	100

(Source: field survey, May 2008)

Table (4.25) Frequency distribution of farmers according to their views about reasons of reduce soil fertility

Reason of Soil fertility	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Sand cover	2	40	10	55.6
Over cultivation	2	40	5	27.3
Pests and Miskats	1	20	3	16.7
Total	5	100	18	100

(Source: field survey, May 2008)

4.8 crops production and productivity in study area

Large proportion (75%, 83.6%) of farmers in the less and the more affected villages respectively, mentioned that there was deterioration in agricultural production (table 4.26).

Table (4.27) reveals that the shortage of rain was the main reason of production deterioration in all the villages. Rain was necessary in the more affected village (qoz villages) and also in the less affected areas (irrigated villages) during July before irrigation by White Nile (Tribach, 1986). The pests were one of the reasons of deterioration, and crops are more vulnerable to pests in areas affected by desertification, and this explains that the pests were more serious in the more affected village than in the less affected ones.

Table (4.26) Frequency distribution of farmers according to their views about deterioration in agriculture production

deteriorations	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
No	8	25	11	16.4
Yes	24	75	56	83.6
total	32	100	67	100

(Source: field survey, May 2008)

Table (4. 27) Frequency distribution of farmers according to their views about reasons of deterioration in agricultural production

Reasons	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Rain shortage	11	45.8	24	42.9
Loss of soil fertility	0	0	1	1.8
Pests	3	12.5	10	17.9
Desertification	3	12.5	4	7
Rain shortage + pests	7	29.2	17	30
Total	24	100	44	100

(Source: field survey, May 2008)

Most (49.1%) of the farmers in the less affected villages cultivated sorghum as rain-fed , while in irrigated lands 38.6 % of the farmers cultivate sorghum and few (7%) cultivated wheat. 31.6 % of the farmers in the more affected villages cultivated sorghum , 41.2 % cultivated millet , 22.8 % cultivated sesame in rain-fed land , while in irrigated agriculture it was found that 2.6 % of the farmers cultivated sorghum and 1.8 % cultivated wheat (table 4.28).This result confirm that the farmers in less affected villages depended on irrigated and rain-fed agriculture and cultivated mainly sorghum in rain-fed, and wheat , sorghum in irrigated parts . The farmers in the more affected villages depend mainly on rain-fed agriculture and important crops were sorghum, millet, and sesame, which are drought resistant crops in the area, but depending on rain-fed agriculture made these villages more vulnerable to drought. the productivity of sorghum (season 2006/2007) was 2.7978 sack / fed , millet was 0.4607 sacks / fed and sesame was 0.7192 sacks /fed in more affected villages in rain-fed ,and loss in crops productivity were 1.88 % , 10% and 70 % in sorghum , millets and

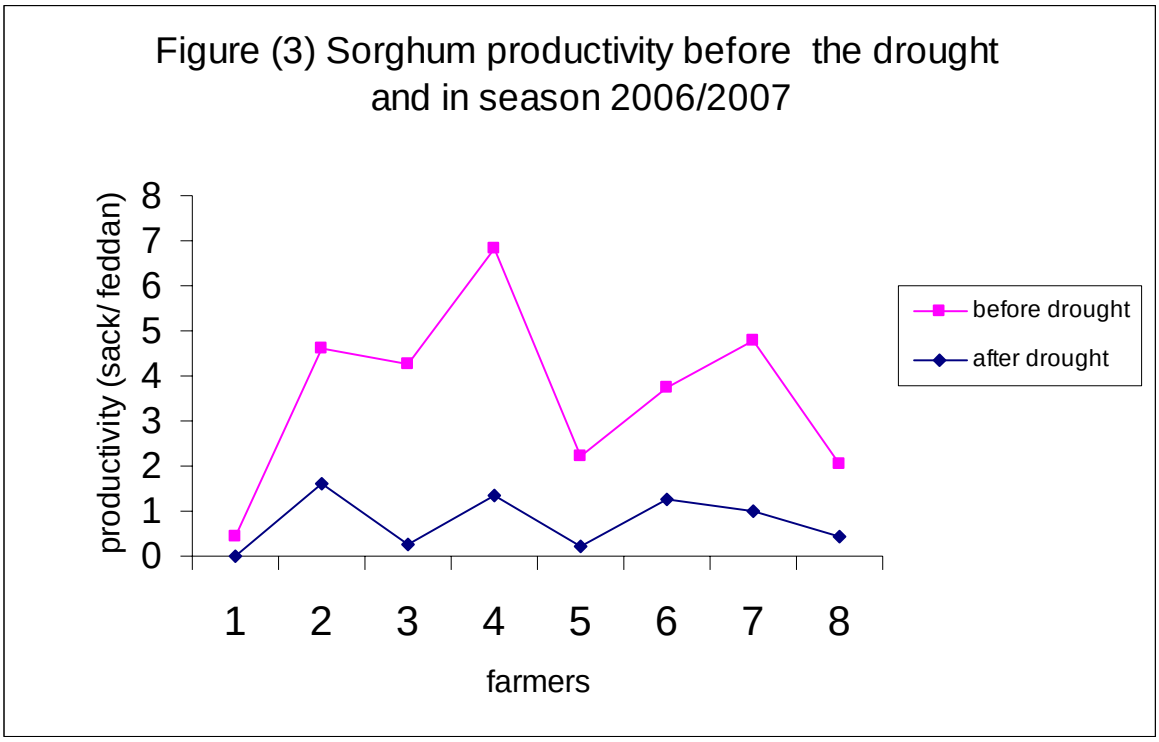
sesame respectively. Decline in sorghum productivity was 34 % in the less affected villages in rain-fed , while it was 6.53 % in irrigated agriculture in more affected villages (table 428).The decline in these crops is attributed to shortage of rain (table 4.27) .figures (3) shows the decline of sorghum productivity for some farmers in the more affected villages before drought of 1983/84 and in season 2006/2007.

Table (4.28) Frequency distribution of farmers according to their crop productivity

Crops		The less affected villages by desertification					The more affected villages by desertification				
		Number farmer		Aver. of prod. season (2006/ 2007)	Aver. of Prod. Before drought	Rat of loss pro.	Number farmer		Aver. of prod. season (2006/ 2007)	Aver. Of Prod. Before drough	Rate of loss prod.
		F*	%				F*	%			
Rain-fed Agricul-ture	Sorghum	28	49.1	2.90	4.4	34%	36	31.6	2.798	2.856	1.88%
	Millet	1	1.8	0			47	41.2	0.46	0.51	10 %
	Sesame	2	3.5	0.57			26	22.8	0.72	2.40	70 %
Irrigation Agricul-ture	Sorghum	22	38.6	5.0			3	2.6	6.17	6.54	6.5%
	Wheat	4	7	2.8			2	1.8	1.0		
Total		57	100				114	100			22 %

* Frequency

(Source: field survey, May 2008)



(Source: Field survey, May 2008)

Table (4.29) shows that the majority (42.9%) of the farmers in the less affected villages achieved moderate productivity in rain-fed. Most (44.4 %) of the farmers had low productivity in the more affected villages. This result showed that the percentage of low productivity was higher in the more affected villages than in the less affected villages. The percentage of moderate productivity was greater in the less affected villages than the more affected village. From observation the sorghum had been cultivated in clay soil near sand dune in the more affected villages. This result confirm that the decline of productivity or deterioration in crops like sorghum in the more affected villages was greater than in the less affected villages .There was a significant and positive relation between sorghum productivity in rain-fed land and desert creeping, (at $p = 0.01$), the positive relation indicates that, the increase of desert creeping lead to decline in sorghum productivity (table 4.30).

Table (4.29) Frequency distribution of farmers by productivity of rain -fed sorghum

Productivity level	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Low productivity 0 – 1.5 (sack/feddan)	8	32.1	16	44.4
Middle productivity 1.6 – 4 (sack/feddan)	12	42.9	11	30.6
High productivity > 4 (sack/feddan)	7	25.0	9	25.0
Total	27	100	36	100

(Source: field survey, May 2008)

Table (4.30) correlation between sorghum productivity and desert creeping

Category	Pearson correlation	Sig. (2-tailed)
Sorghum productivity in rain-fed and desert creeping	.273 **	.000

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

(Source: field survey, May 2008)

4.9 farmers' livestock

Table (4.31) shows that most (87.5 %, 92.6 %) of the farmers in the less and more affected villages respectively, reared animals. “The farmers keep animals as a form of investment, which provide them with meat and milk for domestic use or for sale, and donkeys fulfill a role as beast burden “ (Trilsbach,1986). The rearing of animals for the farmers in more affected villages was more important than to the farmers in the less affected villages and this was attributed to the existence of vast rangeland.

There was a decrease in the farmers' animals in all villages, and it was greater in the more affected villages than in the less affected villages (table 4.32). The important reasons for animal decreased in the less affected villages were the selling of animals (40%) beside the shortage of rangeland (20%) and forge price (20%). Shortage of rangelands was important reason in the more affected villages, and also drought and the selling of animals in order (table 4.33). During drought, the shortage in rangelands which leads to rise forage price and weakens the animals, which become vulnerable to disease, the farmers sell their animals to cover other needs.

From table (4.34) the majority (45.5% , 41.5% , 100% ,100%)of the farmers had1-3 of cows , goats , sheep , and donkeys respectively in the less affected villages . Most (40% , 95.7%) of the farmers had 1-3 goats and donkeys, and most (50 % , 40.9%) of the farmers had 6-10 camels and sheep in the more affected villages. There were no camels in the less affected villages , but they exist in the more affected villages because they were adaptable to drought . The percentage of families who had cows in the less affected villages was greater than families in the more affected villages because cows were more vulnerable to drought, this agrees with Trilsbach (1986). Goats were important animals in all villages because they were adaptable to drought, need a minimum of care and they were the cows of poor . The number of donkeys were a few per family, because the farmers need them for carrying things in particularly water. Sheep were also adaptable to drought, so they exist in the more affected villages more than in the less affected villages.

Table (4.31) Frequency distribution of farmers according to reared animals

Rearing Animals	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
No	4	12.5	5	7.4
Yes	28	87.5	35	92.6
total	32	100	68	100

(Source: field survey, May 2008)

Table (4.32) Frequency distribution of farmers according to increase of animals

Increase of Animals	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
No increase	25	80.6	56	83.6
Increase	6	19.4	11	16.4
Total	31	100	67	100

(Source: field survey, May 2008)

Table (4.33) Frequency distribution of farmers according to reasons of animals decrease

Reason Of animal Decrease	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Shortage of rangeland	5	20	14	29.9
Forge price	5	20	4	7.4
Slaughter of animals	0	0	6	11.1
Sold animals	10	40	12	22.2
Drought	1	4	13	24.1
Disease and death	4	16	5	9.3
Total	25	100	54	100

(Source: field survey, May 2008)

Table (4.34) Frequency distribution of farmers according to animals' numbers

Villages	number of Animal / animals		1-3	4-5	6-10	> 10	Total
The Less Affected Villages By Desertification	Camel	F*	0	0	0	0	0
		%	0	0	0	0	0
	cow	F*	5	1	3	2	11
		%	45.5	9	18.2	27.3	100
	Goats	F*	10	6	5	4	24
		%	41.5	25	20.8	16.7	100
	Sheep	F*	3	0	0	0	3
		%	100	0	0	0	100
	Donkey	F*	17	0	0	0	17
		%	100	0	0	0	100
The More Affected Villages by Desertification	camel	F*	0	0	1	1	2
		%	0	0	50	50	100
	cow	F*	2	1	2	2	7
		%	28.6	14.2	28.6	28.6	100
	Goats	F*	22	15	14	4	55
		%	40	27.3	25.5	7.2	100
	Sheep	F*	2	3	9	8	22
		%	9	13.7	40.9	36.4	100
	Donkey	F*	44	2	0	0	46
		%	95.7	4.3	0	0	100

* Frequency

(Source: field survey, May 2008)

4.10 Rangeland in study area

Table (4.35) shows that most (95.8%, 79.6%) of the pastoralists in the less and the more affected villages respectively, mentioned that the rangelands were not sufficient for their animals during years.

This result indicated that there was shortages in rangeland in the two types of villages , this agrees with AOAD (1996) (table 2.2).shortage in rangeland was greater in less affected villages than in more affected villages in spite of desertification, this is attribute to the agricultural land occupation of large area and rangelands occupy only limited one .

The rain shortage (drought) and desertification was an important reason for shortage in rangeland, particularly in the more affected villages (qoz villages), agricultural expansion is important in the less affected than more affected villages (table 4.36).

The table (4.35) Frequency distribution of pastoralists according to their opinions about rangelands sufficiency

Rangeland Sufficiency	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Not sufficient	23	95.8	39	79.6
Sufficient	1	4.2	10	20.4
total	24	100	49	100

(Source: field survey, May 2008)

The table (4.36) Frequency distribution of pastoralists according to Reasons for shortages of rangelands

Reasons	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Rains shortage	13	56.5	26	66.7
desertification	6	426.1	12	30.8
Agriculture expansion	4	17.4	1	2.6
Total	23	100	39	100

(Source: field survey, May 2008)

Table (4.37) shows that the species of the trees dominated in the area were talh , Tondob , Osher , Miskats and the grasses and herbs like Gaw, Shara, Simsim Al gimal and Tomam, which are of low quality and unfavorable for animal and are indicators to drought and desertification . According to the pastoralists observations after the drought 1983/84 some species disappeared or became rare such as Sider , Loat , Hashab ,Hegleag , Marekh , Seyal , kitir , Sarh ,Makhait , Tondob , Habil and Gafal . The grasses like Siha " Bagil " and hantoot disappeared or became rare, these species are favorable for animals, this agrees with Khogli (1986). From this result it can be concluded that drought and desertification lead to decline in rangelands productivity and composition in the study area.

Table (4.37) Plants species in rangeland in the study area

Species exist now in the rangelands		Species disappeared or became rare	
Local Name	Scientific name	Local Name	Scientific name
(a) trees		(a) trees	
Seyal	*Acacia sub radiana*	Gafal	*Commiphora africana*
Kitir	*Acacia mellifra*	Kitir	*Acacia mellifra*
Sider	*Ziziphus spinachriste*	Sider	*Ziziphus spinachriste*
Loat	*Acacia nubica*	Loat	*Acacia nubica*
Talh	*Acacia seyal*	Talh	*Acacia seyal*
Sunt	*Acacia nilotica*	Sunt	*Acacia nilotica*
Samar	*A .tortilis sub sp tortilis*	Sarah	*Maerua crassifolia*
Misquite	*Proppis chilinesis*	hashab	*Acacia Senegal*
Hegleag	*Balanites aeyypfraca*	Hegleag	*Balanites aeyypfraca*
Marekh	*Leptadenia pyrotechnica*	Marekh	*Leptadenia pyrotechnica*
Osher	*Calotropis procera*	Tondob	*Capparis decidua*
(B)grasses and herbs		Seyal	*Acacia sub radiana*
Gaw	*Aristida mutabilis*	Hibal	*Combretum glutinosum*
Tomam	*Panicum turgidum*	(B) grasses and herbs	
Haskaneet	*Cenchrus biflrous*	Siha (Bagil)	*Blepharis spp*
Shara	*Tragus spp*	hantoot	*Ipomoea cardiosepla*
Taber	*Convolvulus spp*	Nal	*Cumbopogon nervatus*
Difra	*Echinochloa colona*	Om simama	*Aristida pallida*
Bardi	*Echinochloa stagnina*	Simsim al gimal	*Sesamum alatum*
Simsim al gimal	*Sesamum alatum*	Om asabie	*Dactyl lectenium aegptum*
Dahyan	*Farsetia longisiliqua*	Mahreeb	*Cumbopogon. proximus*
Nal	*Cumbopogon nervatus*	Karmat	*Cadaba rotundifolia*
Om simama	*Aristida pallida*		
Handal	*Colocynthus vulagaris*		

(Source: interview with pastoralists , May 2008)

4.11 pastoralists' animals

The study reflected that 41.7% and 49% of the pastoralists in the less and the more affected villages revealed that there was a decrease in their animals, Drought and desertification lead to a decrease in animals number mainly in the less affected villages (table 4.38), disease, drought and desertification were the main reason of this decrease in the more affected villages (table 4.39) , according to Trilsbach (1986) " Drought leads not only to direct losses from lack of pasture and water but also to losses from indirect causes, in that weak animals are more likely to succumb to disease ".

Most (47.6%, 76.4%, 55.6%, 100%) of the pastoralists in the less affected villages had less than 20 heads of cows, goats, sheep and donkeys respectively. Most (58.3% , 62% , 63% , 100%) of pastoralists in more affected villages had less than 20 heads of cow, goats, and donkeys respectively, most (62%)of the Pastoralists in the more affected villages had greater than 40 heads of sheep. It was found that donkeys exist in all villages in few numbers per household for carrying water. Camels exist only in the more affected villages, because they were adapted to drought and desertification. cows were more significant in the less affected villages than in the more affected villages, goats are important through out , but the herds were to be large in the more affected villages . Sheep were important and herds were to be large in the more affected villages (table 4.40). This is attributed to the fact that the cows are very vulnerable to drought and goats and sheep are more adaptable to drought.

Table (4.41) shows that the pastoralists' animals loss during drought of 1983/84 was: most of the pastoralists lost 100 % of cows, goats, and donkeys in the less and more affected villages. Most of the pastoralists lost 100 % of sheep and camels in the more affected and 50 % of them lost 100 % of sheep while

half of them lost 50 % of sheep. From this result it could be concluded that most of the pastoralists lost 100 % of their animals during the drought of1983/84.

The study shows that before drought of 1983/84, most pastoralists had greater than 40 heads of cows per household in the less affected and more affected villages, and between 20-40 heads of goats. Most of the pastoralists had less than 20 heads of donkeys in the more affected villages. A considerable proportion of them had greater than 40 heads of sheep in the more affected villages and less than 20 heads of sheep in the less affected villages (table 4.42). It was clear that there was a significant difference between the number of cows, goats number per household in the less affected and the more affected villages before and after drought, while there was no significant differences between the number of sheep before and after drought in the more and the less affected villages, and also there was no significant differences between the number of camels in the less affected villages (table 4.43).

Table (4.38) Frequency distribution of pastoralists according to animals number status

Animals status	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Increase	12	50	16	32.6
Decrease	10	41.7	24	49
Constant	2	2	9	18.4
Total	24	100	49	100

(Source: field survey, May 2008)

Table (4.39) Frequency distribution of pastoralists according to reasons of animals decrease

Reasons	The less affected villages by desertification		The more affected villages by desertification	
	Frequency	%	Frequency	%
Disease	3	30.8	12	50.0
Drought & desertification	5	50.0	7	29.1
Sold of animals	2	20.0	4	16.7
Slaughter of animals	0	0	1	4.2
Total	10	100	49	100

(Source: field survey, May 2008)

Table (4.40) Frequency distribution of pastoralists according to livestock numbers

Villages	Animals		<20	21-40	>40	Total	%
The less Affected Villages By Desertification	Camel	F*	0	0	0	0	0
		%	0	0	0	0	
	cow	F*	10	8	3	21	31.8
		%	47.6	38.1	14.3	100	
	Goats	F*	13	2	2	17	25.8
		%	76.4	11.8	11.8	100	
	Sheep	F*	5	2	2	9	13.6
		%	55.6	22.2	22.2	100	
	Donkey	F*	19	0	0	0	28.8
		%	100	0	0	100	
The more Affected Villages by Desertification	camel	F*	7	0	5	12	7
		%	58.3	0	41.7	100	
	cow	F*	13	4	4	21	12.3
		%	62	19	19	100	
	Goats	F*	29	7	10	46	27
		%	63	15.2	21.8	100	
	Sheep	F*	9	7	26	42	24
		%	21.4	16.6	62	100	
	Donkey	F*	49	0	0	49	29.7
		%	100	0	0	100	

* Frequency

(Source: field survey, May 2008)

Table (4.41) Frequency distribution of pastoralists according to livestock loss during drought 1983/84

Villages	Animals		100%	% 75	50%	0%	Total
The less Affected Villages By Desertification	Camel	F*	0	0	0	0	0
		%	0	0	0	0	0
	cow	F*	4	3	2	0	9
		%	44.4	33.3	22.2	0	100
	Goats	F*	4	2	1	1	8
		%	50	25	12.5	12.5	100
	Sheep	F*	2	0	2	0	4
		%	50	0	50	0	100
	Donkey	F*	0	1	0	0	1
		%	0	100	0	0	100
The more Affected Villages by Desertification	camel	F*	2	0	0	0	2
		%	100	0	0	0	100
	cow	F*	5	2	1	1	9
		%	55.6	22.2	11.1	11.1	100
	Goats	F*	8	2	5	3	18
		%	44.4	11.1	27.8	16.7	100
	Sheep	F*	11	2	4	1	18
		%	61.1	11.1	22.2	5.6	100
	Donkey	F*	2	0	1	0	3
		%	66.7	0	33.3	0	100

* Frequency

(Source: field survey, May 2008)

Table (4.42) Frequency distribution of pastoralists according to animals ownership before the 1983/84 drought

Villages	The less affected villages									
Animals	Camel		cow		goats		sheep		Donkey	
	F*	%	F*	%	F*	%	F*	%	F*	%
> 20	1	50	1	11.1	3	33.3	2	50	3	100
20- 40	0	0	1	11.1	5	55.6	1	25	0	0
<40	1	50	7	77.7	1	11.1	1	25	0	0
Total	2	100	9	100	9	100	4	100	3	100
Villages	The more affected villages									
Animals	Camel		cow		goats		sheep		Donkey	
	F*	%	F*	%	F*	%	F*	%	F*	%
> 20	0	0	0	0	4	26.7	2	11.8	0	0
20- 40	0	0	0	0	6	40	2	11.8	0	0
<40	0	0	3	100	5	33.3	13	76.4	0	0
Total	0	0	3	100	15	100	17	100	0	0

* Frequency

(Source: field survey, May 2008)

Table (4.43) Chi- square results of the pastoralists animals' number before and after drought

Villages	The less affected villages			
Animals	Pearson chi-square	Degree of freedom	Significant	Relationship
Camels	0.19	1	0.825	N.S
Cows	11.438	2	0.003	*
Goats	5.973	2	0.050	*
Sheep	0.0034	2	0.983	N.S
Donkey	No data			
Villages	The more affected villages			
Animals	Pearson chi-square	Degree of freedom	Significant	Relationship
Camels	No data			
Cows	8.327	2	0.003	*
Goats	6.645	2	0.036	*
Sheep	1.185	2	0.553	N.S
Donkey	No data			

N. S. = not significant

***** Significant at p = 0.05

4.12 Results of chi-square analysis

Regarding some of the socioeconomic characteristics of the farmers in the less affected and the more affected villages, there was no significant differences in education , secondary occupation , income sufficiency, food security, migration, conflicts, sorghum productivity, animals increase, animal per household and deterioration of production between the farmers in the less affected and the more affected villages . While there was a significant difference in farmers' income , and in desert creeping between the less affected and more affected villages(table 4.44).

Table (4.44) Chi- square results of some socioeconomic characteristics of the Farmers

characteristic	Pearson chi-square	Degree of freedom	Significant Sig.(2-tailed)	Relation ship
Education	4.879	3	0.181	N. S
Secondary occupation	0.519	1	.471	N. S
Income	7.422	2	0.025	*
Income sufficiency	0.079	1	0.779	N. S
Food security	0.654	1	0.419	N. S
Migration	0.927	1	0.336	N. S
conflicts	2.560	1	0.110	N. S
Desert creeping	6.070	2	0.048	*
Sorghum productivity	1.709	2	0.425	N. S
Deterioration production of crops	1.028	1	0.311	N. S
Animals per household	0.709	1	0.401	N. S
Increase of animals	0.128	1	0.721	N. S

N. S. = not significant

***** Significant at p = 0.05

Also there was significant differences in secondary occupation and income, while there were no significant difference in income , food security , migration , conflicts , education , practice agriculture among the pastoralists , and there was significant different between rangeland sufficiency in the less affected and the more affected villages (table 4.45).

The study also revealed that there were significant differences in secondary occupation and income, income sufficiency, food security and

migration, while there were no significant differences in conflicts, education between the pastoralists and the farmers in all the villages (table 4.46)

Table (4.45) Chi-square results of some socioeconomic characteristics of the pastoralists

characteristic	Pearson chi-square	Degree of freedom	Significant Sig. (2-tailed)	Relationship
Education	7.718	3	0.052	N. S
Secondary occupation	7.318	1	0.007	*
Income	6.048	2	0.049	*
Income sufficiency	0.064	1	0.800	N. S
Food security	0.837	1	0.360	N. S
Migration	0.410	1	0.522	N. S
Conflicts	0.583	1	0.445	N. S
Rangelands sufficient	3.320	1	0.068	N. S
Practice agriculture	0.224	1	0.636	N. S

N. S. = not significant
***** Significant at p = 0.05

The table (4.46) Chi-square results of some socioeconomic characteristics of the pastoralists and the farmers in all villages

characteristic	Pearson chi-square	Degree of freedom	Significant Sig. (2-tailed)	Relationship
Education	7.499	3	0.058	N. S
Secondary occupation	12.689	1	0.000	*
Income	9.648	2	0.008	*
enough Income	5.793	1	0.016	*
Food security	6.144	1	0.013	*
Migration	11.198	1	0.001	*
Conflicts	0.080	1	0.778	N. S

N. S. = not significant ***** significant at p = 0.05

4.13 correlations between some socioeconomic characteristic

The study reflected that there was a significant and positive relationship between low income and migration, this positive relationship indicated that, the low income lead to the migration of the farmers and the pastoralists, and also significant and positive relationship between income sufficiency and food security, this positive relationship indicated that income sufficiency lead to food security for farmers and pastoralists. There was a significant and positive relationship between conflicts and migration , this positive relationship indicated that conflicts between farmers and pastoralists lead to increase migration among the farmers and pastoralists , and also positive relationship between animals decrease and rangelands insufficiency , this positive relationship indicated that rangelands insufficiency lead to decrease animals of pastoralists (table 4.47).

Table (4.47): correlation between some socioeconomic characteristics of the farmers and the pastoralists

Category	The farmers		The pastoralists	
	Pearson correlation	Sig. (2-tailed)	Pearson correlation	Sig.(2-tailed)
Income & migration	0.461**	0.000	0.789**	0.000
Income sufficiency & food security	0.449**	0.000	0.918**	0.000
Migration & conflicts	0.754**	0.000	0.817**	0.000
Decrease of animals & sufficiency rangelands			0.709**	0.000

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

Chapter Five
Conclusion & Recommendations

5.1 Conclusions of the results:

1- Drought and desertification lead to decline in production and productivity of the main crops in the area (millet, sesame and sorghum) in rain-fed agriculture and irrigated agriculture, of cource the rate of loss was greater in the rain-fed areas.

2- Drought and desertification lead to decline in production and productivity of rangelands, and disappear of good species in rangelands, which lead to decrease and loss of animals of the farmers and the pastoralists. Majority of farmers had greater number of animals (cows, sheep, goats and camel) before the drought of 1983/84. How ever there was a significant difference in the number of cows and goats and there was no significant difference between number of sheep in less affected and more affected village, and there no significant difference in the number of camels per household in the less affected villages before and after the drought of 1983/84.

3- There was migration and some conflicts between the farmers and the pastoralists on natural resources, shortage in water and food, spread of poverty and the farmers and pastoralists practice many jobs to cope with low income, all these socioeconomic aspects were results of drought and desertification in study area.

4- There were no significant differences between the farmers or between the pastoralists in the less affected (irrigated village) and the more affected villages (qoz villages) in most socioeconomics characteristics studied this mean that drought and desertification had similar impacts on all the respondents in study area.

5- There were significant difference between the farmers and the pastoralists regarding migration, income, food security and secondary occupation.

5.2.1 **Conclusions**

The drought and desertification led to decrease of production of main crops in the study area. Disappear of good plants species and decrease productivity of rangelands. This led decrease of animals' numbers and also led to conflicts, migration, illiteracy, work more jobs and poverty.

5.2 **Recommendation**s

1. The societies and government should have a big role in increase the awareness among the farmers and the pastoralists to protect the natural resources.
2. Further studies should be carried out to cover different aspect of natural resources and desert encroachment using monitoring system as remote sensing, GIS and early warning system which help in combating desertification, this through universities, related ministries and nongovernmental organization.
3. Drought and desertification created critical socioeconomic condition in affected area and all over country. Therefore, the rehabilitation programme, cooperation and co-ordination of different concerned authorities and societies are needed.
4. Provision of an optimum level of education, health, water, transportation and other necessary services for the people which improve their life, to raise their awareness about environment and motivate them to protect the natural resources.

5. To preserve, conserve and improve agricultural lands and rangelands, and stabilize the sand dune, through establishing a green shelter belt beside the rehabilitation of irrigation system such as cleaning canals.
6. Attention should be given to livestock as most important source of income, and necessary needs for it.

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Appendix (1)

Questionnaire about socioeconomic impacts of Drought and Desertification in El Duiem and Um in West White Nile

This information for study only

Date …… no ……. Village ……

1. Age …… 2. tribe ……..3. Sex ……

4. Education level …… 5. Social status ……

6. Secondary occupation …… 7. Income ……

8. is the income sufficiency? 1\ yes ( ) 2\ no ( )

9. What important expenditure item. 1\ food ( ) 2\ treatment and clothes ( ) 3\ other ( )

10. Family information

no	sex	Age	Education	occupation	Income

11. Water source 1\ wells ( ) 2\ canal ( ) 3\ haffir ( ) 4\ white Nile 5\ other ( )

12. is there any shortage in water ? 1\ yes ( ) 2\ no ( )

13. What the reason of shortage of water? 1\ rain shortages ( ) 2\ distance of water 3\ dryness of wells 4\ other ( )

14. is there any shortage in food ? 1\ yes ( ) 2\ no ( )

15. If the answer is yes, what are the reasons? 1\ failure of production ( ) 2\ weak of production ( ) 3\ other reason ( )

16. How you fill the gab in food? 1\ sell animals ( ) 2\ secondary occupation 3\ loan 4\ other ( )

17. Do you migrate out of the village? 1\ yes ( ) 2\ no ( )

18. Where do you migrate? …….

19. What the reasons of migration? 1\ income 2\ treatment 3\ Education 4\ other ( )

20. Migration of family

No	Sex	Reason for migration	Where migration

Farmers:

1. Are there any conflicts with pastoralists? 1\ yes ( ) 2\ no ( )

2. What the reason of conflicts? 1\ agriculture expansion ( ) 2\ increase animals number 3\ shortage of rangelands ( ) 4\ other ( )

3. When do the conflicts happen? 1\ every year ( ) 2\ further year ( ) 3\ rare ( )

4. How the conflicts solve? By

1\ court ( ) 2\ Omads and Shakhs ( ) 3\ between them ( )

5. Agriculture production and productivity 2006\2007

Rain-fed agriculture

Crop	area	Production	Productivity

Irrigated agriculture

Crop	area	Production	Productivity

6. Did you practice agriculture during drought 1983/84?

1\ yes ( ) 2\ no ( )

7. If the answer is yes what productivity?

Rain-fed agriculture

Crop	area	Production	Productivity

Irrigated agriculture

Crop	area	Production	Productivity

8. is there any problem in irrigation ? 1\ yes ( ) 2\ no ( )

9. What the reason of irrigation problem? 1\ filling the canal with sand ( )

2\ pumps problem ( ) 3\decline of Nile level ( ) 4\ siltation ( )

10. Does the land suffer of sand encroachment?

1\ now ( ) 2\ not suffer ( ) 3\ suffer in past ( ) 4\ in future ( )

11. is there any deterioration in agriculture production ? 1\ yes ( ) 2\ no ( )

12. What the reason of deterioration in agriculture?

1\ rain shortage 2\ loss of soil fertility 3\ pest ( ) 4\ other ( )

13. Did the soil loosing fertility? 1\ yes ( ) 2\ no ( )

14. What the reason of loss of fertility? 1\ sand cover the land ( ) 2\over cultivation ( )

3\ pest & Miskats ( ) 3 \ other ( )

15. Do you have animals? 1\ yes ( ) 2\ no ( )

16. What the number and type of animals do you have?

Type	camels	Cows	goats	sheep	Donkey
number					

17. Do your animals increase? 1\ yes ( ) 2\ no ( )

18. If the answer is yes what the reasons?

1\ shortage of rangeland ( ) 2\ rise the price of fodders ( )

3 \ slaughter of animals ( ) 4\ sold ( ) 5\ drought ( )

19. What the effect of drought and desertification in the Area……

<u>Pastoralists:</u>

1. Are there any conflicts with pastoralists? 1\ yes ( ) 2\ no ( )

2. What the reason of conflicts? 1\ agriculture expansion ( ) 2\ increase animals number

3\ shortage of rangelands ( ) 4\ other ( )

3. When do the conflicts happen? 1\ every year ( ) 2\ further year ( ) 3\ rare ( )

4. How the conflicts solved? by 1\ court ( ) 2\ Omads and Shakhs ( ) 3\ between them ( )

5. What the number and type of animals do you have?

Type	camels	Cows	goats	sheep	Donkey
number					

6. Do you have animals during drought 1983/84?

1\ yes ( ) 2\ no ( )

7. What the number of animals did you loose during drought

1983/8

Type	camels	Cows	goats	sheep	Donkey
number					

8. What type of plant found before drought 1983/84 and disappears and become rare now?

9. What type of plant found now in rangelands? ……..

10. What the effect of drought and desertification in the Area ……...

……