

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background

Sudan is the third largest country in the African continent (following Algeria and Democratic Republic of the Congo) and the sixteenth largest in the world with a total area of 1.88 million square km, extending between latitudes 8.45° and 23.8° North and longitudes 21.49° to 38.24° East. The country has international borders with seven countries (Egypt, Eritrea, Ethiopia, South Sudan, Central African Republic, Chad and Libya) (see figure 1.1). The River Nile traverses the country from South to North while the Red Sea washes about 550 miles of eastern coast making Sudan a bridge between Africa and the Middle East. Sudan's terrain is generally flat plains, broken by several mountain ranges. The climate is mostly arid, but the amount of rainfall increases towards the South. Sudan's rainy season lasts for about three months (July -September). In the northern and western semi-desert areas, people rely on the scant rainfall for basic agriculture and many are nomads; travelling with their herds of sheep and camel seeking pastures. Closer to the River Nile, exists irrigated farms that grow cash crops. The country faces a number of environmental challenges related to climate change including soil erosion, desertification and recurrent droughts. Agricultural expansion both public and private has proceeded without conservation measures. The consequences have manifested themselves in the form of deforestation, soil desiccation and the lowering of soil fertility and water tables in various parts of the country (UNDP, 2012). The soils of Sudan are broadly divided into six main categories according to their locations and manner of formation: desert, semi-desert, sand, alkaline, catena,

alluvial, and ironstone plateau. Within these soil categories, there are many local variations with respect to drainage conditions (FAO, 2001). Sudan's agro-ecological zone support a variety of food, cash and industrial crops. Vast natural pastures and forest support large herds of livestock including cattle, sheep and goats. The main export crops are cotton, gum Arabic, sesame, groundnuts, fruits, and vegetables, livestock are also important for exports (IFAD, 2002). Sudan total population is estimated at 33.4 millions in year 2008, with a population growth rate of 2.5% (Sudan census committee, 2011). The population of Sudan predominately descends from both indigenous African groups and Arabs, today most tribes in the country speak Arabic and the Arab culture predominates. Over 97% of the population of Sudan is Sunni Muslims with a small Christian minority. Pre-secession, Sudan has cultivable arable land estimated at 86 million hectare. Post-secession that has been diminished by not less than 35% of the total. However, less than 20% are utilized under three major farming sub-sectors: the irrigated, the semi-mechanized rain fed and the agro-pastoral traditional rain-fed (Issam, 2011).

# Sudan New Map



Figure 1.1: Sudan Map

## **1.2 Sudan's Economy**

In 2010, Sudan was considered as the 17th –fastest –growing economy in the world given the rapid development of the country -largely from oil profits, despite international sanctions. However, the secession of the South in 2011, had gravely affected the economy as more than 80% of Sudan's oil fields existed in the southern part of the country. This decline in oil revenues caused a major adjustment to the Sudan's fiscal situation and prompting financial austerity measures. The situation was further exacerbated by the continuing tensions between Sudan and South Sudan and their inability to reach an agreement over transit fees for oil from South Sudan, leading to a complete shutdown of oil production by South Sudan in early 2012. Sudan however is endowed with rich natural resources, including natural gas, gold, silver, chromate, asbestos, manganese, gypsum, mica, zinc, iron, lead, uranium, copper, kaolin, cobalt, granite, nickel, tin and aluminum. Historically, agriculture remained as the main source of income and employment in Sudan, hiring over 80 % of Sudanese, and making up a third of the economic sector. Despite this strong agricultural orientation, oil production drove most of Sudan's post-2000 growth. Real GDP growth was estimated at 2.8 % in 2011 compared to 11.5 %. As a result of the oil loss, the growth of both industrial and service sectors fell in to the negative in 2011 and 2012 while only agricultural sector witnessed positive growth in both years, Table (1.1). In the agricultural sector, the government has tried to diversify its cash crops; however cotton and gum Arabic remain its major agricultural exports. Grain sorghum (Dura) is the principal food crop, and wheat is grown for domestic consumption. Sesame seeds and peanuts are cultivated for domestic consumption and increasingly for export. Livestock production has vast potential, and many animals, particularly camels and sheep, are exported to Egypt, Saudi Arabia, and other Arab countries. Problems of irrigation and transportation remain the greatest

constraints to a more dynamic agricultural economy. Sudan continues to strengthen links with key emerging country partners, especially China, Malaysia and India following the attraction of substantial “resource seeking” since the late 1990s. The Government has already decided to make more credit available to agriculture as part of its future development plans. It continues efforts to engage in strategic partnerships with local and foreign private investors, particularly reared towards increasing agricultural exports and diversification of production to absorb the shock of the declining oil revenues (UNDP, Sudan). Sudan’s economic growth is dominated by agriculture which estimated at 35.9 % of gross domestic product (GDP) in 2008 and to about 36.5% in 2009. Agriculture remains the main source of employment and household income in rural areas where 65% of population live. About 80% of the labour force employed in agriculture and related activities such as agro-industries (FAO, 2007), It provides livelihood to about 70% of the population (Ministry of Finance and National Economy, (2005). The agricultural sector provides most of the raw material required by local industries such as sugar, textile and vegetable oil (Bank of Sudan, 2006), therefore, provision of food, fiber, foreign exchange earnings, labor employment, and sale of industrial goods in rural areas, etc. Importance of agriculture turns out to be outstanding in Sudan’s economy. Table (1.2) shows that the agricultural share to GDP has increased with time during the period 1990-1999, but it has been fluctuated, then decreased after petroleum industry introduced (Bank of Sudan, report 1990-2012).

**Table (1.1): The growth rate % of GDP (Agricultural, Industrial and Services Sectors)**

<b>Year</b>	<b>2011</b>	<b>2012</b>
<b>Agricultural Sector</b>	2.6	6.4
<b>Industrial Sector</b>	(4.3)	(7.2)
<b>Services Sector</b>	5.7	3.1

Source: Bank of Sudan, 2012

**Table (1.2): The contribution of the agriculture sector to GDP (1990/1991-2012/2013)**

<b>season</b>	<b>Percent share to GDP</b>
1990-99	43.4
2000-09	39.4
2010/11	31.2
2011/12	28.9
2012/13	30.4

Source: Bank of Sudan reports, (1990-2012)

### **1.3 Farming Systems in Sudan**

Agriculture in Sudan depends on two principal sources of water: direct rainfall and irrigation, from the Nile and its tributaries. There are also flood irrigation schemes fed by seasonal rivers in the east of contrary in the Gash and Toker deltas. There are five distinct sub-sectors of Sudanese agriculture, irrigated sub- sector, semi -mechanized sub- sector, traditional sub- sector, livestock production sub- sector, and forests sub- sector.

#### **1.3.1 Irrigated sub- sector**

The irrigated sub-sector occupies about 4.2 million feddans, which are under gravity and pump irrigation. It comprises large consolidated areas, such as the Gezira (accounting alone for about 2.2 million feddans), New Halfa, Rahad, Suki and a number of small schemes along the Blue Nile and White Nile ( Eldaw,1998). The sub-sector contributes an average of 21% of the total value of agricultural production, 100% of wheat, 90% cotton and 25% of sorghum produced in the country. Although its contribution to sorghum production is low relative to the rain- fed sub-sector, it is more stable. In years of drought it plays an important role in meeting the consumption requirements. The main crops grown in the irrigated area are cotton, sorghum, groundnuts, wheat, sugar, citrus, dates, grain, legumes, fruits, vegetables, spices and irrigated fodder. (Mohamed, 2011).

#### **1.3.2 Semi -mechanized sub- sector**

The area under mechanized rain-fed crop production is estimated at about 17 million feddans. The mechanized subsector consists of large-scale farms of 1000 - 1500 feddans and is characterized by mechanized cultivation and seeding, manual weeding and semi-mechanized harvesting. The farms in the mechanized subsector

are allotted to private farmers on rent basis. During the 1970's and 1980's, the government operated large areas as state farms, and allotted similar large areas to private Arab investors (Eldaw, 1998). Traditionally practiced in the heavy clay soils in area with rainfall between 400-800 mm per annum. The main crops in this sector are sorghum and sesame. This sector suffers from a number of limiting factors including low yield high cost of production, shortage of formal credit and poor infrastructure That is in addition to the absence of machinery services for the small farmers and poor access to marketing services (Karrar and Elhag, 2006).

### **1.3.3 Traditional sub-sector**

The traditional rain fed subsector has an area of about 20 million feddans. The major crops of this sub-sector are sorghum, millet, sesame, groundnuts, gum Arabic, water melon and karkadeh, in addition to traditional livestock raising. The size of farms in the traditional sub-sector is generally small (less than 10 feddans), but it varies considerably. Farms are privately owned and operated (Karrar and Elhag, 2006).

### **1.3.4 Livestock production sub- sector**

Despite the secession of the South, the Sudan remains Africa's leading country in animal resources production. The country's climatic diversity led to diverse animal resources: camels are in the northern belt and cattle in the southern and eastern belts while sheep and goats are bred in all parts of the country. According to 2012 estimates, the livestock population in the Sudan counts (104.911) million heads, including 29.840, 39.483, 30.837, and 4.751 million head of cattle, sheep, goats and camel, respectively. Distributed as follows: 30.7% in Darfur, 26% in Kordofan, 25.9% in the Central region, 10.9% in the East, 4.7% in the Northern region and 1.3% in Khartoum state. Livestock sub-sector contributes significantly



to the GDP, reaching 20% of the total income of country from foreign income (Bank of Sudan report, 2012).

### **1.3.5 Forests sub- sector**

Trees provide timber and about 71% of the total energy requirements of the country. Gum Arabic produced from hashab is a valuable export product and provides for shelter belts (Abdalla et al, 2001). Forestry contribution estimated at 3% in GDP (forestry area about 25%).

### **1.4 Gezira irrigated scheme**

Irrigated agriculture comprises many public schemes. Among these, the Gezira scheme is the oldest and, area-wise, the largest one. The Scheme occupies a central position in the agricultural sector of Sudan. In relation to the total area under irrigation, the area of the Gezira scheme accounts for about 42%, and it utilizes some 35% of Sudan's current allocation of irrigation water (Ahmed, 2000). While irrigated agriculture contributes about 13%, on average (1991-1997), to national GDP and about 33% to agricultural GDP, the share of the Gezira Scheme's contribution to national and agricultural GDP is estimated at 3% and 7%, respectively (World Bank 2000). In terms of its physical contribution, the Gezira scheme has contributed significant proportions to the country's agricultural production during the past decades. Thus, about two thirds of Sudan's cotton exports and about 70%, 30% and 12% of the country's total production of wheat, groundnuts and sorghum, respectively, originate from the Gezira scheme (Magar 1986; Brandt et al. 1987). Within the Gezira region, the Gezira scheme is of overwhelming importance. The value of infrastructure within the scheme is estimated at about US \$ 8 billion (Omara, 2002). It has experienced a complete change in management in 2009/10 through the implementation of the 2005 Gezira Act, effectively privatizing the scheme and transferring the responsibility for

irrigation to land-owners, water-user associations devolving control and, by association, planting decision-making to the farmers, thereby allowing planting flexibility within the water delivery regimes (FAO, 2012).

### **1.5 Problem statement and justification**

The Gezira Scheme is considered one of the most important schemes in Sudan economy; this is due to its considerable share in the agricultural sector and contributes about 3 % of the GDP of the country. In addition, Gezira Scheme is considered as main source of income for about 114,000 tenant families and provides raw material for the local textile and animal cake industry. In spite of the economic importance of Gezira scheme for Sudan economy large fluctuations in crops area, production and yield occurred in recent years. The Gezira Scheme production of cotton sharply dropped from 156 thousand metric tons in 2004/05 season to 10 thousand metric tons in 2009/10 season. Thus due to decreasing in area brought under cotton cultivated from 244 thousand feddan in 2004/05 season to 26 thousand feddan in 2009/10 season, in addition decline in the yield from 705 kg / feddan in 2004/05 season to 564 kg / feddan in 2009/10 season, (1kantar = 150 kg), table (1.3). Production of groundnut dropped from 266 thousand metric tons in 2008/09 season to 68 thousand metric tons in 2009/10 season. Thus due to decreasing in area cultivated and yield from 231 thousand feddan, 1200 kg/feddan in 2008/09 season to 150 thousand feddan, 650 kg/feddan in 2009/10 season, respectively tab (1.3). In spite of the government policy leading to increase in cultivated area under sorghum and wheat to provide for food security, still fluctuations of in sorghum and wheat production. Production of sorghum dropped from 578 thousand metric tons in 2008/09 season to 319 thousand tons in 2009/10 season, although the area cultivated under sorghum increased from 513 thousand feddan in 2008/09 season to 650 thousand feddan in 2009/10 season. Production of

wheat dropped from 353 thousand metric tons in 2007/08 season to 204 thousand tons in 2009/10 season. Thus due to decreasing yield from 840kg/feddan in 2007/08 season to 700kg/feddan in 2009/10 season, tab (1.3). There are various problems behind productivity deterioration in Gezira Scheme these include lack of credit, high production cost, and may be due to the implementation of the 2005 Gezira Act, effectively privatizing the scheme and transferring the responsibility for irrigation to land-owners, water-user associations devolving control and, by association, planting decision-making to the farmers, and accumulative effects of problems such as tenants' technical inefficiency, scheme management inefficiency and scheme management's decisions of area allocation between the different crops. Production can be increased by increasing the technical efficiency of crops using existing technology. If farmers are found to be technical efficiency, production can be increased to a large extent using the existing level of input and available technology. Several studies in other countries have shown that there is a significant potential for rising agricultural outputs or profitability by improving productive (technical and allocative) efficiency using existing resources. Moreover, these studies have also indicated that there may be significant efficiency differentials between different groups of farms and between different regions among all farms, and it should be possible to improve the performance of the less efficient farms or regions without major investment from outside at least in the short run (Rahman, 2002). In this study, tenant technical efficiency and the crop combination will be investigated to test its suitability as a factor contributing to the solution of tenant productivity deterioration.

**Table (1.3) Cultivated area, production, and yield of the main cultivated crops in Gezira scheme (Area in 000 feddan, production in 000 M.T., yield in kg/feddan)**

<b>crop</b>	<b>season</b>	<b>area</b>	<b>production</b>	<b>yield</b>
Cotton	2004/05	244	156	705
	2005/06	304	191	710
	2006/07	250	140	634
	2007/08	83	50	650
	2008/09	84	58	725
	2009/10	26	10	564
Groundnuts	2004/05	132	127	1021
	2005/06	127	120	1000
	2006/07	161	148	945
	2007/08	151	138	952
	2008/09	231	266	1200
	2009/10	150	68	650
Sorghum	2004/05	434	379	926
	2005/06	470	386	852
	2006/07	604	580	1000
	2007/08	474	446	1000
	2008/09	513	578	1200
	2009/10	650	319	701
Wheat	2004/05	149	114	550
	2005/06	156	122	800
	2006/07	300	226	800
	2007/08	426	353	840
	2008/09	442	245	570
	2009/10	307	204	700

Source: Ministry of Agriculture and Forests, 2010.

## **1.6 Objectives of the study**

The objective of this study was to analyze and evaluate the technical efficiency of crop production in Gezira Scheme, more specifically were to:

- 1- Describe the socio-economic characteristics of farmers' in the Gazira scheme.
- 2- Estimate profitability of produced crops in the study area.
- 3- Evaluate farmers' technical efficiency and investigate the main factor behind their technical inefficiency in producing main crops.
- 4- Determine the optimum crop combination that maximizes farmers' returns.

## **1.7 Hypotheses**

- 1- Farmers' socio- economic factors are assumed to be the main factors behind their technical inefficiency.
- 2- Cash crops are more profitable in Gezira scheme than food crops.
- 3- Factors such as availability of finance and good cultural practices are assumed to improve farmers' efficiency.
- 4- The current crop combination in Gezira scheme is not optimum.

## **1.8 Organization of the study**

The study consists of six chapters. Chapter one contains a background on recent Sudan, Sudan economy, and farming systems in Sudan, the research problem, the objectives of the study, study hypotheses. Chapter two discusses literature review and conceptual frame work. Chapter three includes the study area and research methodology, Chapter four contains the results and discussion for demographic and socio-economic characteristics, technical efficiency analysis. Chapter five includes the results and discussion linear programming and gross margin analysis. Finally, Chapter six summarizes the results, conclusions and recommendations.