

ABBREVIATIONS

MRF: Mechanized rain fed farming; one of the three main farming system in Sudan.

MFC: Mechanized Farming Corporation; responsible for all mechanized farming activities in Sudan.

ARC: Agricultural Research Corporation.

CHAPTER FOUR:

The Agricultural sector of the Sudan:

4.1 Introduction:

This chapter aims at measuring the technical efficiency and productivity change in the areas of the study. The Sudanese mechanized and rain fed schemes in south Kordofan and Gedaref state, because it is useful to various interested groups such as the Government, Central Bank, and the community as well. Therefore, the study gives lights to some topics in Sudanese agriculture that is related to the study. In addition, of the main purpose of the chapter, is to describe the study area and the Sudanese rain fed farming sector in both Gedaref and south Kordofan regions. This area constitutes the back bone of the national economy, because most export crops such as (sorghum and sesame) which support the national economy with hard currency. Also the chapter high lights some factors that have direct effect on agricultural production efficiency such as geographical Features (soil type, climate characteristics) and agricultural policies. In addition, the study covers historical overview of mechanized rain fed farming in the Sudan reviewed first, and then the mechanized rain fed farming, geographical position and geographical characteristics of the two regions under study south Kordofan and Gedaref states come later. These geographical characteristics include climate, rain fall and soil are considered important factors in agricultural production. All these concepts will help us to go deep on the process of comparative study.

So, the next sections illustrate these concepts

4.2 Background of agriculture of the Sudan:

The need for agriculture expansion, horizontally and vertically, has been increased worldwide due to the increase in human population, and subsequently, the demand for more food is also increased. In fact Sudan has a vast arable land reached about 73.5 million hectare (after separation of the south Sudan) out of the total country area but what is. But the actual cultivated land is only 12 million hectare (Osman,

2011). Where 10 million hectare is in the mechanized rain fed land, while 2 million hectare in the irrigated lands. 70% of total arable agriculture land in Sudan is idle land, that is because of many problems facing agriculture in the Sudan such as, traditional technology, short of labor, (Gaafar, 2013) and the increase in the costs of production.

There are three farming systems in Sudan, irrigated, rain semi-mechanized, and rain fed traditional agriculture. Irrigated agriculture accounted for about 21.3 percent of the value of the total agriculture production, it is more stable. In years of drought it plays an important role in meeting the consumption requirements.

(Issam A.W. Mohamed, 2010), semi-mechanized agriculture account for about 6.4 percent, and traditional rain fed agriculture 16.3 percent. Agriculture was the main source of employment and household income in rural areas, and was the main source of export until the start of oil export in 1999. (Salah & Zakir, 2004, p1).

The agricultural sector is the most important economic sector in the country, The beginning of the civil war in 1983 together with the severe drought of 1984, which has mainly hit western Sudan and the famine as a result of that, have led to a substantial change in the demographic distribution. Large numbers of population moved into towns (mainly Khartoum the capital) and the irrigated and rain-fed areas of central and eastern Sudan (Rajaa Hassan, 2006) With regard to land use in Sudan, the total arable land is estimated at 202 million feddans (85 million hectares), the grazing area is estimated at 92 million feddans (39 million hectares), while forests occupy some 152 million feddans (64 million hectares)

The government has suggested in 1990s the end of export taxes in order to promote more agriculture products in the future. Other agricultural products include sesame seeds, sorghum, and gum Arabic. Sudan's climatic conditions, mainly the rainy seasons, enable double annual harvests (in July and November) in the southern parts of the country. Most of the agricultural activities are

concentrated near the River Nile (both rivers merge to form the River Nile) is the most important agricultural area in Sudan.

The National Comprehensive Strategy objectives was to increase the areas of agriculture by the 2001/02 season, and the agricultural revival or green campaign program plan 2001-2006) was to develop the agricultural sector, table(4.2.1).shows The main crops produced by each sub-sector and the area of agricultural Sub-sector .

Table (4.2.1)Agricultural Sub-sector according to the agricultural sub-sector plan(2006)and the Main Crop Areas

Sub-sector	Area (1000fedan)						Main Crops
	The real situation		The future plan				
	2000	2006	2007	2008	2009	2010	
Irrigated Farming	9281	3647	3642	4705	5589	6133	Sorghum, wheat, cotton, sunflower groundnuts, vegetables, fruit trees, alfalfa, forage sorghum
Traditional Rain-fed	22572	5473	23059	24679	26166	20503	Sorghum, millet, sesame, groundnuts, water melon, roselle, cowpea
Mechanized Rain fed Farming	31185	1357	15510	15822	15858	16336	Sorghum, sesame, cotton, guar

Source:republic of the Sudan. Ministry of agriculture and irrigation, green campaign program, 2006.

From the table (4.2.1), It is clear that the area cultivated by crops decreased since (2000 and 2006). After the year 2006 Sudan has announced the adoption of 5 years agriculture development plan, sometimes referred to as the agriculture revival or the green campaign. While, the area of Mechanized rain fed farming (MRF) is increased during the period (2007 -2010). Also the table shows that in Irrigated Farming

area the main crops are Sorghum, wheat, cotton, sunflower groundnuts, vegetables, fruit trees, alfalfa, forage sorghum

, in the Traditional Rain fed area the main crops are Sorghum, millet, sesame, groundnuts, water melon, roselle, cowpea

, and Mechanized Rain fed Farming the main crops are Sorghum, sesame, cotton, guar

For further explanation the coming table (4.2 .2) illustrates the area (planned, harvested and production of the two crops under study.

Table (4.2 .2) the area (planned, harvested and production) of the sesame and sorghum crops

Sub-sector	Main Crops	2005- 2006			2009 -2010		
		plan	harvest	Prod	plan	harvest	Prod
The traditional sector	Sesame	2103	1601	123	2288	1925	152
	Sorghum	9077	6892	1746	7576	6018	1410
Irrigated sector	Sesame	-	-	-	-	-	-
	Sorghum	1122	1010	917	1242	1155	1037
The mechanized rain fed	Sesame	2974	1668	207	1938	1604	211
	Sorghum	11123	7404	1340	13236	10105	2158

Source: ministry of agriculture and irrigation, general administration of planning and agri. Economics (dep.ofagri.statistics), general feature and production estimating for main crops (2010).

The previous table(4.2 .2) gives information about the area planted, harvested, and the real production for sorghum and sesame in Sudanese agriculture sector during the period of (2005 / 06) and (2009/10).

In addition, it is important to give some lights on the geographical features of Sudan and the agricultural policies, because crops production always depends on these factors, besides helping to have a deep understanding about the nature of Sudanese Mechanized and Rain fed Farming sector.

4.2 .The geographical feature of Sudan:

The soil type:

The country is characterized by different soil types include the following:

i. Yermosols: common in the desert and semi-desert zones where rainfall is generally less than 200 mm/annum.

ii. Arenosols: it is sandy and cover large areas in western Sudan and are also known as ‘Qoz’; .

The Qoz sands are highly susceptible to erosion by wind and water; are easy to cultivate using hand tools hence most of the traditional production activities are practiced on these soils.

Within areas dominated by stabilized sands a non-cracking type of clay soil known locally as ‘Gardud’ occurs; this has better potential for retaining water and nutrients and under natural conditions they are compacted and have low infiltration, thus most rain water is lost as runoff; ‘Gardud’ soils are difficult to cultivate using traditional hand tools and therefore are mostly untouched by cultivators.

iii. Vertisols: dark cracking clays, mostly formed between Blue Nile and White Nile , but some might have been Gedarif state . These soils are characterized by clay contents of 60% or more. This type of soil support mechanized farming as well as all large scale irrigated farming.

iv. Nitosols : reddish-brown tropical soils with agriculture horizons and some organic matter, mainly occurring in the hilly areas with dense bushland in southeastern Sudan.

v. Ferralsols : red tropical soils with organic top soils over oxic sub soils in the southwestern part of the country.

Fluvisols: soils of recent alluvium located along the Nile and its tributaries, along major water courses and inland deltas of the Gash and Tokar; prime agricultural land for basin, flood and pump irrigation.

Hill soils: various types occur and they owe their origin to hill and mountain formations; some, such as the soils of JabelMarra, are derived from volcanic rocks and are of reasonable fertility and physical characteristics.

The Climate of the Sudan:

There are a wide range of climatic conditions , the eastern part of the Sudan , the area alongside the red sea with winter rainfall together with high humidity, the south and south west with short summer rainy season in the central parts to tropical sub-humid with a progressively longer wet season . And the JabelMarramountain in western Sudan which have much higher rainfall.Rainfall varies from near zero in the extreme northwest to 1,600 mm per year in the temperate and rich forest zones in the south (Rajaa, 2006). About half of Sudan is susceptible to periodic severe droughts that often span two years.

In common with other parts of the Sahelian zone there has been a major recent decline in annual rainfall and an increase in periods of drought in the Sudan; drought can be widespread over the country or localized. From 1961-1998 two widespread periods of drought occurred, in 1967-1973 and 1980-1984; the latter was more severe than the former. The same period witnessed a series of great droughts during 1987, 1989, 1990, 1991 and 1993 in different parts of the country but mainly in western Sudan .Mean annual temperature varies from place to place with in a country except for the highlands of the Imatonge Mountains in the extreme south JabelMarra in the west (Nierteti) and the Red Sea mountains).32

Agro-ecological Zones (FAO, 2003). The ecological zones of the Sudan are shown in the coming table(4.2.3):

Table (4.2.3) agro - ecological zones of the Sudan

Zone	% of Sudan area	Mean annual rainfall (mm)	Wet season	Dry season	Main land use types
Desert	28.9	<75	July to September	October to June	Irrigated agriculture Grazing along seasonal water courses
Semi-desert	19.6	75-300	July-September- November-January	November-June March-September	Irrigated agriculture Dry land farming in conjunction with water harvesting-Pastoral
Low rainfall savanna	27.6	300-800	May-September	November-April	Irrigated agriculture Rain-fed traditional cultivation Mechanized farming Pastoral Forestry
High rainfall savanna	13.8	800-1500	April-October	December-February	Rain-fed traditional cultivation Mechanized

					farming Pastoral Forestry
Flood region	9.8	600-1000	May-October	December-April	Traditional cultivation Pastoral Wild life
Mountain vegetation	19.6	75-300	July-September- November-	November-June	Irrigated agriculture Dry land

Source: <http://www.fao.org/ag/AGP/AGPC/doc/Counprof/sudan/sudan.htm#1.4> Farming.

4.3 Sudan agriculture policies:

Sudan agriculture policies can be categorized into four periods (Abdelgaber, 1997, p31) as follows:

1. Pre- independent period (the Turkish and colonial periods) where agricultural policies focused on the promotion of cotton growing and export crops, while agricultural development remained limited.
2. Independence period (1956- 1969) .In this period, the colonial type of agricultural policy continued. This policy, as is out lined, neglected the traditional rain fed agriculture and focused, beside that on expansion of mechanized farming and monetization of the livestock.
3. The period starts from (1969- 1977/ 1978) . This period characterized by the persistence of the colonial bias against traditional rain fed agriculture, decline in productivity as a result of nationalization of private pump schemes, strategy of substituting food imports through horizontal agricultural expansion as well as the production of agro- industries.
4. The last period, extends from the 1968 up to the present day. This period, characterized by negative results of stabilization policies on agro-industrial expansion programs have been directed towards irrigated schemes neglecting the traditional rain fed agriculture is concerned; there was no clear control on it. There was strategy formulated towards the development of rain fed agriculture, but it had

shrunk and rejected due to the much risk that revolve around in this investment. The case of risk mainly, the insecurity cause by the civil war and the drought cycle of the 1980.

The most important agricultural sub- sector in the area of the study Sudan; south Kordofan and Gedaref, is mechanized rain fed farming sector prevalent in the area of the area under study. The main crops in the area of the study are sorghum and sesame.

4.4 Mechanized rain fed corporation in Sudan:

Mechanized rain fed sector in Sudan started in 1945 for the mass production of sorghum to meet the grain shortage after the second war (Hassan, 1991, p158) .

i. The development of the Mechanized rain fed farming:

The development of the Mechanized farming has passed through three phases; the first phase 1945 – 1953, was completely under the government control and the total area cropped was 13020 hectare. The second phase 1954 -1968, in this phase the private sector was allowed to invest in agriculture and the government role was to provide the necessary infrastructure including road, domestic water supply, pest control, extension service etc, and to run pilot farms to solve mechanized production problem. The third phase 1969 – 1985, this phase started with establishment of mechanized farming corporation (MFC), as statutory body to be responsible for all mechanized farming activities in Sudan . in this phase the government had made an agreement with the world bank to finance the bush clearance operation , roads , supply water domestic and procurement of machinery for some projects which were planned on sound land use principle . in this phase during the period (1970 – 1980) the MFC was more developed ; the importation of machinery has been increased steadily with few fluctuation , the area reached one million hectare , and it managed to form for state in agadi (at Damazine), Samsam (at Gadarif) , Habiela (at Nuba Mountains), and Gozrom (at ALrank) . in 1985 state farms abandoned due to high cost of production and un remunerative yields .

In 1994 the MFC belonged to state ministries of agriculture, and their role was confined only in schemes demarcation, renting and storage services.

ii . Reasons of performance destruction in Sudanese mechanized rain fed agriculture:

There are some reasons behind the destruction of the performance of the Sudanese rain fed agricultural sub- sector which can be explained as follow:

- 1- Destruction of economic, political, and social situation as a result of October war (1973).
- 2- The flood in last twenty years, madethose who work in the field of mechanized agriculture unrest.
- 3- Increasing of production costs, specially the marketing, finance, and using technology costs as result of adoption of the economicliberation.
4. The financial and political dominance of some institutions over the activities of mechanized and rain fed agriculture.
- 5- Implementation of federal system which play negative role in development of mechanized and rained agriculture.(Mohamed , 2005, p216).

4.5The mechanized rained agriculture in south Kordofan state:

There are two agriculture system are practiced in Nuba Mountains ; (southkordofan) traditional and Mechanized rain fed system with an area of one million and 1.5 million hectare respectively.

The traditional rain fed is characterized by; small farm of size (1-5) Mukhamas , run in a mixed cropping system and shifting cultivation , using local land tools and animals drown implement for tillage , seedbed preparation , sowing and harvesting of crops , recently (since 2005) , many organization have assisted in training and distribution animals – drown equipment which contribute in increasing of crop production to satisfy family consumption and little extra to be exchanged. The mechanized –rain fed agriculture is mainly pre-planting –minimum tillage system,

where 2 wheel drive Tractor of the medium (70- 80) hp , and wide level disk harrow with seed box are used ; either in one operation (locally called syreen) or in two operation ; for seedbed preparation in the first operation , and for broadcasting and covering seed by disks in the second operation . this might be due to less power required , less fuel consumption , less labors , high annual hour of use (multipurpose machine) high field capacity and efficiency.

It was noticed that the average yield of crops in mechanized rain- fed area of Nubba Mountains region had decreased since the mid 1980's and this might be attributed to soil deterioration which might result from one or all of this three points ; lack of nutrients because neither fertilizer are used or crop rotation (Osman , 2011)..Sudan witnessed a civil war, and specifically the area of the study ; south Kordofan state, which started from (1985 – up to now) and an unsecure situation that let the farmers cultivate nearby schemes in exhausted manner , the deterioration may result from weeds infestation in high rates because of using uncertified crop seed that infected by strange seeds weeds , or there might be hard pan under 10 cm caused from machine traffic and using wide level disc with shallow depth (6-8 cm).

4.5.1 General features of South Kordofan State:

Geographical position:

Southern Kordofan State was established on 1991 by presidential decree No.4 of April 1991. It is located in the south part of central Sudan (before south Sudan separation); located in the southern part of the Sudan today. It lies between longitudes 29 – 32 east and latitudes 9-12. The State covers an area of 88,000 Km² and consists of five provinces (localities). The capital "Kadugli" lies some 900 Km south west of Khartoum. It shares common borders with northern Kordofan State to the north , white Nile State to northeast , Upper Nile state to the east , Unity state to the south and western Kordofan state to the west (Alfred, 2005. P97).

Large area of south Kordofan is covered by the Nubba Mountains, and that made a series or isolated range of rocky hills between which lie extensive plains . the

altitude of the plain average 500 Masl and the hill range from 800 to 1300 masl .There are seven (7) of these Mountains with high peaks . These include Mountain Hieban, the highest peak 1.317 meters above the Sea level, Mountain Rashad 1.257 meters, Mountain Garun, 1,084, Mountain Liri and Kalogi, 649 meters and Mountain Kadugli 761 Meters above the sea level.

i. Climate:

The international convergence zone that oscillates from north to south each year influences the climate. This oscillation causes a shift in wind direction from south to North, carrying moist air over the area that with ascending air causes convection rains. This usually starts at the beginning of May when the first erratic rain begins. The area remains under this influence. Until the end October when the winds begin to change from south to the north bringing dry air. The dry period lasts until April. Four seasons are recognized (Ibid,2005): The rainy season , from May to October , the harvest(Winter) season , through November to the December , with low night temperature , the cool dry season , from December to February, and the hot dry season with northerly winds , through March to mid- April.

ii. Rainfall:

Annual rainfall in the southern Kordofan state range from more 750 mm in the south to 350 mm in the North. The " rainy season" occurs between May and October with a number of rain days varies from 150 days in the south to 110 days or less in the north. Rainfall generally occurs in short high intensity storms between May and October, with the concentration of more than 80% in June, July, August and September. "Relative humidity" range between 20 – 30% in the dry season and rise to about 80% in the wet season (Alfred, 2005).

iii. Soils:

The soil of southern Kordofan state fall in to three main type: the " heavy clays (Vertisols)" with clay contents greater than 60% swell when wet and are difficult to work, the " lighter clay " or (Gardoud) soil which is relatively fertile swell when wet but tend to compact when dry and " sandy or (Goz) soil which are poor in

minerals organic matter and clay content. The Vertisol (heavy clays) Gardoud (lighter clay) comprise more than 50% of the state soil and dominate the usable lands (Ibid,2005)The principle feature of the soil type are:

a. Vertisol are cracking clay , which dominate the plains ; they are fertile with good cation exchange and water holding capacities but low infiltration rate when wet , and their self – mulching property is important for moisture conservation in dry farming . They may hold 140 mm / m of moisture but need animal drought or mechanical cultivation to enable satisfactory infiltration and are difficult to work when either dry or wet.

b. Gardoud soil are lighter brown or red clay loams , which occupy the higher position in the landscape – they are prone to erosion but tend to compact and are difficult to work without animal drought or mechanical cultivation. Fertility is quickly depleted when vegetation is clear and they used in cropping but small holder'sfarmers use them for hill gardens with the application of animal manure.

c. Goz soil consists of very deep fine – grained sand with a neural poor inherent fertility and negligible water holding capacity. Despite this, they are used in rain fed arable agriculture because they are easy to cultivate by hand and their ready release of water is suitable for extensive rooted crops such as millet and watermelon.Productivity depend on tree legumes and ephemeral – grass cover and is rapidly depleted when natural nutrient recycling is interrupted.

This system concentrated in Gedaref, Blue Nile, Upper Nile, White Nile Sinnar, and Southern Kordofan states. The average annual area covered about 14 million fedans (6 million hectares), with average holdings size of 1000 fedans The main crops grown in this sector are sorghum and sesame. Mechanized farming accounts for about 65% of the sorghum, 53% of the sesame, 5% of the millet, and almost 100% of sunflower produced in Sudan. Historically, this subsector has been a source of sorghum exports as well as meeting internal needs particularly in urban areas (Alfred, 2005).

B. Managerial Structure of mechanized rain fed agriculture

The general administration of rain-fed farming is technically subsidiaries to the director general of ministry of agriculture and natural resources of south Kordofan state as follows(osman.2006):

- 1- General Director of general administration of rain-fed farming
- 2-Deputy director of general administration of rain-fed farming
- 3-Statistics and follow-up division
- 4-Un-decmarcated schemes division
- 5-Schemes demarcation division
- 6-Farmers services (records) .
- 7-Employees affairs
- 8- Services manager (admin inspector)
- 9-Clerks division
- 10-Finacial division
- 11-Stations officers

C. Main problems of general administration of rain-fed farming:

The main administration problemof(MRF)in south Kordofan are:

- 1-managerial weakness due to local government weakness
- 2-Although the administration is considered the main source of financial import for the ministry of financial, but budget that specialized to it very lowIbid.2011).So that it leads to these negative results;
 - Nothing of training courses and qualification for management staff.
 - All services and development projects have stopped.
- 3-The administration is practicing horizontal expanding instead of vertical expanding through applied experiments and researches.
- 4-Absence of vision for land use, and thatled to soil deterioration which might result from one or all of these three points; lack of nutrients because neither fertilizers are used nor crop rotation,

weeds infestation in high rates because of using uncertified crop seeds that infected by strange seeds of weeds, or there might be hard pan under 10 cm caused from machinery traffic through years and of using wide level disc with shallow depth (6-8cm).

5- The area witnessed a civil war extend from (1985- up to now) and unsecure situation that let farmers cultivate the nearby schemes in exhausted manner as well as restriction of shepherds movement in the farm area that caused to frictions between shepherds and the farmers.

Basing on the previous review, sofor moreunderstandingthe coming section is the organization chart of (MRF) in south Kordofan state.

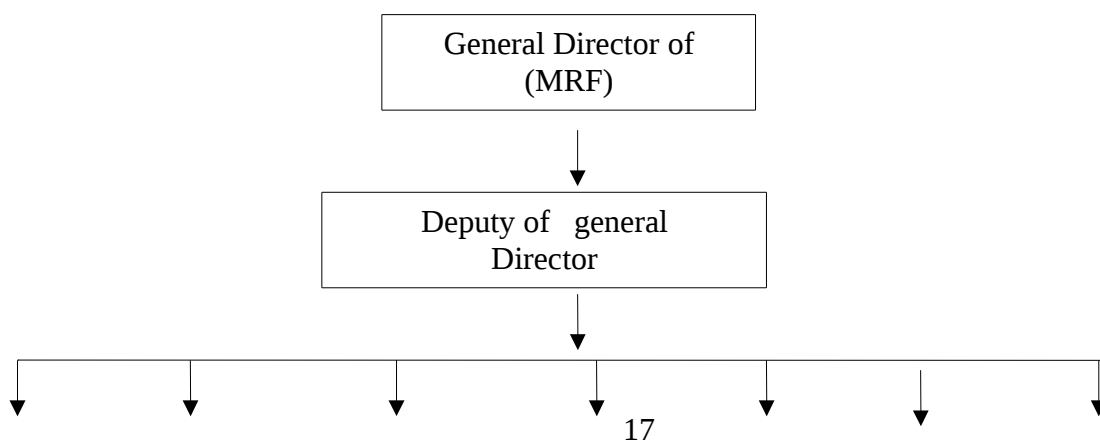
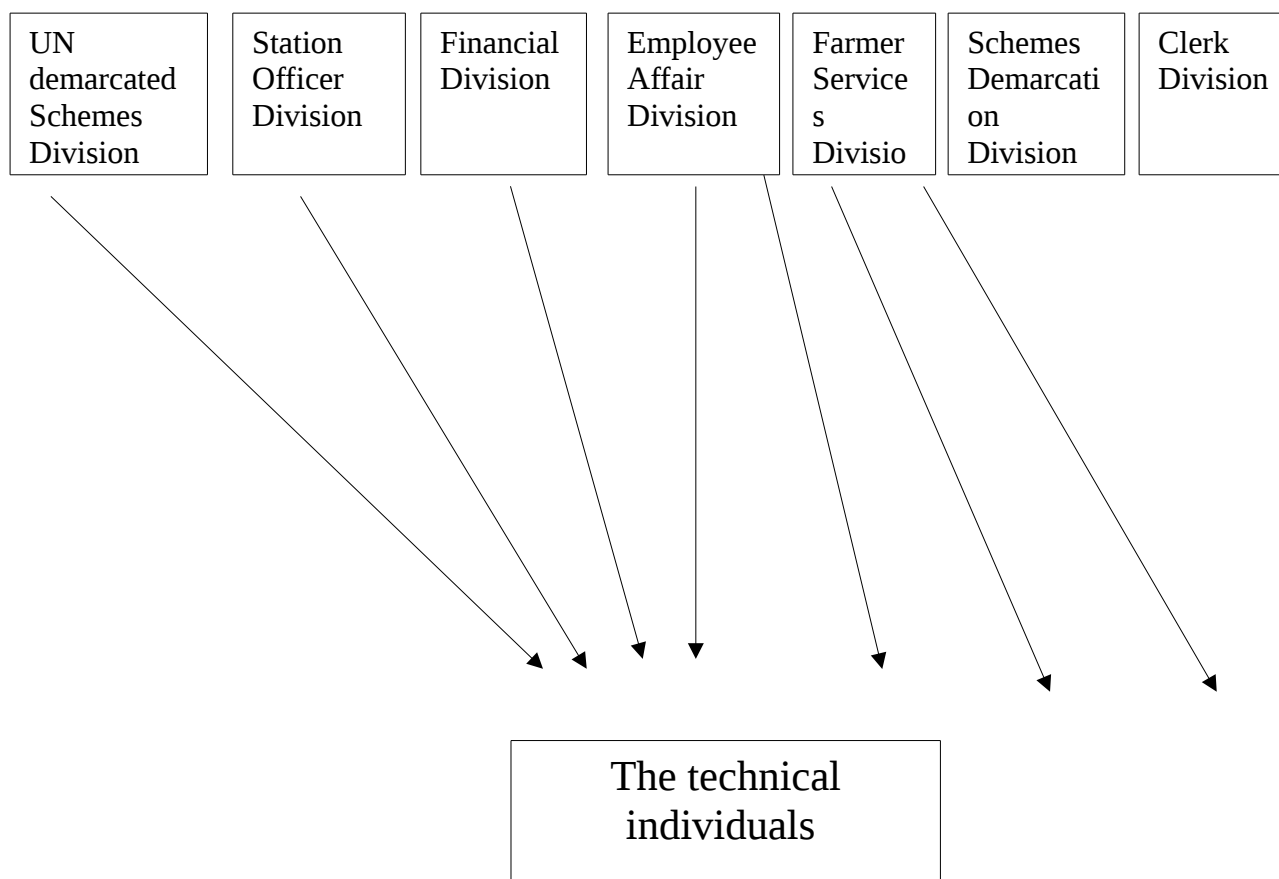


Figure (4.5.1) the Organization chart of (MRF) south Kordofan



Source: the researcher from data of (MRF) south Kordofan, March, 2013.

4.6. The mechanized rain fed agriculture in Gedaref state:

Mechanized farming began in Northern Gedaref area in 1944. This considered the first phase in development of mechanized farming in Sudan. The low annual rainfalls (600 to 700 mm), and the short rainy season (June to September) prevailing in the area retained only a light tree cover, and the short rainy season, and that reduced the costs of land clearing, this is associated with light tree cover which reduced. Subsequently, the areas of mechanized farming have rapidly developed (Simpson and Simpson, 1978). During this stage, development continued through the establishment of government managed schemes where land was prepared

through mechanical means assisted by manual labor from the towns. Due to the difficulties of mechanized crop production schemes as state farms, the system of sharing the cultivators was introduced in the 1948/49 season. In this system, land was to be plowed and sown by the scheme's management then weeded and harvested by the cultivators on a share cropping basis. However, the share-cropping system has not survived because of permanent settlement difficulties manifested by the seasonality of the production and the inadequacies of the requisite infrastructure (Rajaa.2006). Until 1950, sorghum was the only crop grown, but in 1950 American short-staple cotton and local white-seeded sesame were introduced on small areas (SIMPSON and SIMPSON, 1978). In 1952/53, the total crop area expanded from the initial area of 12,000 to 29,000 fedans (5,000 to 12,600 hectares). The second phase began in 1953 when the direct state participation was abandoned and instead 1,000 fedans (420 hectares) holding were subleased to private tenants at a nominal rent. The private tenants were largely from merchants lived in towns and others entrepreneurs of Gedaref with both capital resources and management ability. Generally, the merchants lived in towns and hired farm managers to organize and implement the field operations. Once the concept of 1,000 fedans (420 hectares) was introduced, the area under cultivation in the Gedaref area expanded rapidly by 1959/60 passed one million fedans (420,000 hectares), was introduced into the Dali/Mazmum and Damzine areas in the south east of Gedaref on the opposite side of the Blue Nile on 96,000 fedans (42,000 hectares) that expanded to 780,000 fedans (328,000 hectares) by 1968. In 1957/58 mechanized rain fed farming was also introduced in the Nubba Mountains area of Kordofan in Western Sudan (before separation of south Sudan). The rainfall in these areas is higher than at Gedaref but these areas are more remote from major markets. Encouraged by the rapid spread of mechanized farming, the government has devoted attention to the possibilities of future expansion. Production and most of state being the provision of roads and rural water supplies (Rajaa, 2006). Great emphasis was given to American short-staple cotton production for the recently

established textile industry. The government also emphasized the introduction of sesame into the rotation with the objective of export diversification away from the over dependence on cotton exports from the irrigated zones.

The increased production of sesame and cotton was to be secured by adoption of a new rotation on mechanized farms; cotton-sorghum-sesame-fallow. The government, however, had little success in securing the desired expansion in cotton area at Gedaref. Cotton is a labor-intensive crop and the costs were not justified by the low yield levels normally attained. A major constraint was the shortage of drinking water during the operations of picking, collecting and burning of plant residues (January to March). Sesame also was not successful in Gedaref. The crop is very sensitive to soil moisture conditions in its early stages and tends to die off when rainfall is either insufficient or excessive. Consequently, little progress was made with crop diversification especially in the Gedaref area where the farming system is predominantly sorghum monoculture with small area in sesame. The remedy for this problem was seen in the introduction of four-year fallow; to be implemented by leasing each tenant an extra one thousand fedans (420 hectares) holding so he could alternate a four year cropping period and a four year fallow between the two. The plan did not achieve its objectives, for two basic reasons. The new schemes were often a considerable distance away from the original holdings. Farmers were reluctant to operate a fallow system and find the capital to clear fresh land that they could not farm continuously. In fact, the system was already extensive without these additional constraints.

The third phase began in 1968, when the awareness of the problem of land deterioration, poor agricultural practices, low yields and unauthorized removal of the natural vegetation led the government to establish the Mechanized Farming Corporation (MFC). The MFC was entrusted with surveying and allocating land for mechanized farming, assisting of private investors, managing the state farms, promoting research, and providing of credit and other services. In practice,

the MFC's activities were confined to the first two activities since the state farms had been abandoned in 1984 and the remaining activities are provided by other agencies. When the MFC was established, there were 1,400,000 fedans (600,000 hectares) already under production in the Gedaref, Damazine and Rank areas. The first plan executed by the MFC covered a five year period (1970/71-74/75) during which an additional 2.689 million fedans (1.13 million hectares) were opened for mechanization. Sixty three percent of this development was self-financed by private sector, 22% financed by the World Bank for private farmers and 15% by state farms (Rajaa, 2006). Under this plan, mechanized farming was extended into South Gedaref and Habila in western Sudan. By 1988 mechanized farming in Sudan was practiced on 11.42 million fedans (4.8 million hectares). The current phase has undergone much transformation. Important among the modifications that characterized this phase is the decision by MFC to legalize the selling of the schemes licenses by farmers (Ibid,2006). Some argued that it may increase the concentration of land in the hand of the few rich farmers who already operate multiple farms. Another development in this phase is the increased emphasis and attention given to importance of modernizing production practices and solving the resource mismanagement and low yield problems by technological change. The Agricultural Research Corporation (ARC) began to give more emphasis to rain-fed adaptive research and as a result several hybrids and new cultivars have been released since 1983. A new research station was established at Gedaref city to carry out applied research for the rain-fed area like developing new water retention technologies, improving chemical fertilizer use and designing optimum crop rotations (Rajaa, 2006, p26). The expansion of mechanized agriculture in the Sudan has made a major contribution to its self-sufficiency in sorghum, except in years of severe drought; in many years the value of its sorghum exports may have more than paid for its cereal imports. Private capital has been utilized in the agricultural sector to much greater degree than before. Mechanized farming has also contributed modestly towards cash crop production but through

sesame and very recently sunflower, rather than cotton. The price paid for this success has been the destruction of vast areas of savanna woodland and exhaustion of soils over large areas.

4.6.1 General feature of Gedaref State

i. Geographical position:

The Gedaref state is located in eastern Sudan (figure 3.1), near Kassala state to the north, Kahrطوم state to the northwest, Sinnar state to the south, Gezira state to the west and Eretria to the east. The state covers a total area of 75. 263 km² .it lie between latitude 12° 45 N and 14° 15 N and longitude 34 ° E and 37 E , it average altitude is 600 meters above the sea level .Also the region under consideration is about 490km from the capital Khartoum and 770 km far from port Sudan city , the main sea port of the Sudan . Then the region position is favorable to domestic and foreign trade.

About the ninety percent of people, who live in Gedaref, are classified as farmer engaged in settled agriculture, either in traditional or large scale mechanized farming.

The area is generally divided in to three agro- ecological zone of the bases of the amount of rainfall and main agriculture characteristics. The north zone with rate of rainfall less than 500mm , where the animal specially sheep production is primary practiced beside crops production ,the central zone with rainfall range between 500 to 600 mm and the southern zone with rainfall range between 600 to 900 mm(Rajaa,2006).

ii. Climateand Rainfall:

Climate has always been a major concern; therefore, it is necessary here to briefly review the climate in the area of the study, because agricultural products are dependent mainly on weather.

The Gedaref region is characterized by the semi-arid climatic condition where rainfall is erratic and concentrated in only few months of the year. The length of rainy season fluctuates around four month's i.e. from June to September and the

peak of rainfall is in August. Rainfall varied from 400 mm to over 700 mm with an annual average of 591 mm and standard deviation of 102 mm during this period. The average monthly rainfall in June at the beginning of the rainfall season; ranges from 66 mm at Gadambalia to 70 mm at Gedaref and 95 mm at Doka. At the peak of the rainfall season in August, rainfalls range from 176 mm at Gadambalia to 196 mm at Gedaref and 207 mm at Doka. In September towards the end of the rainy season, the rainfalls range from 72 mm at Gadambalia to 83 mm at Gedaref and 105 mm at Doka.

Although the total amount of rainfall during the rainy season may seem sufficient to meet the requirement of most crops, the high temperatures of the rainy months, together with a high percentage of light rainfalls events, substantially reduce the amount of effective rainfall.

Since agriculture is practiced only under rain-fed conditions in this area, the timing and seasonal distribution of rainfall have greater influence on farmers' decision making process regarding agricultural production as it can be inadequate in amount and unreliable in its distribution. Such decisions involve risks, which calls for caution in timing and selection of production activities and management strategies.

iii. Soils:

The Gedaref area is characterized by a semi-arid climate which is related to soils having dark colors, a high clay content and strong vitriolic properties. The area includes a large, rather uniform, clay plain intersected by small valleys. The clay content is very high and generally 75% to 80%. The color of the soils is very dark grayish brown. The organic matter and nitrogen content of the soil are low but as there is no deficiency of other plant nutrients, the soils are moderately fertile. The water holding capacity of the soil material is very high. This, in combination with the deep penetration of water in the soil through the Vertisolic cracks, causes the available water holding capacity of the soil to be very high. This high water holding capacity allows crops to grow on stored water during dry spells and long

after the rainy season. The soils also have undesirable physical characteristics, such as a low permeability when wet, causing soils in water receiving sites to be waterlogged for certain periods during the rainy season. Also, the soils are difficult to cultivate as they are very hard when dry and very sticky and plastic when wet, causing the moisture range at which the soils can be cultivated to be very narrow. Thus, mechanization of the land preparation operation is critical to work in this narrow time frame (Ibid, 2006). In fact, without mechanization, it would be impossible to develop these vast areas of Vertisols.

From above mentioned, it is clear that the Sudanese agriculture sector in general and the mechanized and rain fed farming in particular, have some strong point and opportunity which can help insuccess the agricultural business, such as Diversity of climatic conditions, rainfalls range, soil types and arable lands, but in the other hand in the recent years there are declining in Sudanese agriculture caused by agricultural policies, miss management due to managerial weakness as, lack of finance and marketing and Absence of vision for land use and designing optimum crop rotations. In addition to that there are problems of formulation agricultural strategies and security problems.

In fact, during the three periods of mechanized and rain fed farming (MRF), which mentioned in previous section, the phase during the period (1970 – 1880) the MFC was more developed; the importation of machinery has been increased, this period witnessed development in agricultural exports.

Another significant factors, is, the exports policies, inventory strategies operation, and openness boarder of the country, which can effect positively or negatively on crops production.

So, according to this situation which is reviewed, the mechanized and rain fed farming can be improved through enhancing the opportunities, and finding solutions for the problems. This way can help these farms policy maker to devise suitable strategies for this sector.

In the coming chapter the study will cover data and the sample of the study, these data will cover the period 2001-2010, for the two major mechanized and rain fed agricultural schemes in Sudan, south Kordofan and Gedaref State.