

## **ABBREVIATIONS**

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

**MRS:** Mechanized rain fed agricultural Schemes.

## **CHAPTER FIVE**

# **SOURCE OF DATA SAMPLE**

## **5.1 Introduction:**

This chapter covers the research design, study population and the sample. Analysis of the field data so as, to answer the research questions. The research design covers the scientific approach of the research and the strategies .Also this chapter presents the procedures of the field study which covers the main sources of the research data and the techniques used in the designing of the study. The main study data are the agricultural inputs (labor, agricultural finance and agricultural machines), and single outputs (Sorghum) and (Sesame). These Data obtained from different sources, and also recorded for the whole period (2001-2010), for the sample of the study; the two major mechanized rain fed agricultural schemes in Sudan; southern Kordofan and Gedaref State. And finally this chapter gives review and discussion of the results.

## **5.2 procedures of the field study:**

This study is based mainly on the different sources of the data collection:

### 1-secondary sources

Secondary sources included references, documents, internet reports, researches, and scientific magazines. This data help in building consistent conceptual theoretical framework of the study and created sizable knowledge and previous studies on the topic of the study.

### 1-Primary sources

Survey is the main source of data collection of this study. In particular the field survey was done to collect the main data to complete this study.

The appropriate annual reports of inputs and outputs data is collected from the area of the study; south Kordofan and Gedaref states, assuming that the data to be positive for all schemes .these data are considered very important in the use of DEA Model to make comparison between the schemes in the two areas to see

which are more efficient and to analyze and measure the changes in productivity in these schemes, which are under evaluation.

### **5.3 study population and sample:**

This research covers the Sudanese mechanized rain fed schemes in Gedaref and South Kordofan area. The 10-year (2001–2010) panel data for this study was extracted from the annually archives from the area of mechanized rain fed schemes in the two areas. These data represented

Agricultural inputs which include labor, finance and machines beside information of agricultural outputs which represented the production of main crops (Sesame and Sorghum) in the study area.

Accordingly, the population of the study is Mechanized rain fed schemes, which include Gedaref, Damazine, Kosti, Alrank and Dillinj areas in Sudan, through which ,the study sample is derived, which located in South Kordofan and Gedaref States, to find out the best one in practice.

The research sees that these schemes are very important sectors in Sudanese agriculture, because they supply country with food, raw materials and hard currency. Therefore the research collects quantitative inputs and outputs data in each State.

### **5.4 Data collection:**

The research is based on the survey data. The data which cover the period from (2001-2010) is about two major mechanized rain fed agricultural schemes in Sudan; south Kordofan and Gedaref States, this data is obtained from sampled area of (MRC) in both Gedaref and South Kordofan state by formal surveys in the period (2001- 2010). The main data were collected by the researcher from planning and agricultural economics department which belongs to the ministry of agriculture and forests, other data are collected from the agricultural bank (head office of Dallanj branch), and the head quarter of the Sudanese mechanized rain fed Corporation (MRC) , in both south Kordofan and Gedaref States.

These (Inputs and outputs) data of Sudanese mechanized rain fed schemes in both the two areas is an important step to create appropriate compound of agricultural inputs and outputs to promote their efficiency. Also it will help in measuring the Total Factor Productivity (TFP) change in the area under study, in which the two crops under study (Sesame); the staple food and (Sorghum) , while the second one is cash crop. Moreover, the most investment is employed in this area.

The secondary data includes: Time series data of production inputs, the area grown of sorghum and sesame, agricultural finance, annual average of rainfall, number of machines units, agricultural labor force. Also the information includes output data, which represent sesame and sorghum products.

After getting an overview of the Sudanese mechanized rain fed farming, the field data organized in the form of (inputs & outputs), so as to deal DEA methodology for estimating the total factor productivity growth and efficiency measurement of mechanize schemes in both south Kordofan and Gedaref State in Sudan. The coming tables,(5.4.1),(5.4.2),(5.4.3) and(5.4.4) present inputs and outputs data of Sudanese mechanize rain fed schemes in the two areas.

#### **5.4.1.Data of Gedaref area:**

The following table presents information about the main agricultural inputs and single outputs in Gedaref, during the period (2001 – 2010).

Table (5.4.1) main agricultural inputs and outputs (per1000Tons) in Gedaref area in Sudan over the period (2001-2010)

Years	Gederef				
	Inputs			Outputs	
	Labor (1000pers)	financemachines (1000SDG)	(1000 units)	Sesame (1000Tons)	Sorghum (1000Tons)
2001	8433	1343788556	3021	75	368
2002	10675	1840806240	3043	46	473
2003	10710	3540012000	3052	27	852
2004	13731	2950010000	3173	114	367
2005	17165	3708584000	3524	55	537
2006	33104	4214300000	3715	47	521
2007	33780	5771519700	3817	70	429
2008	37535	9681065400	3972	68	513
2009	41705	6200000000	4050	54	192
2010	44617	6834253643	4061	74	623

Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues. VOL.1-30

This table (5.4.1) shows three main agricultural inputs which include (labor, Agri-finance and machines) and main outputs which represent sesame ( figure 5.4.1) and sorghum( figure 5.4.2) production in Gederef state during (2001-2010).To give a clear picture, this data had been drawn in graphs as shown in theFigure (5.4.1) ,(5.4.2) ,(5.4.3) ,(5.4.4) ,(5.4.5) ,(5.4.6) and(5.4.7).

Figure (5.4.1) Sesame production in Gedaref areain (2001-2010)

Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues. VOL.1-30

From figure (5.4.1) it is noticed that the Sesame production in some years increased; the years2001,2004,2007 and 2010 witnessed high production of Sesame which is( 75000 tons), (114000 tons), (70000ton)and (74000 ton) per ( 1000 Fed).

Sesame production has increased from 27 ( 1000 ton) in 2003 to 114(1000ton ) in 2004 , one of the reasons behind this increase is rise in machines and laborers in these years , on the other hand there is decrease in the rain fall average and land area cultivated where the Sesame production is also at lower levels. In the year 2003 is the year where the sesame production declined by 42% from the previous year 2002, and it is the worst year among all the periods of the study. This declining is due to the declining in the area cultivated (431000Fedans), see table (5.4.2). Also the overall policy of Sudanese economy is concentrating on oil extraction and export instead of agricultural production, while during 2004 Sesame production increased, and estimated at the highest levels over all periods. The year 2004 had the highest number, which is (114000), while the year 2003 is at the lowest.

On the other hand sorghum production in Gedaref state can be seen as in the coming figure (5.4.2). It is noticed that there is increase in sorghum production during the years 2003, 2005, 2006 and 2010, which is (852000), (537000), (521000),(623000) tons per(1000 fed) respectively.

Figure (5.4.2) Sorghum production during (2001- 2010) in Gedaref area

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

Figure (5.4.2), illustrates sorghum production in Gedaref Mechanized rainfed area. The Year 2003 had the highest number of sorghum production and Year 2009 was at the lowest.

The agricultural production inputs in (MRS) in Gedaref area can be explained clearly in the coming figures (5.4.3), (5.4.4) and (5.4.5).

Figure (5.4.3) finance amount during (2001- 2010) in Gedaref area

Source: Sudanese agricultural bank, Gedaref branch , November 2012.

It is clear that, the agricultural finance size was high during season of 2008, see figure (5.4.3). While in the years 2001, 2002, and 2004, the agricultural finance was at the lowest rate. Machines also considered as one of the main agricultural inputs for its large contribution in increasing agri- production. The coming figure (5.4.4) reviews the number of Machines units during the study period.

Figure (5.4.4) Machines units during( 2001- 2010) in Gedaref state

Source: Headquarters of the Sudanese mechanized rain fed Corporation (MRC), Gedarefstate, November, 2012.

It is noticed that machines units increased in the years (2006-2010) see figure (5.4.4), during the study period in Gedaref (MRF) agricultural schemes. This increasing in the machines can be explained by the country National Comprehensive Strategy and the agricultural revival or green campaign program plan 2001-2006), which were to develop the agricultural sector by increasing the

number of machines, and crops area .The agricultural production efficiency in Mechanized rainfed area in Gedaref was also influenced by the availability of agricultural labor size, see figure (5.4.5) explains this.

Figure (5.4.5), the agricultural labor size in Gedaref area during 2001- 2010.

Source: Headquarters of the Sudanese mechanized rain fed Corporation (MRC), Gedaref, November, 2012.

Figure(5.4.5) shows information about the agricultural labor size in Gedaref during the study period. It is noticed that, the agricultural labor size in the Gedaref state was lowest in 2001 and 2002, while the agricultural labor size increased in 2009 from (37535000) in 2008 to (41705000) in 2009 , and from 41705000 in 2009 to (44617000) in 2010.

For further discussion, it is useful to present quantitative information about climate (rainfall & land) because the total area of schemes and distribution of rainfall during the period of study can affect the agricultural production efficiency. The following table gives information of agricultural land area and annual average rainfall in Gedaref area.



Table (5.4.2) Land Area and annual average rainfall in Gedaref area during (2001-2010).

years	Average Rain fall (mm)	Land area (1000fed)
2001	81	1050
2002	108	737
2003	121	431
2004	77	1010
2005	74	892
2006	96	632
2007	87	576
2008	103	474
2009	141	697
2010	125	673

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

From table (5.4.2) the annual rainfall increase in 2002/ 2003 to (108 mm) and(121 mm) respectively .While agricultural land increase in (2001 and 2004).Theyear 2004 was worst in Gedaref state in terms of average rainfall, the year 2003 was the worst among all periods of sesame production. The main factors behind this declining in production were the shortage in the agri- laborand the average annual rainfall see figure ((5.4.6) . On the other hand, rain fed was considered as the important factor that influenced the agricultural production; the table (5.4.6) ,shows the annual rainfall in Gedaref area.

Figure (5.4.6) annual rainfall in Gedaref areaduring(2001-2010)

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

Figure (5.4.6), explains the annual rainfall quantity, The annual rainfall in Gedaref state was higher in years 2002, 2003, 2008, 2009 and 2010, while years 2001 and 2005 had low level of rainfall . Years 2005 was the worst year in terms of rainfall in Gedaref State.

Figure (5.4.7) agricultural land area in Gedaref state during (2001-2010)

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

Figure (5.4.7), explains the totalannual cultivated farm land in Gedaref area during (2001- 2010). It reveals that about (1302000) and (1050000) Fedans of farm land was the total area cultivated in years 2000 and 2001 respectively, while about (431000) and (576000) fedans was the total area cultivated in years 2003 and 2007 respectively.

## 5.4.2. Data of South Kordofan area:

Table (5.4.3) presents three agricultural inputs and single two outputs (sorghum & Sesame) in South Kordofan state in (2001-2010).

Years	South Kordofan				
	.....Inputs.....			.. .Outputs.....	
	Labor (1000pers)	Finance (1000SDG)	Machines (1000 units)	Sesame (1000Tons)	Sorghum (1000Tons)
2001	3736	21508900	470	21	245
2002	1156	18331650	354	10	123
2003	1594	35663160	171	11	143
2004	4861	17644105	334	20	155
2005	9516	2223000	714	148	149
2006	8838	68610350	651	135	139
2007	2951	423500	231	21	134
2008	2885	175514807	210	20	74
2009	291	67198170	196	17	43
2010	1630	11049500	159	16	65

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri - economic, (Arab Agriculture statistics Year book), various issues.

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The previous table (5.4.3) shows three main agricultural inputs which include (labor, Agri-finance and machines) and the main outputs which include sesame

and sorghum products in South Kordofan state during(2001-2010).For furtherillustrates, this data had been drawn in figures (5.4.8), ( 5.4.9),( 5.4.10), (5.4.11) and (5.4.12).

Figures, (5.4.8) the Sesame production in South Kordofanareaduring (2001-2010).

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

The figure (5.4.8) explains that the sesame production increased during the periods (2005 and 2006), which was (14800) and (135000) tons respectively. The years 2002, 2003 were the lowest, while Sorghum production can be illustrated in the coming figure:

Figure, (5.4.9) the Sorghum production in South Kordofanarea during 2001-2010.

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30

as shown in the figure(5.4.9) ,the sorghum production in southern Kordofan for some years is increased, the years 2001, 2004, 2005 were high in terms of Sorghum production which were (245000) ,( 155000)and ( 14900) tons respectively, the year 2001 had the highest number and Year2009 was at the lowest.

Sorghum and Sesame Production were directly influenced by quality and quantity of agricultural inputs in the area which , such as number of machines units which considerable contribution in terms of agricultural growth and development , finance size , the important source in agricultural production and labor, these inputs can be explained clearly in figures ((5.4.10) ,(5.4.11) and (5.4.12) below.

Figures,(5.4.10)the Finance amount in south Kordofan area in(2001-2010).

Source: Sudanese agricultural bank,Dallanj branch, November 2012

In terms of finance, south Kordofan agriculture faced a problem, the previous figure (5.4.10) shows this. Machines were one of the basic needs for ( MRF) for achieving the agricultural production it serves as a big bone for agriculture in the area of study, figure(5.4.11) gives the quantity situation of machines in south Kordofan.

Figure (5.4.11) number of Machines units in south Kordofan area during (2001-2010).

Source: Head quarter of the Sudanese mechanized rain fed Corporation (MRC), Dallanj, November, 2012.

From figure (5.4.11), it is clear that the (MRF) in south Kordofan during 2002 and 2003 showed dramatic decrease in number of machines. Also there is decrease in the number of machines in years 2008, 2009 and 2010. Only the period between years (2004 – 2007) showed increase in machines numbers. The situation of agricultural labor in south Kordofan (MRF) schemes as one of agricultural inputs can be explained in the figure (5.4.12).

Figure (5.4.12) Size of agricultural labor in south Kordofan area during (2001-2010).

Source: Headquarters of the Sudanese mechanized rain fed Corporation (MRC), Dallanj, November , 2012.

Figure (3.4.11 above, showed that there were increase in agri- labor during 2004-2007. In the year 2009, there was a surprised decrease in agricultural labor.

For the further discussion it is useful to present quantitative information about climate (rainfall & land area). The coming table (5.4.4) gives information of land area and the annual average rainfall in the area of study.

Table (5.4.4) Land Area and Annual average rainfall in south Kordofan area during (2001-2010)

years	Average Rain fall (mm)	Land area (1000fed)
2001	106	468
2002	30	321
2003	82	166
2004	95	329
2005	63	712
2006	112	653
2007	87	223
2008	122	207
2009	109	195
2010	116	157

Source: Source: Ministry of agriculture and forest, general administration t of planning and agri- economic, (Arab Agriculture statistics Year book), various issues

Table (5.4.4), gives information about the quantities of annual rainfall in South Kordofan area. For more explain see figure (5.4.13).

Figure (5.4.13), the annual rainfall in south Kordofanarea during (2001-2010).

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30.

From figure (5.4.13), the year 2002 is the year where annual average rainfall is low (30mm) , while the year 2008 witnessed the higher amount of average rainfall(122 mm). On the other hand, beside information of annual rainfall, the previous table(5.4.4)gives information about the land area which, classified as the main agricultural production inputs in the study area, for more illustration see the coming figure (5.4.14).

Figure (5.4.14), the annual agricultural land area in south Kordofanarea during (2001-2010).

Source: Source: Ministry of agriculture and forest, general administration of planning and Agri- economic, (Arab Agriculture statistics Year book), various issues.VOL.1-30.



Figure (5.4.14) ,shows that the agricultural land area in south Kordofan is increased during 2004 and 2007, while years 2003 , 2009 and 2010 witnessed great reduction in term of agricultural land in south kordofan area during the period of the study, which is (166000 fedans) , ( 195000 fedans ) and ( 157000 fedans ) respectively .

The coming chapter concerned with analysis the sample data, it shows how the methodology of the research conducted and applied in the data of the study area; south Kordofan and Gedaref Mechanized rain fed agricultural schemes. Also gives the main estimate of the efficiency and productivity change during the period of the study. The steps of estimation help in identifying the improvement in efficiency and contribution of (TFP) components to productivity growth in Sudanese Mechanized rain fed schemes, specifically in south Kordofan and Gedaref area in Sudan. However, the study presents the estimated TFP Growth, efficiency change and frontier shift for areas (Gedaref & S. Kordofan) MRs in Sudan, which include the production of Sesame and Sorghum at each scheme level during (2001-2010).