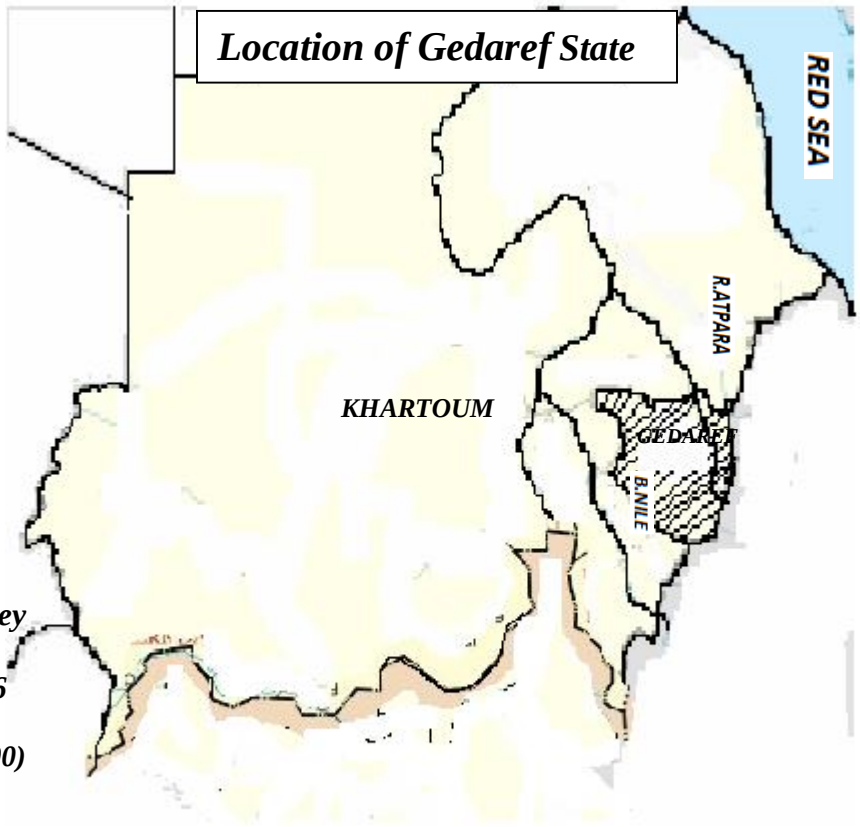
CHAPTER ONE

1- Introduction

1-1- Location:

The Gedaref state is the first part of the Sudan in which mechanized rain fed farming was introduced .Mechanization first started in Ghadambaliya area north of the Gedaref state then extended south and south west; so, a dry region was selected for this case –study because it reflect clearly the impact of mechanized rain fed farming on natural and human environment. The region under consideration lies southeast of Khartoum . It occupies, the southern part of Kassala state in eastern Sudan . It lies between latitudes 12^{o} 45' N and 14^{o} 15' N and longitudes 34^{o} E and 37^{o} E (Approximately) . It has an area of 78.228 sq km and its average altitude is 600meters above sea level figure (1-1)

figure 1-1



Source: Soil Survey Administration Wad Medani 2006

(Scale:-1:10,000,000)

The Gedaref town is about 490km from Khartoum and 770km from Port Sudan . Thus the region is reasonably situated, to internal and external trade . The areas under study is very similar in landscape. Physical and socio-economic characteristics the distance is about 45kms from Gedaref. The population have nearly the same tradition and with different tribes. It lies between latitude 14^{o} N and 14^{o}-15^{o} longitudes 35^{o} E – 35.30 ^{o}E figure (1-4) shows the sites. The area is approximately about 1.12 sq km reserved forests, which are completely cleared, (1120.000 faddans) (46666.66 ha).

1-2- Climate:

The climatic zones of the state were described by Vander Kevie (1976) "traveling from the north to the south through Kassala state one passes through six climatic zones from desert in the far north to the wet monsoon climatic in the southern tip of the state figure (1-2) .The northern part of the Gedaref state is semi - arid zone . In this zone, a short dry spell may cause considerable reduction in yield while, in the dry monsoon zone . It is flooding rather than drought that causes crop failure .Rainfall is considered an important factor in determining the type and variety of crops to be grown and the agricultural techniques, which should be used to the optimum production. Rainfall varies from north to south . The average annual rainfall range from 175mm at Goz Ragab in the north to 570mm at Gedaref in the center and 650mm at Doka in the south . Rainfall at Gedaref area is markedly seasonal in character, the length of the rainy season fluctuates around the four months June to September inclusive it reaches its peak in August .It is semi-arid zone climate the rainy season extends from June to October inclusive, it reaches the peaks in August (Vander kevie 1976). The mean annual rainfall is between (200-800mm). The temperature are generally high averaging 40^{o}C in the summer (Gedaref meteorology office). Table (1-2-1) (1-2-2) (1-2-3) (1-2-4).

Table (1-2-1) Average rainfall during the month of March to November 1950 1980

Year	*30 March mm*	*30 April mm*	*30 May mm*	*30 June mm*	*30 July mm*	*30 August mm*	*30 sept mm*	*30 Oct mm*	*30 Nov mm*
1950 – 1980	*0.5*	*3.4*	*21.2*	*95.9*	*183.4*	*184.4*	*85.5*	*31.4*	*3.5*

Source: Galal Eldin Eltayeb et al (1983)
Etma programme – Gedaref state.

Table (1-2-2) ***Ghadambaliya Area 1981 – 2006***

Season	*Average rainfall*
1981	*580.0*
1982	*475.0*
1983	*430.0*
1984	*285.0*
1985	*285.0*
1986	*462.5*
1987	*598.0*
1988	*436.0*
1989	*651.0*
1990	*644.0*
1991	*379.0*
1992	*462.0*
1993	*730.0*
1994	*616.0*
1995	*619.0*
1996	*463.0*

1997	***627.5***
1998	***452.5***
1999	***426.9***
2000	***490.9***
2001	***678.5***
2002	***480.3***
2003	***607.3***
2004	***493.7***
2005	***529.0***
2006	***486.0***

Source: Mechanized farming Corporation Gedaref 2006

Table (1-2-3) ***Relative humidity , wind direction air temperature during 1950-1980***

Humidity%	***Wind/note***	***Min.Tem /C***	***Max.Tem/C***	***Month***
35%	***Northern 6***	***17.2***	***34.7***	***January***
28%	***Northern 6***	***18.6***	***36.4***	***February***
25%	***Northern 6***	***21.5***	***39.2***	***March***
23%	***Northern 5***	***23.9***	***40.6***	***April***
33%	***West southern***	***25.2***	***40.4***	***May***
49%	***West southern***	***23.4***	***37.5***	***June***
65%	***Southern***	***21.5***	***33.8***	***July***
71%	***Southern***	***21.2***	***38.5***	***August***
65%	***Southern***	***21.4***	***33.6***	***September***
50%	***Southern***	***21.9***	***36.6***	***October***
34%	***Northern 6***	***21.0***	***36.9***	***November***
36%	***Northern 6***	***18.2***	***35.2***	***December***

Source: Gedaref Meteorology office 2005

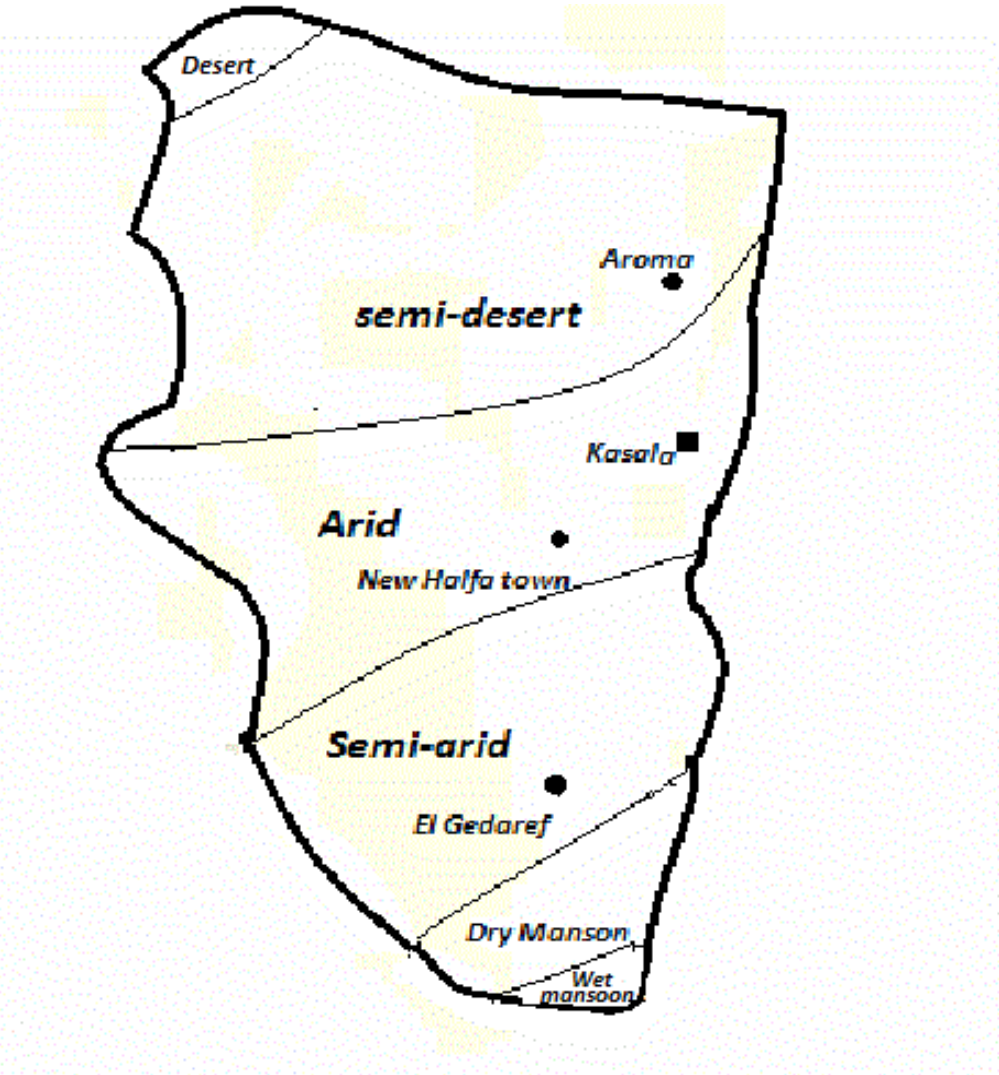
Table (1-2 – 4)

Temperature and relative humidity in the period from 1996 – 2002

2002			2001			2000			1999			1998			1997			1996		
Rh	**Min**	**Max**	**Rh**	**Min**	**Max**	**Rh**	**Min**	**Max**	**Rh**	**Min**	**Max**	**Rh**	**Min**	**Max**	**Rh**	**Min**	**Max**	**Rh**	**Min**	**Max**
48	16.4	33.8	51	16.8	34.2	53	18.0	35.4	51	18.8	35.5	41	17.3	34.8	43	17.9	34.5	36	19.0	35.4
45	20.4	38.2	45	18.9	37.1	50	19.7	37.2	45	22.7	40.9	32	18.4	36.0	49	16.9	37.5	44	19.0	38.3
29	22.5	40.6	26	23.3	40.0	41	21.2	38.9	31	20.9	38.7	29	21.7	38.3	32	21.9	33.7	30	22.0	39.5
27	25.7	42.9	25	26.3	43.2	33	25.2	40.7	29	24.3	41.4	24	25.2	42.9	27	24.3	40.5	28	24.7	41.7
24	25.7	43.3	34	26.2	41.5	41	26.7	41.4	47	25.4	40.4	34	26.8	42.5	43	26.2	38.9	51	23.9	39.1
53	24.7	39.3	58	23.6	37.7	55	24.3	33.5	50	32.5	38.4	51	25.0	40.3	60	23.7	38.0	64	22.6	36.5
65	22.8	36.6	75	21.7	33.7	73	21.8	24.0	76	21.6	33.2	73	22.6	33.7	74	22.4	34.3	69	22.3	35.0
88	21.5	33.8	78	21.5	32.9	77	21.6	32.4	82	21.0	32.0	83	21.3	31.0	79	21.5	32.8	79	21.6	32.8
72	22.0	35.1	74	22.2	35.0	72	21.6	34.3	76	21.2	33.6	77	21.9	33.5	69	22.7	35.7	73	22.3	34.4
84	23.3	37.4	63	22.9	36.5	61	21.9	36.0	66	21.7	37.3	70	22.7	35.2	55	23.0	37.1	56	23.0	37.0
43	23.4	38.0	45	22.9	37.5	45	21.3	37.6	42	21.4	32.4	37	22.6	37.9	43	21.9	37.0	36	21.5	37.0
49	22.5	37.5	49	21.1	36.8	46	18.4	35.3	53	19.9	36.4	49	20.5	36.6	45	19.5	36.3	49	20.0	35.8
52	22.6	38.0	52	22.3	37.2	54	21.8	36.4	55	21.9	36.9	50	22.2	37.4	51	21.9	36.5	52	21.8	36.9
627	270.9	456.5	623	267.4	446	647	263.7	436.7	654	262.4	142.4	600	266.0	448.2	619	262.4	438.3	625	261.9	442.5

Source Gedaref Metrology Office 2005

(figure (1-2) ***Climatic zones in Gedaref state and Kassala state***



Source Kassala State Profile 1976

1-3 **Rainfall Distribution**

It is rather the distribution of the individual showers within the rainy season, which is more important for production than the amount .This is because it is related to the time of sowing, the feasibility of past sowing operations, the regular supply of water and the time of harvest. A recent study in the area by El Tayeb et al (1983) showed that the annual distribution of rains remained fairly constant during the past thirty years. They consider July, August and September as the rainy season during which 75% of the rainfalls. Table (1-3-5)

Average rainfall During Months of July, August and September

Year	**10 year monthly Average Rainfall (mm)**				**Average persentage**
	July	**August**	**September**	**Total(mm)**	
1950-59	155.6	188.4	107.4	583.4	77%
1960-69	177.9	179.7	65.4	582.4	73%
1970-79	187.4	167.0	110.6	348.8	75%

Source:Galal Eldin Eltayeb et al (1983)
Etma Programme – Gedaref state

1-4 **Water**

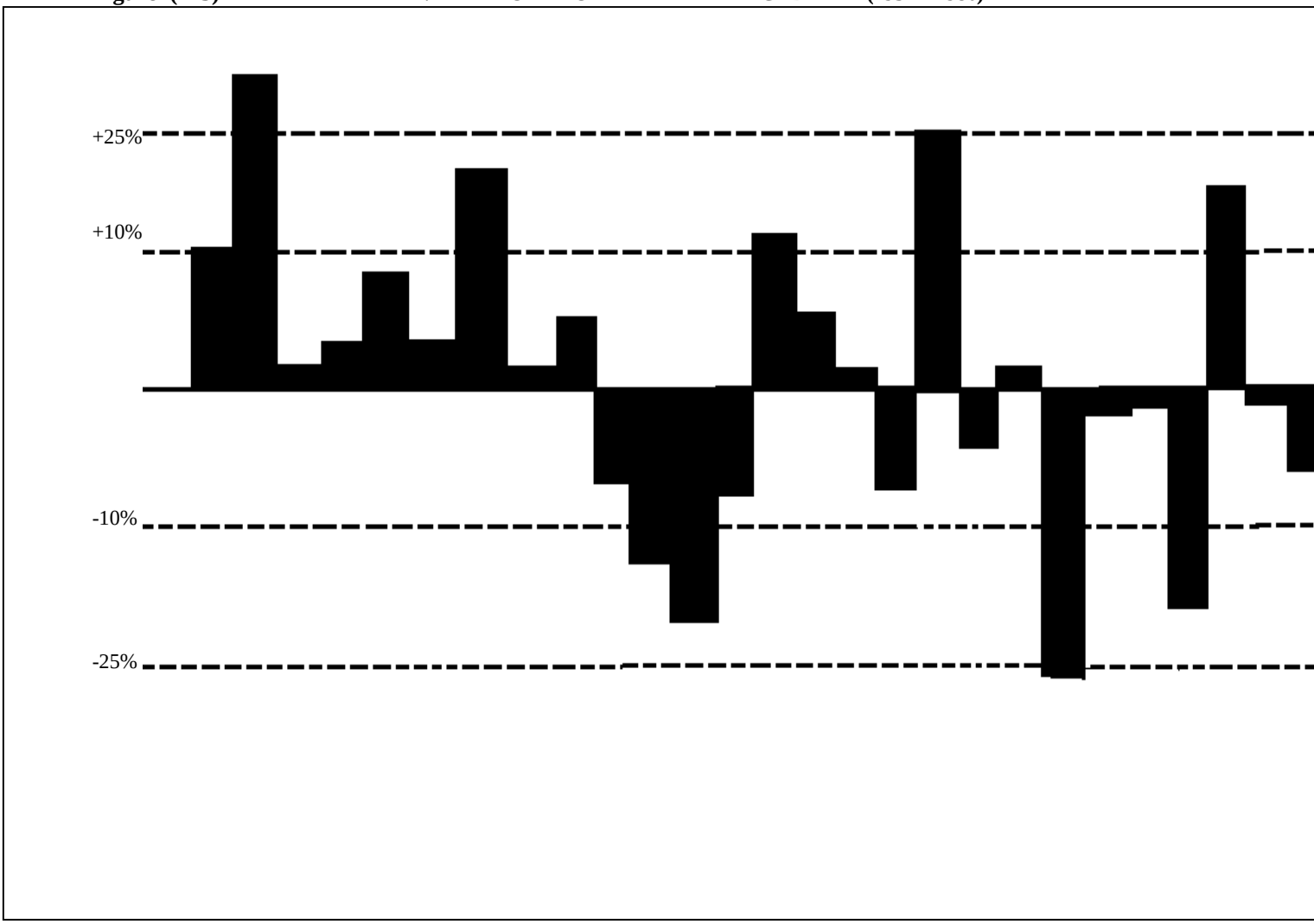
The rainfall in the Gedaref region is characterized by relatively low intensity .Thus, a considerable proportion of the rain will be distributed in a comparatively larger number of moderate rainstorms. This means that much of the rain will be effective in the agricultural sense, since is available to plants and therefore contributing to the moisture storage in the soil. El Mahi (1983) studied the effectiveness of rainfall in the Gedaref areas and found that, there is a short-term fluctuation between surplus and deficiency. He added that April and May have the highest value of water deficiency, while the time of surplus includes June and July and in some years August.

1-5 **Environment and Climatic Variation**

El Tayb and Lewwondowisky (1983) studied and analyzed climatic data (temperature and rain-fall) in the area over the past fourty years to see if any significant changes occurred in either. They concluded that “the temperature did not vary . Also the rainfall (annual totals and rainfall

distribution in the critical months), did not vary significantly over the past fourty years. We there fore ruled out climatic change as a possible cause of environmental degradation in the Gedaref state ” similar study carried by Awadalla (1984) found that the agricultural climate in the area is characterized by its lese, variability when it is compared with similar areas in the Sudan or elsewhere in the tropics. He added that the climate in the area has fluctuated from one year to another but has not varied for better or worse as thought. This can be seen clearly in figure (1-3)

Figure (1–3) **RAINFALL VARIATION FROM THE MEAN IN GEDAREF (1951 – 1980)**



1-6 Geology:

The Gedaref area is assumed to be a flat plain it's part of the central clay plain, which lies between latitudes 10^{o} to 15^{o} N. The Gedaref and its surroundings is located on a high plateau forming, a water divide, between Atbra to the east and river Rahad to the west. (Suliman. Y, 1968). According to Suliman, Y, (1968), Whiteman (1971) and Buraymah (1977)the Gedaref state consists of the following geological formations :

- **Basement complex.**
- **Nubian series.**
- **Volcanic rocks**
- **Superficial deposits.**

- Basement complex :

The Precambrian basement complex is the most extensive geological formation in Kassala state (whiteman,1971). It consists mainly of igneous and metamorphic rocks. Outcrops of the rock formation are found in Gala Elnahal series, Fau jebels and Ghadembalya.

- Nubian series :

It covers an appreciable area in Gedaref state geologically termed as "Gedaref formation " which includes all those sandstones and mudstones that crop out in the area around Gedaref and along Ethiopian frontiers and pass laterally into sandstones of the stite valley and adigrat sandstones. Jebel Sumsam and Um-Belli are outcrops of the Gedaref formation.

- Volcanic rocks :

This is dominated by tertiary basalt, which is surrounded by Mesozoic sandstone and mudstone of Gedaref formation. Decomposed basalt acquired different color ranging from light grey to dark grey and from brown to red. Outcrops of the formation are found on the Gedaref – Gallabat ridges.

-The superficial deposits :

The rock formation are mostly covered by thick layer of quaternary elastic materials. According to Suliman, Y.(1968). These are the result of the decomposition and disintegration of the volcanic rocks which are mostly heavy clays in the central and southern parts of the state where the mechanized rain fed farming is practiced also medium coarse textured materials are found in north and east while river sediments are found along Atbra and Rahad river.

1-7 **Hydrology:**

The area is traversed by many seasonal watercourses in addition to Atbra and Rahad river, there are two major khors namely khor Abu Faraga and khor Magdam , khor Abu Faraga passes immediately north of the town and drains westwards. High floods cause a menace to population ,especially in the parts of the town, which are situated on the two sides of khor. According to geological survey Department and Rural water Corporation , the Gedaref basin is formed mainly of Nubian sandstone and basalt. The Nubian series included consolidated sediments underlying the basalt. Hard mudstone is interbeded with fairly consolidated. Sandstone (fine to coarse texture). They form isolated basin beneath the basalt. Drilling attained thickness of 600feet without reaching the base. However mudstones are non-water yielding but the sandstone form the aquifers in the area table shows the groundwater potentialities of the Gedaref basin. Table (1-7 – 6)

Table(1-7 – 6) Groundwater potentialities of the Gedaref basin

Basin of Gedaref	Underflow Mil.m^3/y	Recharge Mil.m^3/y	Basin storage Mil.m^3/y	Abstraction Mil.m/y
12	41.7	700	4.2	10.07%

Source: Rural water corporation, Khartoum 1976.

General remarks on ground water.

Resource of the basin.

Present state Devoloped
Management: Required
Future potential: Poor

Area of future:

Development and study none
Source : Galal El Din El Tayeb (1983)
ETMA programme – Gedaref state \.

1- 8 **Soils :**

The Gedaref is vast plain of clay soils. The average ground slope is approximately 2.5meters per km. the soils in this region are described as deep, dark colored heavy clay soil. The clay fraction varies from 61% to 73% (Laing 1953) and it tends to increase south eastwards coinciding with the increase of the rainfall. The region of the soil materials is believed to be

Ethiopian highlands (Jewit ,1954). Yet extensive areas of cracking clay were derived from the decomposition of rocks. Tothill (1948) identified areas of chocolate – color cracking clay, apparently formed from basalt giving character to several areas e.g. around Gedaref and north of Doka. Also restricted island of red soils occur in some areas, such as seen at Azaza north of Gedaref and elsewhere. Wide areas of clay are often found remote from hills, known as "basherdi". Buraymah (1977) described the Ghadambaliya soil (the north part of the state) as typical vertisol with deep cracking, self mulching, moderately well-drained profiles and high clay contents. They are of cation exchanging capacity and high base saturation, mild reaction and non – to slight cal - carious matrices. In 1966 a reconnaissance soil survey was carried out in the southern Gedaref state at (Sumsam and Umseneinat). It described the soil of the survey area as having a low inherent fertility status.

1-9 **Vegetation :**

Generally the vegetation of the area is largely dependant on rainfall and soil types. According to (Harrison and Jackson 1955) the Gedaref area lies in the low rainfall woodlands savannah belt on clay. This was subdivided into the following:-

1-9-1 ***Acacia mellifera* thornlands :**

a- On dark cracking clays alternating with grass area (400 – 750 mm of rainfall).

b- On soils formed in situ associate with *Commiphora africana* and *Boscia senegalens's* (200 – 500mm of rainfall)

1-9-2 ***Acacia seyal Balanites Savannah*:**

Alternating with grass area (570 – 800mm of rainfall).

1-9-3 ***Anogeisus leiocarpus combretum hartmannianum Savannah :***

Woodland above (800mm of rainfall). To the north of the *Acacia mellifera* belt lies the Butana region which is an open grassland with patches of *Acacia mellifera* mainly confined to (khors). Perennial grasses are almost absent in the Butana region transition from one rainfall belt to the other is defined by the changes in the dominant trees, though, grasses show no good lines of demarcation.

1-10 Population:

Since the introduction of the mechanized rain fed farming in the early 1940 the Gedaref state has become an economically important market for both grains and animals. So, more and more people are being attracted to this area. In early 1940th the Gedaref town was estimated to have population of less than 20,000 people in 1968 the population of the state was estimated to be 483,032 person and the annual rate of increase for the whole Eastern region was 3% table (1-10-7) shows a high rate of population increase (11.3%) in the period 1973 to 1983.

Table (1-10 – 7)

Rate of increasing in population for the different Councils in the state in the period (1973 – 1983)

Area	1973 census	1983 census	% of increase
North Gedaref	186.085	223.989	20
Southern Gedaref	145.768	223.782	53
Western Gedaref	85.524	88.409	3.3
Gedaref town	78.995	116.447	47.4
Total	496.372	552.657	11.3

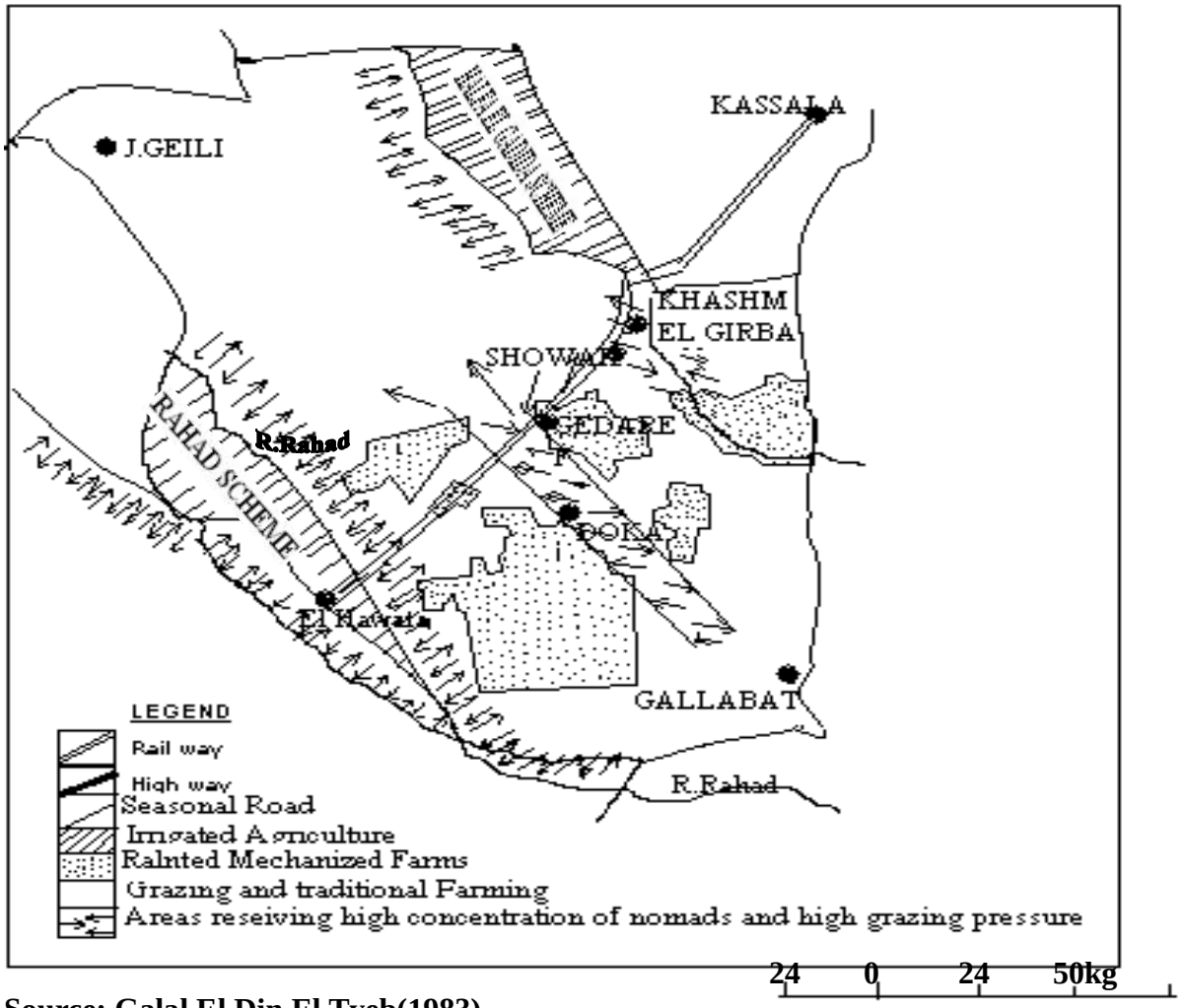
Source: Gedaref municipal Council, 1983.

1-11 Land use :

Traditionally the people of the Gedaref state have been either semi-nomadic pastoralists herding cattle, camels, sheep and goats or subsistence cultivators growing dura. This mode of subsistence showed a high level of adaptation to the environment by the users, now four major types of land used are encountered in the state figure (1-4)

Figure (1 – 4)

Gedaref State Land Use



Source: Galal El Din El Tyeb(1983)
ETMA programme – Gedaref state

1-11-1 Traditional cultivation:

Several systems of rain fed agriculture are found, such as shifting cultivation in the savannah woodlands, burring cultivation in grass savannah and (terus) cultivation in the parts. Production from the traditional cultivation is very low and many hazards are encounted such as drought and water logging, plant disease ,pests etc. these in addition to bad management –practices are responsible for the poor yield.

1-11-2 Pastoral nomadism

This is mainly confined to the northern part of the state, the Butana. This area was described as the best range for camels and sheep. This was largely due to the occurrence of good grazing fodder, however this area was heavily grazed and has almost lost its valuable plant species such as Belpharis the northern state (Butana) cultivation is sporadically practiced there through terus cultivation or on low – lying water receiving sites.

1-11-3 Irrigated agriculture :

These are situated in the northeast in Halfa Elgedida and in the southern part of Rahad schemes.

1-11-4 Mechanized rain fed agriculture:

Modern rain fed agriculture using tractors and disc harrows and sometimes –mechanical harvesters is found in this semi –arid part of the clay plain. It dominates the southern part of the state. Land is leased by the state for individual investors whereby each individual is allotted "a farm" the size of the farm ranges from 1000feddan (420.17 Ha) to 1500feddans (630. 25Ha) These schemes are managed by both private and government sectors. Sometimes rotation of dura, sesame and fallow with or without cotton are practiced but often a piece of land is cropped with dura until the land loses its fertility and then abandoned completely.

1-12 Development in Gedaref state:

Development in the state started in early 1940 with the introduction of mechanization (Agabawi 1969). At that time the decision to introduce mechanization was political rather than economic (Suliman 1977). Later in the following years, the economic importance of mechanized rain fed farming became recognized in all development plans. Despite the economic reorganization, the mechanized rain fed farming is criticized as being a major cause of environmental deterioration as the state. The Mechanized Farming Corporation (M.F.C) was established in 1968 (Act No 14) to act as a main agency for the promotion of large –scale rain fed agriculture.

1 – 13 The problem

Large areas became exposed to the influences of large-scale mechanized rain fed farming. In last fifty years 1942, the mechanized rain farm expanded rapidly at an increasing rate ,it expanded from 13000 Fadden in 1945 to over 18000000 Fadden (7563025.21 Ha)in 1950-1953, 8500000 Fadden (3571428.57 Ha) inter planning and (9.500000) Fadden (3991596.63 Ha) outer planning. This increase of schemes farm lead to the degradation of soil and vegetation cover and environment and decrease in yields. The recommendation of the mechanized farming and forestry administration requires that about 10% of the land of each scheme should be left under forest as a shelter belt , F.e 100 Fadden (420. 17 Ha) for all the 1000 Fadden (630. 25 Ha) Generally vegetation cover cleared for variety of reasons. The perceived need to reduce completion for moisture and to facilitate the use of mechanization especially tractors. Also contributing factor to deforestation was the increase of population as a result of migration. During the last few decades there had been a steady movement of population from other regions of the Sudan, as well as from outside the country, to the state for work as laborers in the mechanized scheme. figure (1 – 5)

figure (1 – 5)

بسم الله الرحمن الرحيم

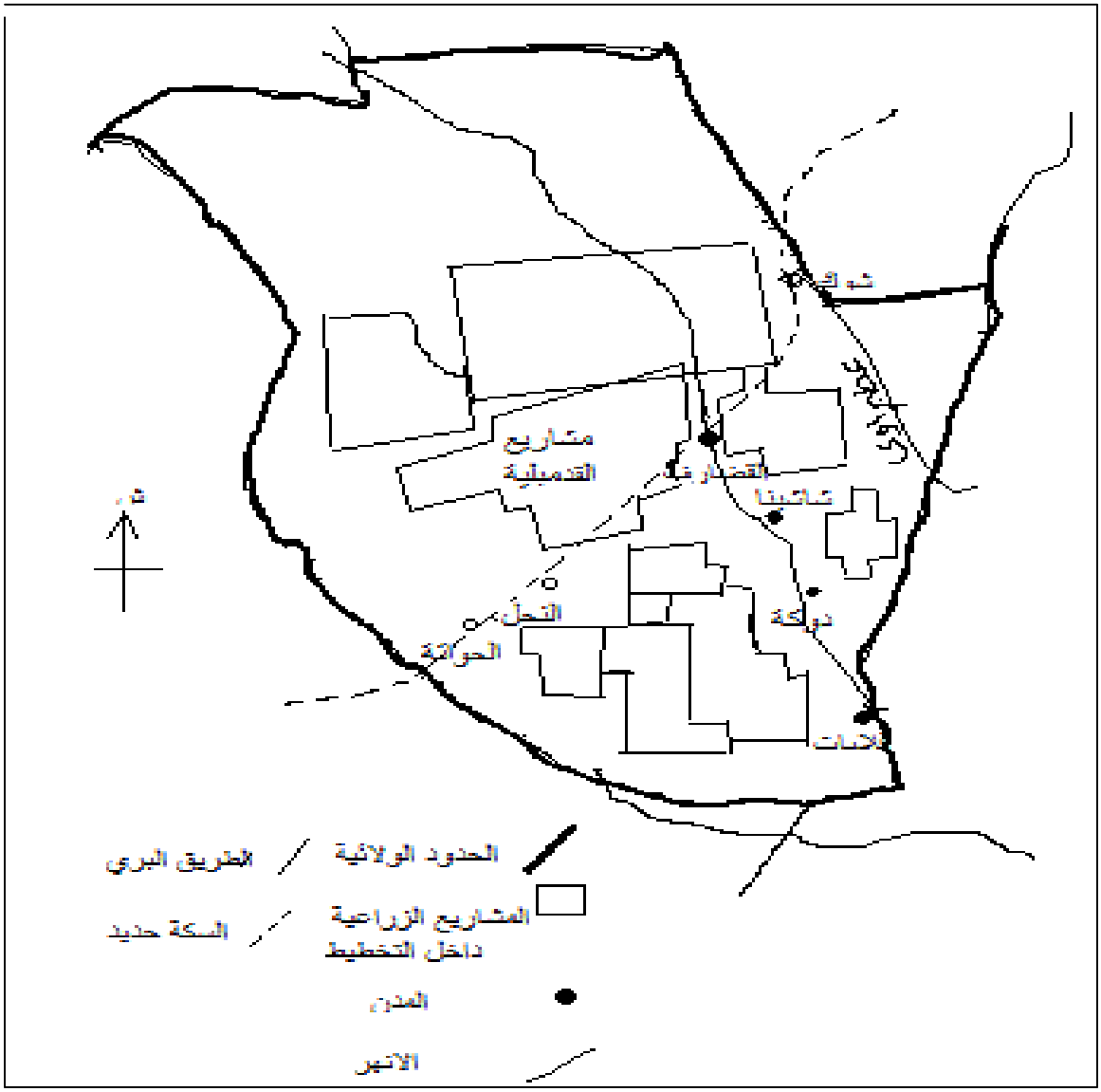
ولاية القضارف

وزارة الزراعة و الثروة الحيوانية و الري

هيئة الزراعة الآلية

Mechanized rain fed farming schemes Gedaref state

خريطة المناطق الزراعية الآلية داخل التخطيط



Source : Mechanized Farming Corporation

Gedaref 2005

1 – 14 Objectives of the study

1 –The objective of the study is to show the extent of destruction of vegetation cover in Ghadambaliya area due to mechanized rain fed farming that contributed to deterioration of vegetation cover.

2 – To study the importance of shelter belts establishment and benefits at the study area that suffered from deterioration of vegetation cover.

CHAPTER TWO
Literature review

2-1 Definition of shelter belts

Shelter belts are known to be a number of rows of planted trees (three rows or more) it defined as rows of vegetation planted across the prevailing wind direction to reduce the velocity of wind within farm land or around buildings, it's mentioned that the term "shelter belts" include all the type of barriers and stated that, the difference between shelter and wind break is minor, (Rahmatalla 1991).

Shelter belts are wind strips of trees, shrubs, and grasses planted in rows raised at right angle to the wind direction, to reduce wind velocity and give general protection to roads, canals, agricultural fields, woody stems, branches and thick foliage help reduce wind hazard (Nair, 1989).

Wind break structure, height, density, number of rows, species composition, length orientation and continuity determines, the effectiveness of wind break in reducing wind speed and altering microclimate, (John & Scott,2004).

Shelter belts (also known as wind breaks) are rows of strategically placed evergreen, deciduous tree, and shrubs. shelter belts are often valuable for wild life habital and often several benefits to property owner, these gains are not exclusive to agricultural lands and farmers that maintain them. home owners and land managers also can benefit from establishing a shelter belts ,(Melissa 2004).

A windbreak is aprotective screen of trees and shrubs made of one or two rows and planted at right angles to the direction of the prevailing wind to protect a garden , a small farm or a house from the harmful effects of such wind . (FAO , 1993) .

A shelter belt is aprotective screen of trees (with or without shrubs) of mor than two rows planted at right angles to the direction of harmful winds in order to decreas their speed and strength , thus protecting large agriculture field , irrigation canal and roads from strong winds , and also protection against moving sand dunes and wind blown sands towares population centres . Shelter belts usually consist of fiv to ten rows or more with a width of 30-120m . (Abido , 1991) .

2-2 The objectives of windbreaks:

Windbreaks are planted mainly for protection against the damaging effects of winds and wind-blown sands . However they have many benefits such as :

Preventing soil erosion , improving the microclimate for growing crops , vegetables and fruits and sheltering people and livestock , they can also serve other function such as fencing and boundary demarcation . Wher wind is a major cause of soil erosion and moisture loss in dry areas , windbreaks can increase and sustain crop productivity . Windbreaks may also supply wood and non-wood products . (Rocheleau et al , 1988) .

2-3 wind:

Horizontal air movements or whate is known as‘‘ wind” result mainly due to differences in pressure forces . Winds , accordingly , move from r-egions of high pressur to regions of low pressure . Wind are named after the direction from which they blow ie winds coming from the northern wind , those from the south west called south westerlies and so on . (Abido, 1991) .

2-4 characteristics of windbreaks:

Al Mutawa (1985) mentioned that when the wind direction is at a right angle to the log axis of the barrier , wind speed to lee-ward side is significantly reduced for a distance up to twenty times the average height of the windbreak , small reduction in wind velocity is extended to 30 times .

2-5 Effect of width , shape and cross-section:

Al Mutawa (1985) continues to say that windbreaks wider than 5H (H=height of the barrier) may actually be less effective than narrower ones . It should be kept in mind that single rows of one species have no safety factor because dead trees may leave gaps in a single row and seriously reduce windbreak is when its height is equal to its width .

2-6 Windbreak direction:

The decrease in wind speed is greater when the windbreaks are perpendicular to the direction of the prevailing (damaging) winds or at a deviation angle of 30°-40° . The role of the windbreak and its efficiency after that degree , will change to that of an impermeable barrier instead of a permeable one (Abido , 1991) .

2-7 Photosynthesis and rate of growth:

Slow winds play active roles in the physiological processes in plants especially photosynthesis , through the renewal of air around the leaves and providing more carbon dioxide (Co^2) . Also calm winds iprove air ventilation in the soil but in case of the increase in winds ’ movement above a certain limit they cause various physiological damages on plants . (Abido ,1991) . In general , when the speed of wind is fast then the rate of photosynthesis in plants is low and evaporation is high . Plants differ in their

response to the increase in wind speed for these two processes Grace, 1977) quoted by Abido (1991) .

2-8 Increased transpiration causing wilting anddeath of plant:

When the wind speeds increase the ratio of leaf area the plant weight is decreased; also average rates of photosynthesis aredecreased . Also the rate of respiration increases causing disequlibrium of water balance in plant transpiration . This case leads to wilting and death of the plant . (Abido , 1991) .

2-9 Breaking of branches and up rooting of trees:

Strong winds cause mechanical damage to plants . When wind speed is 10m/s and above it causes the breaking of the branches and up rooting of the trees (Abido , 1991) .

2-10 Damage and deformation of plant parts:

Strong winds cause damages on the buds , leaves and small branches . The winds which are loaded with sands and salt , particularly cause deformation in young trees (Abido , 1991) .

2-11 Fall of flowers and reduced yield:

Strong winds cause great damages on horticultural crops during the flowering season . They cause the fall of flowers and stop pollination processes leading to losses in fruit yields . There have been no fruits in an olive plantation for ten years in south Tunisia because of great sandy stroms blowing on that area during flowering seasons (Abido ,1991) .

2-12 Positive effects of windbreaks on climatic and edaphic (soil) factors:

2-12-1 On wind velocity:

Windbreaks alter the strength , direction and degree of turbulence of air-flow . The mount and extent of reduction in wind speed and strength depends on the characteristics of windbreaks . Height , density (permeability) windth , length , shape , type and age of trees have an important bearing on the extent and degree of protection but height is the most important factor determining the extent of protection . (AL Mutawa , 1985) .

2-12-2 On air temperature:

The degree of temperature is higher in the protected area than in the open (unprotected) area after sunrise . The temperatures during the afternoon period , in both protected and open area are nearly equal . At dawn the air near the ground surface gets cooler in the protected areas . In general the daily average temperature in the protected area is higher 1.3C° especially in the case of dense windbreaks . (Abido , 1991) .

2-12-3 On soil moisture:

The effect of windbreaks on the water balance of the soil (soil moisture) is often more important than wind reduction . it is governed by the type of soil , natural vegetation , the agricultural purpose of area , the climatic conditions , type of windbreaks and the macroclimate . In arid regions windbreaks save the moisture (from rainfall or irrigation) in the soil . AL Mutawa (1985) reports that protected soil may have up to 7 percent more moisture than un protected ones . He goes to say that the reduction of the evaporation of soil moisture and the decrease in evaporation of soil moisture and the decrease in evapotranspiration in the windbreak itself or adjacent plants are usually one of the most evident effects of windbreaks not only in hot dry periods but also in cool wet ones . The greater soil moisture in the protected area can be seen in cases wher windbreaks were planted for better crop production , also the number of hours in which the soil was dry can be reduced as aresult of windbreaks (AL Mutawa , 1985) .

2-12-4 On evapotranspiration:

Evapotranspiration of moisture from the leaves of plants , whether grasses , field crops or trees is much greater than the direct evaporation from the soil . But when the soil is completely covered with vegetation , evaporation will be unimportant . Transpiration or loss of moisture from the leaves of plants is a natural function , but it is only in a moderate degree necessary to the growth of the plant . It is always a source of great loss of moisture . which is greatly increased by climatic conditions , and may easily become so excessive that plant cannot keep up with the high rate of moisture losses which in return can injure the plants . (AL Mutawa , 1985) . Evapotranspiration depends on a number of factors related to the plant like the temperatures of plant leaves , and the air surrounding them and on the difference in the vapour pressure between the leaves and surrounding air . When air temperature increases its relative humidity decreases , the difference in the vapour pressure increases which causes evapotranspiration to increase . (Abido , 1991) .

2-12-5 Crop competition:

Trees and shrubs of the windbreak compete with field crops for water , light and mineral salt in the leeward side of the windbreak at a distance of 0.5-1.0 H . This competition will reduce the yield just behind the windbreak . Mlika ; M (1989) carried out a study in an orange grove at Benikhalled in Ariara , Tunisia , protected from NW wind by a network of cypress wind breaks , 56 m a part and 10m in height . Yields of trees were

assessed for four consecutive years . It was found that yields of trees in the first two rows closest to the wind break were reduced by 20-70 percent ; compared with trees in the center of the orchard . In another study by Rodriguz-R- et al (1985) on the effect on yields of Valencia late orange in Cuba , it was found that yields were 50 percent lower in trees adjacent to the wind break , compared to yields in the middle of the plantation . Analysis of wind speed in the region suggested that wind breaks were not essential and that replacing the wind breaks with additional rows of orange trees would increase total yields . This harmful effect ie . Competition by windbreak trees can be overcome by using deep rooted trees in the windbreak .

2-12-6 Birds, insects and diseases:

Negative effects of windbreaks may also include damage to agricultural crops brought about by birds , insects and diseases . These damages can be prevented by the proper selection of the trees and by the correct orientation of the windbreaks . (FAO , 1974) .

2-12-7 Windbreaks in Southern Governorates:

Establishment of windbreaks and shelterbelts in Southern Governorates of Yemen started in the year 1966 . (Bazra'a , 1996) . Thes activities were centered in Aden ,lahej , Abyan and Hadhramout Governorates in the period 1969-1981. Many species were tried by the forestry Section , El-kod , and Seiyun Research Centre . The following species were planted :

Acacia nilotica , Albizia lebbek , Azadirachta indica , Casuarina equesitifolia , Conocarpus lancifolius , Eucalyptus sp , Parkinsonia aculeata , Prosopis cineraria and *Tamarix sp* . (Masson , 1981) . On the basis of thes trials the following species were selected as being suitable for the following activities :

2-12-7-1 Coastal soils:

Prosopis juliflora , Suead fruticosa , Tamarix aphylla and *Vernonia sp* .

2-12-7-2 Coastal dune fixation:

Acacia tortilis , Calligonum comosum , Prosopis juliflora , Salvadora persica and *Tamarix aphylla* .

2-12-7-3 Medium dune faxation:

Acacia tortillis , Calligonum comosum , Prosopis juliflora and *Tamarix aphylla* .

2-12-7-4 Shelter belts Where irrigation is limited:

Acacia farnesiana , Acacia mellifera , Acacia nilotica , Parkinsonia aculeate , Prosopis cineraria Prosopis luliflora , Tamarix articulate , The spesia populnea and *Ziziphus spina-christi* .

2-12-7-5 Shelter belts and wind breaks in agricultural areas:

Acacia nilotica , Albizia lebbek , Azadirachta indica , Casuarina equesitiflolia , Conocarpus lancifolius , Parkinsonia aculeate and The *spesia populnea* .

2-12-7-6 High land and catchment areas:

Acacia nilotica , Agave sp , Aloe sp , Azadirachta indica and *Opuntia gigantic* .

2-12-7-7 Flood erosion control in wadis:

Acacia arabica , Albizia lebbek , Azadirachta indica , Conocarpus lancifolius , Eucalyptus camaldulensis , Prosopis cineraria , Tamarindus indica , Tamarix aphylla and *Zizyphus spina –christi* .

2-12-7-8 Road side planting:

Acacia nilotica , Acacia tortilis , Albizia lebbek , Azadirachta indica , Eucalyptus camaldulensis , Prosopis cineraria , Prosopis juliflora and *Tamarix sp* .

2-12-7-9 Amenity planting:

Albizia lebbek , Azadirachta indica , Caesalpeinea pulcherima , Casuarina equesitifolia , Conocarpus lancifolius , Cocos mucifera , Croton spp , Delonix regia , Hibiscus rosa chinen , Hyphenae thebaica , Jasminium indicum , Melia azadirachta , Nerium oleander , Phoenix dactilifera , Sesbania grandiflora and *Thespesia populnea* . (Masson , 1981) .

On alluvial soils under irrigation shelter belts may consist mainly of alternate rows of *Casuarina conocarpus* , on sandy areas or infront of the drifting sand dunes , one or two rows of low crown trees such*asParkinsonia , Tamarix* or prosopis were planted for wind breaks . For dry farming conditions , shelter belts were made from one row of *Azadirachta indica* with one additional row of *Parkinsonia* or *Prosopis* or *Tamarix* and *Zizyphus* , (FAO , 1974) .The first tree planting along roods was done between Lahej and Alhusseini Garden , but the first systematic rood-side plantations were established between November 1973 and july 1974 from lahej to Dar Saa'd , having a length of about 20 km . (Costin etl , 1976) . In Wadi Hadhramout the farmers tried to protect their fields using some green barriers made of date palm trees . The first wind breaks established were in Al-Radoud farm in 1972 and in Ba-Alal and Geima farm in 1975 . They

consisted of an alternate mixture of *Conocarpus lancifolius* and *Casuarina equisetifolia protected* on wind ward side by one pure row of *Parkinsonia aculeate* . (Costin etal , 1981) .

2 – 13 The effects of shelter belts:

Shelter belts can protect the crop from excessive wind speed within the range of 0 – 5H (H- height of trees)on the wind ward side and 10 – 20H on the leeward side of each shelter belts. Shelter belts should be at intervals of 15 – 20H with the tallest trees 2 – 5H from the area, which needs protection. The reduction in wind speed is associated with a reduction in evaporation, (Ssekatembe, 2003).

2-13-1 Effect of shelter belts on microclimate:-

Belts of trees, which obstruct the wind flow, reduce its velocity in the lower layer of the atmosphere and produce shelter zone in the vicinity of the belts. Local climate is created in the sheltered area with characteristic different from unsheltered region. Generally air, temperature, evaporation and transpiration are reduced while one humidity, soft temperature and soil moisture are increased. (Bayouimy, 1976, Caborn, 1957)

2 – 13-2 Effect of shelter belts on yield :-

the effect on yield is clearly dependent in large part on the design on the wind break, and particular corp and environment involved. In Sahil, wind breaks seem to have appositive effect on the crop yield of protected field , it was found that , millet and sorghum yields in fields protected by wind break of neem tree can be as much as 23% higher than in unprotected field nearby. Planners working in the wind breaks for the Gezira irrigationed scheme in the Sudan have estimated that, wind breaks could increase the yield of existing field and could save enough to cover all establishment and maintenance costs of the shelter belts, (Nair, 1989).

2 – 14 The use of shelter belt:-

the use of shelter belts have been found to be effective on sites where tree growth and establishment are feasible. In arid area this is rather difficult as the choice of tree species is limited, also the establishment of tree may not be feasible exept under irrigation, shelter belts have been found extremely useful in improving microclimate thus increasing productivity of agricultural land specially in arid and semiarid region and stabilize canal banks in farm land (Manna 1985).

2-15 General :

Shelter belts are rows of vegetation planted across the prevailing wind direction to reduce the velocity of the wind within farm around buildings (Brimaya, 1976). the term shelter belts and wind breaks is minor, and while Kuchelmeisters (1988) defined shelter belts in terms of width and number of rows, it is usually applied to belts which are more than three rows wide and several kilometers long. Neem is one of the few trees available for multipurpose planting in the sahel (Ciesla, 1993).

Wind breaks in this study is respondents, as far as wind breaks are concerned, are acquainted with the effects of wind breaks in reducing wind effect and provision of other benefits.

The mechanism and design of wind breaks

The extent of the shelter belts zone depends chiefly upon the height of the shelter belt and upon the degree of its permeability (Caborn, 1957).

shelter belts of moderate permeability to the wind provide most effective shelter.

according to Manna (1985), shelter belts having 40 – 50percent porosity with gaps evenly distributed is the best in providing maximum shelter zone. Inter rows spacing depends on the shape and size of the tree species, feasibility of mechanized operation and willingness of land user to allocate part of their land for wind breaks, for fast growing the tree species 3.0 to 4.0 meters wide must be left on both sides of hedges so as to create a margin between the hedges and the field, when the region has annual precipitation of less than 500mm.

2-16 Species used as a wind breaks:

The most desirable species are those having rapid growth, adequate height, longevity, dense crown, wind firmness and valuable woods products. These characteristics qualify the neem tree to play the perfect role as a wind break and shelter belts because the roots penetrate the soil deeply (National Academy press 1991).A single species doesn't possess all these characters, thus, two or more species are more frequently required (Abido 1991).

In Yemen a combination of *Eucalyptus camaldolensis* and *Casuarina equesitifolia* is usually used. Such wind break is tall, has firm structure, semi-permeable and effective for crop protection,(A.Elrahman, 1991).

According to these characteristic neem is used as a shelter belt tree. Brunori et al (1995)suggested that E.sargentii is a better shade and wind break tree species, while E.occidentalis is a better fuel wood species under arid – zone conditions, since E.sargentii has higher above-ground biomass than E. occidentalis.

Branney (1989) reported that *Acacia species, Albizzia lebeck, Azadirachta indica, Balanites aegyptiaca* and *Cassia siamea* are suitable for canal-side plantings. Roederes, (1991) reported that *Faidherbia albida* grows well on sandy soils, *A-auriculiformis* is resistant to wind, but sensitive to salt. *Azadirachta indicia* survives well but grows slowly and *khaya senegalensis* is well adapted to volcanic soils.

The influence of wind breaks on plant yield development Saebo and taksdal (1994)reported that wind has influence on plant development and physiology through leaf temperature, water and carbon dioxide diffusion, and through mechanical disturbance. Wade et al (1979) classified the effect of wind on plants as mechanical damage, physiological response, anatomical adaptation and morphological changes.

Davis and Norman (1988) stated that it is difficult to establish a direct link between the cause and effect of wind on plant, especially at the physiological levels. Low temperatures, salt damage to plant tissues and increased despite pollutants of ten accompany strong winds and also have an influence on plant development. (Grace and Dixon 1977). Unegual heating of ocean and land masses with an expected rise in glopal temperatures and heaviers level of precipitation in northern areas may cause an increase in wind, thus enhancing the importance of shelter belts. (Walsh 1993,NLVF 1992). Selection of wind tolerant plantscan emprove the establishment of high quality shelter belts. Such selection would benefit from the knowledge of the relationship between wind tolerance, morphology, anatomy and with the nutrient status of the soil, plants for shelter belts should be evaluated under multiple stresses (Grace, and Dixon 1977)

2-17 Effect of wind breaks on crop yield :

in the early 1980 the use of wind break has increased the yield of grains by 60% increase natural silk production by 70% and cotton by 300% (Wang 1988) According to one survey covering Argentina, Bulgaria, California, Israel, Italy, Saudi Arabia and Tunisia, well designed wind breaks have given a net increase in crop yield of between 80 and 200 percent (Janzen, 1984).Similar increases have been reported in studies on vegetation yield(Guyot, 1986) . Platti (1973) recorded an increase in yield of lemon in California by two folds in the field protected by wind breaks than in an unprotected field.

Sur (1986) showed an increase in the yield of okra and cowpea by growing rows of pear millet perpendicular to the direction of the wind.

According to Ellakany (1986)the increase in cotton, wheat, Dura and rice due to wind breaks were 36, 38 and 10 percent respectively. Generally, where land is exposed to high wind for most of year, or where soil erosion is

a particular problem, the need for wind breaks will usually by strong (Hamilton 1988) shelter by wind breaks helps to reduce the rate of water loss from crops through evapo. transpiration which can extend to as much as 30 times the height of the tree barriers (Konistantino and Struzer, 1965).

2-18 Wind breaks and crop pests and diseases :

Wind breaks may benefit crop yield by reducing the incidence and severity of pest damage. studies of the Colorado beetle, for instance, showed large reduction in population of eggs and larvae near the wind breaks and higher predator densities closer to the tree (Karg 1976).

The effects are not uniform, and wind breaks can harbour harmful pest species as well as pest predators (Janzen, 1976).

Wind breaks can help in preventing the spread of plant diseases by inhibiting the acrial dispersal of disease spores. the effect may be offset by the mone rapid development of disease spores near the wind breaks resulting from higher relative humidity(Guyot, 1986).

2-18-1 Wind breaks and climate:

when trees are grown at any location they have their effect on the temperature, humidity, moisture available in the soil and height condition by shading (La land Cummings 1979). however, trees have a considerable influence in moderating air and soil temperatures, and increasing relative humidity (La land Cummings ,1979).

2-18-2 Wind breaks and shade:

Shade may also be very desirable in animal husbandry, particulary in hot climates (Daly 1984). Wind breaks protect animals from wind and cold frost, thus the milk and meat production of these animals increase by the increase of the level of energy conservation in the body when protected in wind shelters (Abido, 1991).

2-18-3 Effects of wind breaks on soil erosion:

The most widely recognized benefit of trees on their immediate environment is their ability to reduce wind speed. Farmers in many parts of the world use wind breaks, or more elaborate, multi-species shelter belts to protect crops, water sources and soil settlements (FAO,1990), in addition, wind breaks are essential stabilization. Examples of that are the rows of casuarina along thousands of canals and irrigated fields in Egypt, in Chad and Nigeria. Multi-species shelter belts protect wind expansions of crop land from desertification (FAO,1990)

2-18-4 Selection for wind break resistance:

Climate adapted plants should be made more available for use in shelter belts wind breaks (Hamilton, 1986). Traditionally selection of plants for

shelter belts has been made through observation of plants in established shelter belts (Groven, 1983, 1985).

2-18-5 Management:

The development and efficiency of a wind break, depends primarily on selection of the species and on its manipulation and management later. Abido, (1991) attributed the failure or inefficiency of wind breaks and shelter to the following :-

-unsuitability of the climate.

-Death of trees within rows or entir rows.

-Senescence.

-Ignorance and lack of management.

According to FAO ,1993, the wind breaks management can be summarized as follows:-

- pruning of trees acts as an incentive for their growth and development more over the tree grown expands providing suitable wind permeability.
- When wind breaks are damaged by wind or by the act of pest and diseases, repairing and on suitable control measures should be taken.
- In multi-layered wind breaks, the rows in the direction of wind should be regenerated by new plantations. And when the wind breaks consists of a single row, regeneration can be done by growing another row parallel to the first row.
- Wind breaks and shelter belts in grazing areas should be of thorny trees or fenced with barbed wire.

2–19 Impact of mechanized rain fed farming on forest resources:

2-19-1 Large scale clearance of tree;

Large scale clearance of tree cover is expected to induce many changes. This was clearly seen in the decrease of species diversity as annual biennials and perennials and have been replaced by crops (Bebawi 1983).

2-19-2 Negligence of conservation:

According to Musnad and El Rasheed (1978) negligence of conservation measure such as tree cover between farms (shelter belts)and around natural drains in the newly deforested areas for mechanized crop production , resulted in gully erosion.

2-19-3 Perforestation of trees of khor:

El Tayb and Lewandowski (1983) found that the width of khor Abo Fargha increased from about 21meters 1961 to about 52meters in 1982 as

result deforestation of its catchments area for mechanized rain fed farming they attributed the catastrophic flood which the state witnesses to this magnitude of deforstation.

2–20 Impact of mechanized rain fed farming on the soil:

According to El Tayb and Lewandowski (1983), poor management ,dura monocroping and soil impoverishment contributed to low yield this degradation in soil structure , soil texture and soil fertility. In the study carried out by the national council for research (1975), it was found that the wide level disc was not doing a satisfactory job as weed controlling implement and did not allow deep penetration, the continous use of these machines was expected because drastic changes in physical condition of the soils occurred . Hassan and M.S Osman (1972) the continuous discing and to the same depth with time many lead to formation of hardpan in the subsoil. El Khalil (1981), found that tree was, direct positive correction between discing frequency and development of compaction layer. He also added that "The compaction layer is expected to become a hardpan if the discing is allowed to continue to end of the twenty five years of contract between farmer and the corporation. According to Bryant (1977) this crust formation was responsible for the run-off and crop failure in the state. The rapid expansion of mechanization was also blamed for degradation of soil fertility and hence decrease in yields. Born , (1983) stated that deterioration of soil fertility can also be due to complete negligence of soil construction measures such as shelterbelts, crops rotation and fertilizer application. Agabawi (1969) in the sense mechanized farming is an option only for small number of population, due to high cost of producing and hence the local peasants are not the target group of the planners.

2–21 Extensification of agriculture :

According to Elnagheeb et al (1994) extensification of agriculture is one of the major factors contributing to the destruction of forests in Africa, in Sudan such as horizontal expansion come at the expense of the land devoted to trees and other vegetation, thereby inducing conditions that are inimical to sustainable agricultural production. Different factors have contributed to extensification although high economic returns from crop (mainly sorghum) production was an important factors encouraging extensification of rain fed mechanized farming, other factors outside

agriculture have also contributed to that expansion. This paper uses data from eastern Sudan and acreage response model to identify the most important factors, influencing acreage expansion. Different measures and forms of risk were used in the acreage response model. the paper shows how policies in the energy sector can indirectly influence acreage.

2–22 Establishment Agroforestr techniques :

The results of studies on stand establishment techniques agro-forestry, the indigenous vegetation and of species provenance trails are reported for an extension of phase 1 of the Bura forestry research project in (1988-1989) the forestry project is part of the FINNID A funded Bura fuel wood plantation project, which is it self part of the Bura irrigation settlement project. The data on species performance and expected yield derived mainly from one trail and a few indigenous species. *Prosopis chelinsis, P pallida* and *PEucalyptus spp* established in 1984 . This trail included *Prosopis spp Eucalyptus spp, juliflora* reached an average annual fuel wood yield of *PJuliflora* 2:8 times in comparison with rain fed conditions . The agro forestery studied reported include survey of Bura home gardens and a trail of three wood species (Sesban with zea maiz produced up *Markhamia lutea*) inter cropped with two agricalture crops (zea maiz and vigna unguislata). Inter crop of ssesban with zea maiz produced up to stone /ha of dry biomass annually arvested . Proposal for phase (II) of the forestry project(1989-1993)wassubmittedtoFINNIDA in 1988 kaarakka el al (1990).

2–23 The deterioration of vegetation:

The deterioration of vegetation, soil and water resources during the 20^{th} century due to population growth, firewood collection expansion of arable land of over grazing of rangeland is described . Vegetation cover, caltural practices and slope management are all important in erosion control . The reasons for failure of erosion control project based on important technology are discussed. Comprehensive approach landscape management is proposed based on water soil conversation and sustainable agriculture, forestry pasture system. The better use of run off through the system of tillage creation of permeable micro dams(a traditional African practice) mixed fanning ago forestry, land units for intensive cultivation, and the control of wind, sheet and gully erosion and maintenance of soil fertility are essential. The application of such scheme in various parts of the zone is considered Roose et al (1989).

2 - 24 Deforestation problem in Sudan:

Sudan is threatened by serious deforestation problem total forested area described by a bout 20% over the last two decades largely as a result of expansion of rain fed mechanized farming (RMF). To safeguard against the problems of deforestation, the government's mechanized farm corporation requires each farmer to leave at least 10% of the total farm area under shelterbelts. Few farmers pay attention to his clause. This paper addresses of problem of (RMF) expansion and analyses the effects of different factors of the preservation of shelter belts. The data used were collected through interviews with farmers in Damazin region of central Sudan in 1988. result indicates that the following factor influence the decision to preserve shelterbelts. Farmer's belief in the value of shelter belts, the production of gum Arabic (from *Acacia senegal*) farms size fanner's wealth the umber of years a farm has been cultivated and type of farm Elnagheeb Ah et al(1992).

2 –25 The effect of different vegetative barriers:

Field experiments were conducted for three years (1994-1996) to study the effect of different vegetative barriers (*Cynodon datctylon, Vetiveria zizanioides* (vetiver) *Eulaliop'sis binata, Stylosanthes hamata*, and hybrid napier), on run off soil loss and yield of up land rice. Vetiver was superior to other grasses in the controlling erosion and increasing the productivity of crops. Vetiver barriers reduced run off by 35% and soil loss by 60% over the farmer's practice of broadcasting. Vegetative barriers reduced runoff 19% and soil loss by 41% when acting as enter-terrace treatment compared with no vegetative barriers. Vetiver barriers enhanced the rain fed rice yield by 93% over farmer's practices and 49% over vegetative barrier treatment. It is concluded that based on the overall performance and ease of established, vefiver barriers were recommended for rain fed farming in sloping and red latrictic soil belts of orissa, India ,Subudhi CR et al (1998).

CHAPTER THREE
Research Methods

3-1 General:

This study was carried out to assess the degree of vegetation cover deterioration. The study was carried out in western north of Gedaref state including Ghadambaliya area. The forests in this area were subjected to heavy damage . Relevant secondary data were collected from , report of the project and previous studies , the perception an important element in the study as average rainfall , population , and others . Observations are taken as source of data collection in the area is completely cleared from vegetation cover. Few trees are scattered found in depression. All khors and seasonal courses cleared. Reserved according to the observation , the dominant trees are *Acacia mellifera* and *Acacia nubica*. The series of jebal Ghadambaliya were also shaved of vegetation cover . Relevant secondary data were collected from archives, report of the project and previous studies, the preception of expert form is an important element in the study as average rainfall, population, production of fuel wood, number of livestock and others. Collected in respect to its relevancy, accuracy, and clarity of its defined terms.

3-2 Experiment:

The experimental design adopted was nested design with fourth strips, one was control 300 meter between stripes. The stripes are divided to 10 blocks .The block is 10X20m each block was divided to three plots. figure (1 – 6) .

$$\text{Soil moisture content} = \frac{\text{weight wet soil} - \text{weight dry soil}}{\text{Weight dry soil}} \%$$

(Michel A.M, 1978)

laboratory analysis was done according to

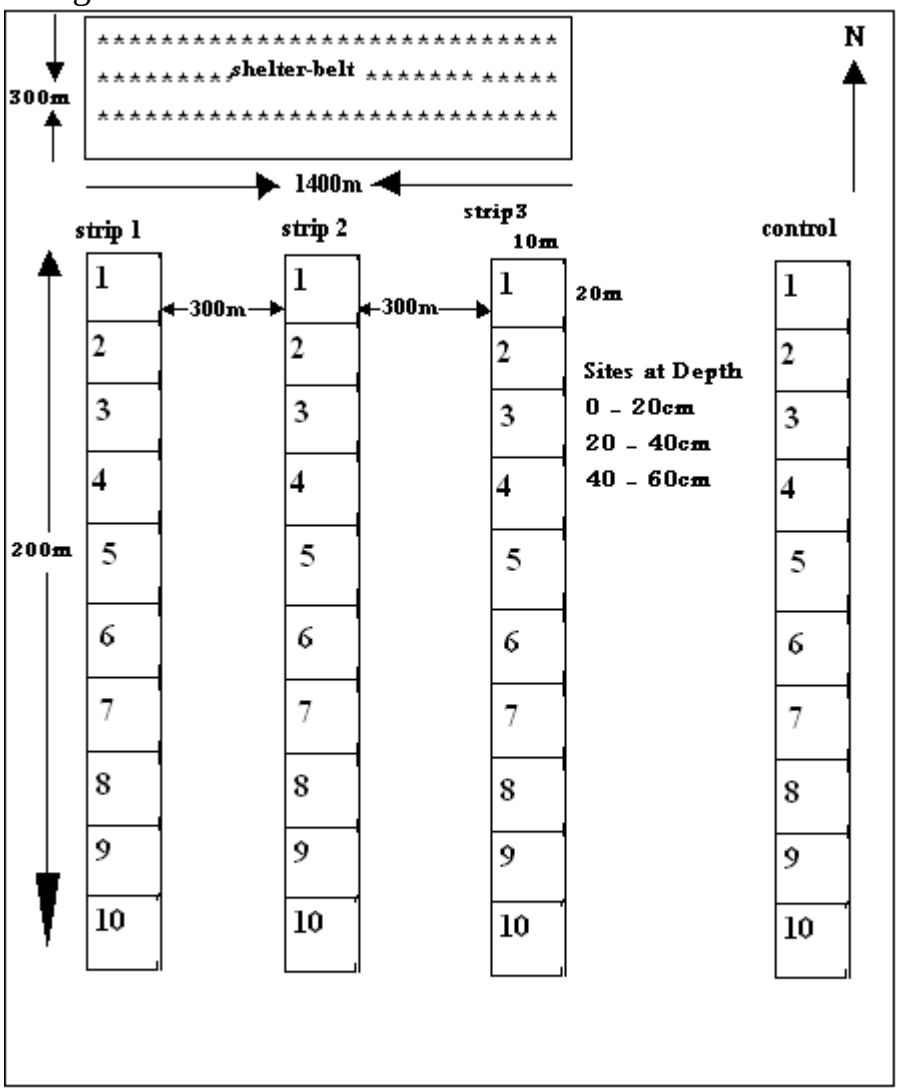
Weight of a can

Weight of a can with wet soil

Weight of a can with dry soil (dry soil by furnace)

In Gedaref Agriculture Research Laboratory Appendix (3-2-1) .

figure (1 – 6) Soil sample plot Design



3-3 Questionnaire:

Questionnaire was prepared for Ghadambaliya area , nineteen questions were used to collect the information such as ,age, occupation and level of education. In this questionnaire questions were about effect of vegetation cover deterioration and other benefits gained from mechanized rain fed farm and other set of questions about the expansion of mechanized rain fed farming for different reasons that affect in the deterioration of vegetation cover and other question is how to rehabilitate the area to solve the problem . Appendix (1-7) .

3-4 Data analysis:

Data analysis had been done using the computer program SAS (Statistical Analysis System) for distance and season . Appendix (3-4-2) For questionnaire the data analyzsis by using statistical package of social science (SPSS) .

2- 5 Interview:

Interviews were done at Ghadambaliya area with farmers , officials and rangers of National forests corporation Gedaref state. Some questions were used to collect the information such as, purpose of shelter belts, where are they found and how many, types of trees at shelter belts, benefits of shelter belts, problem of shelter belts…etc . Appendix (3–7–1), (3–7–2).

CHAPTER FOUR
Results and discussions

4-1 Soil moisture:

The results showed, that the mean of the soil moisture content was 31.023% in September (autumn season), which represented a high rate. While in May (summer season), the moisture showed lowest value 8.260%. From this result the highest value was found in September, is attributed to the rainy season (autumn), in which the soil moisture percentages remaining higher than dry season (summer). January month revealed middle value16.090% , while May showed lowest one. Table (4-1-1)

The results also showed that the mean value of soil moisture content was affected by shelter belts, where the value decreases as the distance increase far from the belt. This showed as follows:

In 40meter distance apart from the tested belt , the mean value was 10.311% (A) which represent a high value , followed by 60meter (BA) 9.422% and 80meter (BA) 8.611% respectively, while the lowest one was obtained in 200meter distance(BA) 6.789% , table (4-1-23) . The 20meter distance (BA) showed low value 7.522% although it is very near to the shelter belt, this because due to the effect of the adventitious root of the *Acacia seyal* (Talih) that covered this area and absorbed soil moisture as *Acacia seyal* usually characterized as high water demand . The result actually showed the clear affect of shelter belt, on soil moisture by increasing its value onward to it and vise versa. The result coincided with that reported by [Lal and Cumming, (1979)]. Who stated that the moisture content, temperatures, relative humidity were affected by shelter belt.

4-2 Socio-economic Aspects :

4-2-1 Farmers location:

The farmers were asked about the condition of vegetation stands in the area 88 farmers , 70.5% from Gedaref , 19.3% from Ghadambaliya and 09.1 from Others . Table (1)

Table (1) ***percentage of farmers location***

location	Frequency	Percentage
El Gedaref	62	70.5
Ghadambaliya	17	19.3
Amshagra	1	01.1
Others	8	09.1
Total	88	100.0

4-2-2 Farmers tribes :

represent 26.1% the tribe of Gaaly , 14.8% the tribe Belala 10.2% tribes Shaygia ,10.2% tribes Shokry and 28.5% Others tribes . Table (2)

Table (2) ***Farmers tribes***

Tribe	Frequency	Percentage
Gaaly	23	26.1
Shygi	09	10.2
Shokry	09	10.2
Bataheen	01	02.1
Belala	13	14.8
Agbat	07	08.1
Others	26	28.5
Total	88	100.0

4-2-3 Age classes of farmers:

The most active farmers age was 41- 60 represent 42.0% , 29.5% represent age classes 61-80, and age classes 21-40 represent 27.4% . Table (3)

Table (3) ***percentage of age classes of farmers***

Age classes	Frequency	Percentage
21 – 40	24	27.4
41 – 60	37	42.0
61 – 80	26	29.5
> 80	01	01.1
Total	88	100.0

4-2-4 The educational level between farmers:

According to the educational level, resulted Khalwa was 39.8%, basic level was 30.7% , secondary was 17.0% , University was 08.0% and 04.5% was illiteracy. table (4)

Table (4) ***percentage of education level between farmers***

Education level	Frequency	Percentage
illiteracy	04	04.5
Khalwa	35	39.8
Basic level	27	30.7
Secondary	15	17.0
University	07	08.0
Total	88	100.0

4-2-5 Condition of vegetation cover in the past:

All farmers agreed that the condition of vegetation cover in the past was good 98.9%. Table (5)

Table (5) ***percentage of condition of vegetation cover in the past***

Condition of vegetation	Frequency	Percentage
Very good	87	98.9
Moderate	1	01.1
Total	88	100

4-2-6 Causes of vegetation cover deterioration:

Most of the farmers said the cause of deterioration represent 47.8% due to mechanized farmed , illegal cutting and over grazing. 28.4% said illegal cutting and mechanized rain . 19.3% said mechanized rain .Table (6)

Table (6) ***percentage of causes of vegetation cover deterioration discussion***

Cause of deterioration	**Frequency**	**Percentage**
mechanized rain fed agricaltur	17	19.3
Illegal cutting	03	03.4
Illegal cutting and mechanized rain fed agricaltur	25	28.4
Illegal cutting , mechanized rain fed agricaltur and over grazing	42	47.8
Illegal cutting and overgrazing	01	01.1
Total	88	100.0

4-2-7 Impact of vegetation cover destruction:

The farmers said there was impacts of vegetation destruction in the area (less fuel wood, decline in crop yield and decline of soil fertility) was 62.3%. Less fuel wood and decline in crop yield was 20.3% , and less fuel wood 5.1% . table (7).

Table (7) ***Impact of vegetation cover destruction***

Impact of vegetati	**Frequency**	**Percentage**
less fuel wood	04	5.1
Decline in crop yield	06	7.1
Less fuel wood and Decline in crop yield	18	20.3
Less fuel wood and Decline in soil fertility	02	3.1
Less fuel wood , Decline in crop yield and decline of soil fertility	57	62.3
Decline in crop yield and decline of soil fertility	01	2.1
Total	88	100.0

4-2-8 Causes resulting from the destruction of vegetation cover:

Those who answered yes, of causes resulting from the destruction of vegetation cover was represent 73.9% and answer (No) was 26.1%. table(8).

Table (8) ***causes resulting from the destruction of vegetation cover***

Answer	**Frequency**	**Percentage**
yes	65	73.9
No	23	26.1
Total	88	100.0

4-2-9 Causes resulting:

Farmer said" yield decline and less soil fertility were causes resulting from the destruction of vegetation cover (22.8%) . And others causes resulting (pests and less rainfall) 29.5% table (9) .

Table (9) ***causes resulting***

Less answer	Frequency	Percentage
yield	8	9.1
Less Soil fertility	8	9.1
Yield decline and less Soil fertility	20	22.8
Others	26	29.5
No answer	26	29.5
Total	88	100.0

4-2-10 Effect of expansion of mechanized rain fed farming:

The expansion of rain fed farming affected greatly in deterioration of vegetation cover , answer yes 93.2% . And answer no 6.8% table (10) .

Table (10) ***Effect of expansion of mechanized rain fed farming***

Answer	Frequency	Percentage
yes	82	93.2
No	6	6.8
Total	88	100.0

4-2-11 Causes of Expansion of mechanized rain fed farming :

Expansion lead to decline of Wild life 42.0% . Dicline of yield , decline of soil fertility and decline of wild life was resulted 10.2% table (11).

Table (11) ***causes of expansion*** of mechanized rain fed farming

Cause of expansion	**Frequency**	**Percentage**
Decline of yield	3	3.3
Decline of soil fertility	2	2.3
Decline of Wild life	37	42.0
Decline of yield and decline of soil fertility	7	8.0
Decline of yield and decline of wild life	7	8.0
Decline of yield , decline of soil fertility and decline of wild life	9	10.2
Others	9	10.2
No answer	7	8.0
Total	88	100.0

This condition was the same to the study of (Etayeb and Lewandowiski 1983) (Bryant 1977) .

4-2-12 Importance of shelter belts establishment :

Those who answered yes, for establishing shelter belts for their importance was 95.5% . And answer no 4.5% table (12) .

Table (12) ***Imoprtance of shelter belts establishment***

Answer	Frequency	Percentage
yes	84	95.5
No	04	4.5
Total	88	100.0

4-2-13 Why establishing shelter belts:

The farmer who answered with yes, for increase of yield was (76.1%) . And increase of yield and increase of soil protection was 18.2% . table(13).

Table (13) ***The farmer answer yes for establishment of shelter belts***

Establishing for increase yield or soil protection	Frequency	Percentage
Increased of yield	67	76.1
Increased of soil protection	02	02.3
Increased of yield and increased of soil protection	16	18.2
No answer	3	03.4
Total	88	100.0

4-2-14 The main trees:

The farmers answered that the main trees species were *Acacia seyal , Balanities aegyptiaca , Acacia senegal* and *Acacia mellifera* (60.2%) . Table (14)

Table (14) ***The farmer answer about the main trees species were***

Kind of trees species	**Frequenc**	**Percentage**
A.seyal and *B.aegyptiaca*	4	4.5
A.seyal and *A.senegal*	3	3.4
A.seyal , B.aegyptiaca and *A.mellifera*	3	3.4
A.seyal , A.senegal and *B.aegyptiaca*	7	8.1
B.aegyptiaca and *A.mellifera*	1	1.1
A.senegal and *B.aegyptiaca*	1	1.1
A.seyal, A.senegal,A.mellifera &B.aegyptiaca	53	60.2
A.seyal , A.mellifera and *A.senegal*	13	14.8
No answer	3	3.4
Total	88	100.0

4-2-15 Harmful effects *of trees species* :

Farmers answer yes, there were harmful effects of trees species (72.7%) . And answer no was 25.0% . table (15).

Table (15) Harmful effects of trees species

Answer	**Frequency**	**Percentage**
yes	64	72.7
No	22	25.0
No answer	2	2.3
Total	88	100.0

4-2-16 Harmful effects of trees species:

Farmers said , the harmful effects for the tree were pests, grazing and birds was 30.7% . 21.6% was said birds and grazing . 26.1% was no answered table (16).

Table(16) ***harmful effects of trees species were***

Harmful effects of trees	**Frequency**	**Percentage**
pests	6	6.8
Pests and birds	5	5.7
Pests and grazing	8	9.1
Birds and grazing	19	21.6
Pests, birds and grazing	27	30.7
No answer	23	26.1
Total	88	100.0

4-2-17 The Use of Agroforestry system:

Farmers said , yes, used agroforestry system was 73.9% . And 26.1% answer no. table (17).

Table (17) The **use of *Agroforestry system***

Answer	**Frequency**	**Percentage**
yes	65	73.9
No	23	26.1
Total	88	100.0

4-2-18 Useful agroforestry system:

76.1% of farmers answered that agroforestry system was useful . 23.9% answer (No) Table (18).

Table(18) ***Useful agroforestry system***

Answer	**Frequency**	**Percentage**
yes	67	76.1
No answer	21	23.9
Total	88	100.0

4-2-19 Rehabilitation:

Farmers said, the best way to rehabilitate the deteriorated area with forestry and a shelter belts was 92.0% . Table (19).

Table (19) ***Rehabilitation***

Through	Frequency	Percentage
shelterbelts	5	5.7
Shelterbelts and forestry	81	92.0
No answer	2	2.3
Total	88	100.0

4 - 3 Interview :

The study included the purposes of shelter belts to protect the schemes from wind erosion , battering winds , erosion , maintain soil fertility , to combat desertification , provide loss of trees due to be removed by the provision of mechanized rain fed and natural resources. There are shelter belts in the northwestern region of Gedaref area and Ghadambaliya kilo six (6) , Abu Kashma , Fawo , the Butana and Almegrah. There are five hundred 500 shelter belts and an area of fifty thousand acres 50,000.Types of trees planted in the shelter belts are *Acacia senegal, Acacia seyal* and *Acacia mellifera*. The benefit of shelter belts is to protect schemes from erosion, combat desertification, raise awareness of environmental and ecological balance, natural resource for the production of firewood, charcoal, gum Arabic, provide pasture for livestock and increase the income of individual. Shelter belts led the purpose of the requested 30%. There are some problems and difficulties do shelter belts represented by the lack of belts convinced some farmers prefer planting crops in the area and the non-implementation of some shelter belts, there are laws to protect the shelter belts such as the Law of Forestry and Natural Resources and local statutes. There is little guidance on the cultivation area of 10% of the scheme's area. Decisioned by, Mr. President of Republic of Sudan. Proposed planting belts again in South Gedaref and the establishment of research studies and dissemination of all the areas in the state of Gedaref and the rest of the states in Sudan. And included at the study area a number of 10 shelter belts at Ghadambaliya area . The interview included the officials and forest rangers forestry national corporation Gedaref state. The purpose of the shelter belts are windbreaks and soil fertility. Shelter belt area is 100 feddans of the scheme's area 1000 feddans. planting date shelter belts 2006 – 2007 – 2008 - 2009 to 2010. Type of trees in shelter belts are *Acacia seyal* and *Acacia senegal*. Shelter belts without rows by tractor's disk. And one in the form of the rows and is now under test. The benefit of the shelter belt fertilize the soil from erosion, protect crops from wind and increase production. Shelter belts led the purpose for which was planted in good soil fertility, install it from erosion, increase production at each other and others did not show its products because it was little. Problems is the protection of the shelter belts in the full shelter belts areas from which crops are planted between the rows do not protection because the farmers protect it and protect crops.I met the farmer Abbas Mohammed and I asked him about the purpose and the area

of the shelter belt he answered that it's as a wind break and soil fertilizer and the area is about 100 Faddan equal to 10% of the scheme area, and the date of shelterbelt cultivation was 25th of July 2007 and the type of trees are *Acacia seyal* and *Acacia senegal* and asked him about the number of rows he answered that the cultivation was by tractor disk no clear rows, and about the shelterbelt benefits he answered as a wind break and soil fertilizer, and asked him if the shelter did the purpose for what it was cultivated, he answered "Yes" it did the purpose, it protected the soil from erosion and increased the production, and asked him about the problems of the shelterbelts, he said it needs protection.I met a village sheikh called Eltahir Hassan Elshereef I asked him about the purpose and the area of the shelter belt he answered that it's as a wind break and soil fertilizer and the area is about 100 Faddan equal to 10% of the scheme area, and the date of shelterbelt cultivation was 6th of Agust 2010 and the type of trees in the shelter belt he said they are *Acacia seyal a*nd *Acacia senegal* and asked him about the number of rows he answered that the cultivation was by tractor disk no clear rows, and about the shelterbelt benefits he answered as a wind break and soil fertilizer, and asked him if the shelter did the purpose for what it was cultivated, he answered "Not- yet", and asked him about the problems of the shelter belts, he said it needs protection . I met the forests official Khogali Bala Elamin I asked him about the targets of the shelter belts in Ghadambaliya area he answered that it was to protect the scheme from erosion and save the soil fertility and asked him where the shelterbelts found and how many he answered that it found in Ghadambaliya area and it's about 50000 Feddan and it's about 500 shelter belts, and the type of trees in shelter belts he said *Acacia seyal, Acacia mellifera* and *Acacia senegal,* asked him about the benefits of shelterbelts cultivation answered it was to protect the schemes from erosion, I asked him if the shelterbelt did the purpose for what it was cultivated, he said "Yes", I asked him about difficulties and problems from the shelterbelts, he said no problems, I asked him about the guidance and environmental awareness to increase shelter belts he said "Yes" I asked him if there any observations he said it still needs research studies .

CHAPTER FIVE

5-0 Conclusion And Recommendations :

5-1 Conclusion :

- The study revealed that environment and soil moisture had been affected by shelter belts.
- It was found that the main factors contributing to the soil moisture defferences at the study area was distance from shelter belts .
- The study revealed that environment and vegetation cover had been degraded at Gedaref area .
- It was found that the main factors contributing to the deterioration of vegetation cover at the study area were expansion of mechanized rain fed schemes, illegal cutting , and over grazing.
- The impact of this had been indiscriminate destruction of vegetation cover , crop yield decline and decline of soil fertility.

5-2 Recommendations:

For better rational use of the environment resources available in order to check the trend of deterioration vegetation cover, the following is recommended:

1. There is a need for coordination between concerned agricultural sectors .
2. Raise the awareness of the local farmers , encourage and support them to participate in planning to improve vegetation cover .
3. Shelter belts of 10 percent of the area round the agricultural schemes in rain fed areas should be enforced and implemented through mechanized farming corporation and forest national corporation .
4. Participation of mass media and other information service in environmental affairs must be developed extended and strengthened.

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APPENDICES

Appendix (3-2-1)

Soil moisture (30.5.2012) Ghedambaliya Area

R_1stripe1
T_1treatment
Distance
D_1(Depth)

Sample No	Can weight	Soil+can weight	Dry soil + can Weight	Wet soil weight	Dry soil weight	M	M%
$R_1T_1D_1$	19.4	84.6	82.1	65.2	62.7	2.5	3.99
T_1D_2	17.4	79.1	75.3	61.7	57.9	3.8	6.56
T_1D_3	13.8	87.6	81.0	73.8	67.2	6.6	9.82
$R_1T_2D_1$	17.2	73.3	71.0	56.1	53.8	2.3	4.27
T_2D_2	19.8	93.5	88.8	73.7	69.0	4.7	6.81
T_2D_3	13.5	77.6	71.0	64.1	57.5	6.6	11.48
$R_1T_3D_1$	20.0	81.8	78.7	61.8	58.7	3.1	5.28
T_3D_2	19.9	96.6	90.8	76.7	70.9	5.8	8.18
T_3D_3	20.5	82.6	73.2	62.1	52.7	9.4	17.84
$R_1T_4D_1$	19.8	84.6	81.8	64.8	62.0	2.8	4.52
T_4D_2	15.5	76.8	74.4	61.3	58.9	2.4	4.07
T_4D_3	13.9	98.4	92.5	84.5	78.6	5.9	7.51
$R_1T_5D_1$	20.1	80.1	72.2	60.0	52.1	7.9	15.16
T_5D_2	19.7	88.5	84.7	68.8	65.0	3.8	5.85
T_5D_3	20.3	107.5	101.8	87.2	81.5	5.7	7.0
$R_1T_6D_1$	17.2	80.8	74.2	63.0	56.4	6.6	11.70
T_6D_2	13.5	79.5	70.8	66.0	57.3	8.7	15.18
T_6D_3	19.3	108.6	100.0	89.3	80.7	8.6	10.66
$R_1T_7D_1$	20.3	77.0	74.7	56.7	54.4	2.3	4.23
T_7D_2	17.2	86.7	81.8	69.5	64.6	4.9	7.58
T_7D_3	19.7	104.3	98.7	84.6	79.0	5.6	7.10
$R_1T_8D_1$	19.4	80.5	77.9	61.1	58.5	2.6	4.44
T_8D_2	17.1	76.5	73.1	59.4	56.0	3.4	6.07
T_8D_3	16.3	91.0	85.4	74.7	69.1	5.6	8.10
$R_1T_9D_1$	19.7	66.9	65.9	47.2	46.2	1.0	2.16
T_9D_2	19.5	101.9	100.0	82.4	80.5	1.9	2.36
T_9D_3	19.7	109.5	104.7	89.8	85.0	4.8	5.65
$R_1T_{10}D_1$	20.1	76.4	73.9	56.3	53.8	2.5	4.65
$T_{10}D_2$	19.5	73.3	70.6	53.5	51.0	2.8	5.49
$T_{10}D_3$	20.1	107.6	102.6	87.5	82.5	5.0	6.06
$R_1T_{11}D_1$ (C)	19.7	80.4	78.8	60.7	59.1	1.6	2.71
$T_{11}D_2$	17.1	85.5	82.7	65.4	65.5	2.8	4.27
$T_{11}D_3$	19.4	107.2	98.5	87.8	79.1	8.7	11.0

Soil Moisture

Sample No	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
$R_2T_1D_1$	20.1	75.9	72.5	55.8	52.4	3.4	6.4
T_1D_2	20.1	95.1	90.1	75.0	70.0	5.0	7.14
T_1D_3	19.3	91.1	88.6	72.6	64.3	8.3	12.91
$R_2T_2D_1$	18.6	71.2	69.1	52.6	50.5	2.1	4.16
T_2D_2	19.7	77.1	73.5	57.4	53.8	3.6	6.7
T_2D_3	19.1	88.7	79.3	69.6	60.2	9.4	15.6
$R_2T_3D_1$	19.5	86.3	84.9	66.8	65.4	1.4	2.1
T_3D_2	20.1	80.0	77.4	59.9	57.3	2.6	4.5
T_3D_3	19.7	104.6	99.2	84.9	79.5	5.4	6.79
$R_2T_4D_1$	16.4	76.1	73.6	59.7	57.2	2.5	4.3
T_4D_2	19.5	71.3	68.9	51.8	49.4	2.4	4.8
T_4D_3	19.9	107.0	103.5	87.1	83.6	3.5	4.1
$R_2T_5D_1$	14.0	61.8	60.9	47.8	46.9	0.9	1.9
T_5D_2	19.6	80.1	77.6	60.5	58.0	2.5	4.3
T_5D_3	19.4	91.4	85.9	72.0	66.5	5.5	8.2
$R_2T_6D_1$	19.6	79.0	76.5	59.4	56.9	2.5	4.3
T_6D_2	20.2	83.9	81.6	63.7	61.4	2.3	3.3
T_6D_3	20.3	91.6	86.9	71.3	66.6	4.7	7.0
$R_2T_7D_1$	19.7	75.2	73.5	55.5	53.8	1.7	3.1
T_7D_2	19.1	82.2	79.3	63.1	60.2	2.9	4.9
T_7D_3	19.5	80.2	76.0	60.7	56.5	4.2	7.0
$R_2T_8D_1$	13.6	70.0	69.0	56.4	55.4	1.0	1.8
T_8D_2	19.8	80.2	78.3	60.4	58.5	1.9	3.2
T_8D_3	17.3	93.0	88.2	75.7	70.9	4.8	6.8
$R_2T_9D_1$	18.8	82.4	79.4	63.6	60.6	3.0	4.9
T_9D_2	18.9	80.9	76.4	62.0	57.5	4.5	7.8
T_9D_3	17.1	93.0	88.7	75.9	71.6	4.3	6.0
$R_2T_{10}D_1$	19.7	72.9	71.8	53.2	52.1	1.1	2.11
$T_{10}D_2$	17.7	70.0	67.8	52.3	50.1	2.2	4.39
$T_{10}D_3$	20.0	81.3	78.3	61.3	58.3	3.0	5.15
$R_2T_{11}D_1$ (C)	20.3	73.7	70.8	53.4	50.5	2.9	5.74
$T_{11}D_2$	20.3	100.0	96.3	79.7	76.0	3.7	4.87
$T_{11}D_3$	19.9	77.2	67.8	57.3	47.9	9.4	19.62

Soil Moisture

Sample No	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
$R_3T_1D_1$	19.8	83.1	79.3	53.3	59.5	6.2	10.42
D_2	20.2	80.5	72.6	60.3	52.4	7.9	15.08
D_3	17.3	72.3	63.6	55.0	46.3	8.9	19.22
$R_3T_2D_1$	16.9	75.1	73.3	58.2	56.3	1.8	3.19
D_2	18.8	91.2	88.5	72.4	69.7	2.7	3.87
D_3	19.8	103.2	98.7	83.4	78.9	4.5	5.70
$R_3T_3D_1$	19.3	122.6	119.3	103.3	100.0	3.3	3.3
D_2	18.6	133.3	124.8	114.5	106.2	8.3	7.81
T_3D_3	18.7	96.4	84.6	77.7	56.9	11.8	17.90
$R_3T_4D_1$	19.1	93.9	90.8	74.8	71.7	3.1	4.32
D_2	18.5	118.5	113.1	100	94.6	5.4	5.71
D_3	18.5	123.1	109.3	104.6	90.8	13.8	15.20
$R_3T_5D_1$	19.8	115.8	109.7	96	89.9	6.1	6.78
D_2	18.6	121.4	108.5	102.8	89.9	12.9	14.35
D_3	18.7	108.8	95.6	90.1	76.9	13.2	17.16
$R_3T_6D_1$	18.5	110.9	106.1	92.4	87.6	4.8	5.84
D_2	18.5	111.7	104.2	93.2	85.7	7.5	8.75
D_3	18.7	101.8	89.6	83.1	70.9	12.2	17.21
$R_3T_7D_1$	18.5	101.3	97.8	82.8	79.3	3.5	4.41
D_2	19.5	102.0	98.2	82.5	78.7	3.8	4.83
D_3	19.7	98.6	88.3	78.9	68.6	10.3	15.01
$R_3T_8D_1$	20.2	91.8	89.7	71.6	69.5	2.1	3.02
D_2	19.4	112.1	108.0	92.7	88.6	4.1	4.63
D_3	19.8	94.7	82.7	74.9	62.9	12.0	19.08
$R_3T_9D_1$	18.5	104.5	98.8	86.0	80.3	5.7	7.1
D_2	18.6	128.3	121.7	109.7	103.1	6.6	6.4
D_3	18.8	98.6	85.9	79.8	67.1	12.7	18.93
$R_3T_{10}D_1$	18.4	93.9	90.6	75.5	72.2	3.3	4.57
D_2	19.7	104.2	99.1	84.5	79.4	5.1	6.42
D_3	19.5	119.6	108.5	100.1	89	11.1	12.47
$R_3T_{11}D_1$ (C)	18.1	111.0	105.8	92.9	88.6	4.3	4.85
D_2	17.2	101.9	94.8	84.7	77.6	7.1	9.15
D_3	18.7	103.5	87.2	84.8	68.5	16.3	23.79

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Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(1)	T_1D_1	19.4	80.2	68.8	60.8	49.4	11.4	23.1
	D_2	17.4	73.1	61.0	55.7	43.6	12.1	27.7
	D_3	13.8	65.8	54.3	52.0	40.5	11.5	28.4
	T_2D_1	17.2	66.2	55.7	49.0	38.5	10.5	27.3
	D_2	19.9	73.7	61.7	53.8	41.8	12	28.7
	D_3	13.5	62.5	51.8	49.0	38.3	10.7	27.9
	T_3D_1	20.0	80.9	70.1	60.9	50.1	10.8	21.6
	D_2	19.9	82.9	70.4	63.0	50.5	12.5	24.8
	D_3	20.5	71.4	61.3	50.9	40.8	10.1	24.8
	T_4D_1	19.8	81.7	68.5	61.9	48.7	13.2	27.1
	D_2	15.5	70.0	57.9	54.5	42.4	12.1	28.5
	D_3	14.0	68.3	55.6	54.3	41.6	12.7	30.5
	T_5D_1	20.1	77.0	65.0	56.9	44.9	12	26.7
	D_2	19.8	72.5	60.5	52.7	40.7	12	29.5
	D_3	20.3	71.6	59.3	51.3	39.0	12.3	31.5
	T_6D_1	17.9	69.0	56.0	51.1	38.1	13	34.1
	D_2	13.5	64.3	50.8	50.8	37.3	13.5	36.2
	D_3	19.3	75.7	60.2	56.4	40.9	15.5	37.9
	T_7D_1	19.7	74.3	62.1	54.6	42.4	12.2	28.8
	D_2	17.2	64.3	52.9	47.1	35.7	11.4	31.9
	D_3	19.7	69.8	57.7	50.1	38.0	12.1	31.8
	T_8D_1	19.4	74.2	61.4	54.8	42.0	12.8	30.5
	D_2	17.1	68.5	55.5	51.4	38.4	13	33.9
	D_3	16.3	65.2	52.6	48.9	36.3	12.6	34.7
	T_9D_1	19.7	66.8	53.6	47.1	33.9	13.2	38.9
	D_2	19.5	72.8	59.6	53.3	40.1	13.2	32.9
	D_3	19.8	75.5	61.0	55.7	41.2	14.5	35.2
	$T_{10}D_1$	20.1	64.3	54.6	44.2	34.5	9.7	28.1
	D_2	19.6	78.3	63.2	58.7	43.6	15.1	34.6
	D_3	20.1	80.3	65.5	60.2	45.4	14.8	32.6
(C)	$T_{11}D_1$	19.7	71.2	58.3	51.5	38.6	12.9	33.4
	D_2	17.1	62.3	50.6	45.2	33.5	11.7	34.9
	D_3	19.4	78.1	63.4	58.7	44.0	14.7	33.4

Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(2)	T1D1	20.1	72.9	62.0	52.8	41.9	10.9	26.01
	D2	20.1	72.4	60.8	52.3	40.7	11.6	28.50
	D3	19.3	65.0	53.3	45.7	34	11.7	34.41
	T2D1	18.6	63.3	52.6	44.7	34	10.7	31.47
	D2	19.8	63.3	52.4	43.5	32.6	10.9	33.44
	D3	19.1	77.0	63.1	57.9	44	13.9	31.59
	T3D1	19.5	68.3	55.9	48.8	36.4	12.4	34.07
	D2	20.1	79.5	64.7	59.4	44.6	14.8	33.18
	D3	19.8	66.5	53.8	46.7	34	12.7	37.35
	T4D1	16.4	72.1	59.6	55.7	43.2	12.5	28.94
	D2	19.5	89.5	72.5	70	53	17	32.08
	D3	20.0	70.3	57.3	50.3	37.3	13	34.85
	T5D1	14.0	64.5	53.7	50.5	39.7	10.8	27.20
	D2	19.6	74.2	59.9	54.6	40.3	14.3	35.48
	D3	19.4	77.7	63.4	58.3	44	14.3	32.50
	T6D1	19.6	82.7	67.0	63.1	47.4	15.7	33.12
	D2	20.3	76.5	62.5	56.2	42.2	14	33.18
	D3	20.3	69.5	55.8	49.2	35.5	13.7	38.59
	T7D1	19.8	75.1	67.5	55.3	47.7	7.6	15.93
	D2	19.1	70.6	59.2	51.5	40.1	11.4	28.43
	D3	19.6	67.0	57.5	47.4	37.9	9.5	25.07
	T8D1	13.6	64.1	57.6	50.5	44	6.5	14.77
	D2	19.9	70.0	57.1	50.1	37.2	12.9	34.68
	D3	17.3	74.1	59.5	56.8	42.2	14.6	34.60
	T9D1	18.9	74.3	60.0	55.4	41.1	14.3	34.79
	D2	19.0	81.7	65.4	62.7	46.4	16.3	35.13
	D3	17.1	70.3	55.5	53.2	38.4	14.8	38.54
	T10D1	20.4	85.7	68.9	65.3	48.5	16.8	34.64
	D2	17.7	68.7	55.1	51	37.4	13.6	36.36
	D3	20.0	74.2	59.4	54.2	39.4	14.8	37.56
(C)	T11D1	20.3	74.7	60.9	54.4	40.6	13.8	33.99
	D2	20.3	77.7	63.7	57.4	43.4	14	32.26
	D3	19.9	74.0	58.3	54.1	38.4	15.7	40.89

Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(3)	T_1D_1	19.8	74.0	59.2	54.2	39.4	14.8	37.56
	D_2	20.3	69.5	56.7	49.2	36.4	12.8	35.16
	D_3	17.4	71.4	57.6	54	40.2	13.8	34.33
	T_2D_1	17.0	62.3	50.0	45.3	33	12.3	37.27
	D_2	18.9	74.6	60.9	55.7	42	13.7	32.62
	D_3	19.8	68.5	55.2	48.7	35.4	13.3	37.57
	T_3D_1	19.3	103.8	82.8	84.5	63.5	21	33.07
	D_2	18.6	109.7	85.4	91.1	66.8	24.3	36.38
	D_3	18.7	103.8	81.1	85.1	62.4	22.7	36.38
	T_4D_1	19.1	98.8	74.5	79.7	55.4	24.3	43.86
	D_2	18.5	101.0	82.1	82.5	63.6	18.9	29.72
	D_3	18.5	101.6	82.5	83.1	64	19.1	29.84
	T_5D_1	19.8	120.0	97.4	100.2	77.6	22.6	29.12
	D_2	18.6	110.0	78.0	91.4	59.4	32	53.87
	D_3	18.7	107.8	83.4	89.1	64.7	24.4	37.71
	T_6D_1	18.6	97.8	80.6	79.2	62	17.2	27.74
	D_2	18.5	105.1	84.5	86.6	66	20.6	31.21
	D_3	18.8	127.3	96.3	108.5	77.5	31	40.00
	T_7D_1	18.5	102.0	83.4	83.5	64.9	18.6	28.66
	D_2	19.5	110.0	88.1	90.5	68.6	21.9	31.92
	D_3	19.7	104.0	83.2	84.3	63.5	20.8	32.76
	T_8D_1	20.2	113.6	91.8	93.4	71.6	21.8	30.45
	D_2	19.4	112.1	89.9	92.7	70.5	22.2	31.49
	D_3	19.9	96.0	75.4	76.1	55.5	20.6	37.12
	T_9D_1	18.5	103.3	80.8	84.8	62.3	22.5	36.12
	D_2	18.6	101.8	82.4	83.2	63.8	19.4	30.41
	D_3	18.8	86.4	68.6	67.6	49.8	17.8	35.74
	$T_{10}D_1$	18.4	83.0	69.7	64.6	51.3	13.3	25.93
	D_2	19.8	84.6	71.1	64.8	51.3	13.5	26.32
	D_3	19.5	84.2	69.1	64.7	49.6	15.1	30.44
(C)	$T_{11}D_1$	18.1	86.8	68.5	68.7	50.4	18.3	36.31
	D_2	17.2	85.1	66.9	67.9	49.7	18.2	36.62
	D_3	18.7	70.1	55.1	51.4	36.4	15	41.21

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Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(1)	T_1D_1	19.4	90.2	84.7	70.80	65.30	5.50	8.42
	D_2	17.4	72.4	65.6	55.00	48.20	6.80	14.11
	D_3	13.8	66.1	58.0	52.30	44.20	8.10	18.33
	T_2D_1	17.2	79.9	73.9	62.70	56.70	6.00	10.58
	D_2	19.9	82.4	73.6	62.50	53.70	8.80	16.39
	D_3	13.5	70.0	61.4	56.50	47.90	8.60	17.95
	T_3D_1	20.0	85.3	81.7	65.30	61.70	3.60	5.83
	D_2	19.9	93.2	86.6	73.30	66.70	6.60	9.90
	D_3	20.5	87.3	78.0	66.80	57.50	9.30	16.17
	T_4D_1	19.9	85.5	80.4	65.60	60.50	5.10	8.43
	D_2	15.5	93.3	84.8	77.80	69.30	8.50	12.27
	D_3	14.0	79.2	69.5	65.20	55.50	9.70	17.48
	T_5D_1	20.1	85.0	79.7	64.90	59.60	5.30	8.89
	D_2	19.7	86.6	80.8	66.90	61.10	5.80	9.49
	D_3	20.3	97.5	91.6	77.20	71.30	5.90	8.27
	T_6D_1	17.9	75.4	70.6	57.50	52.70	4.80	9.11
	D_2	13.5	90.1	82.3	76.60	68.80	7.80	11.34
	D_3	19.3	98.1	90.4	78.80	71.10	7.70	10.83
	T_7D_1	19.7	91.3	84.7	71.60	65.00	6.60	10.15
	D_2	17.2	78.4	68.2	61.20	51.00	10.20	20.00
	D_3	19.7	71.9	62.6	52.20	42.90	9.30	21.68
	T_8D_1	19.4	90.3	83.8	70.90	64.40	6.50	10.09
	D_2	17.1	86.1	76.1	69.00	59.00	10.00	16.95
	D_3	16.3	74.2	64.0	57.90	47.70	10.20	21.38
	T_9D_1	19.7	87.3	81.2	67.60	61.50	6.10	9.92
	D_2	19.6	92.6	84.0	73.00	64.40	8.60	13.35
	D_3	19.8	66.3	58.9	46.50	39.10	7.40	18.93
	$T_{10}D_1$	20.1	88.9	84.7	68.8	64.6	4.2	6.50
	D_2	19.6	97.8	89.0	78.2	69.4	8.8	12.68
	D_3	20.1	78.5	69.0	58.4	48.9	9.5	19.43
(C)	$T_{11}D_1$	19.7	91.5	84.0	71.8	64.3	7.5	11.66
	D_2	17.1	68.1	59.0	51	41.9	9.1	21.72
	D_3	19.4	63.6	55.2	44.2	35.8	8.4	23.46

Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(2)	T_1D_1	20.1	89.8	83.5	69.7	63.4	6.3	9.94
	D_2	20.1	80.8	71.6	60.7	51.5	9.2	17.86
	D_3	19.3	76.5	67.2	57.2	47.9	9.3	19.42
	T_2D_1	18.6	85.9	78.8	67.3	60.2	7.1	11.79
	D_2	19.8	63.0	55.3	43.2	35.5	7.7	21.69
	D_3	19.2	73.8	64.2	54.6	45	9.6	21.33
	T_3D_1	19.5	95.3	89.6	75.8	70.1	5.7	8.13
	D_2	20.0	80.0	70.0	60	50	10	20.00
	D_3	19.7	76.0	65.7	56.3	46	10.3	22.39
	T_4D_1	16.4	73.3	68.0	56.9	51.6	5.3	10.27
	D_2	19.5	78.5	68.9	59	49.4	9.6	19.43
	D_3	19.9	68.6	60.3	48.7	40.4	8.3	20.54
	T_5D_1	14.0	78.9	73.2	64.9	59.2	5.7	9.63
	D_2	19.6	72.3	62.8	52.7	43.2	9.5	21.99
	D_3	19.4	79.7	68.9	60.3	49.5	10.8	21.82
	T_6D_1	19.6	90.0	82.8	70.4	63.2	7.2	11.39
	D_2	20.3	80.0	72.2	59.7	51.9	7.8	15.03
	D_3	20.3	67.4	59.1	47.1	38.8	8.3	21.39
	T_7D_1	19.8	79.3	74.1	59.5	54.3	5.2	9.58
	D_2	19.1	81.2	73.2	62.1	54.1	8	14.79
	D_3	19.6	90.7	77.6	71.1	58	13.1	22.59
	T_8D_1	13.6	71.5	65.9	57.9	52.3	5.6	10.71
	D_2	19.8	69.7	60.6	49.9	40.8	9.1	22.30
	D_3	17.3	59.5	51.5	42.2	34.2	8	23.39
	T_9D_1	18.8	75.5	68.5	56.7	49.7	7	14.08
	D_2	18.9	68.9	59.6	50	40.7	9.3	22.85
	D_3	17.1	62.9	54.3	45.8	37.2	8.6	23.12
	$T_{10}D_1$	20.3	72.4	68.4	52.1	48.1	4	8.32
	D_2	17.7	86.7	78.9	69	61.2	7.8	12.75
	D_3	20.0	84.8	76.4	64.8	56.4	8.4	14.89
(C)	$T_{11}D_1$	20.2	77.0	68.1	56.8	47.9	8.9	18.58
	D_2	20.3	83.9	73.2	63.6	52.9	10.7	20.23
	D_3	19.9	79.3	67.8	59.4	47.9	11.5	24.01

Rep.	Treatment	Can weight	Soil+can weight	Dry soil+can Weight	Wet soil weight	Dry soil weight	M	M%
(3)	T_1D_1	19.8	71.5	66.5	51.7	46.7	5	10.7
	D_2	20.2	70.0	62.5	49.8	42.3	7.5	17.7
	D_3	17.3	60.4	57.3	43.1	40.0	3.1	7.8
	T_2D_1	16.9	85.3	77.7	68.4	60.8	7.6	12.5
	D_2	18.8	64.3	55.8	45.5	37	8.5	22.9
	D_3	19.8	66.1	57.3	46.3	37.5	8.8	23.5
	T_3D_1	19.3	102.1	93.6	82.8	74.3	8.6	11.6
	D_2	18.6	84.8	73.8	66.2	55.2	11	19.9
	D_3	18.7	96.5	82.8	77.8	64.1	13.7	21.4
	T_4D_1	19.1	93.7	88.6	74.6	69.5	5.1	7.3
	D_2	18.5	120.3	111.2	101.8	92.7	9.1	9.8
	D_3	18.5	109	98.4	90.0	79.9	10.1	12.3
	T_5D_1	19.8	123	111.2	103.2	91.4	11.8	12.9
	D_2	18.7	98.5	84.1	79.8	65.4	14.4	22.0
	D_3	18.7	96.4	81.3	77.7	62.6	15.1	24.1
	T_6D_1	18.5	94.8	88.2	76.3	69.7	6.6	9.5
	D_2	18.5	99.2	89.1	80.7	70.6	10.1	14.3
	D_3	18.9	99.0	84.8	80.1	65.9	14.2	21.6
	T_7D_1	18.5	107.1	97.1	88.6	78.6	10	12.7
	D_2	19.5	86.8	74.1	67.3	54.6	12.7	23.3
	D_3	19.7	97.4	82.8	77.7	63.1	14.6	23.1
	T_8D_1	20.2	106.5	98.2	86.3	78	8.3	10.6
	D_2	19.4	105.9	96.7	86.5	77.3	9.2	11.9
	D_3	19.8	96.4	85.8	76.6	66	10.6	16.1
	T_9D_1	18.5	110.9	100.8	92.4	82.3	10.1	12.3
	D_2	18.6	88.9	77.4	70.3	58.8	11.5	10.6
	D_3	18.8	91.4	78.9	72.6	60.1	12.5	20.8
	$T_{10}D_1$	18.4	110.1	101.1	91.7	82.7	9	10.9
	D_2	19.7	70.7	62.2	51	42.5	8.5	20.0
	D_3	19.5	78.5	68.5	59	49	10	20.4
(C)	$T_{11}D_1$	18.1	114.7	103.7	96.6	85.6	11	12.9
	D_2	17.2	104.7	89.0	87.5	71.8	15.7	21.9
	D_3	18.7	106.8	91.0	88.1	72.3	15.8	21.9

Appendix (3-1-1)

Data analysis

strip	Distance	January			May			September		
		Depth 20cm	Depth 40cm	Depth 60cm	Depth 20cm	Depth 40cm	Depth 60cm	Dept h20cm	Depth 40cm	Dept h60cm
1	20	8.2	7.7	7.6	2.5	5.0	8	24.7	33.3	22.4
	40	7.0	9.0	14.3	4.1	5.0	8	28.3	34.2	39.5
	60	10.2	9.5	12.8	4.1	5.0	7	26.2	34.8	38.2
	80	7.0	12.2	17.0	2.91	4.0	7	28.3	31.7	42.4
	100	8.2	12.4	15.5	4.2	5.0	7	33.5	36.2	29.3
	120	9.7	10.1	13.5	3.3	6.5	7	30.4	35.4	30.2
	140	10.2	10.9	10.6	4.4	7.0	7	32.0	35.3	30.1
	160	8.8	12.4	11.5	4.8	6.0	7	26.5	36.6	35.7
	180	8.3	12.2	10.4	3.7	5.0	6	32.1	38.0	24.5
	200	8.9	8.4	8.9	5.6	4.0	7	29.8	39.1	29.4
	Control	12.5	9.9	8.6	3.0	3.0	7	26.3	17.4	15.7

strip	Distance	January			May			September		
		Depth 20cm	Depth 40cm	Depth 60cm	Depth 20cm	Depth 40cm	Depth 60cm	Dept h20cm	Depth 40cm	Dept h60cm
2	20	10.3	12.3	9.7	3.0	8.0	11	27.6	31.9	10.5
	40	9.8	12.7	24.5	7.3	5.0	9	26.1	36.4	24.8
	60	16.6	19.0	21.7	7.0	7.0	8	24.8	35.2	31.1
	80	12.4	19.5	24.0	3.3	7.0	9	30.8	33.2	33.2
	100	13.8	19.8	19.5	6.7	7.0	9	36.9	38.9	30.5
	120	15.6	16.0	23.2	6.4	10.0	10	31.2	38.6	31.4
	140	14.2	19.1	14.1	6.0	10.0	8	32.9	33.5	37.2
	160	12.8	19.4	29.8	7.6	12.0	9	30.3	36.0	31.1
	180	15.7	17.4	18.1	5.1	5.0	8	34.5	38.0	27.7
	200	18.9	12.7	16.4	6.9	6.0	9	30.5	28.7	31.7
	Control	18.5	18.9	14.2	4.2	6.0	8	15.9	23.0	20.8

strip	Distance	January			May			September		
		Depth 20cm	Depth 40cm	Depth 60cm	Depth 20cm	Depth 40cm	Depth 60cm	Dept h20cm	Depth 40cm	Dept h60cm
3	20	19.6	16.4	15.2	6.3	14.0	18	26.7	20.7	15.6
	40	20.9	15.8	25.8	14.8	10.0	14	29.5	35.4	26.5
	60	19.4	20.9	23.0	12.6	9.0	8	25.7	35.2	27.5
	80	20.5	20.7	24.2	4.3	16.0	12	26.3	38.3	19.5
	100	22.7	22.6	24.9	12.6	9.0	12	34.8	38.2	31.2
	120	11.9	22.5	25.2	14.1	15.0	13	29.6	37.6	31.9
	140	17.6	22.6	20.4	9.1	18.0	8	28.7	35.3	39.2
	160	15.8	19.7	23.8	14.4	17.0	15	20.4	34.6	36.2
	180	8.3	12.2	10.4	3.7	5.0	6	32.1	38.0	24.5
	200	8.9	8.4	8.9	5.6	4.0	7	29.8	39.1	29.4
	control	12.5	9.9	8.6	3.0	3.0	7	26.3	17.4	15.7

Appendix (3–7–1)

Interview No. ()

Site ..... Local ..... Date .....

1 / What are the purpose of the shelter belts Ghadambaliya area?

....

.....

2 / Where are the shelter belts found and how many?

....

.....

....

.....

3/ What are the types of trees in the shelter belts?

....

....

....

....

4 / What are the benefits of planting shelter belts?

.....

.....

....

5 / The purpose for which was set up?

....

.....

6 / Are there problems and difficulties arising from shelter belts?

....

.....

7 / Are there laws to protect the shelter belts?

....

.....

8 / Is there guidance and environmental awareness to increase shelter belts?

....

.....

9\Are there any other additions to mention them ....

Signature .....

Appendix (3–7–2)

Interview No. ()

1 / name of shelter belt?
....
.....
2 / The purpose of the shelter belt ?
....
....
....
....
3 /The shelter belt's area?
....
4 / Date of shelter belt cultivation?
....
5 / Type of trees existing in shelter belt?
....
....
6 / Number of rows? .....
7 / Benefits of the shelter belt?
.....
.....
.....
8 / Did it do the purpose ?,.....
9 / Are there problems of the establishment of shelter belt?
....
.....
....
.....

Appendix (1-7) ***Socio – economic studies questionnaire at Gadambaliya***

Name ……..

Date ……

Village …….. Location ..... Tripe……

Age …….. Occupation …….

Educational level

Illiteracy	*Khalwa*	*Basic level*	*Sec.School*	*University*

Put ☐ in the square if the answer is appropriate:

5What the condition of vegetation cover stand in the past?

a\extensive ☐ b\moderate ☐ c\less ☐

6If the answer is extensive, what is the cause of deterioration?

a\from the mechanized rain fed ☐

b\illegal cutting. ☐

c\over browsing and over grazing ☐

7what are the impact of vegetation destruction in the area?

a\ shorting of fuel wood . ☐

b\ decreasing in crop yield ☐

c\ decline of soil fertility ☐

other……..

8Are there any other causes resulting from the destruction of vegetation cover?

a) Yes ☐ b) No ☐

9. If the answer is yes, what are they?

a)……b)……c)…….

10. The expansion of mechanized rain farming affect in the deterioration vegetation cover?

a)Yes ☐ b) No ☐

11. If the answer is yes what are they?

a)……

b)……

c)……

12. The people at this area interested in establishing shelter belt and community forest?

a) Yes ☐ ***b) No*** ☐

13. If the answer is yes, is it for?

a) increase of yield ☐ ***b) increase soil protection*** ☐

14. What are tree species found in the area ?

a)…….b)…….. c)…….

d)…… e)…….……..f)……..

15. Do you find any harmful affects for the trees species found in the area in relation to crop yield?

a) Yes ☐ ***b) No*** ☐

16. If the answer is yes what are they?

a)…….b)……c)……

d)…….e)……f)…….

17. Do you use agroforestry system?

a) Yes ☐ ***b) No*** ☐

18. If the answer is yes, ….

a) is it useful ☐ ***b)is not useful*** ☐

19. What is best way to rehabilitate the deteriorating area?

a)…….b)……..c)……..

d)…….e)…….……..f)……..

Other…….……..

Table (4-1-1) The SAS system

Duncan's multiple Range test for months

Alpha	0.05
Error degreas of freedom	6
Error mean square	4264167

Means with the same letter are significantly different

Duncan grouping	Mean	Trt
A	31.023	September
B	16.090	January
C	8.260	May

Table (4-1-23)

SAS system

GLM procedure

Duncan's multiple Range Test for Distances 20 metter-200 metter month May

Alpha 0.05

Error Degrees of freedom 8.8

Error mean square 14.12716

Duncan's Grouping	Mean	Trt
A	10.311	40
BA	9.422	60
BA	8.611	80
BA	8.578	100
BA	8.422	120
BA	8.144	140
BA	8.056	160
BA	7.522	20
BA	7.279	180
BA	6.789	200
B	5.689	control

Plate (1) shelter- belt

plate (2) The role of shelter belt in animal grazing