

# **The Impact of Tractor Drawn Implements Use on Rangelands and Animal Resource in North Kordofan**

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## PREAMBLE

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قال تعالى

(وَلَا تُفْسِدُوا فِي الْأَرْضِ بَعْدَ إِصْلَاحِهَا وَادْعُوهُ خَوْفًا وَطَمَعًا إِنَّ رَحْمَتَ اللَّهِ قَرِيبٌ مِّنَ الْمُحْسِنِينَ)

صدق الله العظيم

سورة الاعراف الاية (56)

And cause not corruption upon the earth after its reformation. And invoke Him in fear and aspiration. Indeed, the mercy of Allah is near to the doers of good(56).

## **DEDICATION**

This Work is dedicated to

My Mother

My Father

My sisters, brother

with love and respect

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## **ABSTRACT**

This research work was carried out in Sheikan and Umrauaba localities, North Kordofan state, Sudan during February to May, 2017 with the objective of studying the impacts of tractor drawn implements use on rangelands and animal resource in North Kordofan. The primary data was collected from a sample of 120 respondents selected randomly among farmers and herders within two localities (Sheikan and Um Rauaba) using questionnaires. Secondary data was obtained from the references, previous studies, observations key informants and network. With the assistance of SPSS software, the primary data was analyzed where descriptive statistics was used to describe results. Chi-square was also used. The results showed that the farmers were increasingly started using agricultural machinery while herders were observant of decreased rangelands as affected by the plowing. The acreage under cultivation increased from 2-3 Mukhamas per farmer before using machinery to 20-30Mukhamas after introduction of Agricultural machinery. The expansion of agriculture at the expense of rangelands led to deterioration of the later. This in turn initiated conflicts among stakeholders leading to loss of lives. Agricultural machinery use led to a change in the vegetation composition of some areas and loss of large areas of grazing forests. The results also showed that many of the local population depended mainly on the quantity and quality of the natural grazing. Positive effects of agricultural machinery use were reported by the respondents on gardud soils where use of plows was believed to improve rangelands and increase biomass production. The study concluded that the impacts of agricultural machinery are created by expansion of farming on rangelands leading to decrease of the rangeland area. This in turn led to over stocking and deterioration of rangelands. This is the most serious problem faced by pastoralists in some areas and may result in herd loss. It was recommended that more studies be conducted to study impacts of tractor drawn implements on all natural resources and human life in the area.

## المخلص

أجريت هذه الدراسة في محليتي شيكان وأم روابة بولاية شمال كردفان بالسودان خلال الفترة من فبراير إلى مايو 2017 بهدف دراسة تأثير استخدام الآليات الزراعية المسحوبة بالجرارات على المراعي والموارد الحيوانية في شمال كردفان. تم جمع البيانات الأولية من عينة مكونة من 120 مستبان تم اختيارهم عشوائيا بين المزارعين والرعاة في محليتين (شيكان وأم روابة) باستخدام الاستبيانات. تم الحصول على البيانات الثانوية من المراجع والدراسات السابقة، والشخصيات الرئيسية ومن الملاحظات وشبكة الإنترنت. وبمساعدة برنامج SPSS، تم تحليل البيانات الأولية حيث استخدمت الإحصاءات الوصفية لوصف النتائج. كما تم استخدام إختبار مربع كاي. أظهرت النتائج أن المزارعين بدأوا يزيدون من المساحات المزروعة بسبب استخدام الآلات الزراعية على حساب المرعى الطبيعي في حين كان الرعاة يتزاحمون في المساحات المتناقصة من المراعي كما تأثرت حالة المرعى. وزادت المساحة المزروعة من 2-3 مخمس لكل مزارع قبل استخدام الآلات إلى 20-30 مخمس بعد إدخال الآلات الزراعية. وأدى التوسع في الزراعة على حساب المراعي إلى تدهور المراعي. وأدى ذلك بدوره إلى نشوء صراعات بين أصحاب المصلحة، مما أدى إلى خسائر في الأرواح. وأدى استخدام الآلات الزراعية إلى تغيير في الغطاء النباتي لبعض المناطق، وفقدان مساحات كبيرة من غابات الرعي. وأظهرت النتائج أيضا أن العديد من السكان المحليين يعتمدون أساسا على كمية ونوعية المرعى الطبيعي. وأشار المستبانون على أن تربة القردود تتأثر بصورة الإيجابية باستخدام الآلات الزراعية حيث يعتقد أن استخدام المحارث يحسن المراعي ويزيد إنتاج الكتلة الحيوية. وخلصت الدراسة إلى أن آثار استخدام الآلات الزراعية تنشأ عن طريق التوسع في الزراعة على حساب المراعي مما يؤدي إلى انخفاض مساحة المراعي. وأدى ذلك بدوره إلى الرعي الجائر في المراعي وتدهورها. وهذه هي أخطر مشكلة يواجهها الرعاة في بعض المناطق وقد تؤدي إلى فقدان القطيع. أوصت الدراسة بإجراء المزيد من البحث لمعرفة أثر استخدام الآليات على الموارد الطبيعية كافة.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background

North Kordofan state is an undulating plain covering an area of 185,302 km<sup>2</sup> at an altitude of 1,500 feet. The state population is approximately 3.2 million (2008 census), of which approximately 85% is rural (USAID, 2013; WFP, 2010).

The rainy season starts in June and continues to September. Rainfall increases from approximately 100 mm per year in the most northerly areas to 200 mm in the middle zone and 350 mm in the south, although rainfall is unreliable with large variations among years. Precipitation of arid zone is from 0 -75C. There is no permanent river. Soils are generally infertile, with the most productive agricultural land being found in the eastern part of the state (WFP, 2010).

Rural livelihood patterns generally follow rainfall. In northern areas rainfall is insufficient to reliably support crops but provides enough natural grazing s for dominant livestock species raised such as camels, goats and sheep during the rains, although in the dry season herders have to move south in search of grazing. In the middle and southern areas rainfall is sufficient to allow growing some crops such as millet, Roselle, watermelon, sesame and groundnuts (Elnour *et al.*, 2014). In the wetter south and east, sesame and groundnuts are produced abundantly their residues are increasingly used in feeding livestock. Sorghum is mainly grown in the south-western part. Gum Arabic, of which Sudan is the principal global exporter, is produced in parts of the west of the state (USAID, 2013).

A combination of low-lying moisture-retaining areas, seasonal water courses (wadis) and good seasonal rainfall are sufficient, even in northern areas, to allow a small crop of millet in some years and in the south to support vegetable production for sale. However, even in years of good production, few households are self-sufficient in food and mostly rely on the sale of cash crops, livestock, local agricultural employment and seasonal migration to the gold mining sites at al-Mazroub, Nahr-al-Neel, Blue Nile and parts of Northern Sudan. The poor move

into the urban areas of El Obeid, Khartoum and Omdurman and find agricultural work in the semi-mechanized areas of Kassala, Gedaref, Blue Nile and White Nile and South Kordofan States. This provides income to purchase food and other commodities (USAID, 2013).

Livestock production is of central role in the livelihood of the pastoralists and farmers alike in this area. Herders entirely depend on raising livestock for their needs, farmers keep small stocks within their farming system as source of food, cash and labor. Crop sales surplus is saved in owning animals.

Two factors that have important influence on rural livelihoods are: (i) raising sheep, which command high prices because of the high level of demand from the Gulf States, and (ii) the long distances from most rural areas to urban markets and poor road conditions, particularly in the wet season. This reduces the value of exported produce and increases the price of imports agricultural inputs. Prices of Sorghum, the main imported staple and rice, lentils, sugar, cooking oil and other non-staple food items and non-food commodities are high to rural consumers in the State. These are transported from Khartoum and Omdurman to El Obeid for onward distribution to local markets and villages. At village level retail sales are controlled by the better-off, who derive a significant income from this source (USAID, 2013).

The long term decline in rainfall in North Kordofan has led to competition for grazing. Seasonally, northern pastoralists move from the north to southern parts of the state and there are more local livestock movements within more southerly agro-pastoral areas, leading to disputes among agro pastoralists and pastoralists over grazing areas and rights and access to water. In most years, North Kordofan state is a cereal deficit area and requires imports from the semi-mechanized areas of the east and south (USAID, 2013; WFP, 2010).

The importance of range is to provide human population with reasonable animal products. This state is completely dependent on natural rangeland to satisfy its feed requirement , the feed balance differ from season to other according to

amount and distribution of the annual rainfall according to range survey data of 2004, 2005, 2006 (RPA, 2006).

During Last few years rangeland was estimated being 16% of world food production compared to 77% for cropland (Holechek, 2004). Today range land all over the world is subjected to intensive use due to increasing animal and human population, ecological change, and increase in human demands and other economic activities. These factors cause severe rangeland deterioration (Abdalla, 2008). In Sudan, the flexibility of animal movement is progressively hampered by increased population pressure and loss of corridors between wet and dry season grazing areas. Most of the rural areas of the Sudan are dominated by a population of pastoralists and agro-pastoralists who are totally dependent on land and its natural resources to support their livelihood (UNDP, 2006: Ahmed, and Abu Sabah, 1993). North Kordofan State provides an example of increase in natural resources competition and local conflicts that result from the combination of rangeland degradation and agricultural expansion in wet seasonal grazing areas. Livestock raising in North Kordofan practiced two systems. The first one is the village-based adapted by the settled communities whereby livestock is kept throughout the year grazing near settlements. The second type is an open range seasonal grazing system followed by nomads and semi-nomads, and livestock is driven to distant rangelands. Therefore, the traditional open grazing system implies excessive pressure on rangeland by animals and expansions of marginal farming, which accelerate environmental degradation, (Abdullah, 1982 and Zaroug, 2006). Conflicts along these routes have become common in North Kordofan state and they are generally triggered by increasing demand for cropland, expansion of mechanized agriculture, shortage of water points and land degradation. Rules, agreements, acts and resolution committees have been initiated for governing transhumance routes, but they remained ineffective due to lack of satisfactory involvement of farmers and herders (UNDP, 2006 and Fashiret *al*, 2015). Moreover, the demand for natural resources increased as the result of population

growth. In addition to the expansion of agricultural practices into areas that previously have been used as rangeland, the expansion of rain-fed agriculture into marginal areas historically used for grazing land has been the causes of rangeland environmental components degradation.

## **1.2.The research problem**

Increasing acreage of land under cropping year after year is inevitable since population of the country is growing at alarming rates. Most of the rural communities are moving into urban area for a variety of reasons creating high population density in city centers and making farm labor a scarce. Therefore high food demand and lack of farm laborer together with intensified degree of utilization of natural resources and increased demand of agricultural products as the result of population growth in addition to the expansion of agricultural practices into areas necessitated use of farm machinery. The impact of the use machinery use on soil is usually negative and need to be evaluated.

## **1.3 Research Justifications**

The reports and range inventory results have indicated serious decline of rangelands productivity in the localities of the state. The rangelands are indicated being under severe deterioration in areas that are selected for this study. In some areas natural rangelands productivity was reported being less than 0.01ton/feddan while previous studies reported up to 0.03 ton/feddan/ year.

As well, several cases of conflicts over natural resources reported in the area including disputes over e Natural rangelands.

Studies have indicated that use of some agricultural machinery is detrimental. The illegal practice and the misuse of tractor complementary machines have become widespread in the last time.

## **1.4 Study Objectives**

The overall objective of this study is to assist in development of sustainable natural resource use pattern taking into account the interests of all users and avoiding

conflicts over resources. This is together with looking for mechanisms that ensure resources conservation.

#### **1.4 .1The specific objectives**

Specifically, this study is conducted in find out the impacts of expanding use of machinery cultivation on both animal and rangeland conditions.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Livestock population in Sudan is one of the largest in Africa. This wealth was estimated to be 103 millions heads among which cattle; sheep, goat and camels were respectively 29.4, 39.1, 30.5 and 4.6 million heads (Ministry of Animal Resource and Fisheries, MARF, 2010).

The livestock contribution in the national economy is well recognized. In 2010 live animals exported were estimated at 326673 heads where sheep were amounted to 3,324922 heads, goats 2,25323 heads, cattle, 24395 heads and camels 154477 heads .At the same time the animals exported as slaughtered were 700,276 sheep, 30,997 goats, 8,395cattle 17,475camels (M A R F,2010).

Livestock role is crucial to food security and to the social and economic well being of about 80% (FEWS, 2006)

The Sudan is endowed by diversified rangelands covering about 40% of the total area of country and supply the national herd with almost 80% of its feed requirements.

Rangelands are areas, which by reason of low and erratic precipitation, rough topography, fragile soils and poor drainage, are unsuitable for cropping but are a source of forage for free ranging wild and domestic animals as well as a source of forest products such as wood and wild foods. They consist of natural grassland, bush and woodland. Rangelands provide environmental amenities such as scenery and open space and are increasingly being used for various recreational pursuits such as game viewing and trophy hunting (October 31-November 2nd, 2006).

Rangelands in the Sudan are estimated to be 97 million hectares (Africover, 2002). They cover about 40% of the total area of the country and this vast area encompasses different ecological zones extending from desert and semi-desert in

the north to low and high rainfall savannah to the south that sustain a livestock population estimated as 134 million heads (Ministry of Animal Wealth and Fisheries 2004). Sudan has great potential for producing enough animal protein to meet local needs with a surplus that can be exported and about 80% of the total requirements of the national herd is provided from production systems based on the natural rangelands as main feed source while the remainder is met through other sources such as crop residues, industrial by-products and irrigated fodder crops. Various natural and man-made factors have caused deterioration of Sudanese rangelands. At a time when improvement in veterinary services and vaccination of livestock increased animal population, rangelands were neglected and improvement, rehabilitation and conservation have never been a priority. Consequently deterioration of range resources was accelerated due to overstocking in declining rangeland area. Stocking rates were estimated to have increased four or five folds within the past few decades. Due to pattern of rangelands utilization where range resources are used communally, large tracts of rangelands are subjected to overgrazing and inappropriate time of use. Fire and cultivation have added to the large scale deterioration of rangelands consequently short-lived annuals of low environmental and nutritional values now cover several range sites that were previously dominated by perennials. Nevertheless much of the Sudan's rangelands have not yet reached the stage of irreversible improvement through natural process of secondary succession.( Ministry of Animal Wealth and Fisheries 2004)

## **2.2 Significance of Rangelands in North Kordofan**

The importance of the range resource in North Kordofan in the first place is that it occupies a considerable land area in its diversified ecological zones. The different vegetation zones in North Kordofan are the cause of ecological balance. In addition rangelands have several benefits:

- they provide about 80% of cheap natural feed requirement for the national herd.
- protect soil and watershed areas against erosion.

- Protect the sides and beds of the water courses and prevents rill and gully erosion.
- Aid in replenishment of aquifers as it enhances water in filtration.
- A source of biodiversity and plant genetic resources.
- Provide habitat and feed for wildlife (animal, birds and insects) .
- Add to the soil organic matter.
- A source of human food under certain situations (famine, drought etc).
- Absorb and sequesters carbon dioxide.
- Provide recreational sites.
- Provide fuel and building material. (Range Management and Conservation in Sudan)

### **2.3 Impacts of Agricultural Machinery Use on Rangelands**

The role of agriculture in the face of increasing world population cannot be underestimated. Therefore, increased land cultivation can ensure adequate provision of food and fiber for the world population and raw materials for emerging industries. This can only be achieved through the introduction of tractors and equipment which brings about excessive traffic on the agricultural land and thus compaction of agricultural soil is a common occurrence in the face of mechanized agriculture around the world (Ogunjirin *et al.*, 2008).

Ever since field operations became mechanized, traffic by tractors and other machines has caused soil compaction. Even though the draught animals previously used also have had compacted the soils, this was to a lesser extent. As long as only relatively light machines were used, the traffic mainly affected the top soil. In this layer, tillage and natural processes alleviate the compaction effects within some years (Hakansson, 2005). However, when machine size increases, compaction extends to greater depth. In deep subsoil layers, the effects cannot be alleviated by either normal tillage operations or natural processes. Therefore, they become very persistent, or even permanent, and they tend to accumulate over time. Compaction affects nearly all soil properties, physical, chemical and biological, usually in a negative way. Crop yields decrease, time, cost and fuel requirements for tillage

operations increase, soil aeration is hampered, denitrification increases and aerobic microbial processes are impaired. Therefore, knowledge about soil compaction in arable fields and its consequences are needed in many contexts and not only by farmers. To avoid permanent soil degradation, it is necessary to establish limits for the mechanical stresses (Keller *et al.*, 2002, Keller *et al.*, 2005 and Hakansson, 2005).

Plowing pastoral and sloping areas leads primarily to the elimination of pastoral plants and cause the erosion of soil ([https://agrosteppe /2010/06/07](https://agrosteppe.wordpress.com/2010/06/07) wordpress.com).

## **2.4 Conflicts over Rangelands**

Conflict is generally understood as the pursuit of incompatible goals by different people or groups .it is experienced at all levels of human activity from the inra-personal to international. Although many people and cultures regard conflict as a negative experience, it is an intrinsic and inevitable aspect of social life, and is often a catalyst for beneficial change. In other words the nature of all conflicts broadly be classified into town: the first type could be conflicts that involve violence and result in complete destruction and catastrophe, and second type is conflicts that lead too subsequent stage of development (Diro, 2016).

Conflict is a complex process in which structure; attitudes and behaviors are constantly changing and influencing one another. A conflict emerges as parties interest come into conflict or the relationship they are in becomes oppressive. The conflicting parties then begin to develop hostile attitudes and conflictual behavior. The conflict formation starts to grow and develop. As it does so, it may widen, draw in other parties, deepen, and spread, generating secondary conflicts within the main parties or among outsiders who get sucked in. This often considerably complicates the task of addressing the original, core conflict. Eventually, however, resolving the conflict must involve a set of dynamic, interdependent changes that involve de-escalation of conflict behavior, change in attitudes and transformation of relationship or structures (center for conflict Resolution 2000). Desta (2001)

argued that conflicts grow and change their characteristics over time. They are not static but dynamic and dialectical by nature. Having its human relations, a conflict finds its existence in the world of human being and perception. It gets changed by constant human interaction and in turn constantly changes its very people who gave its life as well as social environment in which it is born, evolves and grows.

## **2.5 Degradation of Vegetation and Biodiversity**

Studies of the National Research Council, (1989) indicated that all parts of Sudan, including desert areas, were covered with dense forests during rainy periods, and were subjected to large-scale destruction that led to the deterioration. Bayoumi,(1984) indicated that about 50630 km<sup>2</sup> of vegetation was lost during 13 years (1981-1968) where weeds and shrubs are shown through reports and statistics that this destruction has increased, similar observations were by pointed out Abdul Latif, (1993), which means that forests are decreasing by more than 4.95 million feddans per year. As The Ministry of Energy statistics showed that all forests are in the northern part of Sudan

Would be expected to decrease significantly by the end of the year 1990.As (Desong–B Statistics (Hayati: 1999) indicate that the proportion of natural pastures has decreased from 27.9% to 26.27 of the total area of the country from (1981-1986). Degradation is seen on rangelands through the dominance of many unpalatable plant species, and the disappearance of some plants such as *Blepharis edulis* Al-Saha (Natasha) *calotrips procera* (usher), *Acanthospermum hespidum* (Herab Hausa). Studies have shown that it is possible to expect extinction of group of wildlife species, there are certainly endangered species Significant change occurs in natural environments in many regions of the country (Council Environment and Natural Resources: 1996).

## **2.6 Impacts of Machinery Use on Rangelands and Livestock**

Sudan is largely an arid to semi- arid country located in central Africa. It is the largest country in the continent with an area of one million square mile. Half of the country is rangelands which is the main feed source for livestock production.

Previous records showed that natural rangelands in the country support about 80-90% of the total livestock population (128 million heads) (Zahran, 1982; Khair, 1999). According to Africover (2005), the pasture area in the Sudan was estimated by 96 million hectares. Of the varied forms of land use in Darfur State, pastoralist is mistakenly pointed out by some policymakers and decision-takers as the one that is responsible for most of the environmental degradation. They misconceive pastoral movement, with its characteristic extensive use of lands, as a wasteful socio-economic adaptation. Warren and Khogali, (1992) mentioned that pastoralists are also commonly accused of being responsible for the environmental degradation. Overgrazing is accordingly pointed out as the primary cause underlying the disruption of the ecological balance. By such interpretations, the nature and origins of environmental deterioration are poorly founded and tend to blame the victims. The point here is not to deny the localized incidence of overgrazing in many regions. It is rather to draw attention to the point that the observed processes of overgrazing are consequences of the drastic reduction in the grazing areas underlain by rapid farming expansion, in addition to growth in human and animal population. Other factors, such as water scarcity, conflict and bandit activity seem to have limited further the effective grazing area accessible to pastoral herds. Though pastoral nomads constitutes a form of production characterized by extensive utilization of resources, it cannot be justifiably characterized as wasteful or destructive, (Speirs and Olson, 1992). In context of environmental constraints, the herd cannot be sustained without movement, or use of resources.

Byers et al., (1997) pointed conflicts over land resources causing degradation and the importance of agronomic practices service in land resource management. Effects of soil structural modification on cropping systems were examined to improve crop production and land resource protection using innovative soil management practices. Gore (1991) stated the effective management through well-informed negotiation as well as international agencies and local contributions.

Cultivation and the associated fencing off of the land to protect destruction not only reduce livestock grazing resources but also restrict animal movements in search for water and forage especially during dry season; Over the past 50 years in East Africa, there has been expansion of agriculture at the expense of grazing land (Olson and Maitima, 2006). This leads to increased overgrazing of the remaining land, thus accelerating degradation of grasslands. Overgrazing also means that animals eat most of the available plant material, both fresh and dry in the struggle to survive. In this situation, the deposition of litter which is a major source of food for the majority of termite species in Kakooge is restricted. The litter feeding termites resort to fresh vegetation, competing with livestock and therefore increasing the pressure on grasslands resulting into unprecedented levels of land degradation and creation of immense patches of bare soil. Termite damage is unequivocal in both grasslands and croplands since they resort to feeding on fresh vegetation due to scarcity of dry materials and are thus regarded as a major threat to forage availability in Kakooge Sub County (Mugerwa et al., 2011 ). Because crop residues are not utilized in livestock feeding to lift the burden of overgrazing from grasslands during the dry season, the introduction and intensification of crop production in pastoral rangeland communities has no linkage with livestock production and therefore greatly contributed to the presently high levels of land degradation and decrease in livestock grazing areas

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Study Area

North Kordofan State (NK) lies in the dry zone of central Sudan between latitudes 12:93.6 to 37:3' N and longitudes 29:86 to 55:4 E (Elnour, 2014 and Amara and Saad, 2014). It is bordered by six states; Northern state from the north, Khartoum state and White Nile from the east, South Kordofan in the south, west Kordofan from the west and North Kordofan state covers an area of 244, 700 km<sup>2</sup>, equivalent to 139 square miles and 58.8 million acres of land this is to be up dated. The state is divided into four groups: land Algayzan, Garduod sediment, valleys, and mud-cracked. It is largely an undulating plain, with the Nuba Mountains in the southeast quarter. The rainy season extend from June to September. The population of this state is estimated to be 2,920,992 persons according to 2008 census. They are distributed among the various states and localities and characterized by heterogeneity according to geographical diversity, environmental, lifestyle, rural, urban residents and returnees (Maryoud, 2010; ASSP, 2010 and ASRECA, 2010).

The average monthly temperature was 34.6°C. The mean temperatures in coldest months are December 14.1°C and January 13.5°C. However; the hottest months ( are April, May and June) with an average mean temperature exceeding 30°C (El Hag, 2012). The annual rainfall average varying from 120 cm (47 in) in the south to less than 10 cm (4 in) in the north (Helen,1991 and Amara and Saad,2014). The dominant grasses and herbs in the studied area are Huskneet (*Cenchrusbiflorus*) Shileny *Zornia glochidiata*, Bano (*Eragrostis tremula*) Difra (*Echinocloa colonum*) and Aborakhis (*Andropogon gayanus*). However the dominant trees include Humied (*Sclerocarya birrea*) Higlig(*Balanites aegyptiaca*) Arad (*Albizzia amara*) and Sider (*Zizuphus spinachristi*). The dominant shrubs included Kursan (*Bosciasenegalensis*)Usher (*Calotropis procera*) and Mereikh (*Leptadenia pyrotechnica*) according to MARF (2009) and El Hag *et al.*, (2012).

## **3.2 Data Collection**

### **3.2.1 Survey and primary data collection**

For this purpose a questionnaire was designed for a picked sample of farmers and herders in the localities selected from the study area i.e. Umruwaba and Sheikan. The secondary data was obtained from previous studies, reports and related maps.

### **3.2.2 Equipment and facilities:**

Guided questionnaire

Direct observations

Transportation and office stationary materials

Computer and SPSS programme

### **3.2.3 The sample size**

A sample of farmers and animal breeders in North Kordofan State will randomly select from two locations within the study area (Sheikan and Um rawaba locality). Then 60 of the respondents (farmers and animal breeders) will select from each location (total 120).

## **3.3 Statistical analysis**

Statistical package for social sciences (SPSS) programme was used in data analysis comparing means with chi-square. Descriptive statistics was applied for several variables.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Personal Characteristics of the Respondents

The personal characteristics of the respondents have shown that they were predominantly male where gender ratio of the study sample was 98.3% males and only 1.7% females as presented in table 4.1. Sample of predominantly male in this study could be attributed to the fact that men usually take the responsibility of all activities though women are active participants in farming and feeding. Findings of this study are similar to those reported by Jadalla, (2007) who found upon interviewing respondents from rural areas, men usually represented the majority. Shoka *et al*, (2014) also showed similar trends.

Table (4.1) Distribution of study sample by gender variable

Gander	Frequency	Percentage
Male	118	98.3
Female	2	1.7
Total	120	100

The distribution of this study sample over the localities covered has shown that they were equally taken from Sheikan Locality (50%) and Um rauaba locality (50%) of the sample size and they are presented in table (4.2). This is to ensure equality though the two localities differed in their population and number of farmers and herders.

Table (4.2) Distribution of the study sample by locality

Locality	Frequency	Percentage
Sheikan	60	50.0
Um rauaba	60	50.0
Total	120	100

The percentages of respondents according to their affiliation to administrative units are presented in table (4.3). Those who belonged to Shirkailla had the highest percentage of respondents (21.7%) followed by middle Um rauab 15% of the

respondents and those from Aboharaz represented 13.3, while respondents from Wad Ashana were 13.3 % and they were equal to respondents taken from Tagat 9.2, Elobied rural 9.2 and Elobied west 9.2 also equally percentage of respondents Um semaima 5% and few respondents of Elberka percentage of respondents 4.1%.the sample sizes and distribution of respondents was determined according to intensity of farming and herding in the administrative units.

Table (4.3).Distribution of study sample by the administrative units

Sub unit	Frequency	Percentage
Tagat	11	9.2
Elobied rural	11	9.2
Um semaima	5	4.1
Elberka	6	5.0
Abo haraz	16	13.3
Elobied west	11	9.2
Shirkailla	26	21.7
middle Umrauab	18	15.0
Wad Ashana	16	13.3
Total	120	100

The educational standards or levels of respondents of the study is presented in table (4.4). Most of the respondents were either illiterate ( 40.8%), attended only basic schooling (30% ) Khalwa only percentage of respondents ( 14.2%). Secondary school leavers represented (10%). University and above only percentage of respondents ( 5%).

Table (4.4). The educational level of respondents of the study

<b>Educational Level</b>	<b>Frequency</b>	<b>%</b>
Illiterates	49	40.8
Khalwa	17	14.2
Basic	36	30.0
Secondary	12	10
University and Above	6	5.0
Total	119	100

Low levels of schooling of many farmers and herders are consistent with their mode of life where education is not apriority. The results of this study is similar to those reported by Shoka *et al.*,(2014) who found that nomads were sometimes

against sending their children to schools. They preferred having them as herders. Farmers similarly refused sending kids to schools (Sundus unpublished data)

The distribution of the study sample by age limit is represented in table (4.5). The participants were as young as being less than 15 years of age and they were about 8% and those who were found to be in age limits of 16 -30 reported being 17.5%. the highest percentage of age group were those at 31 -45 years and they were 40.8 % of the sample size. The higher percentage of respondents could of this age category be attributed to the fact that farmers and herders are usually active in their occupation during this age limit. Jadalla,(2007) surveyed and interviewed sheep producers in west Kordofan and found that those who were at age limits of 30 and above and not exceeding 50 were of greater proportion in sample with percentage 40.8%. Those who were in age limits of 46 -50 represented 15.8%. Those who were within age category between 51 -60 percentage 18.3% while those who were in age limits of 70 and above reported 6.6%.

Table (4.5). Distribution of the study sample by age variable

Age	Frequency	%
15less	1	8.
30__16	21	17.5
45__31	49	40.8
50__46	19	15.8
60__51	22	18.3
and above70	8	6.6
Total	120	100

Marital status of the respondents of the present study is shown in table ( 4.6) .it was reported that 90.8% of them were married , 7.5% were single ,1.7%were Widowed. The rural residents usually marry at early age period and even widowed can go to marriage again. Studiers on this field have shown that herders and farmers were usually married not only due to the conservative life of the rural area but because the two occupations need family members; (wives and children.

Table (4.6).Marital status of the respondents

Social status	Frequency	%
Single	9	7.5
Married	109	90.8
Widowed	2	1.7
Total	120	100

#### 4.2 Livestock Raising in Sheikan and Umruaba

The species of animals raised by the respondents of this study is presented in table ( 4.7). It was reported that 32.8%of respondents raised sheep only while goats were kept by 10.1 % of the respondents 4.2% kept cattle , 2.52% reported having camels, about 22.69% of the respondents reported raising Sheep, Goat together , while 10.9% were raising sheep, goat and camels compared with 16.8% who kept sheep, goat and cattle. The small ruminants; sheep and goats were kept exclusively by all groups as they are most adapted and cheap to obtain. Their economic benefits are more than of the large ruminants. Climate change mitigation recommendations also are in favor of keeping small ruminants than large animals that cause severe problems due to their gas emission.

Table (4.7 ).species of animals raising by respondents

Animal species	Frequency	%
Sheep	39	32.77
Goat	12	10.08
Cattle	5	4.20
Camel	3	2.52
Sheep, Goat	27	22.69
Sheep, Goat, Camel	13	10.92
Sep, Goat ,Cattle	20	16.81
Total	119	100.00

#### 4.3 Rangelands Utilization in Sheikan and Umruaba

The grazing and range utilization patterns reported being adopted by the respondents is presented in table (4.8). The most dominant pattern of rangelands utilization is communal grazing as reported by 39.5% while those who communally used the rangelands and then provided supplements were 43.7% of the study sample. Small proportion reported feeding their animals that were

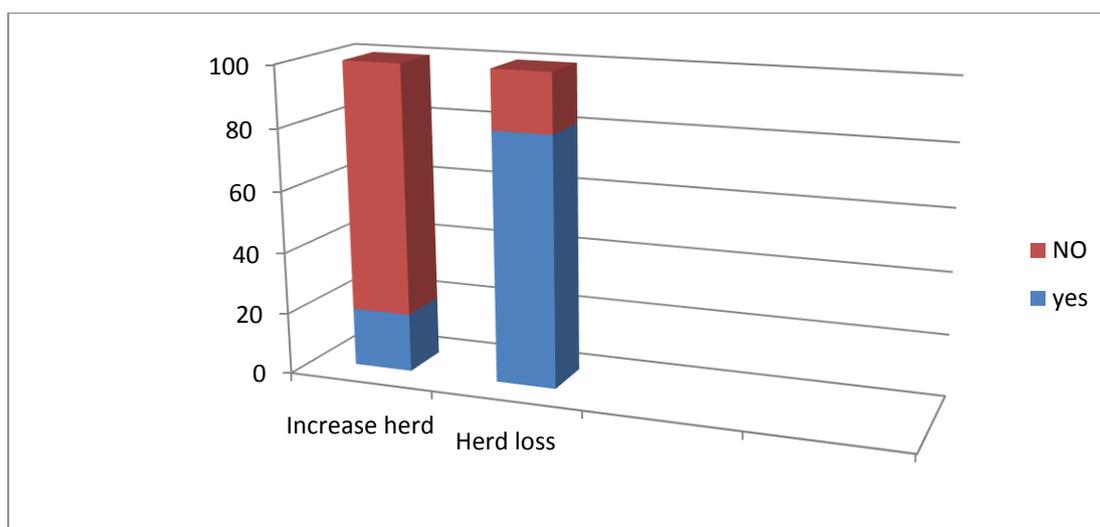
Tethered or left then to scavenge and they represented 12.6% and 4.2% respectively. All the studies on range utilization in Sudan were in agreement with the findings of this study on domination of communal grazing (Ali and Suleiman ,1988; Abu Sowar, 2007 ; /Karamalla,1999 and Khatir, 2012).

Table ( 4.8 ). Grazing patterns adopted by the respondents in Sheikan and UmRuaba

Feed patterns	Frequency	%
Communal grazing	47	39.5
Tethered	15	12.6
Grazing and supplementation	52	43.7
Scavenge	5	4.2
Total	119	100.0

#### **4.4 Impacts of Agricultural Machinery Use on Livestock in Sheikan and Um Ruaba Localities**

The respondents' perception on impacts of the use of agricultural machinery on livestock is presented in the table (4.9). Among the respondents, 77.5 % have admitted that use of machinery had negative effects on livestock. The effects of this is represented in loss of animals, herders are forced to leave this occupation while others believed that use of machinery could increase size of the herds. The negative impact is explained by having rangelands reduced and conflicts over the resources leading to abandoning herding to farming. Those who observed positive impact thought that crop production could secure residues for feeding herds.



Sign \*\*\*

Figure (1 ) forms of impact of A M on livestock

Table (4.9). Impacts of Agricultural Machinery use s on livestock in Sheikan and UmRuaba localities

Effect of plows	Frequency	%
Yes	93	77.5%
No	27	22.5%
Total	120	<b>Chi = 36.3 ch-crit = 7.88</b>
If yes, explain what the effect is		
Increase herd	19	19%
Herd loss	81	81%
Total	100	<b>Chi = 38.44, crit 7.88</b>

#### 4.5 Problems Facing Animal Raising in Sheikan and Umruaba

The problems facing animals raising in the study area as perceived by respondents is presented in table (4.10). Majority of respondents (58.6), reported that the natural grazing deficit to production. Veterinary services are another production as reported by 24% as production constraint while 7.7% of the respondents consider husbandry as main problem to livestock production. Veterinary services and natural grazing deficit were believed being constraint to 4.8% of respondents as illustrated in figure ( 2 ) .

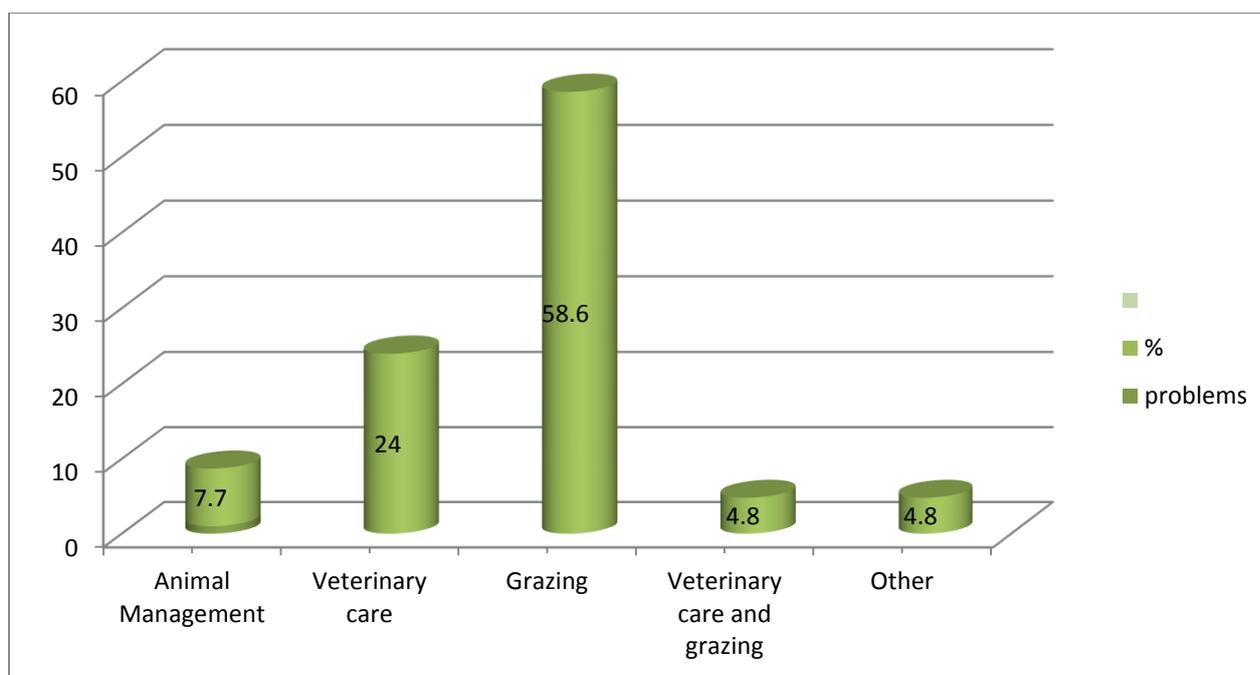


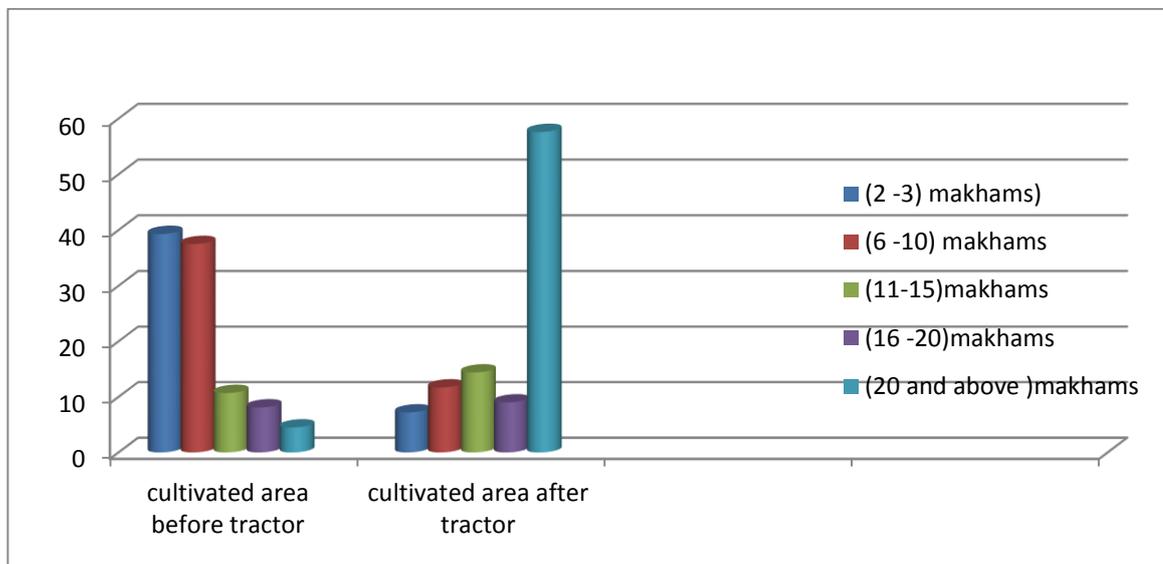
Figure ( ) forms of problems of animal

Table (4.10 ) problems facing animals raising in Sheikan and Umruaba localities

Problems of animal raising	Frequency	%
Yes	94	78.3
No	26	21.7
Total	120	<b>Chi =38.5 , crit =7.88</b>
If the answer is yes the problems are		
Animal Management	8	7.7
Veterinary care	25	24
Grazing	61	58.6
Other	5	4.8
Veterinary care and grazing	5	4.8
Total	104	<b>Chi = 110.42, crit= 9.48</b>

#### 4.6 Impact of Machinery Use on Farming and Range Area Sheikan and Umruaba Localities

The area under cultivation before and after use of agricultural machinery is presented in table (4.11) and illustrated in figure (3). About (39.3%) of the respondents indicated that they cultivated 2-3 makhamas before using agricultural machinery. Only 4.5 % of the respondent could cultivate 20 Mokhamas and above. This has changed where 57.6 have the ability to 20 mukhamas and above. The results also showed that, the respondents in general were capable to cultivate (2-3) before introduction of the agricultural machinery while that have changed were they have become capable to cultivate 20 and above . Only 2.5% were confined to small areas as indicated after using the tractor that enabled them to increase the cultivated area. The respondents who were able to cultivated only (2-3). mukhamas increased their area cultivated on the expense of rangelands while population were cultivated 20 makhamas and above reaching to 57.6% of the study sample.



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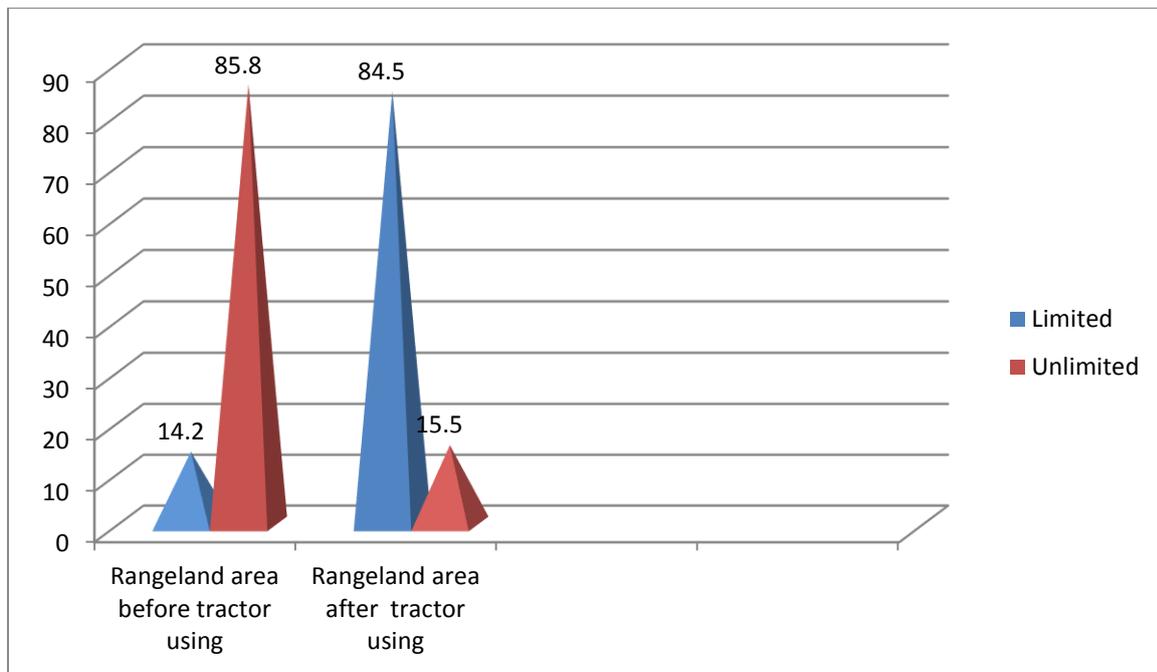
Figure (4.3 ) Sizes of cultivated areas by makhamas

Table (4.11).The area cultivated before and after the using of the tractor in Sheikan and UmRuaba localities

Variables	Frequency	%
Area cultivated before using tractor		
3 -5 makh	44	39.3
6-10	42	37.5
11 – 15	12	10.7
16 – 20	9	8.08
20 and above	5	4.5
Total	112	
Area cultivated after using of the tractor		
3 -5	8	7.2
6 -10	13	11.7
11 – 15	16	14.4
16 – 20	10	9
20 and above	64	57.6
Total	111	<b>Chi = 0.0044, crit = 7.88</b>

#### 4.6.1 Rangelands area before and after using tractors

The expansion of framing area over rangelands after introduction of the agricultural machinery is indicated in table (4.11). The respondents also expressed their views in this regard and their perception is presented in table (4.12). The results indicated that most areas that were cultivated were considered rangelands as reported by (85.8%) . After use of tractors, the range area reduced as reported by (84.5%) of the respondents. This is also illustrated in figure ( 4). The respondents who mentioned that rangelands area was not affected were few, they represented only 15.5%.



Very high significant differences

Table (4. 12). Rangelands area before and after agricultural machinery use in Sheikan and UmRuaba localities

Variables	Frequency	%
Rangeland area before tractor using		
Limited	17	14.2
Unlimited	103	85.8
Total	120	<b>Chi = 61.63, crit = 7.88</b>
Rangeland area after tractor using		
Limited	98	84.5
Unlimited	18	15.5
Total	116	<b>Chi = 55.17, crit = 7.88</b>

#### **4.6.2 Impacts of Agricultural Machinery Use of Range Plant Composition in Sheikan and UmRuaba**

The results of the relative dominance of species for the two periods are represented in Table (4.13) The area that was dominated by *Cenchrus biflorus* *Echinochloa colonum* , *Eragrostis tremula*, scored the highest frequency 28.9%. and *Echinochloa colona* , *Cenchrus biflorus*, *sesamum alutum* percentage 16.7%. showed the highest frequency (16.7%) , *Dactyloctenium aegyptium*, *Blepharis edulis chinochloacolona* (12.3%). *Echinochloa colona*, *Zornica glochiata*, *Cenchrus biflorus* ( 14%). The overgrazing for a long time and, overstocking might change the dominant species in the area with other species such as *Cenchrus biflorus* .am barrow 32.2%) considered less preferred by animals. The study area was dominated by different species in the two periods. This may be due to the differences in the amount of rainfall and grazing intensity as well as, competitions and utilization. Stoddart *et al.*, (1975) stated that physical factors determine the kind of vegetation available, the manner and degree of possible use. Physical factors include climate, soil and topography also affected by type of vegetation.

#### **4.6.3 Impact Of Agricultural Machinery Use on Rangelands in Sheikan and Umruaba**

The results in table (4.14) showed that, there were very high significant differences among respondents' perception on rangelands deterioration. Over 82.3% mentioned that, rangelands were deteriorated by use of modern plows. This may be due to degradation of rangeland, and high demand of rangeland resources, and these led to conflicts among stakeholders, hence, the most of local people abandoned animal raising this may be due to, inefficiency production, and poor production system and rangeland degradation .

Table (4. 14). Impact of agricultural machinery use on rangelands

Variables	Frequency	%
The effect of modern plows on pasture		
Yes	93	82.3%
No	20	17.7%
Total	113	<b>Chi = 47.16, crit = 7.88</b>
Explain how the impact of the use of plows on pastures		
Increased grazing	8	7.4%
Degradation of rangelands	100	92.6%
Total	108	Chi = 78.37, crit = 7.88

#### 4.7.The Types of Agricultural Machinery Use in Sheikan and Umruaba

A result of the types of agricultural machinery used is given in table (4.15). It was highest when compared respondents using Chisel plow percentage 65% , Duck leg plow and disc23% . Duck leg plow and chisel 12%.

Table (4.15) Type of plows in Sheikan and UmRuaba localities

Type of plow	Frequency	%
Duck leg plow and disc	23	23%
Chisel plow	65	65%
Duck leg plow and chisel	12	12%
Total	100	100

#### 4.8The Impact of Agricultural Machinery Use and Soil Type on Rangelands

The results in table (4.16) showed that, there were very high significant differences among respondents ion their perception of the impacts of machinery use on

rangelands. Only 10.8% mentioned that using agricultural plows in gardud rangelands resulted in degradation of the grazing land while 33.3% said that use of machinery caused improvement of rangeland as an effect of machinery use despite of the high demand of land and most respondents mentioned increased feed material (55.9%). while, using implements on sandy rangelands could increase productivity upon using agricultural plows. Despite of that there were overwhelming majority of respondents (94.7%) who mentioned deterioration of rangeland. This may be due to degradation of rangeland and exposure of soil to erosion. A small group of respondents ( 5.3%) said this could increase pasture.

Table (4.16).The Impact of agricultural machinery use on type of soils in Sheikan and UmRuaba localities

<b>Variables</b>	<b>Frequency</b>	<b>%</b>
The effect of using plows on gardud rangelands		
Increased pasture	34	33.3%
Degradation of pasture	11	10.8%
Increase feed material	57	55.9%
Total	102	<b>Chi = 31.12, crit = 5.99</b>
Effect of the use of agricultural plows on sandy rangelands		
Increased pasture	6	5.3%
Degradation of pastures	107	94.7%
Total	113	<b>Chi = 90.27, crit = 7.88</b>

#### **4.9 Impact of Agricultural Machinery Use on Vegetation in Sheikan and UmRuaba**

The effect of machinery use on natural vegetation is presented in table (4.17) and it showed that there were very high significant differences among respondents. About 87.5% mentioned that using agricultural plows affected density of the natural vegetation and 22.4% of the respondents said that the density of vegetation as affected by Expansion of agriculture over rangelands areas. Similarly Nefzaoui, (2002) concluded that several factors are responsible of range plants degradation, but the most significant ones are the increasing number of livestock population in open grazing system and the cropping in marginal lands. For the types of degradation most of the respondents (77.6%) said that, the causes of the

degradation due to soil erosion. According to Scholl and Kinucan (1996) who reported that, heavy grazing can also cause soil erosion, loss of soil structure, and deterioration of soil environment.

Table (4.17). The effect of machinery use on natural vegetation(trees ,shrubs) in Sheikan and UmRuaba localities

Variables	Frequency	%
Yes	98	87.5%
No	14	12.5%
Total	112	<b>Chi = 63.0 , crit = 7.88</b>
Expansion of agriculture	22	22.4%
Destruction and removal of vegetation	76	77.6%
Total	98	<b>Chi = 29.76, crit = 7.88</b>

#### 4.10 Using Agricultural Machinery in Construction of Fire Lines

Result in table (4.18) shown that 48.3% of the respondents reported importance of al agricultural machinery in fire lines construction that could protect rangeland and forests though this not followed usually. On the other hand, the highest proportion of respondents (51.7%) said that they did not use the tractors in the construction of networks for fire lines to protect rangelands and forests from the risk of bush fire that may be lead to deterioration of rangeland.

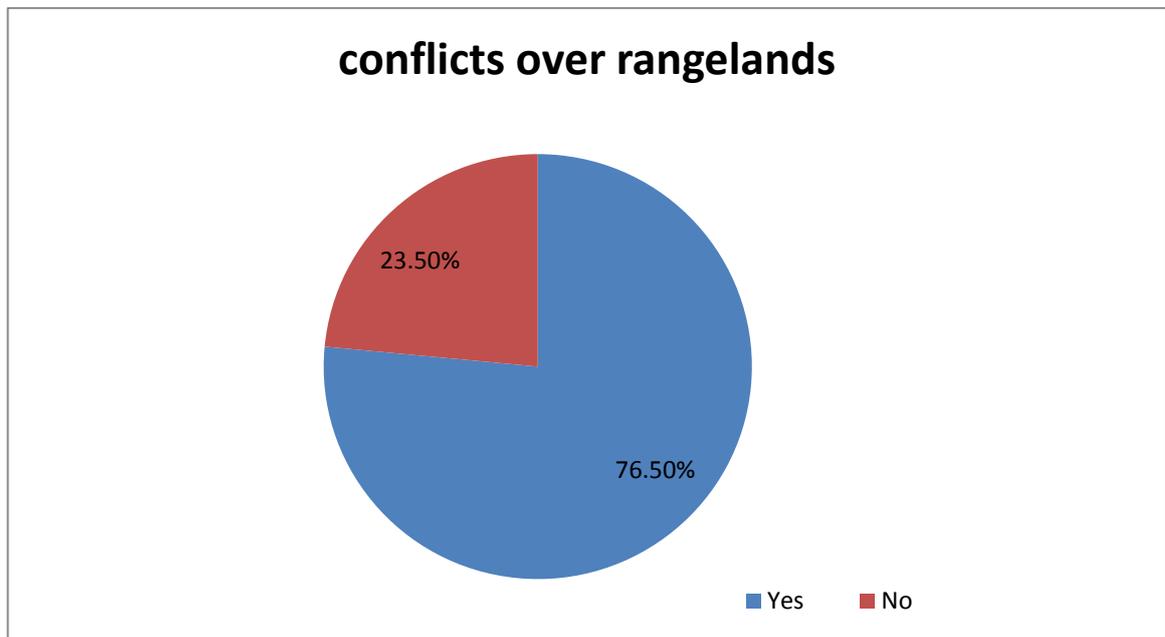
Table (4.18). Using agricultural machinery in the open network of fire lines in Sheikan and UmRuaba localities

Variables	Frequency	%
Yes	56	48.3
No	60	51.7
Total	116	<b>Chi = 0.138, crit = 7.88</b>

Sign =.138 (No significant difference)

#### 4.11 Conflicts over Rangelands

Results in table (4.19) indicated that, the majority of respondents (95.9%) mentioned that, there were conflicts between farmers and herders, especially in rainy season. This may be due to extensive agricultural practices in the area. while (2.1%) said the between settlers and nomads. Moreover, few respondents (1%) said that they have conflicts for rangeland resources, while (1%) said that there were conflicts just between herders themselves. Abdullah, (1982) reported that the access to grazing land, access to water points and rangelands are a serious source of conflict between different communities, in addition to breakdown of traditional system, in which regular inter-tribal conferences were held prior to the movement of nomadic communities from the north to the south, contributes in many conflicts.



Sign \*\*\*

Figure (5 ) forms of conflict over rangelands

Table (4.19).Conflicts over rangelands in Sheikan and UmRuaba localities

Variables	Frequency	%
conflicts over rangelands		
Yes	88	76.5%
No	27	23.5%
Total	115	<b>Chi = 32.36, crit = 7.88</b>
If the answer is yes the conflicts parts		
Between owner s & farms	93	95.9 %
Between owners and government	1	1 %
just Between owners	1	1 %
Between owner and citizen	2	2.1 %
Total	97	100%

#### 4.11.1 Reasons of conflicts over rangelands in Sheikan and UmRuaba

As presented in table (4.20) the majority of respondents (95%) mentioned that, there is degradation of rangeland resources in forage production in particular. This degradation may be due to the high pressure by grazing animals. On the other hand 35% said that, expansion of rain-fed agriculture and high competition between stakeholders and all those reasons may lead to conflicts. Similar results were reported by Manske (2004) who stated that repeated heavy grazing removes a great amount of the leaf area and causes long- term reductions in the total rangeland production. grazing can also cause soil erosion, loss of soil structure, and deterioration of soil environment.

Table (4.20). Reasons of conflicts over rangelands in Sheikan and UmRuaba

Variables	Frequency	%
Limit of rangeland	60	60%
Expansion of agricultural	35	35%
Increasing number of animals	4	4 %
Other	1	1%
Total	100	100

#### 4.11.2 The consequences of conflicts

The consequences of conflicts as reported by the respondents are presented in table (4.21). Among respondents (20.7%) observed that conflicts could lead to exposure of animal to mortality while 51.1% expected that conflicts could lead to loss of human lives, 23.9% propriety loss and 4.3% believed that they property might be looted especially animals and crops.

Table (4.21) the consequences of conflicts in Sheikan and UmRuaba localities

Variables	Frequency	%
Mortality of animal	19	20.7%
Loss in human	47	51.1%
Propriety loss	22	23.9%
Looted in assets	4	4.3%
Total	92	100

#### 4.11.3 Methods followed in Management of Conflicts in Sheikan and UmRuaba

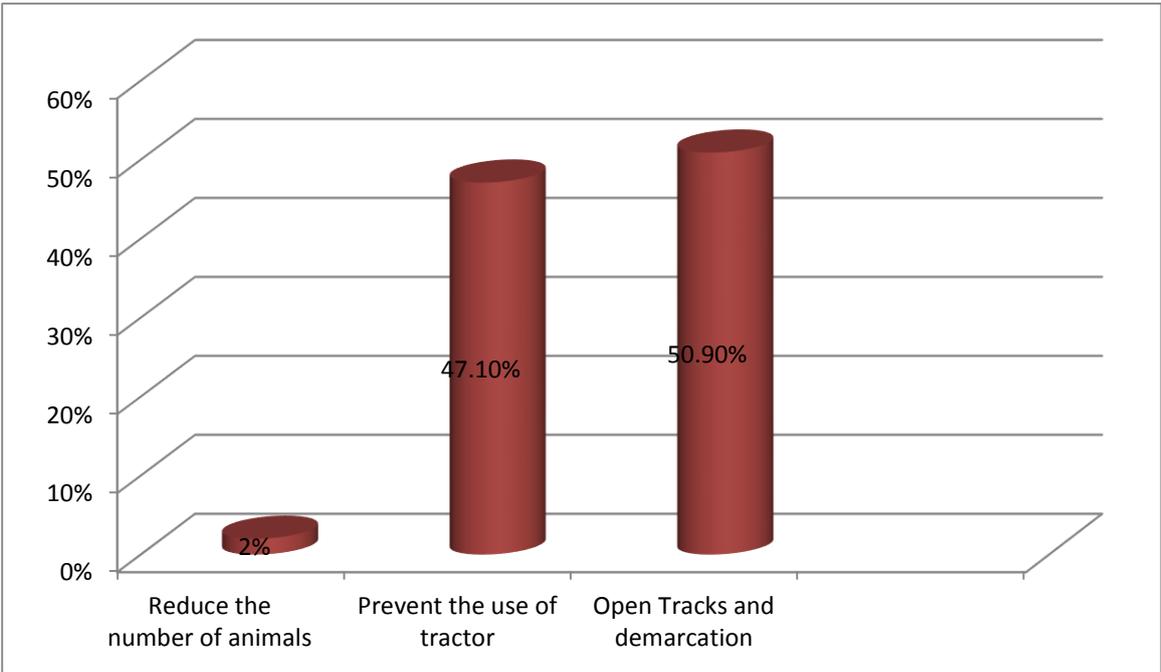
Methods follow in management of conflicts are shown in table (4.22). There are numerous methods to solve conflicts within local communities, most respondents (60.4%) said that, they prefer they used village leaders ( Omads and Sheakhs) to solve conflicts in many cases and (12.9%) said they used Goudiya , and (13.8% ) said they Government mediation while (12.9%) said they used popular courts .

Table (4.22).Methods follow up to management of conflict in Sheikan and UmRuaba localities

Variables	Frequency	%
village leaders ( Omads and Sheikhs)	61	60.4%
Government mediation	14	13.8%
Goudiya	13	12.9%
Popular courts "	13	12.9%
Total	101	100%

**4.11.3. Methods followed in reduction of Conflict**

The preventative measures to reduce conflicts are shown in table (4.23). Majority of the respondents (50.9% ) said that opening tracks and demarcation could reduce conflicts while 2% said better to reduce the number of animals while (47.1 % ) of respondent said prohibition of the use of tractors.



Sign \*\*\* (high significance differences)

Figure ( 6) forms of methods to reduce conflict over rangelands

Table (4.23).the solution in your opinion to reduce the intensity of conflicts over rangelands in Sheikan and UmRuaba localities

Variables	Frequency	%
Open Tracks and demarcation	52	50.9%
Reduce the number of animals	2	2.0%
Prevent the use of tractor	48	47.1%
Total	102	100%

Between routs and preventing tractor utilization (Chi = 0.16, crit = 7.88

Between tractor utilization and animals number minimization (Chi = 42.32, crit = 7.88)

#### 4.12 Conclusion

The study concluded that the use of agricultural machinery in the study area has resulted in expansion of the cultivated area converting rangeland into cropland at the expense of traditionally used rangelands. The average individual farming area increased from 2-3 mukhamas with hand tools to 20 mukhamas and above with tractor drawn implements. Consequently this resulted in limited grazing area, overstocking and overgrazing leading to degradation of rangelands. Conflicts between farmers and herders have become common and is most serious problem facing rangeland stakeholders in Sheikan Um rauaba localities. The increased competition between local communities and pastoralists coming from outside over rangeland resources also triggered conflicts. Physically use of agricultural implements affected negatively the productivity of rangelands and decreased dominance of palatable species. Only on gardud lands it was reported that agricultural machinery used reported to have positive effects.

#### 4.13 Recommendations

It is recommended that principally tractor drawn agricultural machinery be restricted and farmers be encouraged to use animal drawn implements since them can increase land under cultivation to a reasonable size.

Areas be assigned for grazing only that should not be allowed for crop production.

Traditional livestock routes be demarcated and permanently be open for the movement of stocks owned by the nomadic groups.

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## Appendix

### Botanical names of some plant species

<i>Aristida adscensionis</i>	قو
<i>Acacia mellifera</i>	كتر
<i>Cadaba rotundifolia</i>	كرمت
<i>Ipomea cardiosepla</i>	حنتوت
<i>Blepharis linearifolia</i>	بغيل
<i>Convolvulus spp</i>	تبر
<i>Echinocloacolonum</i>	دفرة
<i>Calotropis procera</i>	عشر
<i>Boscia senegalensis</i>	كرسان
<i>Albizzia amara</i>	عرد
<i>Zizuphuss pinachristi</i>	سدر
<i>Balanites aegyptiaca</i>	هجليج
<i>Dactyloctenium aegyptium</i>	أبو أصابع
<i>Acacia nubica</i>	لعوت
<i>Combretum cordofanum</i>	هبيل
<i>Acacia radiana</i>	سيال
<i>Quirra senegalensis</i>	غبيش
<i>Cenchrus biflorus</i>	حسكنيت
<i>Faidherbia albida</i>	حراز
<i>Zornica glochidiata</i>	شيليني
<i>Sesamum alatum</i>	سمسم الجمال