Chapter One

Introduction

1.1 General

In Sudan more than 80% of the population lives in rural areas and is engaged in one way or another in agricultural production (Hamdoun, 1977). Agriculture is of great importance in the national economy in providing food, feed, foreign exchange, fuel and employment. Livestock constitutes a substantial part of agricultural production amounting to 25% of GDP and 50% of agricultural sector export earnings (MAR, 2016).

Global livestock populations were estimated to be1.43 billion cattle, 1.87 billion (sheep and goats), 0.98 billion pigs, and 19.60 billion chickens (Robinson *et al,* 2014). Sudan has animal resources which reach approximately 106.6 million head. Out of this number goats represent 31.2 million head. Central Darfur State hosts about 2.0 million head (MAR, 2016). This large livestock herd of Sudan depends on natural rangelands and forests for most of their feed requirements which are estimated at 133 million tons of dry matter/year (Fadlalla*et al,* 2018). With the ever rising demand for food to feed a rapidly growing population crop yields and animal production must be increased through adoption of good husbandry techniques, including weed control (Braun,1991); however in many cases natural rangelands fall short of meeting animal requirements. Several factors affect rangelands productivity and production such as impact of weeds competition, no rehabilitation for rangeland with desirable species, climate change and human activities etc. Weeds compete with crops when they remove a portion of a resource from a shared resource pool, leaving the crop with less of the resource than is needed for optimum growth (Donald, 1963). Competition may occur for water, creating or

exacerbating water stress. It may occur for nutrients such as nitrogen, leading to chlorosis, leaf senescence and reduced yields (Tollenaar, 1994; Rajcan, 2001). Competition may also occur for light, which may alter plant growth by reducing the quantity or quality of light received (Rajcan, 2004; Markham, 2009).On the other hand seed rates for most range plant species are not known and there are scarce studies in this subject. Knowing the optimum seed rates of range plants helps in increasing the efficiency and reducing the cost of rangeland conservation and reclamation.

1.2 Research problem and justification

Palatable plant species usually decrease or even disappear due to selective grazing which happened for the species of *Dactyloctineum aegyptium, Echinoclowa clona, ipomoea sinensis* and other species. Maintenance of these species in the range requires good management. Knowledge of the ability of plants to withstand competition and lessening of competing plants by removal or by reseeding of desired species may assist in this respect. Application of re-seeding using suitable seed rates may enhance the competitiveness of decreased plants. At the present time seed rates for most range plants are not known and there is scarcity of studies in this area. Also the weeds still make trouble on forage crops production in the developing countries as general and especially in Sudan and affect adversely on gross forages production.

1.3 Hypotheses

1. Weeds control via cultural methods (hand mowing) increase forage production.

2. Suitable seed rates forreseedingmay increase yield and reduce costs of range rehabilitation.

1.4 Research Objectives

1.4.1 Main Objective/Goal

To investigate the effects of weeds reduction and seed rates on forage production of *Dactyloctenium aegyptium*, *Haemanthusmultiflorus*, *Ipomoea sinensis* and *Crotalaria saltiana*. Preference of these plant speciesby goats in Western Jebel Marra Locality, Central Darfur State- Sudan will be assessed.

1.4.2 Specific objectives were to:

- Control weeds by hand removal or by mowing.
- Determine optimum seed rates for *Dactyloctinium aegyptium*, *Haemanthus multiflorus*, *Ipomoea sinensis* and *Crotalaria saltiana*plants for use when re-seeding the range with these plants.
- Determine the plants most preferred by goats.
- Assess pastoralists' perceptions towards rangelands improvement.

Chapter Two

Literature Review

2.1 Rangeland concepts

Rangeland resources include both tangible products such as grazable forage, wildlife, water, recreational opportunities, minerals, energy supplies, and areas for the ecological study of natural systems (Busby, 1987).Rangeland, though produces a variety of these important natural resources, perhaps the most important of these is the vegetation which is used as forage and cover for livestock and wildlife species. Also rangelands provide open space water, wood fuel and numerous other products (Tuller, 1991).The use of rangeland is generally coupled with the use of other types of grazing land and most range livestock and many big game animals use multiple sources of grazing capacity to meet their requirements (Vallentine,1990).

2.2 Range Management concepts

Range Management is a distinct discipline founded on ecological principles. It deals with the use of rangelands and range resources for a variety of purposes such as use as watershed, wildlife habitat, grazing by livestock, recreation and aesthetics, as well as other associated uses (www.science/rangeland, 2014).

2.3 Weeds competition

Every time forage crops are established, weeds will be present to compete with them for light, temperature, space, water, soil nutrients etc.., unless control measures are applied. Forage crop stands that have declined will also be invaded by weeds as they thin out. Weeds are herbaceous plants growing in places where they are not wanted and interfering with the growth of the desired crop. They sometimes reduce crop harvesting quality if allowed to remain (Ashton, 1991).

Moreover, weeds invade sites where competing vegetation has been destroyed. Weeds represent an economically important challenge for crop production. In the United States, average crop yields are depressed by 12% due to weeds (USBC, 1996).

2.4 Weed control

Weed control is one of the most important practices in crop production (Ishag *et al*, 1979). It occupies a high proportion of the farmer's time and consumes a large proportion of his income (Koch, 1982). Until recently, weeds have been controlled by ploughing and disking prior to crop sowing and repeated hand weeding operations carried out by casual labour, the farmer and his family (Walter *et al*, 1984). In 1960ies labour for hand weeding was abundant, wages were low and the cost of weeding constituted only a small proportion of the cost of production. In recent years the available labour was unable to cope with the intensive weed growth during the early stages of neither crop growth nor carrying out the optimum number of weeding and serious crop losses are usually encountered. The scarcity of labour due to expansion of cropped areas, the intensification and diversification of cropping, the continued movement of the younger generation to urban areas and abroad, the attendance of farmers sons and daughters to schools and the reluctance of farm labour to do the tedious hand weeding operation have all led to a considerable rise in the cost of hand weeding and to a steady increase in annual and perennial weed infestations. Such a situation encouraged the registration and use of herbicides in cotton, groundnut, sorghum, sugar cane, vegetables and tree crops. However, farmers and scheme management are not dependent on herbicides only; an integrated weed control program is adopted in all crops and situations whereby cultural, chemical and manual methods are practiced (Koch, 1982). Recently, also physical methods, e.g. Solarisation are under investigation for weed control especially of *Orobanche spp* and other soil borne pests in vegetables (Koch, 1982).

2.5 Cultural methods for weeds control

Some control of erect annual dicotyledonous weeds may be achieved by mowing when their apical parts are above the cutting height. Most prostrate or rosette species, e.g. *Capsella bursa-pastoris* (shepherd,s- purse), *Galiumaparine* (Cleaves), *Stelaria media* (Common chick weed) and *Acanthospermumhespidum* (Horabhawsa), may actually be encouraged by mowing (Stephens, 1982). Grazing, preferably by sheep, encourages rapid tillers of sown grasses, and helps to control some weed species, e.g. *stellaria medica* (common chick weed) (Samways, 1981). Sowing and weeding significantly affected number of leaves per plant of *Blelifarislinarifolia* after from 30 days sowing. Neither sowing method nor did weeding have significant effect on plant height (Abla and Adar, 2015).

2.6 Seed rates

Snider *et al*.(2012) reported that, in Fairhope site in USAD; the plant height increased with increasing seeding rate. The same authors stated that higher plant densities can sometimes stimulate increases in plant height due to inter-node elongation. New ryegrass seed is often drilled at 18-30 kg/ha, although previous research indicated that pastures drilled at 10-12 kg/ha can be just as productive (Frame and Boyd 1986; Praat*et al.* 1996). High seeding rates increase competition between developing seedlings for light, water and nutrients, reduce plant size (Harris, 1990) and potentially survival. The tiller length of ryegrass plants in the 6 and 12 kg/ha treatments (seed rates) were longer than those in the 18-30 kg/ha treatments. It was found that there are more tiller numbers per plant in the 6 and 12 kg/ha treatments than the other treatments, but mean tiller weight was similar for all treatments (Julia *et al*, 2013). Plant survival during the first year in Northland and Canterbury was similar regardless of seeding rate. In the Waikato, however, more plants survived ($P<0.05$) from August to December in pastures drilled at 6 to 18 kg/ha than at 30 kg/ha (Julia *et* al, 2013). Seeding rate did not affect any of the

seed yield and yield components measured (Yunhua Han *et al*, 2013).A target density of up of 400plants/m² is usual; to achieve this, grass seed rates of 15- 25 kg/ha are adequate. Italian and tetraploid ryegrasses, being relatively large seeded, should be sown at slightly higher rates than diploid ryegrasses. There is little scope for preventing weed ingress by increasing seed rates much above this amounts. Clovers have small seeds and sowing rates of 2- 4 kg/ha are adequate (Stephens, 1982).

2.7 Diet selection by small ruminants

Ruminant animals can select their diet from different plants or different parts of plant at least for maintenance requirements, from the available pasture (Forbes, 1995). Rate of food intake and diet selection control the amount of nutrient and energy ingested by herbivores (Illius *et al*, 1999). Forbs were the main component of the diet select by sheep and goats while cereal stubble contribution was higher for sheep than for goats. Goats selected greater amounts of woody species than sheep, which preferred to consume grasses (Yiakoulaki and Papanastasis, 2000). The selection pattern in utilizing the stubble resource was almost the same for sheep and goats but involved different percentages. First residual heads standing and fallen down were consumed, followed by leaf and stem component for grazing sheep (Brand *et al,* 2000). Bartolome *et al.* (1998) observed that, dietary differences probably follow from differences in foraging behaviour. Goats are more agile and forage with their heads raised, while sheep tend to graze with head down. This behavioural difference is an advantage for goats in pre ending more attractive but less accessible feed items in the woody vegetation, while sheep prefer the feed items on lower herbaceous vegetation.

Grazing animals, especially goats are considered despoiler of rangelands. However with good management small ruminants can make apositive contribution to the

natural resource base by enhancing soil quality and increasing plant and animal biodiversity (El Aich and Waterhouse, 1999).

Small ruminant's diet selection is influenced by many factors. Among these the available woody and herbaceous species, forage availability and presence of nutrition alternatives, period of grazing, stocking rate, and whether goats and sheep forage as sole range land users or together other animal species. An important finding, however, is that browse is an important forage source for goats throughout the year and for sheep during the dry periods when herbage was limited (Holechek*et al,* 2004).

In semi-arid subtropical savannas, the diet selection by goats varies with season. For example, during the wet season, goats select amore mixed diet of browse, grasses and forbs, however during the dry season goats spend more time browsing because many species of browse are evergreen that provide good quality forage. There are significant variations among individual that allow them to browse more or graze more (Raats *et al*, 1996). Defining feeding behaviour along a continuum, rather than categorizing different species of herbivores as grazers, mixed feeders and browsers, is preferred because most animal graze or browse opportunistically (Perez-Barberia, *et al*, 2004).

Herbivores select their diets from a range of plant species and plant parts that differ in their physical and chemical attributes (Dove, 1996).

Goats select a diet higher in CP content and more digestible in shrub land, goats also consumed large amounts of browse in the dry and wet period of the year but sheep only consumed large amounts of browse during the dry season when tree leaf litter was a major component of available forage. However during the dry

season browse CP content did not meet animal requirement (Papachristou, *et al*, 2005).

At seed setting stage in a protected rangeland site goat diet contained 4.3% grasses, 51.5%forbs and 44.2% browse (Fatur, 2013). Also in an open range plants with the highest relative preference index (RPI) were *Desmodium*spp. (RPI=15.9), *Ipomeaeriocapa*(RPI=15.7) and *Echniochloacolonum*(RPI=5.1). Generally sheep selected more forbs than grasses (Abdelkreim, 2013).

2.8 Forage evaluation

Evaluation of fodder crops is a function of both yield and quality or nutritive value. Fodder of high nutritive value is characterized by high protein content and high digestibility or low fiber content.

All systems of feedstuff evaluation aim to provide information regarding the capacity of individual feeds to meet the nutritional demands of the animal and, as such, represent some degree of compromise with reality. The most precise way to establish the nutritional value of any feedstuff would be to feed it to appropriate animal classes and to observe the level of animal production achieved, but such an approach is neither practical nor justifiable on cost grounds. However, in any system of feed evaluation, it is important to recognize that the ultimate arbitrator of nutritional value will always be the animal (Beever and Mould, 2000).

2.8.1 Growth and yield Evaluation

2.8.1.1Forage age and maturity stage

Maturity stage at harvest is the most important factor determining forage quality. Forage quality declines with advancing maturity. Maturity at harvest also influences forage consumption by animals. As plants mature and become more

fibrous, forage intake drops dramatically. Intake potential decreased and NDF concentration increased as plants age. This is because NDF is more difficult to digest than the non-fiber components of forage. Also, the rate at which fiber is digested slows as plants mature. Therefore, digestion slows dramatically as forage becomes more mature (Ball *et al.*, 2001).

An inverse relationship between the yield and the quality of forages with the advancement in the crop age was demonstrated for forage sorghum (Khair, 1992) and temperate grasses (Corrall, 1979). A compromise between the quantity and quality of the forage, therefore, has to be made in order to harvest the maximum possible quantity and quality forage. This, however, could be achieved through periodical monitoring of both quantity and quality of the forage during the crop growth period.

2.8.1.2 Plant density

There is a relationship between corn forage yield and plant density. Total dry matter increases 6 to 40% when plant density increases from about 55 000to 88 000 plants ha $^{-1}$ (Karlen*et al*, 1985). Olson and Sander (1988) indicated that optimum plant density may differ between corn grain and forage production with higher plant densities favouring forage rather than grain yield. Even though corn forage yield may have a greater optimum plant density than corn for grain, the negative relationship between plant density and corn forage quality makes it difficult to recommend plant density for optimum animal performance based on yield (Cusicanqui and Lauer, 1999)

2.9 Chemical evaluation

Chemical analyses can provide valuable information about the actual chemical constituents influencing digestion, unlike in vitro methods (Van Soest, 1994). Chemical characterization methods cannot give a direct estimate of nutritive value, but rather rely on statistical association to measure digestibility and intake. Using these statistical associations, characterization of forage fiber, lignin, protein and other chemical components are used increasingly to predict animal performance. Chemical analyses, along with the use of models, are increasingly used to predict performance. Forage chemical analyses can be used to identify factors in forages that may be limiting animal performance (Minson, 1980).

2.9.1 Forage protein

Proteins are chemicals distinguished from carbohydrates by having chains of amino acids that contain nitrogen as well as carbon, hydrogen and oxygen. Proteins have many different functions in the animal's body. They are important as enzymes, hormones and antibodies against disease, and as agents for transport and storage of nutrients within the body. Unlike energy and most minerals, the animal's body cannot store protein, so a continuous supply is required. Actively growing plant parts have much higher protein levels than do those that are dormant. The leaves of grasses, forbs and shrubs are much higher in protein than are the stems. However, leaves from forbs and shrubs are generally higher in protein than in grass leaves and stems at comparative stages of growth. Protein is often used as an indicator of forage quality because it is typically in short supply and is easy to measure (Holechek*et al*, 2010). Ibrahim *et al.*(2014) stated that, crude protein is a significant component of forage quality because quality of forage is better when the level of crude protein contents were high in it. The same authors found that, the effect of cultivars, harvesting times and their interactions were significant. The cultivar "Cargal" harvested at 30 DAS produced statistically

highest crude protein (9.66%), while the cultivar “Akbar” keeping at par with “Goldan” each harvested at 30 DAS produced 9.40% and 9.36% crude protein, respectively. The cultivar “Goldan” was statistically similar with “Pak Afgoi”, when it was harvested at 30 DAS. The lowest crude protein was recorded in “Neelam” (7.73%) when it was harvested at 60 DAS.

2.9.2 Forage lipids

Fats and oils are distinguished from carbohydrates by having fewer oxygen atoms and more hydrogen atoms. Vegetative parts of plants are typically very low in fats but seeds of plants such as corn, peanut and sunflower have high fat levels (Holechek *et al*, 2010).

2.9.3 Vitamins and minerals

Adult ruminants are different from mono gastric (pigs and poultry) with respect to their dependence on an exogenous supply of vitamins. Synthesis of B-group vitamins (thiamine, riboflavin, niacin …) and vitamin K occurs during the degradation and fermentation of feed ingredients by ruminant microorganisms. Vitamin D is synthesized by the action of ultraviolet radiation on the sterols present in the skin of ruminants; vitamin C is synthesized from C6 sugars (glucose and galactose) and niacin from tryptophan (if the amino acid is present in excess). It is therefore mainly with respect to vitamins A and E that ruminants have specific dietary dependence (Ballet *et al*, 2000).

Forage has the potential to play a significant role in the supply of vitamins to ruminants. Although forages are potentially good sources of vitamins, the levels which they may contribute in the diet of ruminants are influenced by a number of factors to both the plant and the animal. The considerable variability found in the vitamin content of forages tends to the: origin of the plant (family, species and

variety), climatic conditions, and stage of maturity of the plant, conservation methods (drying, ensiling, dehydration …) and storage conditions. This range of influencing factors results in a major lack of precision in estimating the quantity of vitamins available to ruminants from forage (Ballet *et al*, 2000).

The seven major minerals supplied by forages are calcium (Ca), chlorine (Cl), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na) and sulphur (S). - and eight trace or micro minerals - cobalt (Co), copper(Cu), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium(Se) and zinc (Zn).Each of these minerals has been found to be deficient for grazing livestock under specific conditions, with the exception of Cl (McDowell, 1985).

Mineral imbalances (deficiencies or excesses) in soils and forages have long been held responsible for low production and reproductive problems among grazing ruminants in the tropics. Wasting diseases, loss of hair, de-pigmented hair, skin disorders, non-infectious abortion, and diarrhea, anemia-loss of appetite, bone abnormalities, tetany, low fertility and pica are clinical signs often suggestive of mineral deficiencies (McDowell *et al*, 1983).

2.9.4 Carbohydrates

Holechek *et al*. (2010) reported that, carbohydrates are the basic source of energy for range animals. Plants have two basic types of carbohydrates: those associated with the cell contents and those associated with the cell wall. Starch and sugar are found in the cell contents. They are easily broken down by the animal's digestive system and are a readily available source of energy. Cellulose and hemicelluloses cannot be broken down by enzymes in the animal digestive tract. Only ruminant animals and animals with enlarged cecums (horses and rabbits) can efficiently use cellulose and hemicelluloses because they have microorganisms capable of digesting these carbohydrates. Lignin is the portion of the plant cell wall that

cannot be utilized even by microorganisms. Lignin content is higher in stems than in leaves, it increases as plants mature and is considered the primary anti-quality component in forages. Crude fiber is an important parameter of quality for estimating the forage diet. The forage quality is considered best having optimum amount of crude fiber, but quality decreased with the increase contents beyond the normal level (Ibrahim *et al,* 2014).

2.10 Comparative nutritive value of grasses and forbs

2.10.1 Grasses

Olorunnisomo (2010) reported that, the proximate and detergent fiber composition (g/100g DM basis) of maize fodder of Dry matter, Crude protein, Ether extract, Crude fiber, Ash, Nitrogen free extract, Neutral detergent fiber and acid detergent fiber were 88.8, 9.56, 2.20, 26.1, 5.03, 57.1, 53.3 and 30.8 respectively. Also he found that the DM digestibility (g/100g) of sundried maize fodder by sheep (71.8), DM intake g/day (670) and DM intake % BW (3.64). On the other hand, Kearl (1982) revealed that,*Panicum maximum* consist 8.3, 32.4, 12.4, and 2.4 CP, CF, Ash and EE respectively. As well as he found that DM intake % (4.3).

Nalk*et al.* (2012) reported that, chemical composition (On % DM basis) of maize fodder were Crude protein (11.14), Ether extract (2.2), Crude fiber (22.25), Nitrogen free extract (53.54), Ash (9.84) and acid insoluble ash (1.03).

2.10.2 Forbs

Kearl, (1982) stated the, proximate CP, CF, Ash and ether extract of *Medicagosativa*were 18.1, 30.2, 11.5 and 2.5 % respectively. Also he found the same plant existed 2.05, 0.08, 1.07, 0.34, 0.25 and 2.90% (k, Na, Ca, Mg, P and N

respectively) while *Arachis hypogoea* has 1.38, 1.23, 0.49, 0.15 and 2.77% (k, Ca, Mg, P and N respectively).

2.11 Energy value of feed

The ability of a food to supply energy is of great importance in determining its nutritive value (Mc Donald *et al,* 2010).

One of the main functions of a dairy ration is to provide energy to an animal. The total energy of food coming free during combustion is called Gross Energy. Only a fraction of this is used for maintenance (including some milk production) and production. Utilization is reduced by losses of defecation, urination, methane gasses in the rumen and heat. The term "energy" includes the actual physical energy an animal needs, the heat to maintain its body temperature, the energy required for production and the nutrients for laying down its own energy reserve. The constituents that provide energy are the carbohydrates. If there is not enough energy from carbohydrates and fats in the food to meet the daily requirements of animal, part of the available proteins is converted into energy-use.

Not all energy value fed can be utilized for production and maintenance. The portion available for maintenance and production is called Net Energy (NE), usually expressed in Joules (KJ = 1,000 J, MJ = 1,000,000 J).

2.12 Biological evaluation

The best evaluator of forage quality is animal performance. Intake, digestibility and efficiency of utilization are characteristics of forages that determine animal performance, with variation in intake accounting for 60–90% of the variation in digestible energy (Mertens, 1994). It would therefore be desirable to measure those forage characteristics that relate most closely to intake and digestibility. Chemical

fractions that have been associated with intake and digestibility include fiber, lignin and protein (Cherney and Mertens, 1998).

2.12.1 Forage palatability

Palatability is traditionally defined as “the relish an animal shows for a particular plant as forage which varies with succulence, fiber content, nutrient and chemical content, and morphological features such as spines and thorns” (Frost and Ruyle, 1993).

Palatability is defined as plant characteristics or conditions which stimulate a selective response by animals (Cowlishaw and Alder, 1960). Webster defines palatable as pleasing to the taste; hence, pleasing to the mind (Heady, 1964). Stapledon (1947) defined palatability as "an appeal sufficient to hold animals to the grazing of one species for days or even weeks on end, and a standard of tastiness that will attract animals to particular plants when the scope for selection is comparatively wide".

The palatability of forage is determined by its ability to provide stimuli to the pharyngeal senses of the animal, e.g. taste, colour and texture. There is evidence that sheep, goats and cattle possess different degrees of sensitivity to palatability factors when a choice of feed is offered (Marten, 1978). Animals tend to select the more nutritive parts of the plants and ignore older and coarser material (Van Soest, 1994). Many factors influence the forage palatability. Animal Factors: are the senses, species or breeds, individual variations, previous experience or adaptation, and physiological condition. Plant factors: are species, intra-specific variation, chemical composition, morphology or physical traits, succulence or maturation, availability in non-controlled situations, and form of forage controlled by mechanization and: Environmental factors are plant diseases (presence or absence

is environment dependent), soil fertility, animal dung, feed additives, climatic variations, and seasonal or diurnal variations (Marten, 1978).

2 .12.2 Intake of forage

Dry matter intake is of primary importance in ruminant feed. The capacity for voluntary feed is a basic limiting factor in feed evaluation (Mc Donald *et al*, 2002). Illius (1998) suggested that intake is probably the single most important variable determining animal performance and voluntary intake is generally correlated with the amount of nutrients that can be extracted from a feed, i.e. its digestibility. For forages, digestibility is largely determined by features of the plant, but potential digestibility, and hence potential intake, may not be achieved, due to interactions between feeds or between one or more feeds and the animal itself. Forage intake is influenced by a number of factors. Understanding how these factors affect forage intake is important, because forage intake affects nutrient intake, as forage intake increases with increased physiological demands such as lactation. However, forage digestibility, forage availability, supplemental feed type, quantity and provision, and environmental conditions may restrict forage intake, preventing adequate nutrient intake. Understanding forage intake is also important from the standpoint of managing the rangeland resource. Forage intake estimates, adjusted for body size and production level of the animals being managed, are an essential consideration in determining an appropriate stocking rate. (NRC, 1987) Intake is influence by some factors:

2 .12.2.1 Physical form of plant

The content of fibrous cell walls is a major physical feature that factor affects the intake. Distribution of the different molecules within the plant and the linkages between them will be important factors affecting the ease with which the microorganisms can break down the cells (Jung and Allen, 1995) and thus the

space occupied in the gastrointestinal tract. In addition, physical characteristics of the cell wall or fiber particles themselves, such as tissue origin, shape, buoyancy and specific gravity, affect the rate at which particles are broken down and the ease of passage (Wilson and Kennedy, 1996).

Grinding, chopping, or pelleting destroy the structure of cell wall, thereby accelerating their breakdown in the rumen and increasing feed intake despite reduction in digestibility. Givens *et al*, (1988) noted that milling and chopping straw whilst increasing intake does not increase digestibility.

2 .12.2.2 Environmental Influences

Climatic conditions in which range herbivores graze and browse can have a profound effect on forage intake (NRC, 1987). Each herbivore species appears to have its own comfort zone with upper and lower temperature limits. This comfort zone is usually called the thermo neutral zone (TNZ).

Intake is not affected when temperatures are within this zone. When temperatures exceed the upper limit of the TNZ, intake decreases. The degree of intake depression at high temperatures is also affected by night cooling. Cooler temperatures generally stimulate intake.

2 .12.2.3 Palatability

Arnold (1970) reported that, palatability influences voluntary intake. Generally it is not thought to be an important factor in determining feed intake, but plant materials which are main food to the animal contain chemical defence compounds which affect palatability and reduces feed intake.

2 .12.2.4 Forage Quality

The most common chemical components used to predict the intake of forages include a measure of the cell-wall content, with acid- or neutral-detergent fiber fractions (ADF and NDF) (Van Soest, 1985) being the most frequently cited.

In general, as forage quality increases, intake also increases. Deficiencies of some specific nutrient such as N, P, Ca, and Cu reduce food intake. Linn and Martin (1999) stated that the high quality forage must have high intake, digestibility, and efficiency of utilization. Numerous agronomic studies have been conducted on the suitability and production potential of annual crops in livestock production systems

2 .12.2.5 Digestibility

Studies involving all-forage diets have consistently shown that intake increases as forage digestibility increases from 40 to 80 percent (NRC, 1987).

2.13 Carrying capacity

It is the maximum stocking rate possible which is consistent with maintaining or improving vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production. The carrying capacity is determined on the basis of total forage biomass production and amount of feed requirement per animal unit. Carrying capacity is sometimes determined using the proper use factor (PUF) of 50% in which only one half of forage biomass produced is considered as available for grazing (Darrag, 1996). Margon (1993) stated that there is no universal formula for determining stocking rate, and the carrying capacity of the pasture is usually imprecisely defined. The determination is more difficult in a region with high variability in rainfall from year to year so that overgrazing is almost inevitable when several years of drought follow in succession.

2.14 Ground cover in natural rangeland

Ground cover measurements are commonly used to evaluate soil protection, watershed health, and rangeland ecological condition and range trend (Holechek *et al*, 2004). Fatur and Fadlalla (2013) found that land cover in two range sites in North Kordofan State, Sudan formed 81.9% and 87.5% respectively. Comparison of plant combination percentage in the study area has shown that in first record

duration, maximum plant combination was grasses and forbs (27.27%), shrubs (26.5%) and minimum amount was for annual forbs (2.09%). In the second record period, shrubs (48.45%) and bushy trees (21.64%), and annual forbs (1.45%), respectively formed the plant combination of area (Diana and Gholam, 2011).

Chapter Three

Materials and Methods

3.1The study area

3.1.1 Location

The study was conducted during 2015- 2017 at Western Jebel Marra Locality (WJML), Central Darfur State, Sudan. The area is located in the north western part of Jebel Marra massive and extends between latitudes 12°57´ and 13° 00´ N and longitudes 24° 02´ and 24°04´ E. The altitude at Nertiti is 600 m above sea level (m.a.s.l.) (DRCO, 2011). Jebel Marra is located in Darfur region, in the western part of the Sudan (figur3.1). It extends along 135 km in a north-south direction with a maximum width of about 80 km in the southern third of the mountain (FAO, 1968).The total area of Jebel Marra is estimated to be about 2000 km². It lies south of a plain of semi-desert and desert to the north.

3.1.2 Climate

Due to the influence of elevation Jebel Marra climate resembles that of the Mediterranean. Rainfall in the western slopes ranges between 420 mm/annum at Golol, Murtagello and Nertiti (1000 m.a.s.l.) and 1200 mm / annum at the upper slopes (2500-3000 m.a.s.l.) Table (3.2).The minimum temperature ranges between 6°Cand 10°C (FAO, 1980) Table (3.1).

Table3.1Temperature (°C) and Rainfall (mm) during 2013- 2017 at study area

Year	Max tem (°C)	Min tem (°C)	Mean tem (°C)	Highest monthly tem (°C)	Lowest monthly tem (°C)	Rainfall (mm)
2013	36.6	9.3	23	40	4	1035.5
2014	35.8	9.8	22.8	39.9	4.5	829.4
2015	35.6	15.6	25.6	39.4	8.5	691.8
2016	37.4	15.2	26.3	39.4	9.4	846.5
2017	35.5	11.3	23.4	38.5	8.2	780.4

Source: Jebel Marra Rural Development Project Meteorological Section, (2018)

Table3.2 Rainfall (mm) distribution during 2013- 2017 at study area

Year	Months							
	April	May	June	July	August	September	October	Total
2013	-	11.7	81.5	287	534	121.3	-	1035.5
2014	0.9	22.6	30.3	153.7	441.4	179.8	0.7	829.4
2015	-	1.2	16.6	118.7	387.1	103.4	64.8	691.8
2016	-	8.7	96.8	229.1	419.9	85.3	6.7	846.5
2017	2.7	15.4	100.6	118.7	440.1	102.9	-	780.4

Source: Jebel Marra Rural Development Project Meteorological Section, (2018)

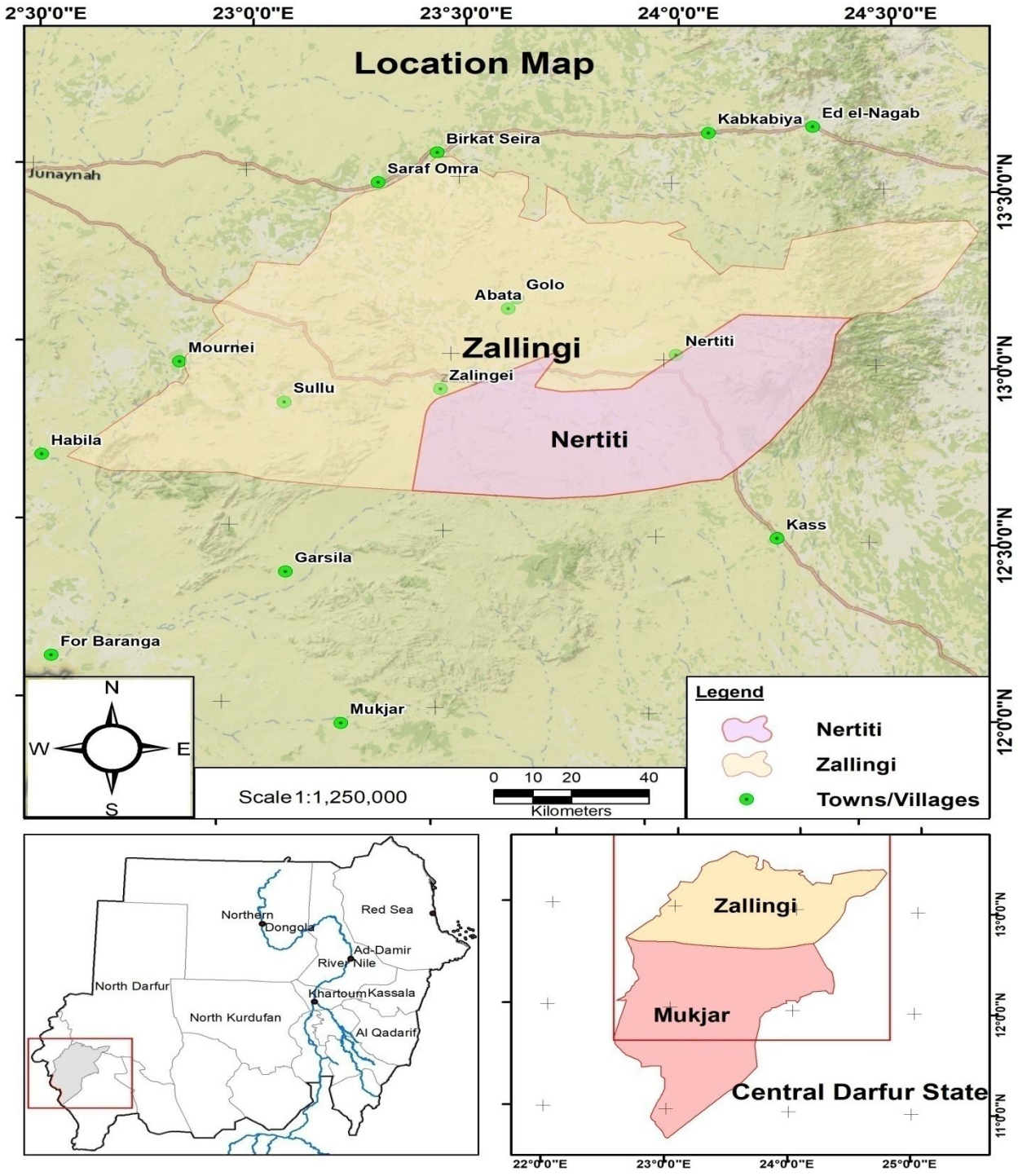

Figure3.1. Central Darfur State Map in Republic of Sudan (Nertiti is the head quarter of WJML)

3.1.3 Vegetation

The distinctive feature of Jebel Marra is the high volcanic mountain up to 3042 (m.a.s.l) resulting fertile soil, lower temperature and higher rainfall than the arid and savannah zones around the mountain. Jebel Marra has floral elements from each of these areas. For these reasons, Jebel Marra has been a refuge for plants, animals and man since long time ago and has a special place in human history. Previous forest cover of the Sudan approximated 40 % of the country (Harrison and Jackson, 1958). Because of mismanagement and unplanned land use, the forest area of the Sudan has declined to almost 19% of the area of the country (FNC / FAO, 1998). After separation of South Sudan the forest cover fell to less than 11%**.**

3.1.4 Population

Different tribes settle in Western Jebel Marra Locality, the majority are Fur, Arab nomad tribes (Nawaiba, Erigat, Jallol, Rizygat), Zaghawa, Masalite, Tama and other tribes. Sudan population is estimated to be around (41) million in 2018 (WPR, 2018), Central Darfur hosts about (1) million while Nertiti locality has approximately (31) thousand (population census council, 2009).

3.2 Socio-economic sampling procedure and sample size

At the end of (2015), socio-economic and rangeland attributes were assessed in (WJML) as a precede plan to candidate some species for rehabilitation program in the coming seasons (2016 and 2017). Two clusters; Nertiti and Khor-ramla livestock market were chosen purposively. Purposive sampling was the best available method in order to reduce cost and time. At each cluster in-accessible villages or damra were excluded. The sample size of this study was 85 distributed

randomly for two segments. All questionnaires were successfully received representing 100% of the total distributed questionnaires.

3.3 Botanical composition

The loop method (Parker and Harris, 1959) was used to measure botanical composition of the range herbaceous vegetation. Plant composition (%) was calculated as follows:

$$\text{Plant composition \%} = \frac{\text{Total hits of plant}}{\text{Total number of all hits}} \times 100$$

3.4Density and frequency of range plants

Density is the number of plants within each quadrat, while frequency is the percentage of total quadrats that contain at least one rooted individual of a given species. Fifty quadrats from the two sampling plots were used to measure density and frequency.

The density of each species was determined by summing up their numbers in all quadrats and dividing by the total number of quadrats

$$\text{The average plant density in quadrat } (m^2) = \frac{\text{No. of plant in all quadrats}}{\text{No of all quadrats}}$$

$$\text{Frequency \%} = \frac{\text{Number of the quadrats containing the species}}{\text{Total number of quadrats}} \times 100$$

3.5Biomass estimate

At each of transects, 5 quadrats of one m^2 were placed at 20 m intervals, giving a total number of 50quadrats. Samples were cut in grazing level 2.5cm and air dried in the house, labelled and their dry weight recorded.

3.6Carrying capacity

According to Mustafa *et al.* (2000), the proper use factor is (0.5). That means half of the forage production was used for determining the carrying capacity. The carrying capacity was calculated according to the daily requirement of a Tropical Livestock Unit (TLU) which is equivalent to (7.5 kg/day) as reported by (Mustafa *al.,* 2000).In this study10% was added to the annual requirement to cater for walking and has thus annual Consumption was 3012kg / year. Carrying capacity can be determined as hectare/ animal unit/ year (ha/Au/Y) according to (FAO, 1980). Carrying capacity was calculated as follows:

Carrying capacity = the desirable production / requirement of TLU

3.7Diet selection by grazing goats

Diet botanical composition has been estimated using the bite-count technique (Van Dyne, 1968). Five mature female goats were followed by observers for three days each goat was followed for 25 minutes a day eventually all bites of each species were recorded for each animal. Also cut and carry system was applied for reseeded species to feed goats during two seasons namely 2016 and 2017 inside zoo (zero grazing) with the same procedure of (Van Dyne, 1968).

3.8 Relative preference index (RPI)

RPI was used to classify herbaceous plants according to their preference and it was obtained from the relationship:

RPI% = plant species in diet (%) ÷ plant species botanical composition in the range (%).

The range plants were classified according to their relative preference index into five forage value categories (NRC, 2003, Abdelkreim and Fadlalla, 2013). In this study the following indicators were adopted:

PP = Preferred plant (RPI > 1.25), DP = Desirable plant (RPI about 0.70 to 1.25), UD = Undesirable plant (RPI < 0.70)

3.9Browse assessment

3.9.1 Density of trees and shrubs

Density is the number of trees and shrubs within each sampling unit. Direct count method was used, where the total number of trees and shrubs was determined by counting them inside the circular sample plots.

Average tree density in plot ($1000m^2$) =

No. of trees in all plots / No. of all plots

Tree density in hectare = average tree density in ($1000m^2$) ×10

3.9.2 Estimation of browse productivity

Browse productivity was assessed according to Michael *etal.* (1987) who adopted the diameter at browsing point (d.b.p) and browsing level. These authors reported 3mm and 1.5m for (d.b.p.) and browsing level respectively. Densities for trees

were obtained by sampling of an area of 1000m². One line transect of 100-meter long was selected across the plot. Twig count method was applied for estimating available browse and total browse (Gaiballa*et al*. 2003 and Lazim. 2001). For estimating available browse, all twigs between the ground level up to goat browsing level (1.5m) with diameter equal to or less than diameter at browsing point (2 mm) for selected trees were counted, and material cut was labelled, dried in the house and their dry weight recorded.

3.10 Re-seeded Experiment

The experiment was carried out during the rainy season between15th of July 2016 and 30th of July 2017 under rain fed condition.

3.10.1 Land preparation

The experimental site was disc ploughed and left for15 days exposed to the sun. It was then disc harrowed to crush clods, and levelled out to maintain a well levelled seed bed. The plots were oriented in a north-south direction. Individual plot size was 2 × 2 meters and then plots were grouped to four blocks each with 24 plots.

3.10.2 Competition and Seed Rates Experiment

The experimental layout was a split plot arrangement with four replications (Bernstein, 1926).Weed control was the main plot, while seed rate represented the sub-plot. Weed control was practiced via hand weeding and carried out through the experiment whenever necessary to evaluate the effect of competition reduction on growth attributes. Un-weeded plots were left un-touched. Three seed rates were used (2, 4 and 6kg/ha), (4, 8 and 12 kg/ha), (2, 4 and 6 kg/ha) and (10, 20, and 30 kg/ha) for *Dactyloctenium aegyptium, Haemanthus multiflorus, Ipomoea sinensis* and *Crotalaria saltiana* respectively. Method of sowing was broadcasting seeds on

flat and then covering by rake at a depth of about one (cm).The parameters investigated were plant height(m), number of tillers /plant, number of leaves /plant and biomass production (kg DM/ha). The design is shown in layout as follows:

Competition and Seed rates experiment layout for one replication and species

Species1	**Main plot** UW	**Sub-plot** UW×Sr1	**Sub-plot** W×Sr3	**Sub-plot** W×Sr2
	Main plot W	**Sub-plot** W×Sr1	**Sub-plot** UW×Sr2	**Sub-plot** UW×Sr3

UW= un-weeded, W= mow weeded, Sr1= seed rate1, Sr2= seed rate2 and Sr3= seed rate3.

3.10.3 Parameters studied in this experiment were

3.10.3.1 Plant height (cm)

Three plants were randomly selected from each individual plot and plant height was measured from the base of the stem to the tip of the flag leaf. The mean height of the three plants was recorded in (cm) and then transferred to (m).

3.10.3.2 Number of tillers per plant

This parameter was measured by counting all tillers or branches of three randomly selected plants. The mean number of branches per plant was recorded.

3.10. 3.3 Number of leaves per plant

This parameter was determined using the same samples used for number of tillers or branches per plant of each treatment counted as done earlier but here was done per branch and then per plant. The mean number of leaves per plant was recorded.

3.10.3.4 Biomass production (kg DM/ha)

The measurement of dry matter yield was conducted by harvesting green forage in an area of (m^2) chosen from the middle plot as destructive samples. A sickle was used for clipping plants around five cm above the soil surface. The samples were weighed (g) using a spring balance after air dried. Final dry matter yield was calculated in kg/ha.

3.10.4Components analysis of reseeded species

3.10.4.1 Samples preparation

Four samples were collected at harvest (milk stage), air dried, chopped, ground and put into plastic bottles. Quality traits were measured at Faculty of Agriculture – Shambat- University of Khartoum for laboratory analysis.

3.10.4.2 Chemical analysis

Forage samples were analyzed for their proximate components. Crude protein (CP %), Crude fiber (CF %), Ash% and Ether extract were measured by standard AOAC (1980) methods. Crude protein was calculated from Kjeldahl method nitrogen as N*6.25. Dry matter was determined by air drying the samples. The minerals (P, K, Na, Ca and Mg) values were analyzed according to AOAC, (1990). All analysis was run in triplicate. The T-test analysis was used to analyze data with SAS (1988).

3.11 Data analysis

Questionnaires analysis: descriptive statistics (Excel) such as simple frequency, percentage distribution and cross tabulation were used in data presentation.

Demographic and other descriptive data were used to develop profiles of respondents. These profiles provide a basis for determining relationship of socio-demographic and economic data with level of forage production and livestock breeding. Forage characteristics include: palatable plants, desirable shrubs, decreases plants, poisonous plants, undesirable plants etc.

Data were analyzed using statistical program version 9.0 STATISTIX. Linear models –analysis of variance-split-plot design and mean comparisons were made at 5% level of significance (Steel and Torrie, 1997).

Chemical analysis: All analysis was run in triplicate. The T-test analysis was used to analyze data with SAS (1988).

Chapter Four

Results and Discussion

4.1 Socio-economic aspects

4.1.1 Personal characteristics

4.1.1.1 Livestock raisers habitation, tribes and gender

Data regarding livestock raisers habitation, tribes and gender are shown in Table (4. 1, 2 and 3) respectively. The majority of livestock raisers are settled in Khor-ramla and Brongrow areas (23.5 and 18.8 %) of respondents respectively. Rizigat and Nawaiba tribes were the dominant livestock raisers in the study area since their percentage were 22.4 and 21.2 % respectively. Respondent's classification according to their gender; showed that the males constituted 72.9 % while females were 27.1 %.

Table4.1 Livestock raisers habitation at the study area according to respondents opinion (N= 85)

Habitation	
Area	**%**
Khor-ramla	23.5
Brongrow	18.8
Eradiba	9.4
Rejil aldlyba	8.2
Mettei	8.2
Koray	4.7
Nertiti	4.7
Arkis	3.5
Madel basy	3.5
Jebel ahmar	2.4
Dros	2.4
Kobalow	2.4
Lodang	2.4
Moskar kho.	2.4
Braka	1.2
Sallakoyol	1.2
Merei	1.2
Total	**100.1**

Table4.2 Tribes of respondents at study area according to respondents opinion (N= 85)

Tribe name	**%**
Rizigat	22.4
Nawaiba	21.2
Erigat	20
Unidentified	15.3
Mahada	7.1
Mesarria	3.5
Zagawa	2.4
Arenga	1.2
Awladjanob	1.2
Banihusien	1.2
Tonjur	1.2
Jallol	1.2
Fur	1.2
Memey	1.2
Total	**100.3**

Table4.3 Gender according to respondents opinion (N= 85)

Sex	**%**
Male	72.9
Female	27.1
Total	**100**

4.1.1.2 Respondents age, education background and income source

Age, education background and income source information are shown in Figures (4. 1, 2 and 3), respectively. According to age groups it was found that the majority of respondents fall between 21- 40 years of age; then between 41- 60 years of age amounting to 47.1 and 40 % respectively. The study revealed that most of livestock raisers were illiterate 55.3% while graduates were only 2.4% of the respondents. This finding emphasizes the importance of awareness campaigns among these communities to empower them so that they can manage their resources more efficiently. A study by IFAD (Fadlalla,2006) in the Butana developed indicators

for empowering rural communities to manage natural resources and concluded that communities with low capabilities are characterized by poor fund management, poor organization and poor achievement; whereas communities with high capabilities are those who are autonomous, with high achievements and are able to manage their land/natural resources.

The findings showed that the main source of income of respondents was livestock raising activity which represent 83.5 % followed by agriculture at 10.6 %.

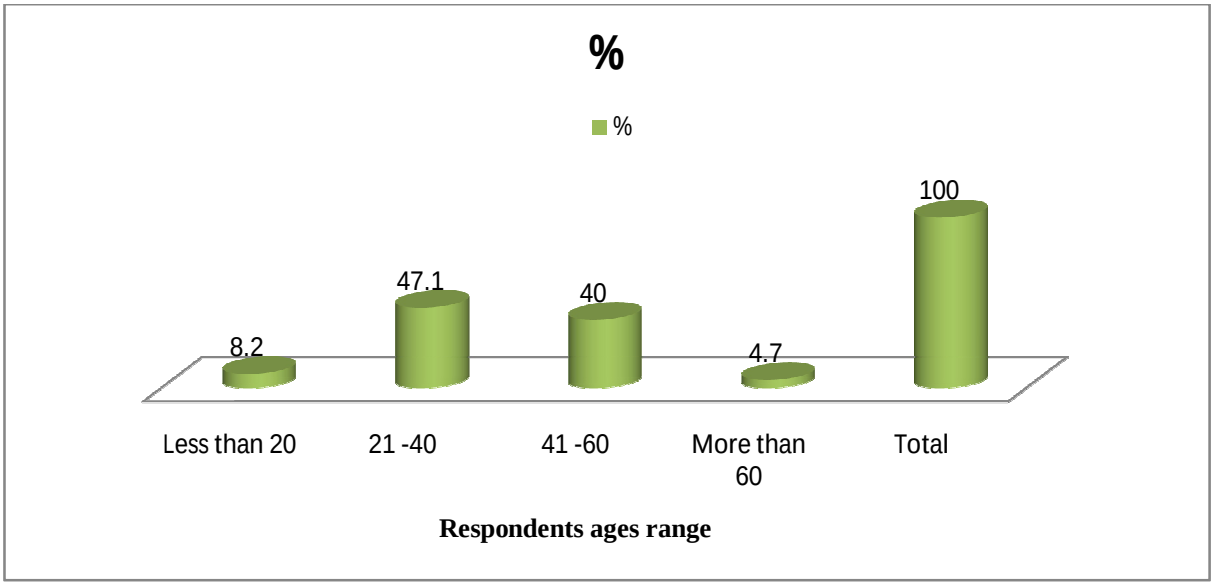

Figure4.1Ages of respondents at study area (N= 85)

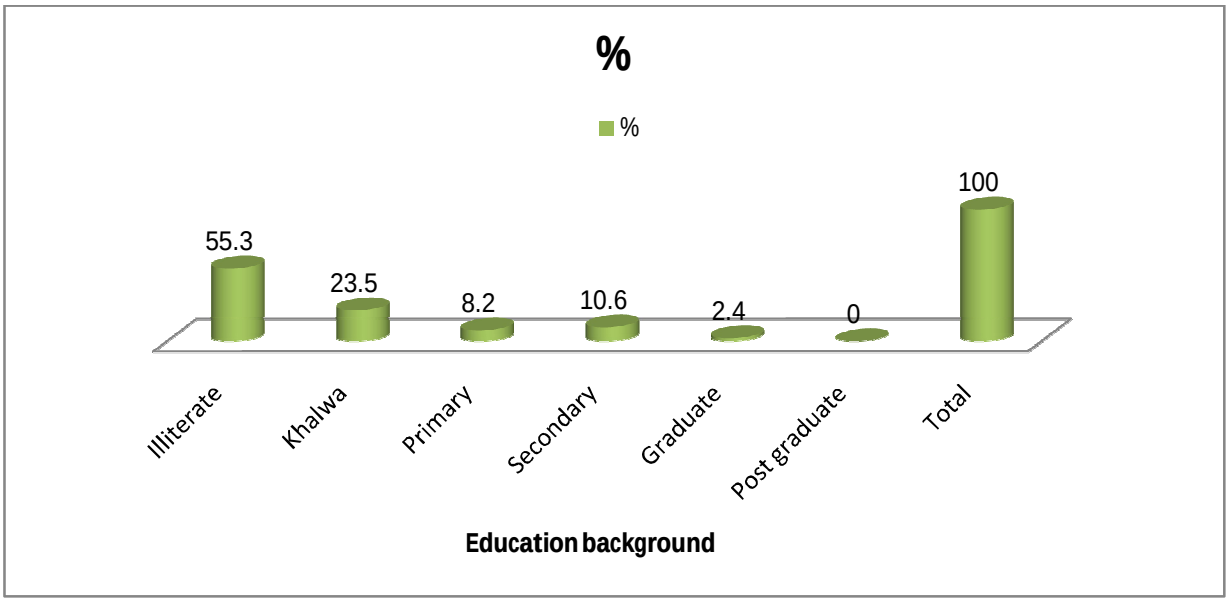

Figure4.2Educational back ground of livestock raisers at study area according to respondents opinion (N= 85)

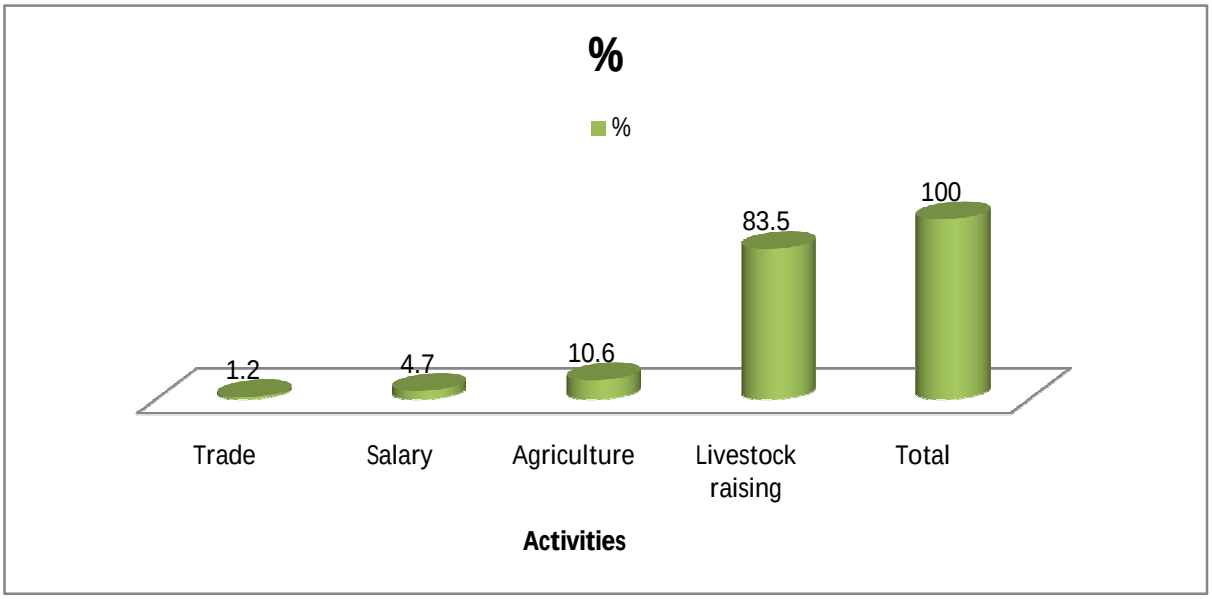

Figure4. 3 Income sources of respondents in study area (N= 85)

4.1.2 Rangeland Utilization Method

4.1.2.1 Livestock raiser status, Duration and Seasonal utilization of rangeland

Table (4. 4) shows that most of livestock raisers were settled and utilize the rangeland all the year round without resting the resource. Only a small proportion of respondents utilized the rangeland on temporary basis in order to reduce stress for insurance of recovery (Table4. 5). On the other hand most of livestock raisers graze around their villages or damra during the rainy season; while in dry season the grazing location was far away from the village or damra (Table4. 6 and 7) respectively.

Table4.4 Livestock raiser status according to respondents opinion (N= 85)

Livestock raiser status	%
Settled	83.5
Semi settled	10.6
Migratory	5.9
Total	**100**

Table4.5 Duration of rangeland utilization according to respondents opinion (N= 85)

Duration of rangeland utilization	%
All year	97.6
Temporary	2.4
Total	**100**

Table4.6Seasonal utilization of range land at rainy season according to respondents opinion (N= 85)

Grazing location at rainy season	%
Around damra or village	55.3
Far away from the damra	35.3
Both	9.4
Total	**100**

Table4.7Seasonal utilization of range land at dry season according to respondents opinion (N= 85)

Grazing location at dry season	%
Around damra or village	42.4
Far away from the damra	51.8
Both	5.9
Total	**100.1**

4.1.2.2 Types of forage stored at the dry season

Table (4.8) shows the crops storing on dry season since livestock raisers stated that they were kept forages or straw for dry season where their opinion represented 88.2%. The most plants or forage store as forage in dry season were *Dactyloctinium aegyptium* and *Sorghum bicolour* (Abu asabi and sorghum crops).

Table4.8Types of forage stored at the dry season according to respondents opinion (N= 85)

Statement			
Are there any forages or straw kept as forage for dry season feeding		**If yes what are those forages**	
	%		**%**
Yes	88.2	*Digitaria ciliaris (Retz.)* (Shaar elbnat)	1.2
No	11.8	*Ischaemum afraum* (Ankouj)	1.2
Total	**100**	*Setaria acromelaena* (Lesagh)	1.2
		Arachis 37hypogea (Groundnut)	5.9
		Cyndon dactylon L.(Najila)	7.1
		Sorghum bicolour(Sorghum)	8.2

		No idea	11.8
		Dactyloctinium aegyptium (Abuasabi)	15.3
		(Abuasabi & Sorghum).	48.2
		Total	**100.1**

4.1.2.3 Palatable and unpalatable plants

Table (4. 9) shows palatable and unpalatable plants according to respondent's opinion; the most palatable plant was *Dactyloctinium aegyptium* (Abuasabi) 45.9%, *Setaria acromelaena* (Lesagh)21.2% and *Cyndon dactylon L.* (Najila) 10.6%, while the unpalatable plants were represented by *Pennisetum pedicellatum* (um dofofo) 24.7%, *Senna obtucifolia* (kawal) 21.2 %and *Cassia occidentalis* (simeldabib; majerio plants) 12.9%.

Table4.9.Palatable and unpalatable plants according to respondents opinion (N= 85)

Statement			
Palatable plants	**%**	**Unpalatable plants**	**%**
Dactyloctinium aegyptium(Abuasbi)	45.9	*Pennisetum pedicellatum*(Umdofofo)	24.7
Setaria acromelaena (Lesagh)	21.2	*Senna obtucifolia* (Kawal)	21.2
Cyndon dactylon L.(Najila)	10.6	*Cassia occidentalis* (simeldabib; Majerio)	12.9
Echinochloa colona (Difra)	5.9	No idea	7.1
Ipomoea sinensis (Alhantout)	4.7	*Xanthium brasilicum* (Rantook)	5.9
Ischaemum afraum(Ankouj)	3.5	*Ipomea aquatic* (Aweer)	5.9
Chloris virgata Sw.(Abumaleh)	2.4	*Acanthuspermum hispedum*(Hrab hawsa)	5.9
Aristida seibrana (Algaw)	2.4	*Datura stramanium L.*(Sacran)	2.4
Pennisetum pedicellatum(Umdofofo)	1.2	*Tribulus terrestris L.*(Derasa)	2.4
Chloris gayana (Afan alkhadim)	1.2	*Aristida seibrana* (Algaw)	2.4
Andropogon gayana (Marhbaib)	1.2	*Achyranthus aspera* (Khashim alnasiba)	2.4
Total	**100.2**	*Leucas urticifolia*(Asal attar)	2.4
		Phragmites spec (Albose)	1.2
		Cyperus rotundus L(Seida)	1.2
		Physalis angulata (Um kram kram)	1.2
		Corchorus trilocularis(hamra)	1.2

		Total	**100.4**

4.1.2.4 Decreaser and invader plants at study area

Most of respondents stated that they don't have idea an about decease and invader plants (34.1 and 45.9 %) respectively, but some of them stated that the decreases plants in the area were *Dactyloctinium aegyptium* (Abuasabi), *Echinochloa colona* (Difra) and *Andropogon gayana* (Marhbaib) 16.5, 11.8 and 8.2 respectively. While the invader plants were *Xanthium brasilicum* (Rantook) and *Senna obtucifolia* (Kawal) plants (Table4. 10).

Table4.10 Decreaser and invader plants at study area according to respondents opinion (N= 85)

Statement			
Decreaser plants	**%**	**Invader plants**	**%**
No idea	34.1	No idea	45.9
Dactyloctinium aegyptium(Abuasabi)	16.5	*Xanthium brasilicum* (Rantook)	36.5
Echinochloa colona (Difra)	11.8	*Senna obtucifolia* (Kawal)	9.4
Andropogon gayana (Marhbaib)	8.2	*Leucas urticifolia*(Asal attar)	3.5
*Sporobolus festivus (*Um dibajo)	5.9	*Ipomea aquatic* (Aweer)	1.2
Blepharis linarifolia (Al beghal)	4.7	*Achryanthes asper*(Um alrokab)	1.2
Aristida seibrana (Algaw)	3.5	*Physalis angulata* (Um kram kram)	1.2
Chloris virgata (Abumaleh)	2.4	*Pennisetum pedicellatum*(Umdofofo)	1.2
Phragmites spec (Albose)	2.4	**Total**	**100.1**
Schoenfeldia gracilis (Um fraw)	2.4		
Chloris gayana (Afan alkhadim)	2.4		
Pennisetum violaceum (Wiwei)	2.4		
Ipomoea sinensis (Alhantout)	1.2		
Setaria pallide-fusca (Dnab alflo)	1.2		
Cucumis dipsaceus(Ajor algzal)	1.2		
Total	**100.3**		

4.1.2.5 Poisonous plants at study area according to respondent's opinion

About 64.7% of livestock raisers indicated that there were hazardous or poisonous plants in the area such as *Cassia occidentalis* (simeldabib; Majerio), *Ipomoea aquatic* (Aweer) and *Tribulus terrestris L.* (Derasa) plants 38.8, 9.4 and 8.2 % respectively (Table4. 11).

Table4.11 Poisonous herbaceous plants at study area according to respondents opinion (N= 85)

Statement			
Are there poisonous plants	**%**	**If yes; what are those plants:**	**%**
Yes	64.7	*Cassia occidentalis* (simeldabib; Majerio)	38.8
No	35.3	No idea	35.3
Total	**100**	*Ipomoea aquatic* (Aweer)	9.4
		Tribulus terrestris L.(Derasa)	8.2
		Datura stramanium L.(Sacran)	3.5
		Albizia amara (arad)	2.4
		Ocimum basilicum L. (Um rihan)	1.2
		Dobera glabra (Ladobe)	1.2
		Total	**100**

4.1.2.6 Desirable and undesirable shrubs at study area according to respondent's opinion

Table (4. 12) shows that the desirable shrubs were *Dichrostachys cinerea* (Kadad) 30.6 %, *Ziziphus spina-christi* (Sidr) 25.9% and *Acacia Senegal* (Hashab) 24.7% according to livestock raisers opinion, as well as they stated that the undesirable shrubs were *Albizia amara* (Arad) 27.1%, *Calotropis procera* (Oshar) 18.8% and *Ipomoea aquatic* (Aweer) 15.3%.

Table4.12 Desirable and undesirable shrubs at study area according to respondent's opinion (N=85)

Statement			
Desirable shrubs	**%**	**Undesirable shrubs**	**%**
Dichrostachys cinerea (Kadad)	30.6	*Albizia amara* (Arad)	27.1
Ziziphus spina-christi (Sidr)	25.9	*Calotropis procera* (Oshar)	18.8
Acacia senegal (Hashab)	24.7	*Ipomoea aquatic* (Aweer)	15.3
Balanites aegyptiaca (Hajleej)	10.6	No idea	11.8
Acacia seyal var *seyal* (Taleh)	3.5	*Acacia gerrardii* (Saljam)	8.2
Azanza garkeana (Jaghjagh)	2.4	*Combretum ghasalense* (Habeel)	7.1
Dalbergia melanoxylon (Abanose)	1.2	*Ricinus communis* (Khirwa)	4.7
Combretum aculeatum (shehait)	1.2	*Acacia mellifera* (Kitir)	2.4
Total	**100.1**	*Commiphora africana* (Gaful)	1.2
		Cassia occidentalis (simeldabib; Majerio)	1.2
		Boscia angustifolia (Um swago)	1.2
		Anogeissus leiocarpus (sahabb)	1.2
		Total	**100.2**

4.1.2.7Comparison between present and past range condition

Livestock raisers reported that the past rangeland condition was better than current rangeland the percentage being 85.9 and 14.1% respectively. The main reasons for that were quoted as forage abundance, less animals and adequate rainfall (40, 30.6 and 16.5 %) respectively (Table4. 13).

Table4.13Comparison between present and past range condition according to respondents opinion (N= 85)

Statement			
Which is better, current or past range condition	**%**	**What is the reason**	**%**
Past	85.9	Forages abundance	40
Current	14.1	Less animals	30.6
Total	**100**	Heavy rain	16.5
		Security stable	3.5

		Awareness	2.4
		Less agriculture	2.4
		Less fire	2.4
		Desert creep	1.2
		Less population	1.2
		Total	**100.2**

4.1.2.8 Adequacy of grazing

Regarding herbaceous adequate; the majority of respondents 78.8% expressed insufficiencies due to greater amount of animals 49.4%, shortage of forages 14.1% and fires 11.8% (Table4. 14).

Table4.14 Adequacy of grazing at study area according to respondents opinion (N= 85)

Is grazing adequate	%	If no; what is the reason?	%
Yes	21.2	More animals	49.4
No	78.8	No idea	21.2
Total	**100**	Less forage	14.1
		Fires	11.8
		Agriculture	2.4
		Others	1.2
		Total	**100.1**

4.1.3 Types and number of animals kept and minerals feeding

4.1.3.1 Supporting animal with salt and other minerals

About 95.3% of the livestock raisers showed that they gave animals' salt and Na_3Co_3 both together (Table4. 15).

Table4.15 Supporting animal with salt and other minerals according to respondents opinion (N= 85)

Statement	
Minerals	**%**
Salt	3.5
Na_3Co_3	1.2
Both	95.3
Total	**100**

4.1.3.2 Numbers and kinds of livestock bred by respondents

Table (4. 16) shows number sand kinds of livestock raised by respondents in study area. There were 36.5 % own around 100 heads of cattle, 22.4 % have no cattle and 1.2 % own700 head of cattle. Regarding goats; 44.7 % do not have goats, 11.8 % own around 150 head of goats and 1.2 % have about 500 head. An about sheep; 78.8% of respondents do not breeding sheep. Also 89.4 % of respondents were not having camel. Figure (4.4) shows that livestock density or rate in range land was high (78.8%).

Table4.16 Numbers and kind of livestock bred by respondents (N=85)

Statement							
Numbers and kind of livestock bred by respondents							
Cattle		Goats		Sheep		Camels	
head	%	head	%	head	%	head	%
0	22.4	0	44.7	0	78.8	0	89.4
20	1.2	10	1.2	10	2.4	25	1.2
25	1.2	15	1.2	20	2.4	30	1.2
30	1.2	30	4.7	30	1.2	50	2.4
50	4.7	35	2.4	50	3.5	100	3.5
65	1.2	40	4.7	60	1.2	300	1.2
70	5.9	50	5.9	100	8.2	800	1.2
100	36.5	70	2.4	150	1.2	**Total**	**100**
150	5.9	100	10.6	200	1.2		
200	12.9	150	11.8	**Total**	**100**		
300	3.5	200	8.2				
400	1.2	250	1.2				
500	1.2	500	1.2				
700	1.2	**Total**	**100**				
Total	**100**						

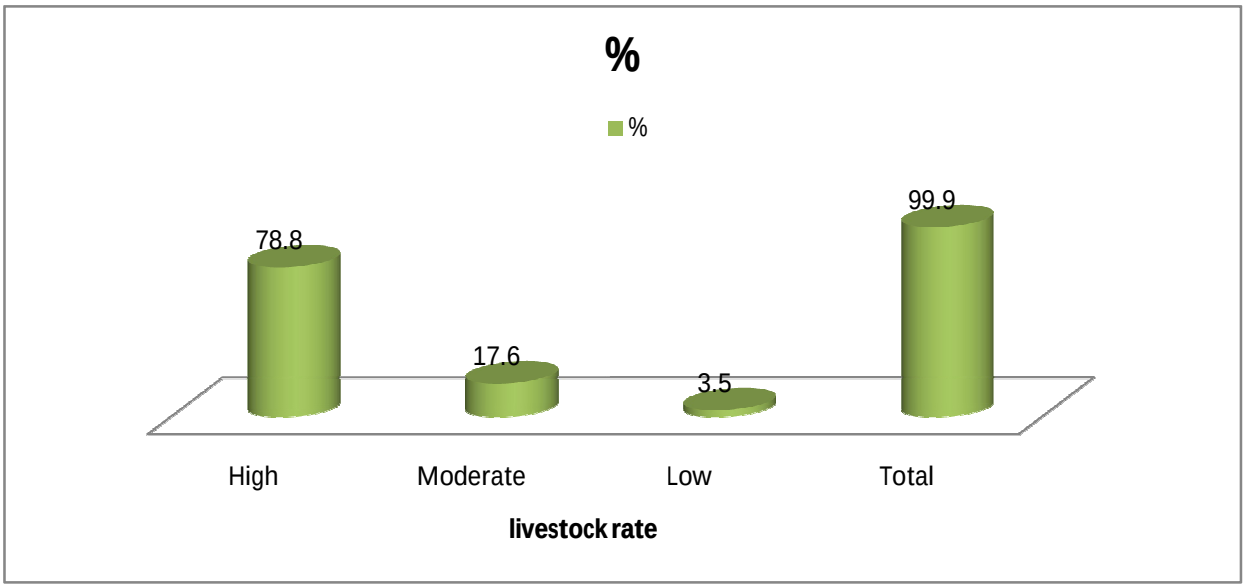

Figure4. 4 Livestock rate in rangeland according to respondents opinion (N= 85)

4.1.4 Issues concerning rangeland utilization

4.1.4.1 Deterioration of the rangeland

Table (4. 17) shows 65.9% of livestock raiser reported that there is deterioration in rangeland and that was attributed to over grazing, fires and agriculture expansion(43.5, 10.6 and 5.9%) respectively.

Table4.17Deterioration in the rangeland according to respondents opinion (N= 85)

Statement			
Is there deterioration in the rangeland	**%**	**If yes; what are the reasons**	**%**
Yes	65.9	Over grazing	43.5
No	34.1	No idea	34.1
Total	**100**	Fires	10.6
		Agriculture expansion	5.9
		Desertification	4.7
		Others	1.2
		Total	**100**

4.1.4.2 Troubles facing settled and semi-settled livestock raisers with nomads and others

Regarding troubles faced by livestock raisers: the results showed that about 46% of the respondents faced problems 54% stated that there were no problems (Table4. 18).

Table4.18 Troubles facing settled and semi-settled livestock raisers with nomads and others according to respondents opinion (N= 85)

Troubles facing settled and semi-settled livestock raisers with nomads and others	**%**
Yes	45.9
No	54.1
Total	**100**

4.1.4.3 Fires status in rangeland

According to respondents opinion fire incidence on rangelands was low 60%, (Table4. 19). Figure (4.5) shows that most of respondents consider water was abundant for animal drinking.

Table4.19 Fires incidence in rangeland according to respondents opinion (N= 85)

Statement	%
high	25.9
Medium	14.1
Low	60
Total	**100**

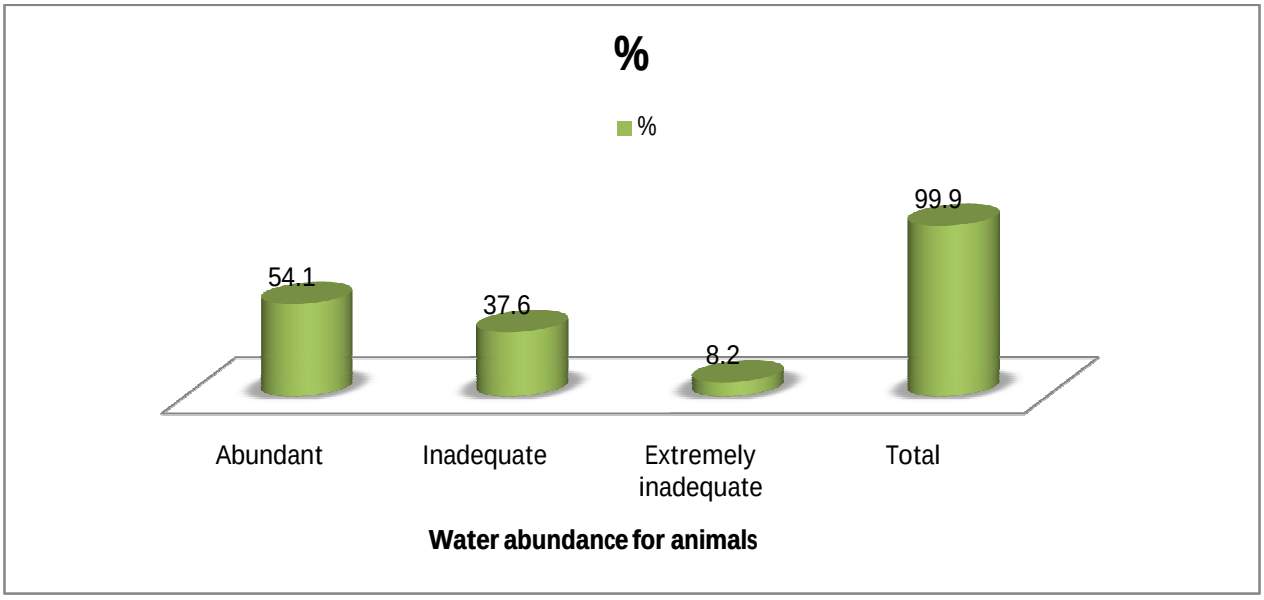

Figure4.5Water abundance for animal drinking at study area according to respondents opinion (N= 85)

4.2 Natural rangeland attributes

4.2.1 Botanical composition % of herbaceous layer at both range sites during the two seasons

Herbaceous botanical composition for both range sites north (N) and south (S) is shown in (Table4.20). Forbs are more than grasses at study area reaching 83and 78% for the two sites respectively; while grasses composition was 17 and 22% respectively in season (2015).In season 2016 also the forbs showed high botanical composition percentage than grasses reaching 60 and79 % for both sites respectively; while grasses composition was 40 and 21 % for both sites respectively. The forb species with highest % composition were *Spermacoce sp.* (22%) and *Corchorus trilocularis* (6%) in the (N) range site while for the(S) range site the dominant forbs were *Spermacoce sp.* (13%) and *Ipomoea sinensis* (10%). The grasses species with highest % composition were *Pennisetum pedicellatum* (17%) and *Schoenfeldia gracilis* (4%) in the (N) range site while for the (S) range site these were *Cyperus rotundus L.* (7%) and *Eragrostis sp. Koel* (4%).

Table4.20 Botanical composition % of herbaceous layer at the two range sites

Botanical name	Type	Local name	Sites					
			North			South		
			2015	2016	Mean	2015	2016	Mean
Spermacoce sp. DC.	Forb	Mahlab	17	26	22	16	9	13
Corchorus trilocularis	Forb	Molokhia	10	1	6	0	0	0
Haemanthus multiflorus	Forb	Gesh elfoul	8	2	5	10	11	10
Achryanthes aspera	Forb	Abu elrokab	5	0	3	0.4	1	1
Crotalaria saltiana Andr.	Forb	Um tagtaga	5	0.2	3	1	0.4	1
Senna obtucifolia	Forb	Kawal	4	5	5	1	2	1
Xanthium brasilicum vell.	Forb	Rantook	4	0.2	2	7	3	5
Abutilon spp.	Forb	Erig elnar	4	2	3	0	1	0.4
Leucas urticifolia	Forb	Um jallout	4	1	3	2	3	2
Ipomoea sinensis (Desr.)	Forb	Hantout	3	1	2	11	10	10

Oxygonum atriplicifolium	Forb	lisan elbagar	3	6	5	9	6	7
Amaranthus graecizans L.	Forb	Lisan eltiar	2	0	1	0	0	0
Crotalaria senegalensis	Forb	Sufera saghira	2	1	1	2	2	2
Acalypha indica L.	Forb	Almabitarba	0	2	1	0	0	0
Acanthuspermum hispedum	Forb	Horab hawsa	1	0.2	1	8	7	8
Zaleyea pentandra	Forb	Rabaa	1	0	1	0	0	0
Setaria acromelaena	Forb	Lissagh	1	7	4	0.1	1	1
Portulaca quadrifida L.	Forb	Lagab elhimar	1	0.2	1	2	10	6
Talinum portulacifolium	Forb	Einab barry	1	2.3	2	0	0	0
Sida alba	Forb	Um shadida	1	0	0.4	0.4	0	0.2
Commelina kotschyi	Forb	Ibrig elfaki	1	1	1	1	0.4	1
Kohautia aspera	Forb	Um habiba	1	0	0.4	1	0.4	1
Euphorbia hirta L.	Forb	Um laban	1	0	0.4	0	0	0
Cucumis dipsaceus	Forb	Ajur elghazal	0.3	0	0.2	0.1	0.4	0.3
Allium vineale	Forb	Basal almarfien	0.3	0.2	0.3	0	0	0
Boerhavia erecta L.	Forb	Shokal elkhil	0.3	0	0.2	0	0	0
Polygala erioptra DC.	Forb	Um saboon	0.3	0	0.2	0	0	0
Tribulus terrestris L.	Forb	Derasa	0	0.2	0.1	0	0	0
Abelmoschus esculentus L.	Forb	Bamia barry	0.1	0	0.1	0.2	1	1
Farsetia longisiliqua	Forb	Um adafir	0.1	0	0.1	1	1	1
Abutilon pannosum	Forb	hambouk	0	0	0	0	1	0.3
Aristolochia bracteolata	Forb	Um jalajil	0.1	0	0.1	0	0	0
Indigofera hochstetteri	Forb	Dahasir sharaya	0	1	0.2	1	0	1
Solanum dubium	Forb	Jibben jibben	0	0	0	2	1	2
Sida ovata	Forb	Mokshashat rojal	0	0	0	1	0	0.4
Ocimum basilicum L.	Forb	Raihan	0	0	0	0.2	0	0.1
Datura stramanium L.	Forb	Sacran	0	0	0	0.1	0	0.1
Verbascum nubicum	Forb	Saisil	0	0	0	0.1	0	0.1
Cucumis prophetarum L.	Forb	Hanzal	0	0	0	0	0.4	0.2
Rhyanchosia minima (L.)	Forb	Adan elfar	0	0	0	0	3	1
Sesbania arabica	Forb	Surieb	0	0	0	0.2	2	1
Cleome gynandra L.	Forb	Tamalika	0	0	0	1	4	2
Francoeuria crispa	Forb	Tugur	0	0.2	0.1	1	0.4	1
Chrozophora plicata	Forb	Tarba	0	0	0	0	0.2	0.1
Total forbs			**83**	**60**	**71**	**78**	**79**	**78**
Pennisetum pedicellatum	Grass	Um dofofu	9	25	17	1	0.4	1
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	3	2	2	2	0	1
Schoenfeldia gracilis	Grass	Danab elnaga	3	5	4	2	0.2	1
Cyperus rotundus L.	Grass	Sieda	1	2	2	5	8	7
Brachiaria deflexa	Grass	Um fraw	1	0	1	0.1	0	0.1

Eragrostis sp. (Koel.)	Grass	Banu	1	3	2	4	3	4
Cynchrus ciliaris	Grass	Haskanit naim	1	0	0.4	3	1	2
Chloris virgata Sw.	Grass	Um malih	1	0	0.3	0.1	0	0.1
Dactyloctenium aegyptium	Grass	Abu asabi	0.4	3	2	2	3	2
Chloris virgata Sw.	Grass	Abu malhi, korm	0	1	1	2	4	3
Eragrostis megastachya	Grass	Banu kabir	0	0	0	1	0.4	1
Echinochloa colona (L.)	Grass	Difra	0	0.2	0.1	0	0	0
Cyndon dactylon (L.)	Grass	Najila	0	0	0	1	0	0.3
Cymbopogon nervatus	Grass	Nal	0	0	0	0.4	1	1
Total grasses			**17**	**41**	**29**	**22**	**21.4**	**22**
Grand Total			**100**	**100**	**100**	**100**	**100**	**100**

Key: Standard error (SE = ±0.5)

4.2.2 Ground cover percentage for both range sites during the two seasons

Data on ground cover are presented in (Table 4.21). Marked differences were found in plant cover between the north and south range sites. For the (N) range site the plant cover was 83.33% while for the (S) site it was 91.22% during the first season 2015. While in the second season 2016 the plant cover was 86.4 and 96.2 % for the two sites respectively. The variations between range sites at Nertiti area in Western Jebel Marra Locality may be due to the topography nature, the (N) site was rockier than (S) site. Bare soil, litter and rock results are also shown in (Table4.21) for both sites. Rocks were more in the north site than the south one (8.46% v 0.11%).

Table4.21 Ground cover percentage for the two range sites

Parameters	**Northern site%**			**Southern site%**		
	2015	**2016**	**Mean**	**2015**	**2016**	**Mean**
Bare soil	5.33	5	5.17	5.67	2	3.84
Litter	1.22	1.8	1.51	2.89	1.8	2.35
Rock	10.11	6.8	8.46	0.22	0	0.11
Plant	83.33	86.4	84.87	91.22	96.2	93.7
Total	**100**	**100**	**100**	**100**	**100**	**100**

These results are in line with Fatur and Fadlalla (2013) who reported that the plant cover in the two range sites formed 81.9% and 87.5% respectively in North Kordofan State, Sudan.

4.2.3 Plant frequency (%) for the two range sites during the two seasons

Plant frequencies % for the two range sites (N) and (S) are given in (Table4. 22). Plant species showing the highest frequency in range site (N) were *Spermacoce sp. DC.* (80%), *Pennisetum pedicellatum* (74%) and *Senna obtucifolia*(64%).In range site (S) plants with highest frequency were*Haemanthus multiflorus* (82%), *Acanthuspermum hispedum* (78%) and *Oxygonum atriplicifolium* (76%).

Table4.22 Plant frequency (%) for the two range sites during the two seasons 2015 and 2016

Botanical name	Type of plant	Local name	Sites					
			North			South		
			2015	2016	Mean	2015	2016	Mean
Spermacoce sp. DC.	Forb	Mahlab	68	92	80	72	32	52
Pennisetum pedicellatum	Grass	Um dofofu	56	92	74	20	20	20
Senna obtucifolia	Forb	Kawal	56	72	64	20	52	36
Setaria acromelaena	Grass	Lissagh	28	92	60	0	20	10
Digitaria ciliaris (Retz.)	Grass	Shahar elbanat	28	88	58	52	8	30
Schoenfeldia gracilis Kunth.	Grass	Danab elnaga	12	92	52	16	16	16
Haemanthus multiflorus	Forb	Gesh elfeel	68	36	52	68	96	82
Corchorus trilocularis	Forb	Molokhia	64	32	48	0	0	0
Achryanthes aspera	Forb	Abu elrokab	64	12	38	20	16	18
Eragrostis sp. (Koel.)	Grass	Banu	4	72	38	44	68	56
Dactyloctenium aegyptium	Grass	Abu asabi	4	60	32	32	88	60
Oxygonum atriplicifolium	Forb	Lisan elbagar	4	56	30	60	92	76
Abutilon spp.	Forb	Erig elnar	36	16	26	4	20	12
Leucas urticifolia	Forb	Um jallout	24	20	22	24	72	48
Crotalaria saltiana Andr.	Forb	Um tagtaga	36	8	22	48	8	28
Echinochloa colona (L.)	Grass	Difra	0	36	18	0	0	0
Crotalaria senegalensis	Forb	Sufera saghira	12	20	16	48	96	72
Ipomoea sinensis (Desr.)	Forb	Hantout	20	4	12	40	96	68
Cynchrus ciliaris	Grass	Haskanit naim	0	24	12	20	28	24

Commelina kotschyi Hassk.	Forb	Ibrig elfaki	0	20	10	8	4	6
Talinum portulacifolium	Forb	Einab barry	4	12	8	4	0	2
Sida ovata	Forb	Mokshashat rojal	16	0	8	28	0	14
Acalypha indica L.	Forb	Almabitarba	0	12	6	0	0	0
Xanthium brasilicum vell.	Forb	Rantook	12	0	6	48	12	30
Cyperus rotundus L.	Grass	Sieda	8	4	6	68	0	34
Chloris virgata Sw.	Grass	Abumalhi-korma	0	8	4	12	60	36
Allium vineale	Forb	Basal almarfien	4	4	4	4	0	2
Indigofera hochstetteri Bak.	Forb	Dahasir sharaya	0	8	4	20	8	14
Cyndon dactylon (L.)	Grass	Najila	8	0	4	24	0	12
Cucumis dipsaceus Ehrenb.	Forb	Ajur elghazal	4	0	2	8	12	10
Abutilon pannosum	Forb	Hambouk	0	4	2	0	12	6
Acanthuspermum hispedum	Forb	Horab hawsa	4	0	2	56	100	78
Amaranthus graecizans L.	Forb	Lisan eltiar	4	0	2	0	0	0
Zaleya pentandra (L.)	Forb	Raba	0	4	2	0	0	0
Boerhavia erecta L.	Forb	Shokal elkhil	4	0	2	24	92	58
Cleome gynandra L.	Forb	Tamalika	4	0	2	4	8	6
Kohautia aspera Bremek.	Forb	Um habiba	0	4	2	0	8	4
Euphorbia hirta L.	Forb	Um laban	4	0	2	0	4	2
Rhyanchosia minima (L.)	Forb	Adan alfar	0	0	0	0	32	16
Abelmoschus esculentus L.	Forb	Bamia barry	0	0	0	4	16	10
Eragrostis megastachya	Grass	Banu kabir	0	0	0	40	20	30
Solanum dubium	Forb	Jibben jibben	0	0	0	4	12	8
Portulaca quadrifida L.	Forb	Lagab elhimar	0	0	0	16	96	56
Sesbania arabica	Forb	Surieb	0	0	0	20	52	36
Ipomoea cordofana	Forb	Tabar	0	0	0	0	12	6
Francoeuria crispa Cass.	Forb	Tagar	0	0	0	0	12	6
Farsetia longisiliqua Decne.	Forb	Um adafir	0	0	0	16	28	22

4.2.4 Plant density (plant/ m^2) for the two range sites during the two seasons

Plant density (plant/m^2) for the two range sites (N) and (S) is shown in (Table4. 23).The mean density was159 and 232plants/m^2 for the two sites respectively in season 2015.While in the second season 2016 the plant density was 182 and 161 plants/m^2 respectively. The variations between two seasons at (S) site may be due to rain distribution consequence less plant density in the second season.

The species with highest density for site (N) were *Spermacoce sp. DC.* (80), *Haemanthus multiflorus* (17) and *Achryanthes aspera* (13) plants/m^2. Plant species

with highest mean density for site (S) were *Spermacoce sp. DC.* (64), *Haemanthus multiflorus* (24) and *Eragrostis sp. Koel* (12) plant/m^2.

Table4.23 Plant density (plant/ m^2) for the two range sites during the two seasons 2015 and 2016

Botanical name	Type of plant	Local name	Sites					
			North			South		
			2015	2016	Mean	2015	2016	Mean
Spermacoce sp. DC.	Forb	Mahlab	80	14	47	64	1	32.3
Haemanthus multiflorus	Forb	Gesh elfeel	17	1	9	24	10	17
Digitaria ciliaris (Retz.)	Grass	Shahar elbanat	16	10	13	6	0.2	3.1
Achryanthes aspera	Forb	Abu elrokab	13	0.1	6	1	0.2	0.4
Corchorus trilocularis	Forb	Molokhia	8	1	9	0	0	0
Pennisetum pedicellatum	Grass	Um dofofu	7	25	16	1	0.2	1
Leucas urticifolia	Forb	Um jallout	6	1	3.5	2	2	4
Schoenfeldia gracilis Kunth	Grass	Danab elnaga	5	19	12	1	2	2
Senna obtucifolia	Forb	Kawal	3	2	3	1	1	1
Abutilon spp.	Forb	Erig elnar	2	0.3	1	0.1	0.4	0.2
Setaria acromelaena	Grass	Lissagh	2	16	9	0	1	0.3
Crotalaria saltiana Andr.	Forb	Um tagtaga	2	0.2	1	2	0.1	1.2
Sida ovata	Forb	Mokshashat rojal	1	0	0.5	0.4	0	0.2
Cyperus rotundus L.	Grass	Sieda	1	3	2	73	69	71
Xanthium brasilicum vell.	Forb	Rantook	1	0	0.3	2	0.1	1.2
Crotalaria senegalensis	Forb	Sufera saghira	1	1	0.6	2	1	1.5
Ipomoea sinensis (Desr.)	Forb	Hantout	0.4	0.1	0.1	7	8	7.5
Amaranthus graecizans L.	Forb	Lisan eltiar	0.2	0	0.1	0	0	0
Cyndon dactylon (L.)	Grass	Najila	0.2	0	0.1	1	0	0.5
Dactyloctenium aegyptium	Grass	Abu asabi	0.1	3	2	2	4	3
Cucumis dipsaceus Ehrenb.	Forb	Ajur elghazal	0.1	0	0.1	0.2	0.1	0.7
Abelmoschus esculentus L.	Forb	Bamia barry	0.1	0	0.1	0.1	0.3	0.2
Eragrostis sp. (Koel.)	Grass	Banu	0.1	7	4	12	12	12
Allium vineale	Forb	Basal almarfien	0.1	0	0.1	0.1	0	0.1
Talinum portulacifolium	Forb	Einab barry	0.1	0.1	0.1	0.1	0	0.1
Acanthuspermum hispedum	Forb	Horab hawsa	0.1	0	0.1	6	3	4.5
Oxygonum atriplicifolium	Forb	Lisan elbagar	0.1	4	2	12	8	10
Boerhavia erecta L.	Forb	Shokal elkhil	0.1	0	0.1	4	0	2
Cleome gynandra L.	Forb	Tamalika	0.1	0	0.1	0.1	2	1
Euphorbia hirta L.	Forb	Um laban	0.1	0	0.1	0	0.1	0.2
Chloris virgata Sw.	Grass	Abu malhi, kor.	0	0.3	0.1	1	6	3.4
Rhyanchosia minima (L.)	Forb	Adan elfar	0	0	0	0	1	0.5
Acalypha indica L.	Forb	Almabitarba	0	2	1	0	0	0
Eragrostis megastachya	Grass	Banu kabir	0	0	0	2	0.3	1

Indigofera hochstetteri Ba	Forb	Dahasir sharaya	0	0.3	0.2	1	0.2	0.4
Echinochloa colona (L.)	Grass	Difra	0	2	1	0	0	0
Abutilon pannosum	Forb	Hambouk	0	0		0	0.2	0.1
Cynchrus ciliaris	Grass	Haskanit naim	0	0.3	0.2	2	1	1.1
Commelina kotschyi Hassk	Forb	Ibrig elfaki	0	2	1	0.1	0.1	0.1
Solanum dubium	Forb	Jibben jibben	0	0	0	0.1	0.4	0.2
Portulaca quadrifida L.	Forb	Lagab elhimar	0	0	0	1	7	4
Zaleya pentandra (L.)	Forb	Raba	0	0.1	0.1	0	0	0
Sesbania arabica	Forb	Surieb	0	0	0	0.3	0.1	0.2
Ipomoea cordofana	Forb	Tabar	0	0	0	0	0.1	0.1
Francoeuria crispa Cass.	Forb	Tugar	0	0	0	0	0.2	0.1
Farsetia longisiliqua Decn	Forb	Um adafir	0	0	0	1	1	1
Kohautia aspera Bremek.	Forb	Um habiba	0	0	0	0	0.1	0.04
Total			**159**	**182**	**170**	**232**	**161**	**197**

4.2.5 Biomass productivity (kg/ha) at the two range sites during the two seasons

The biomass productivity (browse and herbaceous) at the two sites is shown in (Table4. 24). The biomass productivity was (2666.2and 1748 kg/ha) in the northern range site (N) for the two seasons respectively, while in the southern range site (S) the productivity was (3236.5 and 3153.**7** kg/ha) for the two seasons respectively. Productivity in the northern site was lower than that in the southern site which may be attributed to the rocky nature of the northern rangeland site that restricts plant growth as a result runoff and poor water infiltration compared with the case in the southern site.

Table4.24 Biomass productivity (kg/ha) at the two range sites

Type of vegetation	Sites					
	North			South		
	2015	2016	Mean	2015	2016	Mean
Herbaceous	2074.1	1133	1603.6	2655.6	2581.3	2618.45
Browse	592.1	615	603.6	580.9	572.4	576.7
Total	**2666.2**	**1748**	**2207.2**	**3236.5**	**3153.7**	**3195.15**

4.3 Carrying capacity in northern and southern range sites during the two seasons

The carrying capacities of herbaceous plants in the two range sites at seed set stage during season 2015and 2016 are presented in (Table4.25). According to Mustafa *et al.* (2000) carrying capacity can be defined as the "maximum animal numbers which can graze each year on a given area of grassland for a specific number of days without inducing a downward trend in forage production, forage quality, or soil".

The carrying capacity in this study was determined according to Darrag, (1996), who reported that the Carrying capacity is usually, determined using the proper use factor (PUF) of 50% in which only one half of forage biomass produced is considered as available for grazing. The carrying capacity in southern site was not different during season 2015and 2016. But in northern site the carrying capacity in season 2016 was lower than that during2015.

Table4.25 Carrying capacity in northern and southern range sites during the two seasons 2015 and 2016

Season	Site	TLU /ha /year	Ha/TLU/year
2015	Northern	0.35	2.90
	Southern	0.45	2.27
2016	Northern	0.19	5.32
	Southern	0.44	2.33
Mean		**0.36**	**3.21**

4.4 Diet selection of goats by plant class at study area

Diet selection by goats according to plant class (forbs, grasses, trees/shrubs) is presented in (Table4.26). Browse constituted 43.66%, forbs 52.68% and grasses 3.67% of the diet. *Fedeherbia albida* was the dominant tree in the diet of goats (18.29%) while *Ipomoea sinensis* was the forb most selected (7.17%) and *Pennisetum pedicellatum* was the most selected among grasses (3.53%).

Table4.26 Diet selection of goats by plant class at north range site (N) during season 2015

Botanical Name	**Type**	**Local Name**	**% in Diet**
Ipomoea sinensis (Desr.)	Forb	Hantout	7.17
Kohautia aspera	Forb	Um hibayha	5.53
Spermacoce sp. DC.	Forb	Mahlab	4.06
Oxygonum atriplicifolium	Forb	Lisan elbagar	3.81
Haemanthus multiflorus	Forb	Gesh elfoul	3.25
Setaria acromelaena (Hochst)	Forb	Lissagh	3.08
Crotalaria senegalensis (Pers.)	Forb	Sufera saghira	3.08
Portulaca quadrifida L.	Forb	Lagab elhimar	2.94
Corchorus trilocularis	Forb	Molokhia	2.62
Commelina kotschyi Hassk.	Forb	Ibrig elfaki	2.59
Abutilon spp.	Forb	Erig elnar	2.8
Talinum portulacifolium	Forb	Einab barry	2.55
Abelmoschus esculentus L.	Forb	Bamia barry	2.52
Achryanthes aspera	Forb	Abu elrokab	1.78
Senna obtucifolia	Forb	Kawal	1.22
Amaranthus graecizans L.	Forb	Lisan eltiar	1.22
Sida alba	Forb	Um shadida	0.74
Leucas urticifolia	Forb	Um jallout	0.7
Acanthuspermum hispedum	Forb	Horab hawsa	0.28
Xanthium brasilicum vell.	Forb	Rantook	0.25
Crotalaria saltiana Andr.	Forb	Um tagtaga	0.21
Boerhavia erecta L.	Forb	Shokal elkhil	0.14
Farsetia longisiliqua Decne.	Forb	Um adafir	0.14
Total forbs			**52.68**

Faideherbia albida	Tree	Haraz	18.29
Ziziphus spina-christi	Tree	Sidir	7.77
Albizia amara.	Tree	Arad	7.66
Acacia nilotica	Tree	Sonot	4.69
Acacia Senegal	Shrub	Hashab	2.48
Grewia tanex.	Shrub	Gidaim	1.5
Calotropes prosera	Shrub	Oshar	0.63
Acacia seyal.	Tree	Taleh	0.35
Combretum cordofanum Engler.	Shrub	Habeel	0.18
Diospyros mespiliformis A.DC.	Tree	Joghan	0.07
Ricinus communis	Shrub	Khirwa	0.04
Total trees/shrubs			**43.66**
Pennisetum pedicellatum	Grass	Um dofofu	3.53
Cynchrus ciliaris	Grass	Haskanit naim	0.07
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	0.07
Total grasses			**3.67**
Grand Total			**100**

Key: Standard error (SE = ±0.5)

In general goats selected more forbs (52.68 %) compared with shrubs/trees (43.66%) and grasses (3.67%) table (4.24). These results agree with Fatur and Fadlalla (2013) who reported that at seed setting stage in a protected rangeland site the diet of goats contained 51.5%forbs, 44.2% browse and 4.3% grasses. Regarding individual speciesour findings revealed that *Faideherbia albida, Ziziphus spina-christi*, *Albizia amara, Ipomoea sinensis Desr, Kohautia aspera* and *Pennisetum pedicellatum* recorded highest percent diet selection (18.29, 7.77, 7.66, 7.17, 5.53 and 3.53 respectively). This shows that these tree species were apogeal by goats even more than other individual forb and grass species. Holechek *et al.* (2004) stated that the browse is an important forage source for goats throughout the year and for sheep during the dry period when herbage was limited.

4.5 Relative preference index of forbs and grasses selected by goats grazing at study area

The Relative preference indices (RPI) of forbs and grasses are presented in (Table4.27). Only forbs showed RPI that place them as preferred or desirable plants. The top of these are *Abelmoschus esculentus L.* 25.2, *Kohautia aspera* 7.9, *Commelina kotschyi Hassk.* 3.7, *Portulaca quadrifida L* 3.68 and *Talinum portulacifolium* 3.64

Table4.27 Relative preference index of forbs and grasses selected by goats grazing at north range site (N) during season 2015

Botanical Name	Type	Local Name	% in Range	% in Diet	RPI	PC
Abelmoschus esculentus L.	Forb	Bamia barry	0.1	2.52	25.2	PP
Kohautia aspera	Forb	Um hibayha	0.7	5.53	7.9	PP
Commelina kotschyi Hassk.	Forb	Ibrig elfaki	0.7	2.59	3.7	PP
Portulaca quadrifida L.	Forb	Lagab elhimar	0.8	2.94	3.68	PP
Talinum portulacifolium	Forb	Einab barry	0.7	2.55	3.64	PP
Setaria acromelaena (Hochst)	Forb	Lissagh	0.9	3.08	3.42	PP
Ipomoea sinensis (Desr.)	Forb	Hantout	3.2	7.17	2.24	PP
Crotalaria senegalensis (Pers.)	Forb	Sufera saghira	1.5	3.08	2.05	PP
Farsetia longisiliqua Decne.	Forb	Um adafir	0.1	0.14	1.4	PP
Oxygonum atriplicifolium	Forb	Lisan elbagar	3.2	3.81	1.19	DP
Sida alba	Forb	Um shadida	0.7	0.74	1.06	DP
Abutilon spp.	Forb	Erig elnar	4	2.8	0.7	DP
Amaranthus graecizans L.	Forb	Lisan eltiar	2.1	1.22	0.58	UP
Boerhavia erecta L.	Forb	Shokal elkhil	0.3	0.14	0.47	UP
Pennisetum pedicellatum	Grass	Um dofofu	8.5	3.53	0.42	UP
Haemanthus multiflorus	Forb	Gesh elfoul	8	3.25	0.41	UP
Achryanthes aspera	Forb	Abu elrokab	5.2	1.78	0.34	UP
Senna obtucifolia	Forb	Kawal	4.4	1.22	0.28	UP
Corchorus trilocularis	Forb	Molokhia	10.4	2.62	0.25	UP
Spermacoce sp. DC.	Forb	Mahlab	17.1	4.06	0.24	UP
Acanthuspermum hispedum	Forb	Horab hawsa	1.3	0.28	0.22	UP
Leucas urticifolia	Forb	Um jallout	3.9	0.7	0.18	UP
Cynchrus ciliaris	Grass	Haskanit naim	0.7	0.07	0.1	UP
Xanthium brasilicum vell.	Forb	Rantook	4.4	0.25	0.06	UP
Crotalaria saltiana Andr.	Forb	Um tagtaga	5.2	0.21	0.04	UP
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	2.9	0.07	0.02	UP

Cucumis dipsaceus Ehrenb.	Forb	Ajur elghazal	0.3	0	0	UP
Allium vineale	Forb	Basal almarfien	0.3	0	0	UP
Zaleyea pentandra	Forb	Rabaa	1.1	0	0	UP
Aristolochia 58ypogeal58te Lam.	Forb	Um jalajil	0.1	0	0	UP
Euphorbia hirta L.	Forb	Um laban	0.7	0	0	UP
Polygala erioptra DC.	Forb	Um saboon	0.3	0	0	UP
Dactyloctenium aegyptium L.	Grass	Abu asabi	0.4	0	0	UP
Eragrostis megastachya (Koel.)	Grass	Banu Abu malih	0.7	0	0	UP
Schoenfeldia gracilis Kunth.	Grass	Danab elnaga	2.7	0	0	UP
Cyperus rotundus L.	Grass	Sieda	1.1	0	0	UP
Brachiaria deflexa	Grass	Um fraw	1.1	0	0	UP
Chloris virgata Sw.	Grass	Um malih	0.6	0	0	UP
Total			100.4	56.35		

Key: PC= Plant classification, RPI= relative preference index, PP= preferred plant (RPI>1.25), DP= Desirable plant (RPI 0.70 to 1.0), UP = undesirable plant (RPI< 0.70). SE = Standard error (±0.5).

Abelmoschus esculentus, Kohautia aspera were highest in (RPI) showing 25.2, 7.9 respectively. These results resemble those of Abdelkreim and Fadlalla (2013) who found that in open range, plants with the highest (RPI) were mainly forbs (*Desmodium* spp. RPI=15.9; *Ipomea eriocapa* RPI=15.7 and *Echniochloa colonum* RPI=5.1. This reflects that goats preferred forbs more than grasses.

4.6 Trees, shrubs density/ha and browse productivity (kg/ha) at both range sites during the two seasons

Trees and shrubs density at the two sites is shown in (Table4. 28). The density was (450 and 470 trees and shrubs/ ha) in the range site (N) for the two seasons respectively, while in the range site (S) the density was (430 and 400 trees and shrubs /ha) for two seasons respectively. Browse productivity was (592.1 and 615 kg/ha) in range site (N) for the two seasons respectively, while in the range site (S) it was (580.9 and 572.4 kg/ha) for the two seasons respectively. The differences between the two range sites were not high in browse productivity.

Table4.28 Trees, shrubs density/ha and their productivity (kg/ha) at the both range sites during the two seasons 2015 and 2016

Statement	Sites					
	North			South		
	2015	2016	Mean	2015	2016	Mean
Trees or shrubs/ plot	45	47	46	43	40	41.5
Browse (kg/ plot)	59.21	61.5	60.36	58.09	57.24	57.67
Trees or shrubs/ha	450	470	460	430	400	415
Browse(kg/ ha)	592.1	615	603.6	580.9	572.4	576.7

4.7 Growth and yield attributes of reseeded species

As stated earlier in chapter three; four plants were studied for growth attributes and biomass yield. Their preference by goats was also assessed during two seasons namely 2016 and 2017 in Western Jebel Marra Locality (WJML). The plants under study were *Dactyloctenium aegyptium,Haemanthis multifolorus, Ipomoea sinensis* and *Crotalaria saltiana*.

4.7.1Effect of competition and seed rate on growth and yield attributes of *Dactyloctenium aegyptium*

The results showed significant differences in plant height between weeded and un-weeded treatments in season 2016. Plants were taller in un-weeded than weeded treatment. No significant differences were observed among treatments on number of tillers, number of leaves per plant and biomass production (kg DM/ha) as shown in table (4.29). These results differed with those of Stephens (1982) who reported that most prostrate or rosette species, e.g. *Capsella bursa-pastoris* (shepherd's- purse), *Galiumaparine* (Cleaves), *Stellaria media* (Common chick weed) may actually be encouraged by mowing. On the other hand no significant

differences were found between all treatments in season 2017. This may return to appropriate establishment to the crop and which compete the weeds vigorously by release large amount of tillers as well as it height was taller than it in the first season (Table4.29) due to the good distribution of rainfall in the second season.

The study revealed no significant differences in all growth and yield attributes due to seed rates during the two seasons (Table 4.29). These results agree with Yunhua Han *et al*. (2013) who reported that seed rate did not affect any of the seed yield and yield components measured of *Leymus Chinensis*.

Table4.29 Effect of competition and seed rate on growth and yield attributes of *Dactyloctenium aegyptium* during seasons 2016 and 2017

Factor	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Biomass(kg DM/ha)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
W	0.48[b]	0.62[a]	6.53[a]	14.08[a]	40.06[a]	60.13[a]	553.8[a]	2493.2[a]
UW	0.55[a]	0.63[a]	6.46 [a]	14.24[a]	33.49[a]	63.13[a]	368.9 [a]	1863.6[a]
Mean	0.52	0.63	6.5	14.16	36.78	61.63	461.4	2178.4
SE±	0.03*	0.08[Ns]	0.51[Ns]	2.01[Ns]	4.43[Ns]	8.02[Ns]	120.1[Ns]	317.1[Ns]
S1	0.50[a]	0.66[a]	6.19 [a]	14.03[a]	34.25[a]	61.27[a]	442.3[a]	2178.0[a]
S2	0.49 [a]	0.60[a]	6.20 [a]	14.79[a]	34.42 [a]	63.56[a]	468.1 [a]	2496.0[a]
S3	0.57 [a]	0.62[a]	7.10[a]	13.66[a]	41.67 [a]	60.06[a]	473.6 [a]	1861.1[a]
Mean	0.52	0.63	6.50	14.16	36.78	61.63	461.3	2178.37
SE±	0.07[Ns]	0.07[Ns]	0.70[Ns]	1.32[Ns]	3.15[Ns]	6.58[Ns]	157.4[Ns]	527.2[Ns]
W×S1	0.45[a]	0.64[a]	5.95 [a]	14.73[a]	34.7[ab]	63.1[a]	580.5 [a]	2808.2[a]
W×S2	0.46 [a]	0.57[a]	6.75 [a]	13.93[a]	43.1[a]	58.6[a]	551.8 [a]	2979.2[a]
W×S3	0.54 [a]	0.65[a]	6.90 [a]	13.58[a]	42.4[a]	58.8[a]	529.0[a]	1692.0[ab]
UW ×S1	0.55 [a]	0.67[a]	6.43 [a]	13.33[a]	33.8[ab]	59.5[a]	304.0[a]	1547.7[b]
UW ×S2	0.51 [a]	0.63[a]	5.65 [a]	15.65[a]	25.7b	68.6[a]	384.5 [a]	2012.7[ab]
UW ×S3	0.60 [a]	0.60[a]	7.30 [a]	13.75[a]	41.0[a]	61.4[a]	418.3 [a]	2030.2[ab]
Mean	0.52	0.63	6.5	14.16	36.8	61.63	461.4	2178.4
SE±	0.08[Ns]	0.11 [Ns]	0.94 [Ns]	2.80 [Ns]	6.3*	11.82 [Ns]	215.4 [Ns]	654.8*

Ns= not significant at P> 0.05, * = significant differences at P ≤0.05, W= Weeded, UW= un-weeded, S1= 2kg/ha seed rates, S2= 4kg/ha seed rates, S3= 6kg/ha seed rates. Treatments with the same letter are not significantly different.

In the present study the interaction between weed control and seed rate during the two seasons was assessed. No significant differences in plant height were found through both seasons, which mean the weed control through hand removal and different seed rates had no effect on plant height. These results agree with Yunhua

Han *et al.*(2013) who reported that seed rate did not affect any of the seed yield and yield components measured. On the other hand results obtained in the current study differed from those achieved by Julia *et al.*(2013)who found that ryegrass plants tiller length in 6 and 12 kg/ha seed rates were larger than those in 18-30 kg/ha treatments.

Tillers or shoots number per plant, were not significantly different among all treatments (Table4.29). These results differed from those obtained by Julia *et al*, (2013)who found that there were more tiller numbers per plant in the 6 and 12 kg/ha treatments than the other treatments, but mean tiller weight was similar for all treatments.

Regarding number of leaves per plant there were significant differences between weeded× 4kg/ha seed rates treatment and un- weeded× 4kg/ha seed rates treatment, where the number of leaves was larger in the first case than in the second which reached 43.1: 25.74 respectively (season 2016).This emphasized that the competition between different plants reduced stem thickness and number of shoots per plant, while the thinning or reduction of some plants (weeding)encouraged the growth in diameter and increased the tillers or shoots number per plant, which reflect positively on total number of leaves in plant. This result agreed with (Harris, 1990) who stated that high seeding rates increase competition between developing seedlings for light, water and nutrients; and reduce plant size and potential survival. This result it is also in line with (USBC, 1996) who reported that, in the United States, average crop yields were depressed by 12% due to weeds. No differences were observed on effect of weed control and different seed rates treatments on number of leaves per plant during season 2017.

The study revealed that there were no significant differences among all the treatments on biomass production (kg DM/ha) in season 2016, but in season 2017significant differences were found between the treatment weeded× 4kg/ha and un-weeded×2kg/ha seed rates on forage production. Since the dry matter yield was larger in weeded× 4kg/ha seed rates treatment, therefore the best method for increasing dry matter yield of *Dactyloctenium aegyptium* plant was to apply the treatment weeded× 4kg/ha seed rates which yielded 2979.2 kg/ha compared with the mean production of the other treatments which was 2178.4kg DM/ha (Table4.29). This result is in line with Stephens, (1982) who stated that there is little scope for preventing weed ingress by increasing seed rates much above this amount (4 kg/ha). Clovers have small seeds and sowing rates of 2- 4 kg/ha are adequate. Also this result agreed with Tollenaar (1994); Rajcan (2001) who stated that competition may occur for water, creating or exacerbating water stress. It may occur for nutrients such as nitrogen, leading to chlorosis, leaf senescence and reduced yields. Also it agreed with Rajcan (2004); Markham (2009) who reported that competition may also occur for light, which may alter plant growth by reducing the quantity or quality of light received.

4.7.2Effect of competition and seed rates on growth and yield attributes of *Haemanthis multifolorus*

No significant effect for hand weed control on *Haemanthus multiflorus* plant height during the two seasons, while differences were found in number of tillers, number of leaves per plant and biomass yield (Table4.30).

Hand mowing of weeds had a positive effect on number of plant tillers or branches per plant and also on number of leaves per plant in 2016 which reflect significant differences among weeded and un-weeded treatments, since these parameters were

higher in weeded treatments. These results resemble those achieved by Abla and Adar (2015) who stated that sowing and weeding significantly affected number of leaves per plant of *Blepharis linariifolia* after 30 days from sowing. No statistical differences were found between weeded and un-weeded treatments on the same parameters in 2017 (Table4.30). Biomass (kg DM/ha) was greater in weeded pattern than un-weeded treatment in 2017, which reached1449 and 1042 kg DM/ha respectively resulting in significant differences. This finding is in line with Walter, *et al.* (1984) who reported that until recently weeds have been controlled by ploughing and disking prior to crop sowing and repeated hand weeding operations carried out by casual labour, the farmer and his family.

Seed rates treatments had an influence just on plant height in season 2016 while no effect was found in season 2017. On the other hand no significant differences were found on tillers/plant or number of leaves per plant according to different seed rates treatments over two seasons. Also seed rates did not affect biomass production (Table4.30).

Table4.30 Effect of competition and seed rates on growth and yield attributes of *Haemanthis multifolorus* during seasons 2016 and 2017

Factor	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Biomass(kg DM/ha)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
W	0.58 ^{a}	0.59^{a}	7.28a	12.81^{a}	152.7a	159.3^{a}	568.2 ^{a}	1449.3^{a}
UW	0.55 ^{a}	0.62^{a}	5.55^{b}	9.58^{a}	89.0^{b}	117.8^{a}	363.6 ^{a}	1042.8^{b}
Mean	0.57	0.61	6.42	11.20	120.9	138.6	465.9	1246.1
SE±	0.06^{Ns}	0.05^{Ns}	0.62*	1.48^{Ns}	12.18*	21.96^{Ns}	104.9^{Ns}	81.92*
S1	0.53^{b}	0.69^{a}	6.43 ^{a}	11.61^{a}	107.8 ^{a}	143.89^{a}	414.6 ^{a}	1145.9^{a}
S2	0.53^{b}	0.54^{a}	6.40^{a}	11.71^{a}	142.1 ^{a}	146.09^{a}	395.6 ^{a}	1259.8^{a}
S3	0.64^{a}	0.59^{a}	6.40 ^{a}	10.25^{a}	112.7 ^{a}	125.68^{a}	587.4 ^{a}	1332.6^{a}
Mean	0.57	0.61	6.41	11.19	120.9	138.55	465.9	1246.1
SE±	0.04*	0.06^{Ns}	0.30^{Ns}	1.07^{Ns}	14.78^{Ns}	13.82^{Ns}	153.7^{Ns}	274.9^{Ns}
W×S1	0.56 ^{a}	0.64^{a}	6.63 ^{a}	14.1^{a}	122.25^{b}	181.58^{a}	457.8 ^{a}	1410.5^{a}

W×S2	0.55 [a]	0.55[a]	7.43 [a]	13.4[a]	187.5[a]	160.35[a]	400.5 [a]	1400.2[a]
W×S3	0.64 [a]	0.58[a]	7.78 [a]	10.9[a]	148.3[a]	135.98[a]	846.3 [a]	1537.3[a]
UW ×S1	0.49 [a]	0.74[a]	6.25 [a]	9.2[a]	93.25[c]	106.20[a]	371.5[b]	881.3[c]
UW ×S2	0.50 [a]	0.53[b]	5.38[b]	10.0[a]	96.65[c]	131.83[a]	390.8 [a]	1119.2[b]
UW ×S3	0.65 [a]	0.60[a]	5.03[c]	9.6[a]	77.1[c]	115.37[a]	328.5[b]	1128.0[b]
Mean	0.57	0.61	6.42	11.19	120.85	138.55	465.9	1246.1
SE±	0.08 [Ns]	0.08*	0.82**	2.10 [Ns]	21.0**	30.24 [Ns]	200.2*	292.6**

Ns= not significant at P> 0.05, * = significant differences at P ≤0.05, **= high significant at P <0.01, W= Weeded, UW= un-weeded, S1= 4kg/ha seed rates, S2= 8kg/ha seed rates, S3= 12kg/ha seed rates, treatments with the same letter are not significantly different.

The hypothesis that plant height is increased at high seeding rates was confirmed in season 2016. These findings are consistent with Snider *et al.* (2012), who reported that in Fairhope site (USDA-ARS / UNL Faculty) plant height increased with increasing seeding rate. In this study seed rates had no effect on number of tillers, number of leaves per plant and biomass production over the two seasons of the study. These results agree with Yunhua Han *et al.* (2013) who stated that seeding rate did not affect any of the seed yield and yield components measured.

The interaction between the different treatments namely: hand weeds control, un-weeded and seed rates had no effect on *Haemanthis multifolorus* height in the first season (2016) while significant differences were found among un-weeded ×4kg/ha seed rate and un-weeded ×8kg/ha seed rates treatment on plant height in season (2017). Also significant differences were found between treatments on number of tillers per plant (Table4.30). Moreover, significant differences were found on number of leaves per plant and biomass productivity due to effect of treatments.

The study revealed that none of the treatments had an effect on plant height in season (2016), while un-weeded involved 4 kg/ha seed rate had a significant effect on plant height in season (2017) which caused differences among it and un-weeded with 8 kg/ha seed rates treatment (0.74 and 0.53m respectively). This result

differed from that obtained by Snider *et al.* (2012) who reported that higher plant densities can sometimes stimulate increases in plant height due to inter-node elongation. Regarding number of tillers or branches per plant; weeded ×12 kg/ha seed rate treatment demonstrated significant differences from un-weeded ×8 kg/ha seed rate and un-weeded ×12 kg/ha seed rate treatments in season (2016) which reach (7.78, 5.38 and 5.03 tillers per plant respectively).This may be attributed to hand weed control more than seed rates. This finding is in line with USBC,(1996) who reported that in the United States, average crop yields were depressed by 12% due to weeds. Also these results were similar to those achieved by Julia *et al.* (2013) who stated that there were more tillers per plant in the 6 and 12 kg/ha treatments than the other treatments (18 and 24 kg/ha), but mean tiller weight was similar for all treatments. On the other hand no effect was found for all treatments on tillers number in the second season (2017). Weeded ×8 kg/ha seed rate treatment had a positive effect on number of leaves per plant more than other treatments in season (2016), which showed significant differences between this treatment and weeded ×4 kg/ha, un-weeded×4 kg/ha, un-weeded×8 kg/ha and un-weeded×12 kg/ha seed rates respectively (187.53, 122.25, 93.25, 96.65 and 77.1 leaves per plant respectively). These results agree with Abla and Adar (2015) who stated that sowing and weeding significantly affected number of leaves per plant of *Blelpharis linarifolia*30 days after sowing. No statistically significant effect was found among all treatments on number of leaves per plant in second season (2017). Weeded ×12 kg/ha seed rate treatment have shown superior results on biomass production than other treatments which caused differences among this treatment and un-weeded ×4 kg/ha and un-weeded ×12 kg/ha seed rates treatments in the first season which reached 846.3, 371.5 and 328.5 kg DM/ha respectively. In the second season the same treatment (Weeded ×12 kg/ha) obtained superiority on biomass yield and revealed highly significant effect between it and un-weeded ×4 kg/ha

treatment. There were also significant differences among this treatment and un-weeded ×8 kg/ha and un-weeded ×12 kg/ha seed rates treatments which reach 1537.3, 881.3, 1119.2 and 1128.0 kg DM/ha respectively. These results resembled those achieved by Donald (1963); Tollenaar (1994) and Rajcan (2001) who stated that weeds compete with crops when they remove a portion of a resource from a shared resource pool, leaving the crop with less of the resource than is needed for optimum growth. Competition may occur for water, creating or exacerbating water stress. It may occur for nutrients such as nitrogen, leading to chlorosis, leaf senescence and reduced yields. These results also resemble those achieved by Stickler and Laude (1960); Steiner (1986); Habyarimana *et al*. (2004) and Wortmann *et al*. (2010) who reported that the effect of seeding rate on yield in sorghum have been inconsistent, where higher seeding rates have been shown to increase dry matter productivity in some instances, and to have no effect on yield in others.

4.7.3Effect of competition and seed rates on growth and yield attributes of *Ipomoea sinensis*

Weeded and un-weeded treatments did not have significant effect neither on plant height, number of tillers per plant nor number of leaves per plant during the two seasons, while weeded treatment positively affected biomass production (Table 4.31).

The hypothesis that biomass production increased when crops were weeded via hand mowing was confirmed in both seasons. These findings are consistent withStephens, (1982) where he stated that some control of erect annual dicotyledonous weeds may be achieved by mowing when their apical parts are above the cutting height. On the other hand weeded and un-weed control

treatments did not show significant effect on plant height, number of tillers per plant and number of leaves per plant in *Ipomoea sinensis*studies. These results are in line with Abla, and Adar (2015) who reported that neither sowing method nor did weeding have significant effect on plant height.

Moderate seed rate (4 kg/ha) treatment significantly affected number of tillers per plant in the second season, while no statistical differences were found among all seed rate treatments on other parameters measured (Table4. 31).

Table4.31 Effect of competition and seed rates on growth and yield attributes of *Ipomoea sinensis* during seasons 2016 and 2017

Factor	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Biomass(kg DM/ha)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
W	2.07 ^{a}	2.42^{a}	5.80 ^{a}	6.44^{a}	254.7 ^{a}	168.3^{a}	439.4^{a}	2178.9^{a}
UW	1.86 ^{a}	2.08^{a}	5.53 ^{a}	5.88^{a}	183.8 ^{a}	137.0^{a}	196.5^{b}	1060.1^{b}
Mean	1.97	2.25	5.67	6.16	219.25	152.66	318.0	1619.5
SE±	0.23^{Ns}	0.16^{Ns}	0.51^{Ns}	0.77^{Ns}	37.04^{Ns}	44.40^{Ns}	67.52*	188.1*
S1	1.89 ^{a}	2.05^{a}	5.36 ^{Ns}	5.61^{b}	194.9 ^{a}	140.5^{a}	341.6 ^{a}	1088.0^{a}
S2	2.13 ^{a}	2.48^{a}	5.73 ^{Ns}	6.70^{a}	244.8 ^{a}	175.9^{a}	297.0 ^{a}	1713.3^{a}
S3	1.88 ^{a}	2.23^{a}	5.90 ^{Ns}	6.18^{a}	218.0 ^{a}	141.5^{a}	315.3 ^{a}	2057.2^{a}
Mean	1.97	2.25	5.67	6.16	219.25	152.65	318.0	1619.5
SE±	0.22^{Ns}	0.26^{Ns}	0.50^{Ns}	0.42*	32.26^{Ns}	15.21^{Ns}	139.2^{Ns}	439.6^{Ns}
W×S1	1.85 ^{a}	2.26^{a}	5.63 ^{a}	6.15^{a}	247.4 ^{a}	170.9^{a}	549.5 ^{a}	1600.0^{ab}
W×S2	2.23 ^{a}	2.54^{a}	5.85 ^{a}	7.00^{a}	261.7 ^{a}	183.5^{a}	374.5 ^{ab}	2109.0^{ab}
W×S3	2.13 ^{a}	2.48^{a}	5.93 ^{a}	6.18^{a}	255.0 ^{a}	150.6^{a}	394.3 ^{ab}	2827.8^{a}
UW ×S1	1.93 ^{a}	1.84^{a}	5.1 ^{a}	5.08^{a}	142.5 ^{a}	110.2^{a}	133.8^{b}	576.0^{b}
UW ×S2	2.03 ^{a}	2.42^{a}	5.6 ^{a}	6.40^{a}	227.9 ^{a}	168.3^{a}	219.5 ^{ab}	1317.5^{abc}
UW ×S3	1.64 ^{a}	1.99^{a}	5.88 ^{a}	6.18^{a}	180.9 ^{a}	132.4^{a}	236.3 ^{ab}	1286.8^{abc}
Mean	1.97	2.25	5.67	6.16	219.23	152.65	318.0	1619.5
SE±	0.35 ^{Ns}	0.32 ^{Ns}	0.80 ^{Ns}	1.03 ^{Ns}	55.7 ^{Ns}	33.53 ^{Ns}	162.0*	496.3*

Ns= not significant at P> 0.05, * = significant differences at P ≤0.05, W= Weeded, UW= un-weeded, S1= 2kg/ha seed rates, S2= 4kg/ha seed rates, S3= 6kg/ha seed rates, treatments with the same letter are not significantly different.

The different seed rates used in this study did not have an effect on *Ipomoea sinensis* height, number of leaves per plant or biomass yield. These results agreed with Yunhua Han *et al.* (2013) who reported that seeding rate did not affect any of the seed yield and yield components measured. This differed with Snider *et al.*

(2012) who stated that in Fairhope site (US) the plant height increased with increasing seeding rate. On the other hand (4 kg/ha) seed rate had a significant effect on tillers increase per plant more than the (2 kg/ha) seed rate treatment which reached: 6.70 and 5.61 tillers/plant respectively. This result is in line with those achieved by Stephens (1982) who indicated that there was little scope for preventing weed ingress by increasing seed rates much above this amount.

The interaction between different treatments did not have an effect on *Ipomoea sinensis* height, number of tillers and number of leaves per plant during the study period. Significant differences were, however, found among weeded ×2 kg/ha seed rate and un-weeded ×2 kg/ha seed rate treatment among biomass production in the first season. Also the same differences were found between weeded ×6 kg/ha seed rate and un-weeded ×2 kg/ha seed rate treatment in the second season (Table4. 31). Hand weeding involving 2 or 6 kg/ha seed rates treatments was superior compared with un-weeded with 2 kg/ha seed rates treatment.

Weeded× 2kg/ha seed rate treatment had significant effect on biomass production as compared with un-weeded× 2kg/ha seed rate treatment in the first season (Table4. 31), where their yield reach approximately 549.5 and 133.8 kg DM/ha respectively. These results express that weeds compete with crops on growth requirements and reduce their yield. This finding resembles the result obtained by Ishag *et al*. (1979) who stated that weed control is one of the most important practices in crop production. In the second season the superiority was for weeded× 6kg/ha seed rate treatment than the other treatments, which exposes significant differences among it and un-weeded× 2kg/ha seed rate treatment in biomass yield where their production reached 2827.8 and 576.0 kg DM/ha respectively. This result is in line with Stickler and Laude (1960); Steiner (1986); Habyarimana *et al*.(2004)and Wortmann *et al*.(2010) who stated that lower seeding rates ranging

from 116,000 to 291,000 seeds ha-1did not significantly impact yields. The study revealed that no effect for interaction was observed between different treatments on *Ipomoea sinensis* height, number of tillers or number of leaves per plant (Table4. 31).These results agree with Yunhua Han *et al*. (2013) who indicated that seeding rate did not affect any of the seed yield and yield components measured.

4.7.4Effect of competition and seed rates on growth and yield attributes of *Crotalaria saltiana*

The results indicated no significant differences among treatments neither on *Crotalaria saltiana* height nor tillers number per plant during the study. But significant differences were found between weeded and un-weeded treatments on number of leaves per plant and biomass production in some instances (Table4. 32).

As shown in table (4. 32) above; weeding and un-weeded did not affect plant height and number of tillers per plant. These results in line with those obtained by Abla and Adar (2015) who stated that neither sowing method nor did weeding had significant effect on plant height. In the first season weeded treatment a statistically significant effect on number of leaves per plant. This result is confirmed by the findings from the same authorise, who stated that sowing and weeding significantly affected number of leaves per plant of *Blepharis linarifolia* after 30 days from sowing. Significant differences were also found between weeded and un-weeded treatments on biomass production in the second season. Weeded treatment was superior by: 2212.1 and 1449.8 kg DM/ha respectively. These results agree with Steiner (1986); De Bruin and Pederson (2008) who stated that higher yields at wide row spacing could be explained by improved light interception and decreased intra-row competition between plants.

Different seed rates treatments did not have an effect on growth and yield attributes of *Crotalaria saltiana* plant in this study (Table4. 32).

Table4.32 Effect of competition and seed rates on growth and yield attributes of *Crotalaria saltiana* during seasons 2016 and 2017

Factor	Parameters							
	Plant height (m)		No. of tillers/plant		No. of leaves/plant		Biomass(kg DM/ha)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
W	104.0^{a}	1.05^{a}	11.02^{a}	8.09^{a}	198.7^{a}	74.45^{a}	2207 ^{a}	2212.1^{a}
UW	97.91 ^{a}	1.05^{a}	10.43^{a}	7.18^{a}	156.8^{b}	55.67^{a}	1567 ^{a}	1449.8^{b}
Mean	100.94	1.05	10.73	7.64	177.75	65.06	1887	1830.95
SE±	5.45^{Ns}	0.07^{Ns}	0.90^{Ns}	0.66^{Ns}	18.24*	9.70^{Ns}	351.1^{Ns}	281.8*
S1	93.1 ^{a}	0.95^{a}	11.3 ^{a}	7.80^{a}	181.3 ^{a}	68.59^{a}	1376 ^{a}	1523.0^{a}
S2	102.7 ^{a}	1.11^{a}	10.23^{a}	7.21^{a}	177.6 ^{a}	53.60^{a}	1985 ^{a}	2129.5^{a}
S3	107.0 ^{a}	1.10^{a}	10.6 ^{a}	7.89^{a}	174.3 ^{a}	72.99^{a}	2300 ^{a}	1840.2^{a}
Mean	100.94	1.05	10.73	7.63	177.75	65.06	1887	1830.9
SE±	7.80^{Ns}	0.12^{Ns}	1.45^{Ns}	0.78^{Ns}	33.05^{Ns}	11.03^{Ns}	593.1^{Ns}	283.2^{Ns}
W×S1	0.89 ^{a}	0.91^{a}	11.5 ^{a}	7.60^{a}	199.3 ^{a}	75.85^{ab}	1706 ^{a}	1853.0^{ab}
W×S2	1.10 ^{a}	1.11^{a}	10.5 ^{a}	7.93^{a}	194.0 ^{a}	64.83^{ab}	2343 ^{a}	2470.7^{a}
W×S3	1.13 ^{a}	1.14^{a}	11.1 ^{a}	8.75^{a}	202.9 ^{a}	82.66^{a}	2572 ^{a}	2312.5^{ab}
UW ×S1	0.97 ^{a}	0.99^{a}	11.2 ^{a}	8.00^{a}	163.4 ^{a}	61.33^{ab}	1046 ^{a}	1193.0^{c}
UW ×S2	0.96 ^{a}	1.10^{a}	9.95 ^{a}	6.50^{a}	161.3 ^{a}	42.37^{b}	1627 ^{a}	1788.3^{ab}
UW ×S3	1.01 ^{a}	1.06^{a}	10.2 ^{a}	7.03^{a}	145.7 ^{a}	63.32^{ab}	2027 ^{a}	1368.0^{b}
Mean	1.01	1.05	10.73	7.63	177.75	65.06	1886.8	1830.9
SE±	1.02 ^{Ns}	0.13 ^{Ns}	1.83 ^{Ns}	1.12 ^{Ns}	39.89 ^{Ns}	16.22*	732.6 ^{Ns}	446.5**

Ns= not significant at P> 0.05, * = significant differences at P ≤0.05, **= high significant at P <0.01, W= Weeded, UW= un-weeded,S1= 10kg/ha seed rates, S2= 20kg/ha seed rates, S3= 30kg/ha seed rates, treatments with the same letter are not significantly different.

This study emphasized that there was no effect of different seed rates treatments on *Crotalaria saltiana* plant height, number of tillers per plant, number of leaves per

plant or biomass production during the two seasons. These results are in line with those achieved by Yunhua Han *et al.*(2013) who reported that seeding rate did not affect any of the seed yield and yield components measured. In contrast Frame and Boyd (1986) and Praat *et al.* (1996) stated that new ryegrass seed is often drilled at 18-30 kg/ha, although previous research indicated that pastures drilled at 10-12 kg/ha can be just as productive.

The different treatments which composed weeded, un-weeded and seed rates showed that there was no interaction with regard to *Crotalaria saltiana* plant height and number of tillers per plant. But the treatment weeded with 30 kg/ha seed rates had a significant effect on number of leaves per plant compared with un-weeded involving 20 kg/ha seed rates treatment in the second season. Also the weeded ×20 kg/ha seed rates had statistically significant effect on biomass yield in the second year compared with the un-weeded ×10 kg/ha and un-weeded ×30 kg/ha seed rates (Table4.32).

The study revealed that interaction between different treatments did not have an influence in *Crotalaria saltiana* plant height and number of tillers per plant. These results indicated that hand weeding and seed rates had inconsistent results; where they sometimes encourage plants to release more tillers while in others they led to reduction in tillers. These results are similar to those found by Stephens (1982) who reported that there was little scope for preventing weed ingress by increasing seed rates much above 15- 25 kg/ha. No difference was observed between treatments in number of leaves per plant in the first season, while weeded ×30 kg/ha seed rates treatment significantly affected number of leaves per plant in the second season when compared with un-weeded ×20 kg/ha seed rate treatment. This finding agreed with Snider *et al.* (2012) who reported that lower seeding rates ranging from 116,000 to 291,000 seeds ha^{-1}did not significantly impact yields.

Weeded ×20 kg/ha seed rates treatment was significantly different from un-weeded ×30 kg/ha seed rates treatment; also highly significant differences were shown between the same treatment and un-weeded ×10 kg/ha seed rate treatment on *Crotalaria saltiana* biomass production in the second season, where their average yield reach 2470.7, 1368.0 and1193.0 kg DM/ha respectively. These results confirmed the importance of weed control in forage production either in rain fed or even in extensive irrigation schemes. The result is in line with that achieved by Ashton (1991) who stated that weeds are herbaceous plants growing in places where they are not wanted and interfering with the growth of the desired crop; they sometimes reduced its harvesting quality if allowed to remain. Moreover, weeds invade sites where competing vegetation has been destroyed. Also weeds represent an economically important challenge for crop production. It is believed by many author that higher seed rates can increase biomass production in some cases, where Stickler and Laude (1960); Steiner (1986); Habyarimana *et al*. (2004) and Wortmann *et al*.(2010)stated that the effect of seeding rate on yield in sorghum have been inconsistent, where higher seeding rates have been shown to increase dry matter productivity in some instances, and to have no effect on yield in others.

4.8 Reseeded species chemical analysis

4.8.1Chemical analysis of different plants under study

Proximate crude protein, crude fiber, ash, carbohydrate, ether extract and moisture content of the target species in this study is shown in (Table4.33). *Haemanthus multiflorus* was higher in crude protein content 17.95%, while *Dactyloctenium aegyptium* had protein content 10.45% this variation may return to species diversity.

Table4.33 Chemical analysis of different plants under study

Species	CP%	CF%	Ash%	CHO%	EE%	MC
Dactyloctenium aegyptium	10.45	31.8	9.48	40.00	2.0	5.62
Haemanthus multiflorus	17.95	29.3	12.3	34.47	2.2	5.83
Ipomoea sinensis	15.83	21.17	11.67	44.25	2.5	6.23
Crotalaria saltiana	14.22	22.2	7.67	48.11	2.4	7.3

CP= crude protein, CF= crude fibre, CHO= carbohydrate, EE= ether extract, MC= moisture content.

The results revealed that the nutritional value of *Dactyloctenium aegyptium* (CP= 10.45%) resembled those found in millet by Ibrahim *et al.* (2014). Those authors found that crude protein is a significant component of forage quality because quality of forage is better when the level of crude protein contents was high in it. Also the same authors found that the effect of millet cultivars, harvesting times and their interactions were significant,t he cultivar "Cargal" harvested at 30(DAS) produced statistically higher crude protein (9.66%), while the cultivar "Akbar" keeping the same value with "Goldan" each harvested at 30 DAS produced 9.40% and 9.36% crude protein, respectively. The cultivar "Goldan" was statistically similar with "Pak Afgoi", when it was harvested at 30 DAS. The lowest crude protein was recorded in "**Neelam**" (7.73%) when it was harvested at 60 DAS. On the other hand it was found that *Haemanthus multiflorus*had 17.95, 29.3, 12.3, and 2.2% CP, CF, Ash and ether extract respectively. These compositions it is resample to those showed by (Kearl 1982) who reported that proximate CP, CF, Ash and ether extract of *Medicago sativa* were 18.1, 30.2, 11.5 and 2.5 % respectively. While the *Ipomoea sinensis* and *Crotalaria saltiana* were showed 15.83 and 14.22% crude protein respectively.

4.8.2 Macronutrient composition of the plants under study

The macro nutrients are great important in ruminants feed which stimulate forage intake, since the deficiencies of some specific nutrient such as N, P and Ca reduce food intake(Table4. 34).The high quality forage must have high intake, digestibility, and efficiency of utilization (Linn and Martin, 1999).

Table4.34 Macronutrient composition of the plants under study

Species	**Macronutrients**					
	K%	**Na%**	**Ca%**	**Mg%**	**P%**	**N%**
Dactyloctenium aegyptium	1.80	0.06	0.5	0.66	0.29	1.67
Haemanthus multiflorus	2.24	0.06	0.5	0.72	0.26	2.87
Ipomoea sinensis	1.58	0.062	0.5	0.72	0.39	2.53
Crotalaria saltiana	1.64	0.055	0.5	0.66	0.24	2.28

The study revealed that *Dactyloctenium aegyptium* contained 1.80, 0.06, 0.5, 0.66, 0.29 and 1.67 K, Na, Ca, Mg, P and N respectively. *Haemanthus multiflorus* was indicated 2.24, 0.06, 0.5, 0.72, 0.26, and 2.87 K, Na, Ca, Mg, P and N respectively. *Haemanthus multiflorus* macro nutrients compositions were similar to those stated by Kearl (1982) who found that *Medicago sativa* had 2.05, 0.08, 1.07, 0.34, 0.25 and 2.90% (k, Na, Ca, Mg, P and N, respectively. While *Ipomoea sinensis* was showed 1.58, 0.062, 0.5, 0.72, 0.39 and 2.53 k, Na, Ca, Mg, P and N, respectively. *Crotalaria saltiana* had 1.64, 0.055, 0.5, 0.66, 0.24 and 2.28 K, Na, Ca, Mg, P and N, respectively.

4.9 Preference of reseeded species by goats using bite count during the two seasons

At the first season (2016) *Ipomoea sinensis* was more selected by goats 42.96 % then *Haemanthus multiflorus* 26.22%. In the second season (2017) both species showed similar value in diet selection by goats grazing which reached31.27 and31.81 in percent respectively. While it was found that lowest % in diet selection during the seasons represented by *Dactyloctenium aegyptium*7.76 and 9.8% respectively (Table4.35).

Table4.35 Preference of reseeded species by goats using bite count during the two seasons 2016 and 2017

Species	% in diet		Mean
	2016	2017	
Dactyloctenium aegyptium	7.76	9.8	8.78
Haemanthus multiflorus	26.22	31.81	29.02
Ipomoea sinensis	42.96	31.27	37.11
Crotalaria saltiana	23.06	27.12	25.09
Total	100	100	100

The results showed that *Ipomoea sinensis* plant was more selected by goats at the first season; these may return to their chemical composition which contains 15.83% crude protein (Table4. 33). Since this ratio it was higher than those found in *Dactyloctenium aegyptium* and *Crotalaria saltiana* 10.45 and 14.22 % crude protein respectively. This result is in line with Papachristou *et al*. (2005) who reported that Goats select a diet higher in CP 17% content and more digestible in shrub land, goats also consumed large amounts of browse in the dry and wet period of the year but sheep only consumed large amounts of browse during the dry

season when tree leaf litter was a major component of available forage. However during the dry season browse CP content did not meet animal requirement. Also it is believed by Illius *et al.* (1999) that rate of food intake and diet selection control the amount of nutrient and energy ingested by herbivores. In the second season *Haemanthus multiflorus* and *Ipomoea sinensis* was showed similar values in diet selection beyond them was *Crotalaria saltiana* then *Dactyloctenium aegyptium* 31.81, 31.27, 27.12 and 9.8% in diet selection respectively. This preferred mean that goats animal favourites' forbs more than grasses, since *Haemanthus multiflorus, Ipomoea sinensis* and *Crotalaria saltiana* are classified as forbs either the *Dactyloctenium aegyptium* is considered form cereals or grasses. These findings it is agreed with Dove (1996) who showed that Herbivores select their diets from a range of plant species and plant parts that differ in their physical and chemical attributes. Also it was confirmed with Holechek *et al.* (2010) who stated that leaves from forbs and shrubs are generally higher in protein than are grass leaves and stems at comparative stages of growth. Protein is often used as an indicator of forage quality because it is typically in short supply and is easy to measure.

Chapter Five

Conclusion and Recommendations

5.1 This study concluded that

- The moderate seed rates (4kg/ha) involving weeds reduction treatment encouraged greater biomass production (551.8 and 2979.2kg DM/ha) during the two seasons respectively for *Dactyloctenium aegyptium.*
- weeded with 12 kg/ha seed rate treatment demonstrated significant differences; since it increased number of tillers per plant in season (2016) as well as it was shown superior results on biomass production for *Haemanthus multiflorus*
- Hand weeding involving 2 kg/ha seed rates treatments was superior than other treatments in biomass production of *Ipomoea sinensis*
- Weeded with 20 kg/ha seed rates treatment was showed higher yield for *Crotalaria saltiana*.
- The species with highest % composition were *Spermacoce sp.* (17.1%) and *Corchorus trilocularis* (10.4%) in the north range site. While for the south range site these were *Spermacoce sp.* (15.8%) and *Ipomoea sinensis* (11.2%).
- Rocks were more in the north site than south one (8.46% v 0.11%).
- *Faideherbia albida* is the dominant tree in the diet of goats (18.29%) while *Ipomoea sinensis* is the forb most selected (7.17%) and *Pennisetum pedicellatum* was the most selected among grasses (3.53%).

- The study was also covered preference of reseeding species by goats grazing under cut and carry system; since *Ipomoea sinensis* plant was more selected by goats at the first season 42.96% as compared to *Dactyloctenium aegyptium* and *Crotalaria saltiana* which recorded7.76 and 23.06% respectively.

- Herbaceous botanical composition for both range sites north (N) and south (S); it was found that forbs were more than grasses at study area reaching 82.9 and 78.3 % for the two sites respectively; while grasses composition was 17.44 and 21.52 % respectively.

- The biomass productivity (browse and herbaceous) was (2666.2and 1748 kg/ha) in the northern range site (N) for the two seasons respectively, while in the southern range site (S) the productivity was (3236.5 and 3153.**7** kg/ha) for the two seasons respectively.

- Most of livestock raisers 88.2 % stated that they store forages or straw for dry season. The most plants or forage keeping as forage in dry season were *Dactyloctenium aegyptium* (Abu asabi) and sorghum crops.

- The majority of respondents utilize range land all year.

- The study revealed that most of livestock raisers were illiterate 55.3% while graduates were only 2.4% of the respondents.

5.2 Recommendations

- Application of weeding and a seed rate of (4 kg/ha) is recommended for *Dactyloctenium aegyptium L,*
- Weeding plus (12 kg/ha) seed rate is recommended for *Haemanthus multiflorus.*
- Weeding combined with (2 kg/ha) seed rate is recommended for *Ipomoea sinensis.*
- Weeding concomitant with (20 kg/ha) seed rate is recommended for *Crotalaria saltiana* establishment in study area.
- Agrosilvo-pastoral system is recommended for natural rangeland conservation.
- Compulsory education must be applied in all community stratums in order to consolidate awareness activities and to avoid ethnic problems.
- More studies should be done regarding weed control and seed rates for accreditation.

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Appendixes

بسم الله الرحمن الرحيم

جامعة السودان للعلوم والتكنولوجيا

كلية علوم الغابات والمراعي

قسم علوم المراعي

استبيان جمع معلومات لغرض علمي

المعلومات العامة

1. السكن:.....
2. القبيلة:.....
3. النوع: ذكر ( ) انثى ( )
4. العمر: اقل من 20 سنة ( )، من 21-40 ( )، من 41-60( )، اكثر من 60 ( )
5. مستوى التعليم: امي ( )، خلوة ( )، اساس ( )، ثانوي( )، جامعي ( )، فوق الجامعي ( )
6. المصدر الرئيسي للدخل: زراعة ( )، تجارة ( )، تربية حيوان ( )، مرتب ( )، اخرى ( )

نمط الاستخدام

1. هل انت: مستقر ( )، شبه مستقر ( )، مترحل ( )
2. طرق استخدام المرعى: استخدام طول العام ( )، استخدام لفترة محددة ( )
3. مكان رعي الحيوانات ؟

	حول الدامرة	مكان بعيد من الدامرة	الاثنين معا
عند موسم الامطار			
عند موسم الجفاف			

4. هل توجد نباتات (مخلفات محاصيل، مراعي طبيعية، محاصيل زراعية) تحفظ في الصيف كعلف للحيوانات؟ نعم ( )، لا( )
5. اذا كانت الاجابة بنعم ماهي تلك النباتات؟

.....

.....

استخدام المرعى

1. ما هي النباتات الجيدة والاكثر استساغة للحيوان؟.....

.....

2. ما هي النباتات الغير جيدة والغير مستساغة للحيوان؟.....

.....

3. ما هي النباتات المنقرضة أي المتناقصة؟.....

4. ما هي النباتات الجديدة في المنطقة؟:.....
5. هل توجد نباتات سامة في المنطقة؟ نعم ( )، لا( )
6. اذا كانت الاجابة بنعم ما هي؟ .....
7. ما الشجيرات الجيدة للحيوان؟.....
8. ما الشجيرات الغير جيدة للحيوان؟.....
9. ايهما افضل المرعى السابق ( ) ام الحالي ( ) ولماذا.....
10. هل الكلأ في المرعى الطبيعي كافي لتغذية الحيوان؟ نعم ( )، لا( )
11. اذا كانت الاجابة بلا هل السبب: كثرة الحيوانات( )، قلة المرعى ( )، الحرائق ( ) ، الزراعة( )، اخرى( )

الحيوان

1. هل تعطي الحيوان؟ ملح( )، عطرون ( )، الاثنين معا( )
2. ما هي انواع الحيوانات التي تقوم بتربيتها وعددها؟

	الابقار	الماعز	الضأن	الجمال	اخرى
النوع					
العدد					

3. الكثافة الحيوانية بالمرعى: عالية ( )، مناسبة( )، قليلة( )

المشاكل المرتبطة باستخدام المرعى:

1. هل هنالك تدهور في المراعي؟ نعم ( )، لا( )
2. اذا كانت الاجابة بنعم ما نوع التدهور؟ زحف صحراوي( )، رعي جائر ( )، حرائق( )، توسع زراعي( )، اخرى حدد( ).....
3. هل تواجه مشاكل مع الرعاة وغير الرعاة اثناء الرعي: نعم ( )، لا( )
4. اذا كانت الاجابة بنعم ما هي؟.....
5. هل الحرائق بالمرعى: كثيرة ( )، متوسطة ( )، قليلة ( )
6. توفر مياه شرب الحيوان: متوفرة ( )، قليلة( )، قليلة جدا( )