Wisdom at the source of the Blue Nile

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Scientific Community Debates on Causes and Consequences of Global Warming: Review

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Abstract: *Global warming is a most burning topic gained the attention of many social thinkers such as scientists, policy makers, environmentalists, researchers and student worldwide. It is the increase of the average temperature on the Earth. The root cause for the increase of the temperature is global warming. As the Earth is getting warmer, disasters like hurricanes, disease and injury of heat waves, droughts, storms and floods are getting more frequent. Over the last 100 years, the average air temperature near the Earth's surface has risen by a little less than 1^0C. The causes and consequences of global warming on the Earth`s environment have been reviewed in the present study. The controversy between scientists on the causes of global warming may be natural or may be caused by human interference. The natural causes were atmospheric carbon dioxide (CO_2), Volcanic Eruptions, the dynamic system of the Earth, Sun, and Cosmos. Human activities have been emitting extra greenhouse gases, which were mostly resulted from burning of fossil fuels (like coal, oil and gas). Urbanization and associated human activities like industrialization and use of cars, deforestations and land use changes and etc. have been identified as human-induced causes of global warming. About 97% of climate experts believed that human-activities are the major causes of global warming. Generally, global warming is affecting rainfall, shrinking of the ice sheets, increasing average temperature, affecting plants and animals, rising sea level and shifting seasons.*

Keywords: Atmosphere, Carbon dioxide, Fossil fuels, Greenhouse gases, Increase temperature

1. Introduction

Currently, there are growing concerns about global warming and its impacts on people and the ecosystems on which they are depended. Global warming, which is the increment of the average temperature on globe (Smitha, 2011). According to Smitha (2011), the average air temperature near the Earth's surface has risen by a little less than one degree Celsius over the last 100 years where global warming is the cause while climate changes are its immediate effect. Climate change refers to any significant long-term changes in the expected patterns of the average weather of a given region or the whole Earth over a significant period of time. It is about non-normal variation to the climate, and the effects of these variations on other parts of the Earth. The long term changes may take tens, hundreds or perhaps millions of years. The word "weather'' points out to the short term (daily) changes in temperature, wind, and/or precipitation of an arena (Merritts *et al*.,1998). Experts often prefer to speak about climate change rather than global warming, as a result of higher global temperatures doesn't necessarily mean that it will be warmer at any given time at every place on globe (Smitha, 2011). Warming is strongest at the Earth's Poles, the Arctic and the Antarctic, and will continue to be so (Smitha, 2011). Melting ice is the most visible impact of the warming climate. Due to the thermal expansion of the ocean, sea levels are rising; in addition to melting of land ice. Changes in temperature and precipitation patterns increase the frequency, duration, and intensity of other extreme weather events, such as floods, droughts, heat waves, and tornadoes (Trenberth, 2005). Other effects of global warming include lower agricultural yields (Regmi, 2007), further glacial retreat, reduced summer stream flows, species extinctions (Paudel, 2012).

Global warming is one of the current most popular and controversial topics among scientists and other stakeholders. The controversy involved almost every aspects of global warming, including its causes, consequences and even whether the global

warming has really happened. The objective of this paper is therefore to review the causes and consequences of global warming on Earth`s environment which are currently discussed by different scientists and organizations who are working in this respect.

2. Scenario of Global Warming

The continuous rise in temperature of the planet is really upsetting. The root cause for this is global warming. Global warming begins when sunlight reaches the Earth. The clouds, atmospheric particles, reflective ground surfaces and surface of oceans then sends back about 30 % of sunlight back into the space, whilst the remaining is absorbed by oceans, air and land (Shahzad, 2015). This consequently heats up the surface of the planet and atmosphere, making life feasible. As the Earth warms up, this solar energy is radiated by thermal radiation and infrared rays, propagating directly out to space thereby cooling the Earth. However, some of the outgoing radiation is re-absorbed by carbon dioxide, water vapors, ozone ground level, methane and other gases in the atmosphere and is radiated back to the surface of Earth.

These gases are commonly known as greenhouse gases due to their heat-trapping capacity. The concentration of greenhouse gases in the atmosphere was artificially increased by humankind at an alarming rate since the past two centuries (Shahzad, 2015). This is due to burning of fossil fuels which increase the amount of greenhouse gases (carbon dioxide, methane and oxides of nitrogen) present in the atmosphere.

There are many greenhouse gases which are mainly emitted by human activity (Guggenheim, 2006). The first and foremost in the list is carbon dioxide. Excessive burning of fossil fuels like coal and oil is the major factor for producing this gas. Moreover, deforestation i.e. removal of trees for acquiring lands also causes large amount of carbon dioxide in the atmosphere. Living plants store carbon dioxide. When those plants die and decay, carbon dioxide is released back into the atmosphere. As forests and grasslands are cleared for your use, enormous amounts of stored carbon enter the atmosphere. Cement manufacture also contributes carbon dioxide to atmosphere when calcium carbonate is heated generating lime and carbon dioxide.

The second culprit gas is methane, commonly known as natural gas. It is produced as a result of agricultural activities such as livestock digestion, paddy rice farming and use of manure. Methane is also produced due to improper management of waste. Nitrous oxides are generated mainly by fertilizers. Moreover, fluorinated gases such as chlorofluorocarbons (CFCs) are chiefly a result of various industrial processes and refrigeration (Shahzad, 2015)

3. Causes of Global Warming

There are literally thousands of scientists who are working on the causes of global warming around the world. However, no one can really prognoses what will be the climate looks like in the coming 50 or 100 years' time (Goel and Bhatt, 2012). Generally, there are real uncertainties among the scientists that rapid climate change will have dramatic impacts on life on earth. Over the last 10,000 years, the earth has experienced a very stable climate and life has adapted to it (Goel and Bhatt, 2012). Recently, however, the earth has experienced an overall increase in temperature changes and many scientists now believe that there is a direct link between this warming and the causes of the warming.

Although the cause of global warming is the controversial, various scientists summarized in to two main categories which are natural or may be caused by human interference (Goel and Bhatt, 2012).

3.1. Natural causes of climate change

According to Endersbee (2008), climate change is a characteristic feature of the dynamic system of the Earth, Sun, and Cosmos. The major driving forces causing climatic variations on Earth are the variations in the full spectrum of radiation of the Sun, the variations in the orbit of the Earth around the Sun, the varying gravitational influence of the larger planets on the Sun, and the influences of cosmic radiation on both the Sun and the Earth. According to Wang and Chameides (2007), the thermodynamics of warming of the Earth's lower atmosphere must arise from one or more processes that supply excess heat to the lower atmosphere. The greenhouse effect is the results of the increased output from the sun, the increased absorption of heat from the sun due to changes in the Earth's planetary reflectivity or "albedo" and an internal variation in the climate system that transfers heat

from one part of the Earth to the atmosphere (Wang and Chameides, 2007). Direct observations confirm that none of these explains the observed warming over the latter half of the 20th century as indicated in Figure 1 where no appreciable change in solar output over the past two decades has been observed.

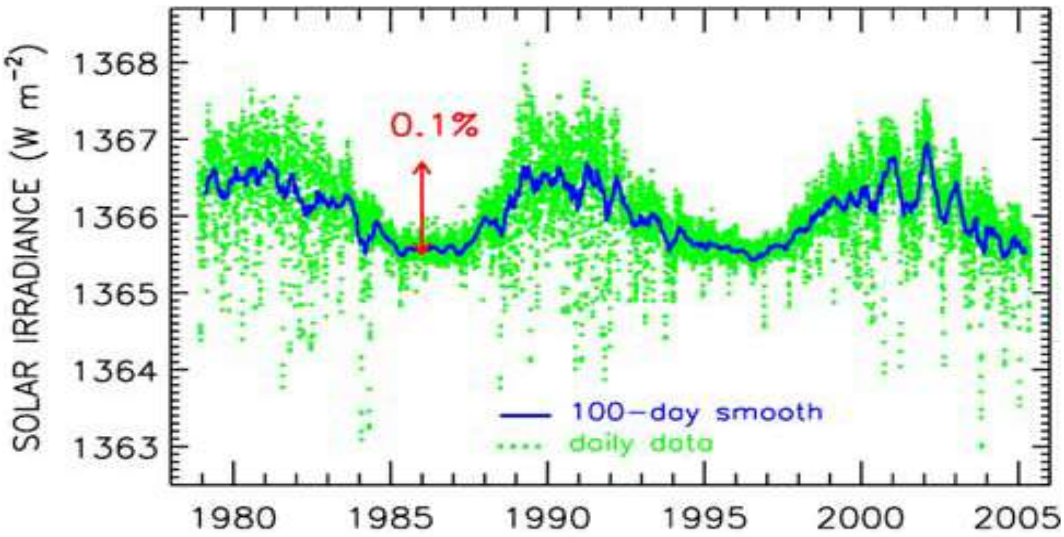

Figure 1. Change in solar output from 1980 to 2005
Source: Lean and Froelich (2006)

According to Wang and Chameides (2007), satellite data reveal that the Earth's reflectivity increased in the '60's, '70s, and early '80s and has decreased modestly since which causes cooling instead of warming. The overall warming from the recent decrease in reflectivity is also small compared to the greenhouse warming. The amount of heat stored in the ocean over recent years matches the amount of heat that the models predicted be trapped on Earth due to an increase in greenhouse gases (Hansen *et al*., 2005).

Volcanic eruptions, one of the natural causes of climate change, may also contributed to global warming as a source of carbon dioxide. In this regard, Chhatwal (2009) claim that Mount Etna, an active but at present a relatively subdued volcano in Sicily, adds about 25 million tons of carbon dioxide to the atmosphere of the entire region around the volcano and concluded that the nature by itself has a great contribution for CO_2 accumulation in the atmosphere not the human activities.

3.2. Global warming caused by human activities

Several studies have surveyed climate scientists who are actively publishing climate research. Each study found the same answer - over 97% of climate experts are convinced humans are changing global temperature (Doran and Zimmerman, 2009; Anderegg *et al*., 2010), which includes dependence on fossil fuels, urbanizations, deforestation, land use change and others.

A survey of all peer-reviewed research on the subject 'global climate change' published between 1993 and 2003 found that among the 928 papers found, not a single paper rejected the consensus position that human activities are causing global warming (Oreskes, 2004), surveying members of the relevant scientific community (Bray and von Storch, 2007; Doran and Zimmerman, 2009; Bray, 2010; Rosenberg *et al*., 2010; Farnsworth and Lichter, 2012; Stenhouse *et al*., 2014; Verheggen *et al*. 2014; Carlton *et al*., 2015), compiling public statements by scientists (Anderegg *et al*., 2010), and mathematical analyses of citation patterns (Shwed and Bearman, 2010).

Burning of fossil fuels is the main source of human-caused greenhouse gas emissions. According to Marland *et al*. (2009), however, carbon dioxide (CO_2) emissions sourced from the human activities are tiny compared to natural emissions. Natural emissions add up to 776 billion

tons of CO_2 per year (IPCC, 2007). On the other hand, nature doesn't just emit CO_2 but also absorbs CO_2. Plants for example breathe in CO_2 and the huge amount of CO_2 is dissolved into the ocean. Generally, nature absorbs about 788 billion tones of CO_2 every year (Lastovicka *et al.,* 2006) which roughly balanced the CO_2 emitted naturally.

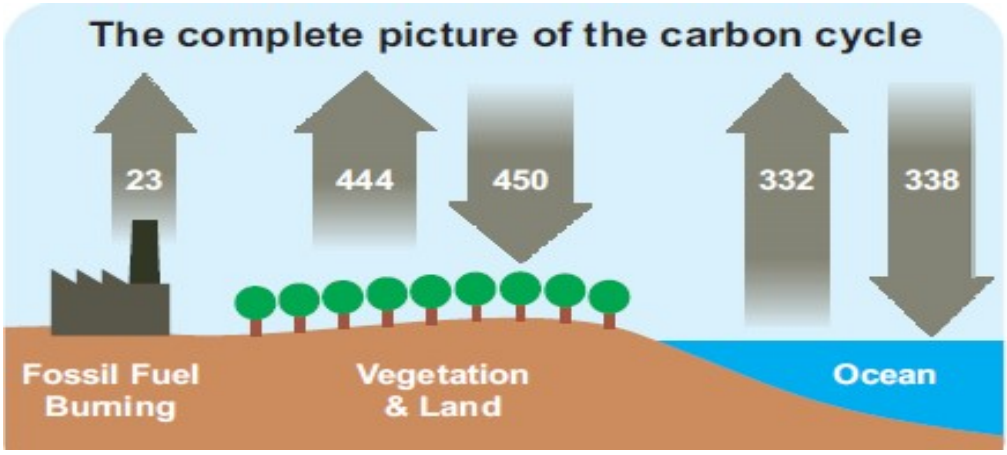

Figure 2. Carbon Cycle for the 1990s

Source: Lastovicka *et al*. (2006): Numbers are in billions tones of CO_2

The activity of the human being like fossil fuel burning on the other hand upsets the balance between emission and absorption of CO_2. While some of the CO_2 emitted from human activities is being absorbed by the ocean and land plants, around half of the emitted CO_2 remain in the air which disturbs the balance between emission and absorption. In this regard, Tripati (2009) expressed that because of burning of fossil fuels, atmospheric CO_2 is currently at its highest level in the last 2 million years which will increase in the future.

Continuation of human-induced CO_2 emissions may cause devastating rise in temperature in the future. According to Luterbacher *et al*. (2004), human-caused global warming may have already doubled the chance of "killer" heat waves like the one that scorched Europe in July–August 2003 which was the hottest summer in Europe in the past 500 years.

Urbanization and associated human activities in the cities are also the other sources of global warming which affect the urban environments worldwide. Heat released from various industries, households and cars contributed to artificial warming of the earth's environment (Goel and Bhatt, 2012). Moreover, the release of greenhouse gases from industries and cars in the cities have significant influences on our environment and contributed to global warming.

The magnitude of urban warming is highly variable over both time and space. On average, urban temperatures may be 1–3°C warmer, but under appropriate meteorological conditions (calm, cloudless nights in winter) air temperatures can be more than 10°C warmer than surrounding rural environments (Oke, 1981). However, in some regional settings, for example in arid environments, cities with large amounts of irrigated greenspace (parks, suburban vegetation) may actually be cooler than the surrounding dry areas (Grimmond *et al.,* 1993).

Deforestation and land use change are the other human activities that contribute to global warming worldwide. The fact that forests store massive amounts of carbon destroying such forests for farming and other purposes facilitate the release of carbon into the atmosphere which accelerates climate change. According to Bennett (2017), about 25% the world greenhouse gas production is contributed from deforestation alone. About 24% of the human-induced greenhouse gases are CFCs (Chloro-Fluoro-Carbons) as indicated by Goel and Bhatt (2012) which deplete the ozone in the stratosphere. Land-use changes are among the primary forcing of climate change, both at regional and global scales (Avissar and Werth, 2005), among others. Similarly, climate changes can impact the current global vegetation distribution and will further modify it in the future (Salazar *et al*., 2007).

4. Consequences of Global Warming

4.1. Fertilizer effect of carbon dioxide

The fact that plants require CO_2 to prepare their food, some argue that emission of CO_2 is a good thing. However, they ignore the fact that plants rely on more than CO_2 to survive. According to Challinor *et al.* (2010) the fertilizer effect of CO_2 is limited and will be quickly overwhelmed by the negative effects of heat stress and drought, which are expected to increase in the future. Over the past century, drought severity has increased globally and is predicted to intensify in the future (IPCC, 2007). Plants cannot take advantage of extra CO_2 supply if they are dying of thirst from drought and other stressing factors (Zhao and Running, 2010).

4.2. Effects on plants and animals survival

Each plant and animal species have specific temperature ranges for their survival and development. As the results of warming temperature, many species of plants and animals are already moving their range northward or to higher altitudes. They are in most cases migrating from the equator toward the poles following the ranges of comfortable temperatures as the global average temperature warms. This becomes a problem when the rate of climate change velocity is faster than the rate that many organisms can migrate. Warmer temperatures will also expand the range of many disease-causing pathogens that were once confined to tropical and sub-tropical areas, killing off plant and animal species that formerly were protected from disease (Alina and Stephanie, 2017). These and other effects of global warming, if left unchecked, will likely contribute to the disappearance of up to one-half of Earth's plants and one-third of animals from their current range by 2080 (Warren *et al*., 2013).

Oceans are absorbing much of the CO_2 in the air, which leads to ocean acidification (Hoegh-Guldberg *et al*., 2007). This is predicted to have severe destabilizing effects on the entire oceanic food-chain, on top of the negative effects of coral bleaching from warming waters (Hoegh-Guldberg *et al*., 2010). An estimated one billion people depend on the ocean for a substantial portion (>30%) of their animal protein (Tibbets, 2004).

4.3. Melting of ice

Increasing atmospheric temperatures in the last years caused melting of ices in the North Pole which in turn increases the sea level and storm activity that affected millions of people in the world (Goel and Bhatt, 2012). As glaciers and snowfields dwindle, so does the water supply for millions of people who are deeply reliant on those freshwater supplies, especially for irrigated agriculture (Immerzeel *et al*., 2010). Moreover, rice paddies are inundated with salt water, rivers are contaminated with seawater, aquifers become polluted and populations are displaced. This will force many millions of people to move inland that may increase the risk of conflict (Dasgupta, 2007).

Some studies have even suggested the possibility that warming over the next several centuries would lead to the complete, irreversible dis-appearance of the Greenland ice sheet, which would raise sea level by an extra 7 m, there is also a slight chance that the West Antarctic Ice Sheet could collapse, further raising sea level by 4–6 m (Gregory *et al*., 2004).

4.4. Increase in average temperatures and temperature extremes

One of the most immediate and obvious effects of global warming is the increase in temperature around the world. According to the National Oceanic and Atmospheric Administration (NOAA, 2017), the average global temperature has increased by about 1.4 degrees Fahrenheit over the past 100 years. However, the impacts of the increased temperature differed with the developmental stages of the country. According to Goel and Bhatt (2012), the developing countries are twice at risk to climate change compared to industrialized countries, while small Island states are thrice at risk. In 2007, IPCC drew estimates from projects reports, the increase of average global temperatures that will range from 1.4^0C to 5.8^0C by the 2100. Global warming may also lead to extreme weather other than cold or heat extremes. In the United States, Chicago experienced one of the worst weather-related disasters in Illinois history when a heat wave resulted in 525 deaths during a 5-day period in July of 1995 (Kunkel *et al*., 1996). Another example, hurricane formations will change. Though this is still a subject of active scientific research, current computer models of the atmosphere indicate that hurricanes are more likely to become less frequent on a global basis, though the hurricanes that do form may be more intense **(**Alina and Stephanie, 2017).

5. Conclusions

Global warming is currently one of the most popular and controversial topics among scientists where most of the scientists are argued about its happening the globe. Over 97% of the climate experts are convinced that human activities are changing the global temperature. There is consensus of evidence that human activities are the main causes of increased carbon dioxide level in the atmosphere which causes warming of the atmospheric temperature. Moreover, burning of fossil fuels is the main source of carbon. Measurements from satellites indicated that less heat is escaping to space while more heat returns to Earth surface that causes warming. Global warming is affecting shrinking ice sheet, rising sea level, as well as causes extinction of plants and animals. The human causes and its consequences of global warming are not just a consensus of scientist; there is also a harmony of confirmation. People throughout the world must collaborate and work together to mitigate global warming and seek an appropriate adaptation strategies to fight global warming.

Conflicts of Interests

The authors declared that there is no conflict of interests.

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Performance of Boer and Woyto-Guji Crossbred F1 Goats (50%) under Semi-Intensive Management System in Konso District, South Ethiopia

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Abstract: *The study was undertaken to evaluate at on-station growth and reproductive performance of F1 crossbred Boer-Woyto Guji goat kids reared under semi-intensive management system in Konso district, south Ethiopia. A total of 57 F1 crossbred kids were used to evaluate two independent variables: birth type and sex and ten dependent variables: age at first mating, gestation length, age at first kidding, birth weight, weaning weight, six-month weight, nine months weight, yearling weight and weight gains to weaning and yearling were analyzed. The study revealed that yearling weight of the crossbred kids was higher for males (30.72±6.29 kg) and single born (30.50±4.46) kids than females (27.74±1.67) and twins (25.67±3.54), respectively. Pre and post-weaning growth rates for Boer- Woyto-Guji F1 kids were 97.73 and 62.99 (g/day), respectively. Average age at first mating, gestation length and age at first kidding of the crossbred were 8.10±1.27, 5.03±0.02 and 12.91±1.22 months, respectively. Liter size of F1 does was 1.26. The mortality rate was higher during post-weaning (40.81%) than pre-weaning age (10.00%). Although the growth and reproductive performance were faster, the survivability of the F1 crossbred kids was under question. Hence, further comparative performance evaluation is needed with local goats under intensive management system.*

Keywords: Crossbred Boer and Woyto-Guji goats, Semi-intensive management, Pre and post-weaning growth rates

1. Introduction

In Ethiopia, there are a number goat breeds that have good potential for meat production (Simret, 2005). However, low emphasis is given in the overall management aspect and genetic improvement of the indigenous breeds. The present productivity of goats is very low. This low level of productivity in Ethiopian goats could be attributed to disease, lack of proper management, poor nutrition and low emphasis given to genetic improvement (Shumuye *et al*., 2014). According to Philipsson and Rege (2003), the genetic improvement has been a fundamental part of the many goat development programs in the tropics where breeding policies mostly aimed to upgrade local goats by crossbreeding with either temperate or tropical exotic breeds.

Cross breeding is an easy way to get very productive goats within a short period of time. It is also the easiest way to acquire superior stock from elsewhere. Such a breeding scheme is preferred in development programs to attain the desired goal (Belay *et al*., 2014). Breed selection is also very important to improve the genetic potential of a given breed. But breed improvement through selection is a slow process (Shumuye *et al*., 2014).

Boer goats are meat type breed that originated in South Africa and have been introduced to different countries of the world including Ethiopia. They have good resistance to disease and adapt well to hot, dry, semi-desert conditions (http://en.wikipedia.org/wiki/Boer_goat#Crossbreeding). In Ethiopia, this breed has been used in crossing with the indigenous goat breeds to improve their productivity. The Woyto-Guji goat breed is one of the breeds that are used for crossing with Boer goats.

Woyto-Guji goat breeds are kept mainly for meat production. In addition to this, these goats are also kept for manure production and cash income generation. When Woyto-Guji goat breeds are compared with Boer goat breeds, they have great differences in their body weight and growth rate (Mohammed *et al*., 2012; Dereje and Ermias,

2018). Boer goat is considered to be one of the most desirable goat breeds for meat production (Lu, 2001). It has gained worldwide recognition for excellent body conformation, fast growing rate and good carcass quality. As a result, crossing of Woyto-Guji goats with Boer goats is becoming an important method to improve productivity of indigenous goat breeds (Belay *et al.,* 2015). The crossbred (F1) can get important traits from their parents that enable them to better resist disease and harsh environments. Therefore, the objective of this study was to evaluate the growth and reproductive performance of the first filial generation (F1) of Boer-Woyto-Guji crossbreds.

2. Materials and Methods

2.1. Description of the study area

The study was conducted at Baide goat breeding and dissemination (BED) station, which is situated 565 km from Addis Ababa to the South at 13° 14' 06" N latitude and 38° 58' 50" E longitude. The area is categorized as hot to warm lowland agro ecological zone of the region with an altitude of 1305 meter above sea level. The rainfall is characterized by low, erratic and variable. The area is known for its large livestock population especially cattle followed by goats. The main crops produced in the area are sorghum, teff, maize and pigeon-pea. Cheka (local alcoholic drink prepared from maize and sorghum) is the main Woyto-Guji goat supplementary feed in the study areas.

2.2. Animal management and diet

Mature Woyto-Guji breeding does (N = 70) were intentionally identified and purchased from the local market (Shelle-Mela market). Thereafter, the animals were housed in the barn of the Baide breeding, evaluation and breeding (BED) site. Two pure Boer male goats were introduced from Jinka Agricultural Research Center for crossbreeding purpose.

External parasites were prevalent in the study area. Therefore, both the does and bucks were de-wormed using Albendasole at the end of the wet season and beginning of the rainy season. They were sprayed with diazinone against the external parasites three times in a year and were also vaccinated against pasteurellosis and pest des petits ruminants (PPR) which are common diseases of the area. Throughout the year, animals were allowed to graze for 6 hours per day on natural pasture around the vicinity of the sub-research center. The lactating does also received 200 g/day of wheat bran. In each case, the supplement was given in two equal feeds morning and evening.

From birth up to four months of age, kids were suckled by their dams two times per day in the morning (8:00 am) and evening (5:00 pm). They also received a supplement of 100 g/day of wheat bran and had free access to grass starting from three weeks of age up to weaning at 4 months. After weaning, the supplement of wheat bran was increased to 200 g/day and had access to pasture for 6 hours per day.

2.3. Measurements and observations

Birth weight (BW), weaning weight (WW), six month weight (SMW), nine months weight (NMW) and yearling weight (YW) were recorded in the morning before grazing and watering. All weight measurements were taken monthly using the salter scale with capacity of 50kg. In this study, data from 2015 to 2016 were used for analysis. Out of the 57 F1 kids, 28 were females.

2.4. Data analysis

The BW, WW, 6MW, 9MW and YW, the weight gains of the kids at different ages, age at first mating, gestation length and age at first kidding were taken as dependent variables. Sex and birth type were taken as independent variables. Growth rate (Average daily gain (gm)) was computed as: Pre-weaning ADG (gram) = (Three Months Weight-Birth Weight)/90 and Post-weaning = (Yearling Weight-Three Months Weight)/275. The data were analyzed by using statistical software in SPSS (16.0).

3. Results and Discussion

3.1. Growth performance

The F1 Boer-Woyto Guji goat cross kids growth performance in the study area under semi-intensive management system was indicated in Table 1. The current study showed that the overall birth weight, weaning weight, six month weight, nine month weight and yearling weight were 2.82±0.48, 11.61±2.74, 16.18±4.19, and 22.36±4.21 and 29.18±4.71 kg, respectively. The current finding was higher than the report of Abd-Allah *et al.* (2016) for Boar and Baladi crossbred kids in Egypt at all different age groups. According to Đuričić *et al*. (2012), birth weight for pure Boar goat was

3.48±0.04kg under the same management system. This was higher than the current finding.

Sex and birth type have statistically significant effect on growth performance of crossbred F1 kids, except birth weight (although males weighed higher). Non significant effect of both sex and birth type on birth weight could be attributed to poor feeding system of does during late pregnancy period. The birth weight, weaning weight, six month weight and yearling weight for male born crossbred kids were 2.83±0.58, 11.81±2.78, 16.70±4.96 and 30.72±6.29 kg, respectively. The corresponding values for female were 2.80±0.34, 11.41±2.72, 15.65±3.28 and 27.74±1.67 kg. Except birth weight, both males and single birth crossbred kids have showed statistically higher values at different age categories than females and twin born ones, respectively. The higher body weight of male kids may be attributed to their birth weight; this is because they were born heavier than females. Almost similar result obtained for Boar-Abergelle crossbred kids reported by Shumiye (2014) under semi-intensive management system. However, growth performance at different age categories were lower for pure indigenous goat breeds as reported by Dereje and Ermias, 2018 on Woyto-Guji goat and Belay and Mengiste, 2013 on Abergelle goat breeds. This could be crossbreds have gained heterosis effect from Boar goat breed for growth trait (Ssewannyana *et al.*, 2004).

The birth weight, weaning weight, six month weight and yearling weight for single born crossbred kids were 2.96±0.40, 12.79±2.06, 17.79±3.58 and 30.50±4.46 kg, respectively. The corresponding values for twin born were 2.44±0.45, 8.51±1.59, 12.71±3.24 and 25.67±3.54 kg. The difference in body weights for different type of births at all age groups may be due to that litter mates had to share the prenatal maternal nourishment in contrast to the single born kids (Zahraddeen *et al.*, 2008). Local, exotic and crossbred goats were presented in Figure 1.

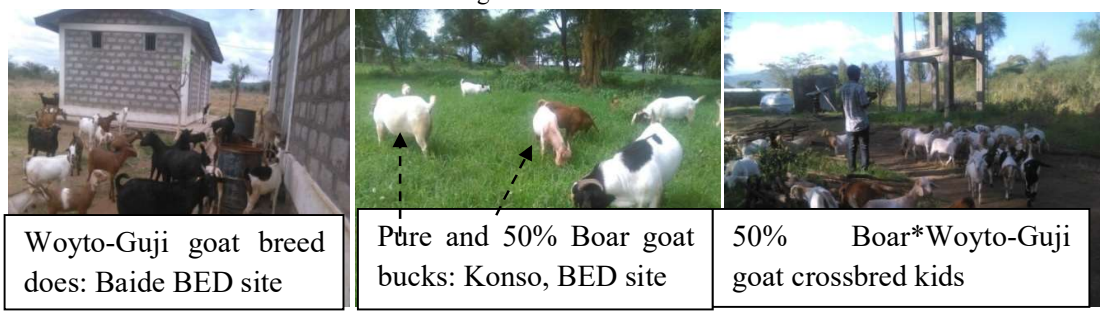

Figure 1. Woyto-Guji Does, Boar bucks, and crossbred kids in the study area

Table 1. Growth performance of F1 Boer-Woyto Guji goat crossbred kids

Effect	BW	WW	6MW	9MW	YW
Overall (57)	2.82±0.48	11.61±2.74	16.18±4.19	22.36±4.21	29.18±4.71
Sex	NS	*	*	*	*
M(29)	2.83±0.58	11.81±2.78	16.70±4.96	23.97±5.24	30.72±6.29
F(28)	2.80±0.34	11.41±2.72	15.65±3.28	20.98±2.43	27.74±1.67
Birth Type	NS	*	*	*	*
Single (42)	2.96±0.40	12.79±2.06	17.79±3.58	23.71±4.08	30.50±4.46
Twin (15)	2.44±0.45	8.51±1.59	12.71±3.24	19.65±3.07	25.67±3.54

BW (Birth weight), WW (weaning weight), 6MW (six month weight), 9MW (nine month weight) and YW (yearling weight), NS (non-significant at P>0.05) and *(significant at P<0.05)

3.2. Pre- and post-weaning weight change

The pre and post-weaning daily growth rate (g day^{-1}) of 50% F1 Boar with Woyto-Guji crossbred kids were presented in Table 3. The overall pre-weaning and post-weaning weight change obtained were 97.73±27.58 and 62.99±14.09 g day^{-1}, respectively. The current result indicated that 50% F1 crossbred kids showed statistically significant fast weight gain during pre-weaning days than post-weaning. Low growth rate during post-weaning seasons may be due to weaning shock. This daily weight gain finding was lower than that of Boar-Abergelle crossbred kids (Shumuye *et al.,* 2014) where as higher than indigenous Woyto-Guji goat under traditional management system (Dereje and Ermias, 2018).

Both sex and birth type have significant effect on both pre and post weaning growth rate of F1 crossbred kids. Pre and post-weaning growth rate for males were 83.83±39.73 and 64.36±13.48% where as the corresponding values for females were 106.45±18.37 and 61.12±15.17%, respectively. Females showed fast weight gain during pre-weaning where as the reverse is true for males during post-weaning days. Pre and post-weaning growth rate for single born kids were 109.47±21.02 and 62.72±15.34 and the equivalent parameters for twin born ones were 67.18±17.25 and 93.33±12.86%, respectively. Single born crossbred kids showed fast weight gain during pre-weaning where as the reverse is true for twin born crossbred kids during post-weaning days. In agreement with this finding, Belay and Mengistie (2013) reported that single birth kids had faster growth rate than kids from multiple births. Alula *et al* (2013) also reported that kids born as singles were heavier than twins and triplets.

Table 2: Pre and post-weaning daily weight gain rate of 50% F1 Boar*Woyto-Guji goat kids in the study area

Effect	Pre-weaning		Post-weaning	
	N	Mean ± STD	N	Mean ± SD
Overall	54	97.73±27.58	33	62.99±14.09
Sex		*		*
Male	27	83.83±39.73	19	64.36±13.48
Female	28	106.45±18.37	14	61.12±15.17
Birth Type		*		*
Single	39	109.47±21.02	24	62.72±15.34
Twin	15	67.18±17.25	9	93.33±12.86

N (frequency), SD (standard deviation) and *P<0.05

3.3. Reproductive performance

The reproductive performance and effect of birth type on age at first mating, age at first kidding and gestation length of F1 Boer-Woyto Guji goat crossbred does were illustrated in Table 1.

Overall ages at first mating, age at first kidding and gestation length for does were 8.10±1.27, 12.91±1.22 and 5.03±0.02 months, respectively. Except gestation length, birth type had significant effect on age at first mating and age at first kidding. Single born does have fast age at first mating (7.93±1.06 months) and age at first kidding (12.81±1.24 months) than twin born ones.

Table 3: The reproductive performance and effect of birth type on age at first mating, age at first kidding and gestation length (month) of F1 Boer-Woyto Guji goat crossbred does

Effect	AFM (32)	AFK(15)	GL(15)
Overall	8.10±1.27	12.91±1.22	5.03±0.02
Birth Type	*	*	NS
Single (42)	7.93±1.06	12.81±1.24	5.03±0.02
Twin (15)	8.55±1.69	13.58±1.17	5.03±0.00

AFM (age at first mating), AFK (age at first kidding) and GL (gestation length)

3.4. Prolificacy

The liter size of the F1 Boar X Woyto-Guji goat crossbred does was 1.26. However, the does were largely dependent on low quality pasture and scarce availability of browse plants and were supplemented with poor quality hay in the current study. This finding was slightly higher than for Boar-Abergelle crossbred does (1.11) under similar management system reported by Belay and Mengistie (2013). However, it was lower than the report of (1.76) Đuričić *et al*. (2012) for pure Boar goat in Croatia in semi-intensive management system.

3.5. Mortality rate of cross Boer-Woyto Guji F1 kids

Mortality of the F1 crossbred kids was higher during post-weaning (40.81%) than pre-weaning (10%). This could have been the result of a lower nutritional plane after weaning as suckled milk was replaced by poor quality grazing (Kanwaldeep *et al*., 2015). The current finding was higher than the

report of Belay and Mengiste (2013) for Boar-Abergelle crossbred kids in which an average pre-weaning mortality rate was 6.73% and post-weaning mortality was 16.6% although post-weaning mortality was also higher than pre-weaning mortality. Some of disease clinical signs observed were diarrhea, bucks scrotum and lung (after postporum) infection and physically low performing boar bucks as illustrated in Figure 2.

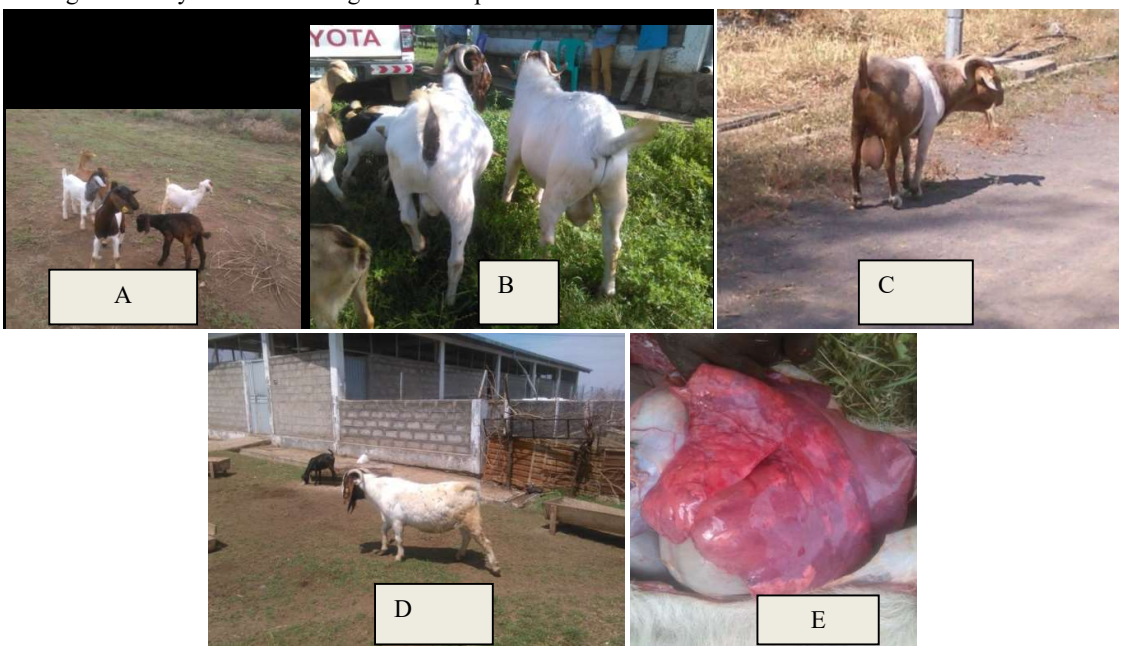

Figure 2. Kids with diarrhea, buck with infected scrotum, low performing and infected lung in the study area (A-E).

4. Conclusions

Boer-Woyto Guji F1 crossbred kids had high growth performance at all age groups. However, growth rates were high during pre-weaning than post-weaning. Additionally, post weaning kid mortality was high under semi-intensive management conditions. So that it is better to undertake comparative performance evaluation under intensive management systems in the future.

Conflicts of Interests

The authors declared that there is no conflict of interests.

Acknowledgments

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Stakeholders' Perception on Impacts of Natural Environment Deterioration and Armed Conflict on Plant Production: Case Study of North Darfur State - Sudan

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Abstract: *The study was conducted to assess the awareness and perception of local farmers with the causative factors of environmental degradation and to analyze the interactions of natural resources, rural livelihoods and armed conflict in North Darfur State. Six localities: El Fasher, Maleit, Malha, Kabkabia, Darsalam, and Omkadada were selected as study field using stratified random sampling method. A total of 300 interviewees were randomly selected for the household survey adopting semi-structured interviews. Questionnaires were used to collect socioeconomic characteristics. Key informants' interviews and group discussions were also used to obtain additional information. The results revealed that great changes have been taken place in quantity and quality of natural vegetation towards negative trends according to respondents' views. Majority of interviewees agree that the disappeared vegetation types were more palatable to livestock. About 88% of interviewees are farmers and agro-pastoralists, where their main food crops are millet and sorghum. While the cash crops are represented in groundnuts, water melons, and tobacco. However, during last decades the crop production was kept decreasing pattern due to climatic and anthropogenic factors spreading food insecurity. The impacts of ecosystem resource diminishing and armed conflict on each other and their effects on livelihoods became clear and recognizable by the local people. The community perception of ecosystem degradation in the area could be used to set strategies for conservation and rational use of natural resources. The study recommends for further investigation about the impacts of natural resource degradation on livelihood and plant productivity in the region.*

Keywords: Environmental degradation, Food security, Livelihoods, Natural resources

1. Introduction

Natural resources are building blocks and strongly linked to the livelihoods of most countries in Africa and elsewhere and are the basis of subsistence in many poor communities (Maranga *et al.,* 2010; Lind *et al*., 2012; Sinare and Gordon, 2015). Natural resources account for 26% of the wealth of low-income countries (UNEP, 2007a) and are the mainstay of many developing economies. The world natural ecosystems are capital assets if properly managed; they yield flow of vital services including the land, water, and production of goods such as food, fiber, timber, bioenergy, and can be foundation for transformative change (Daily *et al.,* 2000; Harris, 2004; Sanginga *et al*., 2010; Power, 2010; Nawrotzki *et al*., 2011; ADBG, 2014). Thus, livelihoods of mankind collectively remain natural environment dependent. For example in Africa more than 320 million people depend on dryland forests to meet their various basic needs and more than 90% of the populations in Sub-Saharan Africa rely on firewood and charcoal as source of fuel energy (Chidumayo and Gumbo, 2010). It is obvious that, natural resources play dual role in life net, it is part of ecosystem component on a side and of socio-economic system on the other side. In that sense means, measures, and approaches to restore degraded environments have social and economic implications (Gebregziabher *et al*., 2017; Masoudi *et al*., 2018; Amiraslani and Caiserman, 2018).

In North Darfur natural recourses are considered to be backbone of life, as livelihoods of more than 80% of populations depend on rural agricultural activities competing over diminishing resources (PA, 2014). Moreover, the dominant energy source in rural as well as urban North Darfur is firewood and charcoal. Cereal crops mainly millet and sorghum are tend to be staple food particularly for rural dwellers in Darfur (Hadi, 2013a). However, under increasing rates of populations, frequent

occurrence of drought, and ongoing armed conflict; the deterioration of natural resources become inevitable (Jasper and O'Callaghan, 2008; Abdelaziz *et al*., 2012; Lind *et al*., 2012; Sulieman *et al*., 2013). Severe arid condition on the northern parts of State had pushed people to the southern parts causing acute pressure on natural resources (Siam *et al*., 2014; Abdalla, 2014). In Darfur a third of the forest cover was lost between 1973 and 2006 (UNEP, 2007b), destroying the vast sources of livelihoods and subsistence of local communities. Cycles of drought in the 1970s and 1980s and the resulting desertification of the northern parts of Darfur rendered different groups against each other in disputes over increasingly scarce natural resources (Jasper and O'Callaghan, 2008). Thus, causes of catastrophic armed conflict erupted in Darfur in 2003 were might partially refer to environmental factors. Resource management institutions are entirely collapsed in the area and more than 25% of the population have been displaced (PA, 2014).

Thus the recognition of degradation causative elements by stakeholders including local people and respective institutions tends to be corner stone towards collective action for situation improvement. Awareness of rural men and women with the situation of resources; increases the likelihood that their needs and priorities are heard and addressed by policy makers (Kaaria and Osorio, 2015; Wayessa and Nygren, 2016). People have to learn to manage ecosystems in order to assure sustainability in broad sense which implies securing long term productivity and protecting given resources (Laresen, 1995; Blaikie, 2006; Harvey *et al*., 2018; Okereke and Stacewicz, 2018). Because, lack of public awareness about the importance of ecosystem often leads to it's misdeem and degradation (Mohammed and Mengist, 2018). The aim of this study was to assess the awareness, identification, and recognition of local community with the causative factors of environmental degradation and to highlight interactions of natural resources, rural livelihoods and armed conflict in North Darfur State. The specific objectives were to: (1) assess the perception of local community with the impacts of natural environmental factors on vegetation type and crop production, (2) evaluate the impacts of fragile natural environment on vulnerability of local people to food insecurity, and (3) identify the effects of armed conflict on agricultural production and livelihoods of rural community in North Darfur State.

2. Material and Methods

2.1. Description of the study area

North Darfur State locates between latitude 12-20^{o}N and longitude 24-27^{o}E occupying area of 290,000 Km^{2}. Climate is typical Saharan-Sahelian zone. Magnitudes of rainfall range from zero in the north to 500 mm/year in the south with rainy season lasts about 75 days whereas 90% of rain falls between July and September (Abdalla, 2014). The average of higher and lower temperatures is 41 and 18 ^{0}C respectively (Hadi, 2013b) in El Fasher. Months of May and April show the highest rates of temperature; meanwhile December and January are the lowest (FMS, 2015). North Darfur occupies more than half of the area of greater Darfur region, and includes part of the high volcanic origin mountain known as Jebel Marra in the southwest site (Abdalla, 2014). The area between 16 – 20^{o}N is entirely desert with no land use activities and equivalent 50% of whole area of the State (Fadul, 2004). To the south there is slightly more rainfall with the eastern side characterized by plain lands with low sandy hills (Abdalla, 2014).

The key feature of vegetation is desert and dry savanna consists of annual grasses and perennial woody thorny and dwarf trees and shrubs (Abdalla, 2014) with few broadleaved tree species around water courses. The main perennial natural tree and shrub species include *Acacia tortilies, Acacia melifera, Acacia nubica, Boscia senegalensis, Caparis deciduas, Maerua crassifolia, calotropis procera, Leptadenia pyrotechnica, Balanites aegyptiaca* in the sandy and clay rocky areas, while *Fedherbia allbida, Acacia nilotica, and Ziziphus species* grow on the water courses basins. The main annual natural plant species are: *Aristida sp, Cenchrus setegrus, Hygrophyla spinosa, Euphorbia sp, Ipomea sp, Dactyloctenium aegyptium*, *Echinochloa sp*, *Tribulus terristeris*, *Eragrostis sp, Schenofeldia gracilis, Sporobolus marginatus, Tephrosia uniflora, Striga gensnerioids* and *Cida cordifolia*. Sandy soils are the main soil of area found either in stabilized or moving dunes. While clay soils are found on the coasts of river and water courses. In this study, the *natural environment and natural resources* are used interchangeably. The term *environment*

generally refers to a natural resource base that provides sources and performs sink functions (Bucknall, 2000; Sanginga *et al*., 2010).

North Darfur is bounded on the northwest by Libya, on the west by Republic of Chad and West Darfur State, on the east by Northern State and North Kordofan, on the southeast by West Kordofan, on the south by East and South Darfur, and on the southwest by Central Darfur State. North Darfur State consists of 17 localities: El Fasher, Maleit, Malha, Kutum, Kabkabia, Saraf Omra, El Sireaf, Um Buru, Kornoi, Tina, Tawila, Darsalam, Omkadada, Klaimendo, El Taweisha, Alliet, and El Kuma. El Fasher town is capital of the State. The names of all localities are derived from their administrative headquarter towns. Six localities (Figure 1) namely: El Fasher, Maleit, Malha, Kabkabia, Darsalam, and Omkadada representing different geographical directions of the State were selected for the data collection, their coordinates are shown in Table 1.

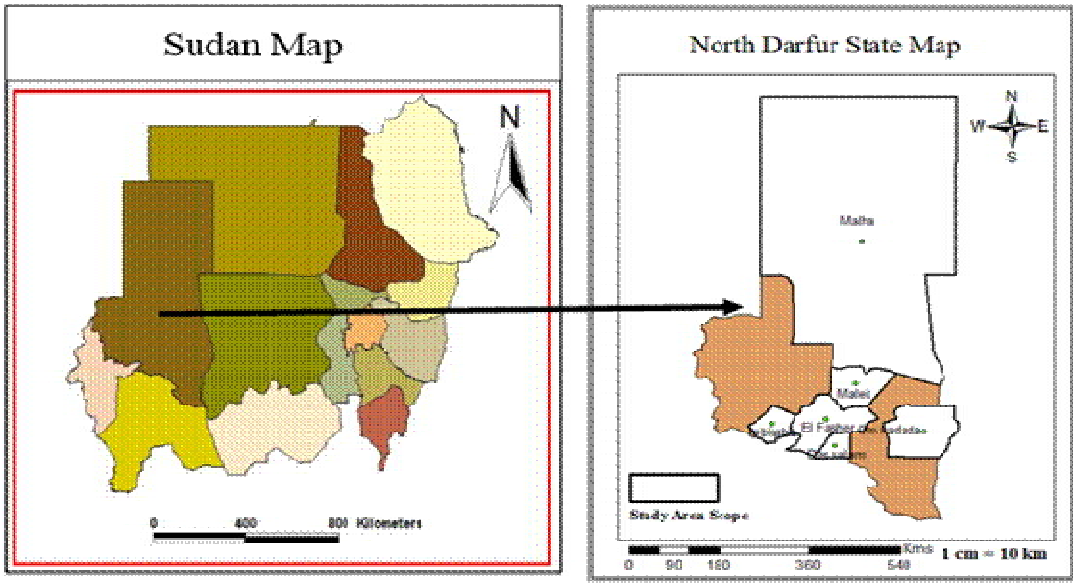

Figure 1. North Darfur map shows the six study localities

Table 1. Coordinates of six study localities in North Darfur state

Locality	El Fasher	Maleit	Malha	Omkadada	Kabkabia	Darsalam
Latitude	13.63° N	14.25° N	15.01° N	13.23° N	14° N	13.03° N
Longitude	25.33° E	25.45° E	26.27° E	26.62° E	24° E	25.33° N

2.2. Types of data and method of collection

Data of study were obtained from primary and secondary sources. Primary sources include questionnaires, field visits, interviews and discussion with key informants in addition to personal accumulative observations. The fore mentioned six localities were selected for household and field survey using stratified random sampling method. A total of 300 interviewees (50 per each locality) were randomly selected for the household survey using semi-structured interviews. Questionnaires were used to collect socioeconomic characteristics (viz. gender, age, education level, occupation, vegetation status, crop type, production trends, and factors affecting production). Additional information was also obtained through key informants' interviews and group discussions. Secondary sources based on extensive scientific

literature, and records pertinent to the subject. Cereal crop production including total production and consumption demand for period of 25 years (1991-2015) were obtained from Planning Unit (PU) of State Ministry of Agriculture (SMA). Agricultural production data of 2006 and 2007 were not available, because the data of 2006 were incomplete and the survey was not taken in 2007. Forest tree and rangeland plant status were obtained from Forest National Corporation (FNC) and Directorate of Rangeland and Fodder (DRF) respectively. Rainfall records of localities for 30 years (1985-2015) were obtained from El Fasher airport and agricultural meteorological stations in the State. Figure 2 shows rainfall of El Fasher locality for 30 years (1985-2015).

Figure 2. Rainfall variables for the period from 1985 to 2015 at El Fasher locality

2.3. Statistical Analysis

For the calculation of means and percentage of variables the Statistical Package of Social Science (SPSS) was used. Relationship between five localities coordinates (longitudes and latitudes) and average of respective total rainfall was established using excel program regression analysis and the significance of correlations was tested at $P = 0.05$. Darsalam locality was excluded from regression analysis due to incomplete of respective rainfall data.

3. Results

3.1. Perception of local communities of the impacts of ecosystem deterioration on natural vegetation and crop production

3.1.1. Status of the natural vegetation

Compared to the last two decades abundance of natural vegetation is poor today according to the views of 47.4% of interviewees (Figure 3). Forty percent of respondents considered the abundance of vegetation is medium and only 12.6% believe that is good. Eighty seven percent of El Fasher and more than 60% of Kabkabia and Omkadada interviewees indicated that the plant abundance is poor. Seventy percent of Maleit and more than 40% of Darsalam and Malha interviewees believed the change of plant abundance is medium. On the other hand, more than 80% of farmers indicated that many plant species in the area were disappeared (Figure 4). Hundred percent and 90% of Omkadada and Malha dwellers respectively were responded that many plant species were disappeared. It is worth mentioning that 89% of respondents were indicated that the disappeared plants belong to preferred-plant species by animals (Figure 5). Hundred percent and more than 90% of Malha and El Fasher interviewees respectively indicated that the disappeared vegetation types are belonging to palatable plant species for animals.

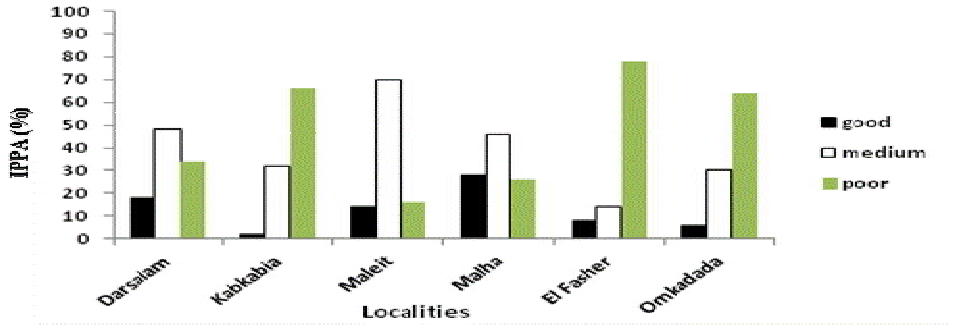

Figure 3. Interviewees' perception of plant abunndace (IPPA) at six localities in North Darfur. Black, white, and green columns represent good, medium, and poor respectively.

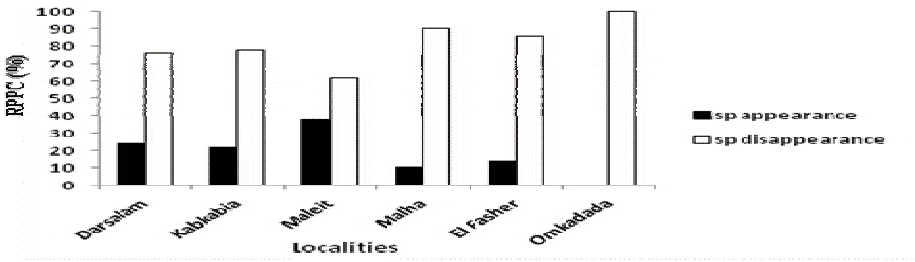

Figure 4. Respondents' perception plant species change (RPPC) at six localities in North Darfur. Filled and empty columns represent plant species appearance and disappearance, respectively

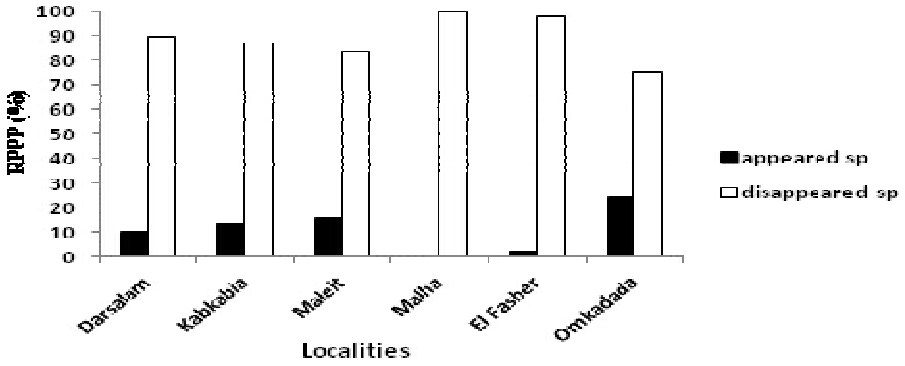

Figure 5. Respondents' perception of plant species preference (RPPP) by animals at six localities in North Darfur. Filled and empty columns represent appeared plant and disappeared plant species, respectively

3.1.2. Socio-economic characteristics

The results revealed that male and female household head represent 66.3 and 33.7% respectively among the respondents (Figure 6). About 55% of interviewees are farmers and 33% are agro-pastoralists (Table 2). In El Fasher locality the female household represents 56%. The age of household head range 40-59 and 20-39 years represent 47.7% and 41% respectively. More than 85% of interviewees have acquired reading and writing level of education.

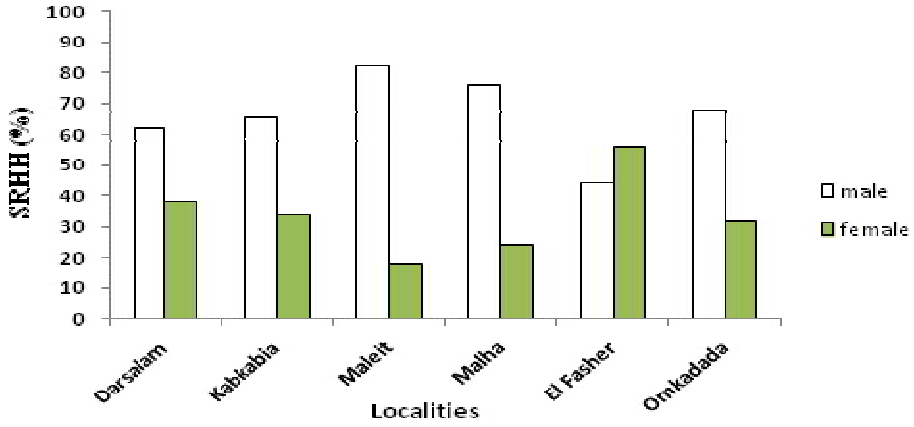

Figure 6. social gender of respondents' household heads (SRHH) at six localities in North Darfur

Table 2. Basic socio-economic and education of interviewees at six localities of North Darfur State

Locality	Age of house hold head (%)			Education (%)		Occupation (%)			
	20-39	40-59	>60	Illiterate	Literate	Farmer	Pastoralist	Agro-pastoralist	Others
Darsalam	44	50	6	4	96	48	2	28	22
Kabkabia	46	38	16	14	86	68	0	4	28
Maleit	50	48	2	8	92	48	2	48	2
Malha	40	46	14	20	80	20	6	72	2
El Fasher	44	46	10	12	88	80	0	18	2
Omkadada	22	58	20	28	72	64	6	26	4
Average	41	47.7	11.3	14.3	85.7	54.7	2.7	32.7	10

Table 3. Types of food and cash crops grown at six localities of North Darfur Sate

Locality	Millet (%)	Sorghum (%)	Water melon (%)	Groundnuts (%)	Tobacco	Millet + sorghum (%)	Millet+ watermelon + Groundnuts (%)	All + others (%)
Darsalam	12.2	6.1	8.2	44.9	2	8.2	14.3	4.1
Kabkabia	19.5	12.2	4.9	14.6	0	43.9	0	4.9
Maleit	70	0	0	0	0	28	0	2
Malha	38	0	2.1	2.1	0	53.2	0	4.6
El Fasher	12.2	2	0	0	10.2	4.1	0	71.4
Omkadada	4.1	0	8.2	0	0	0	73.5	14.2
Average	26.3	3.2	3.9	10.2	2.1	22.1	15.1	15.8

3.1.3. Crop production

Table 3 shows that main crop type produced in North Darfur is millet as indicated by more than 26% of respondents. In addition to that about 22.1% responded they grow millet and sorghum. In Maleit locality 70% of interviewees mentioned that they grow millets. In Darsalam about 45% indicated that they produce groundnuts. In Malha and Kabkabia about 53% and 44% responded that they grow millets together with sorghum. The farmers grow watermelon and groundnuts beside millet represent 73% in Omkadada locality. In El Fasher locality more than 71% responded that they grow all types of crops in the question with various other crops.

For the periods 1990-2003 and 2004 -2015 about 69.3% and 90.7% of respondents respectively indicated that there was decrease in crop production (Table 4 and 5). More than 51% of target group believed that the rainfall was main factor of decrease for the period 1990-2003. Fifty percent of respondents of Kabkabia locality indicated that the insecurity was the reason of production decrease for such period. While for the period 2004-2015, about 42.9%, 25.5%, and 24.5% of respondents indicated that all factors together, rainfall, and insecurity as main factors beyond crop production decrease respectively. In Omkadada 62.8% of surveyed farmers believe that the rainfall variability was a cause of production reduction while 76.6% of Maleit farmers attributed reduction to armed conflict. About 68.8% in Darsalam, 65% in El Fasher, 53.1% in Kabkabia, and 51.2% in Malha linked production decrease with all listed factors (rainfall, armed conflict, desertification, and soil infertility) for the period 2004-2015.

Table 4. Crop production patterns for period from 1990 to 2003 at six localities of North Darfur State

Locality	Production trends (%)		Factors of decrease (%)				
	Increase	Decrease	Rainfall	Desertification	Soil infertility	Insecurity	All
Darsalam	42	58	66.7	3	3	15.2	12.1
Kabkabia	40	60	6.7	3.3	0	50	40
Maleit	62	38	66.7	0	0	33.3	0
Malha	18.7	81.3	84.6	2.6	10.3	2.5	0
El Fasher	12	88	28.3	4.3	21.7	4.3	41.4
Omkadada	4	94	58.3	20.8	20.8	0	0
Average	29.9	69.3	51.4	7	11.7	13.6	15.5

Table 5. Crop production patterns for period from 2004 to 2015at six localities of North Darfur State

Locality	Production trends (%)		Factors of decrease (%)				
	Increase	Decrease	Rainfall	Desertification	Soil infertility	Insecurity	All
Darsalam	6	94	22.9	0	0	8.3	68.8
Kabkabia	2	98	0	0	0	46.9	53.1
Maleit	8	92	8.5	0	0	76.6	14.9
Malha	22	78	46.2	0	0	2.6	51.2
El Fasher	14	86	16.3	7	4.7	7	65
Omkadada	4	96	62.5	20.8	12.5	0	4.2
Average	9.3	90.7	25.5	4.7	2.9	24.5	42.9

As shown in Figure 7 the relationship between average total rainfall and longitudinal coordinates of localities was very strong ($R^2 = 0.98$), where the precipitation decreases from west to eastwards. However, the rainfall amounts were poorly correlated ($R^2 = 0.0002$) with latitudes of the localities under this study (Figure 8).

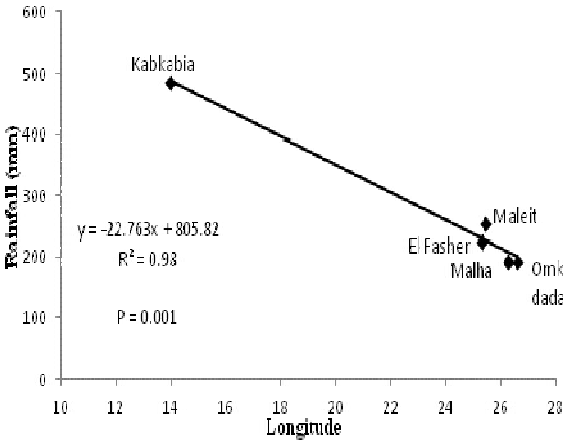

Figure 7: Relationship between precipitation and longitudes of five localities in North Darfur State

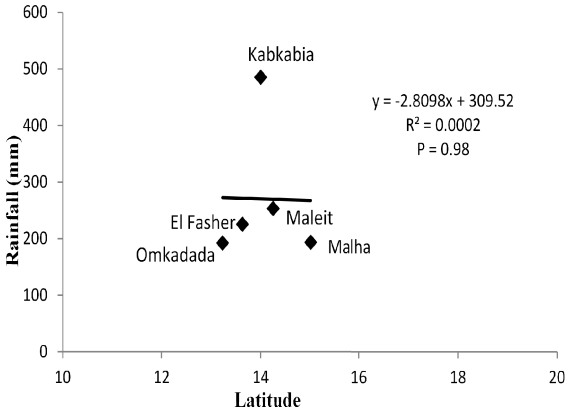

Figure 8: Relationship between precipitation and latitudes of five localities in North Darfur State

4. Discussion

4.1. Local communities' perception of ecosystem deterioration impacts on the natural vegetation and crop production

As shown in the results great changes have been taken place in availability and quality of natural vegetation towards negative trends according to respondents' views. Such changes are presumably exposing North Darfur area to high risks hence making local communities more vulnerable to disturbance of livelihood bases. Fragile natural resource base due to variability of rainfall in amount and distribution within the same year and from year to year has exposed the Darfur region to environmental erosion and production hazards (UNEP, 2007b; Abdelaziz et al., 2012). Climate change specially rainfall often affects the plant growth and alters the functioning and resilience of ecosystems such as rangelands and forests, which support the livelihoods of dryland inhabitants (UNEP, 2007b; FAO, 2010, 2012; Kim et al., 2016). Magnitude of change in vegetation is locality specific since the majority of El Fasher, Kabkabia, and Omkadada respondents believed that plant availability is poor while those of Maleit, Darsalam and Malha considered the vegetation abundance as medium. It is worth to mention that the magnitude of vegetation change is also subjective as there no standard or quantitative measurements in this study.

However, almost all interviewees in all localities agree that the disappeared vegetation types were palatable to livestock. Thus, disappearance of palatable plant species immediately impact on livestock production hence livelihoods of people. Profound alterations in plant ecosystems and services they provide to human being and animals are already and will increasingly play a pivotal role in livelihood and food security (FAO, 2007; Backlund et al., 2008; ESF, 2010; Somorin, 2010). The community perception of vegetation change in the area could be used to restore and maintain the preferred indigenous plant types. For instance through initiating projects of improved planting techniques and seed germination properties. The assessment and identification of use and knowledge of local rural communities with their surrounding ecosystems assist in setting development, conservation, and community-based natural resource management strategies (Reyes-Garcia et al., 2005; Blaikie, 2006; Siam et al., 2014). The stakeholders' acknowledgement of the role of natural vegetation in livelihood activities may lead to community support for conservation projects. Local participants' perception of the livelihood project benefits has induced community support for forest conservation in rural areas of Madagascar (Harvey et al., 2018).

More than 88% of respondents are crop farmers or agro-pastoralists growing crops and or rear livestock for their livelihoods as detected by socio-economic analysis. The findings agree with statement that in North Darfur more than 80% of populations depend on rural agriculture as base of livelihoods (PA, 2014; SMA, 2014). Although, the majority of household head are male the collective response of interviewees could not be changed

since there is no specific livelihood confining specific social gender (Siam et al., 2014). On the other side, acquisition of writing and reading level of education by great ratio of respondents shown in the study would help in adoption of environmental awareness and advocacy. It is obvious that main food crops are Millet locally known as dukhun and sorghum (dura), while the cash crops are represented in groundnuts, water melons, tobacco, and various types of fruits and vegetables. Northern localities namely Maleit and Malha farmers are mainly depend on millet as staple food crop and they don't grow sorghum and tobacco. Cultivation in Darfur is largely taken place in sandy lands and small range practiced in relatively more productive alluvial soil around watercourse. Valley bottomlands are key areas for cultivators and pastoralists providing source of arable or grazing during drought or dry seasons in Savanna Africa (Scoones, 1991). Agro-pastoralism activity which combines sedentary farming and livestock herding is also common practice in North Darfur as revealed by the study results. However, during last decades the crop production is immensely decreased due to rainfall variability, insecurity, and other factors. According to views of more than 50% of interviewees precipitation was the main factors of production decrease for the period from 1990 to 2003. Many factors such as recurrent drought, rainfall variability and scarcity, desertification, deforestation, overgrazing have acted against agricultural productivity in Darfur (Fadul, 2004; Robinson, 2005). Food insecurity became usual event in North Darfur during the last decades as the total production of cereal runs below the total consumption amounts (SMA, 2014). The rainfall magnitudes were increased towards west localities as exhibited by strong direct longitudes relationship. The phenomenon might be corroborated to the location of some western localities such as Kabkabia within or near Jebel Marra territories where the precipitation is relatively high compared to the other areas of north Darfur. However, either strong or weak correlation between rainfall and geographical coordinates should be taken with caution because rainfall distribution and intensities in North Darfur are greatly varying even within area less than 10 km^2.

Total cereal production failure is a common phenomenon, for instance the deficit of production was more than 90% in 2009 and 90%, in 2004 (SMA, 2004). Consequently farmers expand their cultivated lands horizontally to maximize production for self satisfaction. The horizontal expansion equals 125 -150% compared to that of sixties of last century (Fadul, 2004). The sedentary farmers adopted various strategies to cope with the harsh environment such as rearing small animals, collection of firewood, charcoal, building pole and fruits of some forest trees and dry fodders for selling to buy food crops and other commodities when necessary. However, such trends have compounded degradation of natural environments including forests, range lands and water catchments. The situation after year 2003 was aggravated by armed conflict whereas great sector of rural farmers have been displaced to Internal Displaced Persons (IDPs) camps around larger cities leaving their farmlands behind. Therefore, people believe that armed conflict was main factor beside rainfall in crop production decrease for the period 2004-2015. Within this context, the views of more than 76% and 46% of Maleit and Kabkabia respondents respectively correlated the crop production decline with the impacts of armed conflict over the period following year 2003. Sedentary farmers' displacement from farmlands in response to armed conflict has resulted huge decrease in crop production. Before conflict there were seasons with sufficient or surplus crop production depending on precipitation conditions, but since 2004 up 2015 there was no year of surplus production (SMA, 2014). Consequently, about fifty percent of respondents linked the crop production decrease with armed conflict beside precipitation variability.

4.2. Impacts of natural resources degradation on armed conflict occurrence

According to the interviews and questionnaires findings the precipitation scarcity with consequent natural resource depletion are widely perceived as causative factors of armed conflict. Decline in precipitation due to regional climate change has been significant stress factor in arid areas of Sudan particularly in Darfur and Kurdufan (UNEP, 2008a); for the period 1978 – 2007 average annual rainfall value was only 194 mm in El Fasher and much of this rainfall is concentrated in a few months of the year. The fragile environment with a consequent food insecurity due to change in the magnitude of rainfall become the dominant and real condition in North Darfur (Hadi, 2013a). Thus, environmental and natural resource degradation seemed to be one of the prominent factors

provoked land ownership disputes and conflict between pastoralists and farmers and between pastoralists themselves in Darfur (Fadul, 2004; Bromwich, 2008; Lind *et al*., 2012). There are at least three scenarios could exemplify occurrence of conflict that resulted from increase rate of drought and desertification: acceleration of drought and desertification lead to: (i) deforestation, overgrazing, increase of dry lands, diminishing of water resources, change in seasonal movement of nomads, destruction of crop stands of sedentary farmers by nomad animals, then conflict between nomads and farmers, (ii) low agricultural production, expansion of agricultural lands at the expenses of rangelands, diminishing of grazing areas, entrance of nomad animal to villagers farms, and then development of conflict, and (iii) rangelands degradation, mass death of animals due to lack of pastures and fodder, feed animals with peasants pre-harvesting agricultural crops, thus development of conflict. These scenarios are further triggered by political interventions and ethnic tension causing pervasive conflict. Generally, in Sudan the impacts of climate change and desertification are clearly linked to ongoing war, as there are strong indications that the hardship caused to nomadic communities by precipitation deficit and desertification is one of the underlying causes of the conflict in Darfur (UNEP, 2007b).

4.3. Impacts of armed conflict on natural resources

The armed conflict erupted in Darfur in 2003 has resulted catastrophic humanitarian situation with large numbers of IDPs and refugees around cities and neighboring countries. Subsequently, insecurity within IDP camps is also became a major issue and affects many informal livelihood activities that have emerged in and around them such as selling wood for construction and fuel, farming, and operating animal driven carts causing further deterioration of local environments (UNEP, 2007b; Lind *et al*., 2012). As IDPs could not able to go far away from the camps they may cut any vegetation grows near around. The placement of IDP camps around commercial town centers is likely to cause the loss of shelter belts, forestry and farmland (Bromwich, 2008) to sustain demand for fuel, construction material and brick making. The imbalance between accessible biomass production and demand has become greatest near to Darfur's largest cities and caused significant change in vegetation (UNEP, 2008b; Lind *et al*., 2012). According to State FNC Director "high pressure on vegetation cover was made due to needs of fire woods and building poles consequently, woody plants especially trees were cleared out around and near IDPs camps". Two reserved forests with area of 456.6 ha were completely destroyed around El Fasher (FNC, 2011) as consequences of armed conflict, in general the area of 711.8 ha equivalent 28.9% to the total area of reserved forest has been affected negatively. Furthermore, IDPs have uprooted (Plate 1) the illegally cut stem remainders, by doing so inhibited any opportunity of natural regeneration (personal communication).

Plate 1. In need of fuel wood, elder IDP woman uproots tree at depth of 50 cm near Abu shok camp around El Fasher town

Prevailing insecurity atmosphere caused unsafe grazing lands leading to sharp reduction in livestock owned by rural families whereas average animal heads per household decreased from 407 before conflict to only 55 in North Darfur (Ismail *et al*. 2014). Dependence of great numbers of IDPs camp people on limited source of drinking water has affected underground water table negatively

especially near El Fasher and Nyala (Bromwich *et al*., 2007; Nicol *et al*., 2012). On the other hand, it has been observed that the evidence of densely re-vegetation cover in abandoned villages and lands as a positive environmental indicator. This observed improvement of vegetation is likely attributed to population displacement, decline of livestock herds, and decrease of their pressure. Such vegetation recovery could not withstand the domestic needs of returnees that largely involved in fuel energy and building materials. Therefore, search and use the alternative fuel energy and building materials in order to decrease pressure on woody vegetation are prerequisite for sustainable natural resource management.

4.4. Implication of ecosystem deterioration, armed conflict and livelihood interaction

The impacts of ecosystem resource diminishing and armed conflict on each other and their effects on livelihoods have become clear in Darfur. The majority of respondents as shown in this study acknowledged that climatic factors were prime factor for livelihood deterioration before armed conflict occurrence in 2003. However, thereafter the insecurity became prominent factor especially in some localities beyond production decline in crops and livestock. This perceived knowledge of local communities would be used for adopting rational use of natural resources and for building peaceful coexistence between different groups if the other issues are addressed. This perception also could be used to promote and build natural ecosystem rehabilitation and conservation strategies. It is well reported that, the public involvement became a prime principle for contemporary governance of environment and can empower individual and communities response (Swinton *et al*., 2005; Smiley *et al*., 2010). On the other side, abandon of sedentary farmers their farms for long time may cause loss of indigenous knowledge particularly among young generations regard to plant genetic resources including domesticated and wild species such as drought tolerant and famines food which are key to livelihoods. The consequences of the conflict depleted assets, insecurity, inaccessibility to land and resources, the loss of agro-ecological knowledge among younger generations, may induce further complicated impacts in the region (Lind *et al*., 2012). Many IDPs themselves are not willing their children to return rural homelands but prefer them to move into skilled trades and professions (UN, 2010). Thus, initiation of ambitious plans and strategies for maintenance and conservation of wild plant and local crop genetic resources must be top priority to sustain food security and livelihoods over long and short terms. Many armed conflict related agents have caused destruction of vegetation cover. For instance, Director of State FNC told that (i- because of insecurity and inaccessibility to areas of dead fire woods, bakery and brick kilns owners tended to cut trees not only around towns but also inside the homes, ii- Hybrid Mission of United Nations and African Union in Darfur (UNAMID) which came therein to protect civilians and build peace has established its camps on Hizam El Fasher reserved forest, and iii- fighting groups destroy vegetation covers through various means. To maintain sustainable and community-based natural resources management in Darfur, successful intervention plans should be sought. For example integrated natural resource management research may lead to improved natural resource management practices hence improvement of human wellbeing (Freeman *et al*., 2005; Bagine *et al*., 2010).

5. Conclusion

The results revealed that the abundance of natural vegetation today is either poor or medium compared to the last two decades according to the views of more than 87% of interviewees. Substantial change has occurred in both quantity and quality of natural vegetation exposing the region to risks and disposing the livelihoods of local communities to high vulnerability. About 88% of interviewees in North Darfur State grow crops and/or rear livestock for their livelihoods. However, crop production level was maintained decreasing patterns according to respondents' views. Rainfall was believed to be the main factor of decrease for the period 1990-2003, while for the period from 2004 to 2015, about fifty percent of respondents correlated decline in crop production with armed conflict alongside rainfall variability. The impacts of ecosystem resource diminishing and armed conflict on each other and their consequent effects on livelihoods have become reality in Darfur and well acknowledged by local communities and respective institutions. Environmental and natural resource degradation seemed to be one of the prominent factors provoked land ownership disputes and conflict

between stakeholders spoiling their livelihood activities. The perceived acknowledgement of local communities about the implications of natural plant and crop production deterioration could be used to set principles for natural environment governance and for peaceful coexistence between stakeholders. Based on the study findings the further investigation on the relationship between natural environment deterioration; and livelihood options, mitigation measures, and adaptation mechanisms of local communities can be recommended.

Conflict of interest

The authors declare that the absence of conflicts of interest.

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Evaluation of Desho Grass *(Pennisetum Pedicellatum)* Productivity under Different Fertilizer Combinations and Spacing at Gamo Gofa Zone, Ethiopia

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Abstract: *Desho grass is a perennial drought tolerant feed to contribute a lot for dry season feed demand of Ethiopian livestock. A field experiment was conducted at Chano Substation, Southern Ethiopia, to determine dry matter yield of desho grass using factorial combination of five fertilizer rates (0:0, 11.5:43.5, 15:59.5, 20:64 and 25:91.5 kg /ha P:N) and four spacing (plant: row) (25:50, 50:75, 75:100 and 100:125 cm) in RCBD with three replications. Plant height, tiller number and dry matter yield were computed with Least Significant Difference. With increase in P: N rate from 0:0-25:91.5 kg/ha; plant height increased from 61 to 93 cm and tiller number shown an increment from 214.2 to 308.6. The respective increase in tiller number with plant and row spacing from narrower (25; 50cm) to wider (100:125 cm) was 248.5 to 346. Dry matter yield increased from 9.27 to 25.54 ton/ha for the fertilizer rate from control to 20:64 kg/ha. Dry matter yield increased for wider spacing from 25;50 cm to 75;100 cm having the yield of 14 to 26.61 ton/ha. The present experiment suggests that at low lands of Southern Ethiopia the optimum dry matter yield could be obtained at phosphorus and nitrogen rate of 20;64 kg/ ha with 75;100 cm plant and row spacing of Desho grass.*

Keywords: Nitrogen, Phosphorus, Plant spacing, Row spacing

1. Introduction

Desho grass (*Pennisetum pedicellatum*) is an indigenous forage species of Ethiopia with different names in different countries of Africa: As annual kyasuwa grass in Nigeria, Barrein in Mauritius and Desho in Ethiopia (EPPO, 2014). In Ethiopia Desho grass is a perennial plant which was first identified in the Southern region of the country at Chencha in 1991 and was utilized for soil conservation and animal feed (Welle *et al*., 2006). The grass is drought tolerant and is used as feed for ruminant animals (FAO, 2010; EPPO, 2014). It has potential to address some of the challenges of feed scarcity, since it produces high dry matter yields of forage per unit area and ensures a sustained forage supply due to its multi-cut nature (ECOCROP, 2010). Desho grass is suitable for intensive management and performs well at elevations of 1500-2800 masl (Leta *et al*., 2013). Asmare (2016) suggests that desho grass is both potential feed source and a means of soil conservation in the mixed crop-livestock production systems of Ethiopia.

Desho grass responds well to fertilizer application and could be combined with fodder legumes either in mixtures or in rotational cropping. In short rotation with maize or groundnuts, the grass yields better than traditional forage grasses, especially when fertilized, while the roots and stubble also increase organic matter in soil (Leta *et al*., 2013). It requires compost or manure of about 1,000 – 4,500 kg/ha and 25-100 kg/ha of urea fertilizer for establishment and maintenance (Danano, 2007).

Crude protein concentrations of desho grass, 9.6% on dry matter basis during early growth 1.6% at the straw stage have been reported at low elevation (Asmare *et al*., 2016), with lower values at mid elevation (8.6% CP) and high elevation (7.5% CP). The grass is widely used as green fodder for cattle in different parts of the world (Cisse *et al*., 2002).

In Ethiopia, factors like shortage of land, shortage of planting materials, poor soil fertility and lack of awareness (Yenesew *et al*., 2014) limit forage production and there is no predetermined agronomic practice for optimal production of desho grass yet. Therefore the objective of this study was to determine some morphologic traits and dry

matter yields of desho grass at different levels of phosphorus and nitrogen fertilizer and plant and row spacing.

2. Materials and Methods

2.1. Description of study areas

The experiment was conducted on the Arba Minch Research Center at Chano Substation ($6^0$2' N, $37^0$33' E; 1170 meter above sea level), Southern Ethiopia, from September 2014-April 2015. The nearby town of Arba Minch, 10 km from the experimental site, has average rainfall of 1,000 mm per annum and the monthly average minimum and maximum temperatures are 16 and 37°C, respectively.

2.2. Soil chemical and physical properties of the study site

Laboratory analysis for particle size (texture), pH, available phosphorus, total nitrogen, organic carbon and cation exchange capacity for composite soil (0-30 cm) samples collected from the experimental site before planting are shown in Table 1.

Table 1. Selected physico-chemical properties of the experimental soil at 0-30 cm depth

Soil Properties	Quantity
pH	6.2
Organic carbon (%)	1.16
Available phosphorus (mg/kg)	14.5
Total nitrogen (%)	0.2
Cation exchange capacity (cmol(+)/kg)	29.5
Texture (Sandy loam)	
Sand (%)	64
Silt (%)	21
Clay (%)	15

Source: Own laboratory result

2.3. Treatments and experimental design

Factorial combinations of 5 fertilizer (phosphorus: nitrogen) rates (0:0, 11.5:43.5, 15:59.5, 20:64 and 25:91.5 kg/ha) x 4 plant spacing (between plants: between rows) (25:50, 50:75, 75: 100 and 100:125 cm) were laid out in a randomized complete block design with 3 replications. Planting was done on 15 September 15 2014 on plots of 3 x 4 m, each plot having 4 rows x 2 m long. The distance between plots was 1 m and that between blocks 1.5 m. Phosphorus fertilizer as di-ammonium phosphate was applied at planting time and N as urea was applied at the 2-leaf stage of establishment. Weeds were controlled with frequent hand weeding throughout the experiment.

2.4. Data collection and analysis

Plant height (cm), tiller number and dry matter (ton/ha) were recorded on 2 central rows. The recorded data were subjected to analysis of variance (ANOVA) followed by means separation using the Genstat statistical software (VSN international, 2013).

3. Results and Discussion

The main effects of fertilizer rates (P: N combinations), plant spacing and their interaction were highly significant ($P<0.01$) for plant height, total dry matter yield and tiller number ($P<0.05$) (Table 2).

Table 2. Analysis of Variance

Source of Variation	DF	PH (cm)	Tiller number	DMY (ton/ha)
Replication	2	31.67^{ns}	7704^{ns}	12.9^{ns}
Fertilizer Rate	4	1934.52^{***}	19272^{***}	675.19^{***}
Spacing	3	3655.01^{***}	26737^{***}	429.86^{***}
Fertilizer Rate x Spacing	12	663.3^{***}	4896^{*}	81.1^{***}
Error	38	30.19	2074	6.26
CV (%)		6.7	16	13.1

DF: degree of freedom, PH: plant height, DMY: dry matter yield, CV: coefficient of variation

3.1. Plant height

In the absence of fertilizer, plant and row spacing had no effects on plant height (P>0.05) with a mean height of 61.1 cm. When fertilizer was applied plant height tended to increase, with the effect being more pronounced at wider spacings and the highest fertilizer levels (Table 3). The greatest plant height occurred at the highest fertilizer level (P: N) of 25P:91.5N kg/ha and widest spacing of 100:125 cm (128.7 cm).

As to the present experiment, the increase in nitrogen and phosphorus fertilizer application increase plant height of *Pennisetum glaucum* (El-tilib *et al.,* 2006) and desho grass (Worku *et al*., 2017). The highest plant height of desho grass at wider spacing and high level of fertilizer in the present research agrees with Shiferaw *et al.* (2011) which grows upright with the potential of reaching 90 to 120 cm based on soil fertility. Plant spacing was not affecting plant height (Tilahun *et al*., 2017; Worku *et al*., 2017). That is due to the physiological functioning of nitrogen and phosphorus fertilizers to involve in growth and development of desho grass. Plant height is an important parameter contributing to yield in forage crops (Tessema *et al*., 2002).

Table 3. Effect of phosphorus and nitrogen fertilizer and spacing on plant height of desho grass at Chano Substation in 2014

P:N (kg/ha)	Plant: Row spacing (cm)			
	25:50	50:75	75:100	100:125
0	60.3^{gh}	62.0^{gh}	61.0^{gh}	61.0^{gh}
11.5:43.5	74.7^{ef}	79.8^{de}	102.2^{bc}	101.5^{bc}
15:59.5	68.3f^{g}	60.2^{gh}	85.2^{d}	98.2^{c}
20:64	58.5^{h}	68.0f^{g}	106.0^{bc}	109.3^{b}
25:91.5	101.0^{bc}	55.2^{h}	87.7^{d}	128.7^{a}
CV (%)	6.7			

$LSD_{0.05}$: Fertilizer rate = 4.54; Spacing = 4.06; Interaction = 9.08

Means followed by common letters are not statistically different (P>0.05); CV: coefficient of variation, $LSD_{0.05}$: Least significant difference at p = 0.05

3.2. Tiller number per plant

In the absence of fertilizer plant and row spacing had no effect on tiller numbers (P>0.05) with a mean figure of 214 tillers/plant (Table 4). Application of fertilizer increased the number of tillers with highest numbers (406 and 418 tillers) being recorded at the widest plant: row spacing and the high applications of fertilizer (P<0.05).

The plant tiller number was higher in wider plant and row spacing (Tilahun *et al*., 2017; Worku *et al*., 2017). The present result also agrees with (Lakhana *et al*., 2005; Pathan and Bhilare 2009; Kizima *et al*., 2014) for the increment of tiller number per plant with increasing level of fertilizers. That may be due to the plant under and above ground resource competition would be lower in wider spacing than narrower which favors the development of more tiller number per plant. Having higher number of tiller advantages the farmer to satisfy the need of planting material. Effective tillers are having leaves and there may add forage feed to livestock (Mushtaque *et al*., 2010).

Table 4. Effect of phosphorus and nitrogen fertilizer and spacing on tiller number of desho grass at Chano Substation in 2014

P:N (kg/ha)	Plant: Row Spacing (cm)			
	25:50	50:75	75:100	100:125
0	215^{ef}	215^{ef}	216^{ef}	211^{f}
11.5:43.5	298^{bcd}	294^{bcd}	277^{cdef}	326^{bc}
15:59.5	287^{cde}	310^{bc}	261^{cdef}	369^{ab}
20:64	210^{f}	270^{cdef}	308^{bc}	406^{a}
25:91.5	232^{def}	299^{bcd}	285^{cdef}	418^{a}
CV (%)	16			

$LSD_{0.05}$: Fertilizer rate = 37.64; Spacing=33.66; Interaction = 75.27

Means followed by common letters are not statistically different (P>0.05); CV: coefficient of variation, $LSD_{0.05}$: Least significant difference at p = 0.05

3.3. Dry matter yield

In the absence of fertilizer plant and row spacing had no significant effects on DM yield (P>0.05) with mean yield of 9.27 t DM/ha (Table 5). Yields responded to increasing levels of fertilizer with highest yields being recorded at 20P:64N or 25P:91.5N for all spacings (P<0.05), while at all fertilizer levels the highest yields were at the 75:100 cm plant: row spacing (P<0.05). The highest yield recorded (41.13 t DM/ha) was for the highest fertilizer application and the 75:100 cm spacing.

As to the present experiment, the highest dry matter yield was reported at 150 DAP: 200 Urea kg/ha for desho grass (Worku *et al*., 2017) and at the nitrogen rate of 90-120 kg/ha for millet (Hegde *et al*., 2006; Bhilare *et al*., 2010). Dry matter yield of 28.35 t/ha was recorded with 100 kg/ha DAP and 50*50 cm spacing (Tekalign *et al*., 2017). There was highest total dry matter yield recorded for desho grass at 50*100 cm spacing (Yenesew *et al*., 2014) and for napier grass at narrower (50*40 cm) spacing under intensive management of nitrogen application and irrigation (Sumran *et al*., 2009) whereas for desho grass at present experiment the dry matter yield of highest ton recorded at 75*100 cm spacing. The results for dry matter yield indicate that wider spacing produces higher dry matter per clump as has been reported by the Vetiver Information Network (VIN, 1992) when intra-row spacing of 15 and 30 cm were compared. The significant increase in dry matter yield with increase in fertilizer rate was in agreement with the results reported by Yasin *et al.* (2003) may be due to the additional tillers developed which brought an increase in leaf formation, leaf elongation and stem development (Crowder and Cheda, 1982).

Table 5. Effect of phosphorus and nitrogen and spacing on dry matter yield (t/ha) of Desho grass at Chano Substation in 2014

P:N (kg/ha)	Plant: Row Spacing (cm)				
	25:50	50:75	75:100	100:125	Mean
0	9.03^{h}	9.03^{h}	9.73^{h}	9.27^{h}	9.27^{d}
11.5:43.5	11.97^{gh}	9.83^{h}	21.97^{de}	15.33^{fg}	14.78^{c}
15:59.5	17.7^{f}	12.2^{gh}	28.4^{bc}	15.2^{fg}	18.38^{b}
20:64	13.13^{gh}	31.77^{b}	31.83^{b}	25.43^{cd}	25.54^{a}
25:91.5	18.63^{ef}	22.67^{de}	41.13^{a}	26.87^{c}	27.33^{a}
Mean	14.09^{c}	17.1^{b}	26.61^{a}	18.42^{b}	19.06
CV (%)	13.1				
$LSD_{0.05}$: Fertilizer rate =2.07; Spacing=1.85; Interaction = 4.12					

Means within a column followed by common letters are not statistically different, CV: coefficient of variation, $LSD_{0.05}$: Least significant difference at p = 0.05

4. Conclusion

This study has shown that the tallest plant height and higher number of tiller recorded at higher level of nitrogen and phosphorus fertilizer application with a wider plant and row spacing. The total green forage and dry matter yield increment recorded with increasing level of phosphorus and nitrogen fertilizer rate and wider plant and row spacing for desho grass production at low lands of the study area. At low lands of Arbaminch research center, Gamo Gofa area, the optimum dry matter and green forage yield could be obtained at phosphorus and nitrogen rate of 20:64 kg ha^{-1} with 75:100 cm plant and row spacing. Further study should be conducted on response of fertilizer rate and type to chemical composition and mineral content of different variety of desho grass.

Conflict of interest

Authors clearly declare that there is no conflict of interest in publication of this work.

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Assessments of Current Practices and Problems in the Management of Livestock in Selected Human Shelters (Refugee Camps) in Ethiopia

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Abstract: *The objective of the study was to investigate the current practices and problems in the management of animals in selected human shelters (Refugee camps). The study was conducted in three districts of Western Ethiopia namely, Sherkole in Komosha, Tongo in Mao-Komo, and Bambasi in Bambasi districts. Secondary data, desk reviews of different documents, focus group discussions, key informants interviews and field observations were used as the study methods. The findings of the study confirmed that eight humanitarian organizations operate in the refugee camps, namely ARRA, ICRC, UNHCR, IOM, UNICEF, NRDEP, WFP and RADO to supply and manage humanitarian aids. However, the livestock emergency response intervention such as health, feed, water and other conditions of animal management is not represented and documented. There is no animal welfare organization /humanitarian organization working on animal management in refugee camps. Following the culture of their ancestors and their experiences, some Sudanese refugees have brought their animals to Ethiopia. Nevertheless, the Ethiopian government do not have regulations that protect the entrance of animals with refugees. Even though the number and types of animals entering with the refugees are not well known, different species of animals are found in all the visited refugee camps. Some have brought them from their origin of country and others restocked it in the host country, Ethiopia. The major livestock species found in the refugee camps include cattle, goats, sheep and donkeys. There is no specific management given for the animals in the refuges except that the regional government provides vaccination and other veterinary services to protect the transfer of cross-border disease from the displaced to the local animals. Some of the hosting community leaders around Tongo and Bambasi are also expressing their frustration on the refugees' livestock, mentioning that the refugees are allowing animals to graze on their crops and private grazing land deliberately. Some livestock owners confirmed that they are using traditional (herbal) medicines for disease prevention. The refugees strongly expressed the importance of regular vaccination and animal service program for their livestock. There was also interbreeding among Ethiopia and Sudanese cattle as they share the same grazing land. Zoonotic diseases are also a fear for the refugees. All the respondents explained that there are no clearly defined funds for the management of livestock in the refuges.*

Keywords: Bambasi, Livestock management, Refuges, Sherkole, Tongo

1. Introduction

Livestock play a crucial role in people's livelihoods throughout the world, and when humanitarian emergencies arise rapid assistance is needed to protect and rebuild the livestock assets of affected communities (LEGS 2009). Although the importance of livestock in food security and disaster coping is understood and acknowledged by experts and animal welfare organizations, livestock-keeping in many refugee-camps faces implementation problems both from the host country and the humanitarian organizations. An evaluation report by Action Against Hunger (AAH 2007) revealed that a large proportion of people in the country in the refugee camps owned livestock, but that disease was a major cause for livestock loss as animals were managed in very close quarters.

While general Livestock Emergency Guidelines and Standards (LEGS*)* for the design, implementation, and assessment of livestock interventions to assist people affected by humanitarian crisis exists, it is not known where and how these guidelines are practiced and what problems arise in the management of animals in shelters (LEGS 2009). At present, there appear to be no best practices in managing livestock in

human shelters (refugee camps). Furthermore, there are limited literature and case study works that demonstrate current practices and problems in the management of animals in human shelters (refugee camps) globally with a broad geographical focus. Therefore, investigating the scale and type of problems occurring with animal management in human shelters (refugee camps) and matching available practical solutions from other areas of animal management and veterinary sciences would mean a significant improvement in the tools that humanitarian agencies have available for the care of livestock in camps. A number of concerns came to the fore in refugee operations, particularly in situations where refugees bring their livestock herds with them. These concerns varied considerably depending on the local situation – mainly with regards to local ecological conditions, social systems and existing stocking practices such as depletion of water resources, disruption of traditional livestock production patterns, competition for rangelands, conflicts with local population and impacts on public health (UNHCR 2005).

Therefore, the objective of this study was to investigate the current practices and problems in the management of farm animals in human shelters (in specific Refugee camps) in Ethiopia.

2. Materials and Methods

2.1. Description of the study areas

This study was conducted in three '*Woredas'* (administrative districts) in Western Ethiopia in 2013. The selected refugee camps assessed were Sherkole in *Komosha Woreda, Tongo* in *Mao-Komo Woreda* and *Bambasi* in *Bambasi Woreda* (Figure 1).

Sherkole is the oldest refugee camp opened in 1997 and currently hosts around 10,011 refugees (UNHCR 2012) from different ethnic tribes such as Mabaan, Funj, and Uduk who have fled fighting and insecurity in the Blue Nile province of Sudan. The refugee's camp is located in Komosha wereda, 720 kilometers away from Addis Ababa and some 50 kilometers east of the Ethio-Sudan border. The local inhabitants are the Berta communities who depend mainly on agriculture and a little trade. Berta cattle have been destroyed by the tsetse fly and as a result, they can no longer rely on animal traction, which has a serious impact on their agricultural production and productivity.

Initially, refugees stayed close to the border, hoping to return soon. However, due to the conflict in South Sudan, Tongo camp was reopened in October 2012, 200 km far from the border. About 12,952 refugees (UNHCR, 2012) have been moved from way stations and Adamazin Transit Center to Tongo Camp.

Bambasi is the third refugee camp in the region opened to accommodate the refugees from the Blue Nile province of Sudan who has been affected by the new conflict. The camp began receiving refugees back in June 2012 after Sherkole and Tongo - reached maximum capacity. As of 31 October, 2012, about 12,284 refugees were in Bambasi who relocated from Ad-Damazin transit center (UNHCR, 2012).

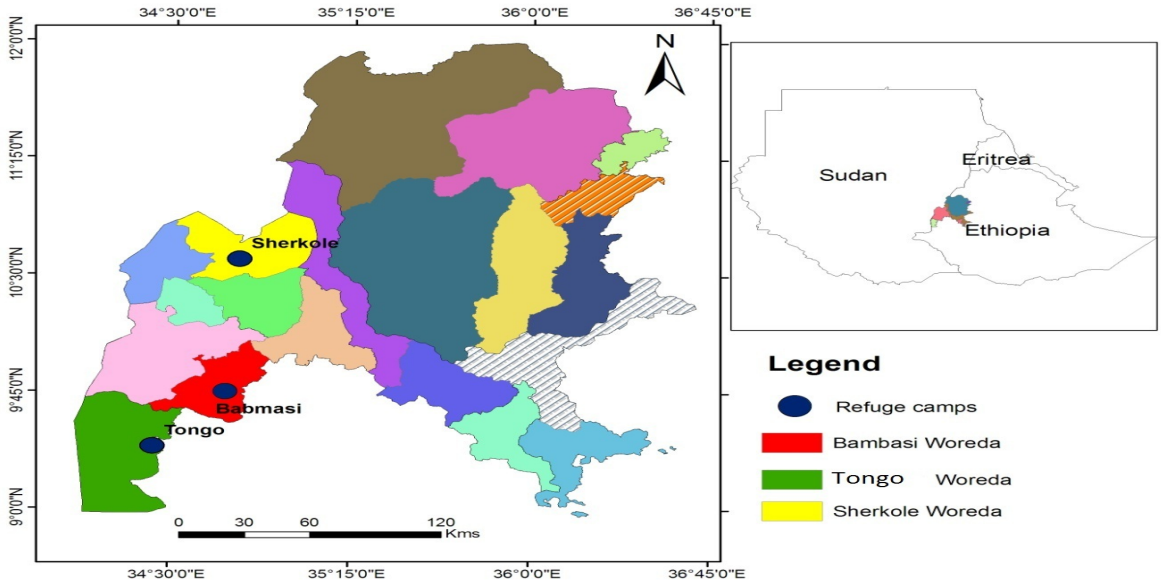

Figure 1. Map of the study areas

2.2. Data collection and sampling techniques

The study was conducted using multi-stage approaches to gather important information on current practices and problems in the management of animals in human shelters namely Tongo, Bambasi and Sherkole refugee camps. The data was collected using purposive sampling techniques by selecting individuals who have relationships with the refuges and those refugees came with their domestic animal to the camp. Collection of secondary data, desk reviews of different documents and studies, focused group discussions, key informants interviews and field observations were made up on the schedule.

The focused group discussions were made by selecting pertinent individuals from GOs, NGOs, communities, individuals or livestock keepers in the refuges (community leaders in the refuges). Three focused group discussions were conducted at each selected refugee camps (one for each). Each focused group discussion composed of about12 members consisting of males, females and livestock owners in the refuges, and community leaders. Personal interviewers were also conducted with individuals selected by the communities in the refuges. The in-depth information was collected using interviewing key informants who have deep knowledge on current practices and problems in the management of animals in human shelters (refugee camps) in the area. Filed visit or direct observations of the problems were employed and the situations observed were photographed and recorded in the format pre-prepared. The data collected by the questionnaires were analyzed using SPSS (16, 2017). Descriptive statistics (percentile) was used to quantify the determinants for human and livestock management in the refuges.

3. Results and Discussion

3.1. Management of refugee camps

While forced displacement is often linked to a single proximate cause such as a war or natural disaster, the historical struggles happened between racial and ethnic groups, access to natural resources and livelihoods, environmental change or degradation, and political dynamics at local, state, and international levels is becoming fundamental. While there has been some development of a structure of international norms through the Universal Declaration of Human Rights and the United Nations Convention Relating to the Status of Refugees, the complex overlapping of issues imply that each situation has its unique set of issues and concerns that must be addressed. The Somali refugee camps in Northeastern Kenya are one of the cases in this regard (Asefaw and William, 2014). The results of this assessment also revealed that eight humanitarian organizations namely ARRA, IRC, UNHCR, IOM, UNICEF, NRDEP, WFP and RADO are operating in the refugee camps in supplying and managing

humanitarian aids. However, these organizations missed the livestock emergency response intervention such as health, feed, water and other conditions of animal management. There is no animal welfare/humanitarian organization working on animal management in refugee camps.

The management of all refugee camps in Ethiopia is led by a government organization – Administration for Refugees and Returnee Affairs (ARRA). The role of ARRA is facilitating and supporting the actors and the communities for effective management of refugee camps. According to ARRA officials, multiple organizations were providing support to refugees with different services. For example, WFP is responsible for food distribution; UNHCR provides nonfood items; ARRA is responsible for health services through temporary clinics in the camps; IRC and WVI are providing water, sanitation and hygiene services; and UNICEF is supporting education services. However, none of these organizations is working on animal management in the refuges. However, all the discussants including the government officials are very concerned on how to integrate emergency animal management responses in the emergency preparedness plans. Particularly, government experts stated that they are committed to delivering veterinary and other animal management services if favorable working arrangements are created by the concerned bodies.

3.2. Livestock ownership movement with refugees

The result also showed that some Sudanese refugees brought their animals. However, the Ethiopian government doesn't have regulations that protect the entrance of animals with refugees**.** During the assessment period, food assistance, remittances, petty-trading and animal husbandry are the main sources of the livelihoods in the refugee camps. Sudan refugees or their ancestors were pastoralists and agro-pastoralists. The pastoralists depend primarily on livestock or livestock products for income and food, while the agro-pastoralists derive their income from both livestock and non-livestock sources. It was also reported that some refugees have been benefited from gardening with the delivery of selected seeds and farming tools distributed by ARRA and UNHCR.

Currently, the Ethiopian government doesn't have regulations that protect the entrance of animals with refugees. Following the culture of their ancestors and their experiences, some Sudanese refugees have brought their animals. Even though the animal population size entering with the refugees are not known, in all the visited camps the refugees have managed different kinds of animals around the refugee camps. Some have brought them from their origin of country and others restocked it in the host country, Ethiopia. The main livestock species found in the refugee camps were cattle and goats, sheep.

3.3. Current livestock management in the refugee camps

It was also important to note that there is no specific management given for animals in the refuges except that the regional government is providing vaccination and other veterinary services to the refugee's animals to protect the transfer of cross-border diseases from the displaced to the local animals. Some of the hosting community leaders around Tongo and Bambasi were also expressing their frustration on the refugees' livestock, mentioning that the refugees have been grazing their crops and private grazing land deliberately. Some livestock owners confirmed that they are using indigenous traditional herbal medicines for disease preventions.

The refugees coming with their animals use fences and open shelter for keeping their animals at night. Most of the refugees use open grazing, however, some of the refugees who have restocked in Ethiopia have reported that they buy forage and cereals for their sheep and goats. All of the refugees are using river water for drinking their animals. All the discussants particularly animal management experts and government officials revealed their concern about the unsafe conditions of animal management in and around refugee camps both to the refugees and the host community. Animal veterinary experts have expressed their discontent that the refugees' animals are entering to Ethiopia without quarantine service at the border and are causing a new drug-resistant animal disease for the host communities' livestock. It is reported that approximately 2000 individuals, along with an estimated 8000 livestock are living amongst the local community (UNHCR 2012) which may have a disastrous effect for host community as well as the refugee livestock.

It is mentioned that the refugees used host communities' crops and private grazing lands deliberately. Experts from the district agricultural office explained this is because that the refugee community could not differentiate the Ethiopian crop, particularly millet from other grasses. Both government officials and the community also mentioned that dogs brought by the refugees usually bite the host community's cattle and caused human health risk because of rabbis. Some experts are also being indecisive that increased concentration of livestock in the future is likely to have a localized negative environmental impact on the area.

The refugees, on the other hand, express the problem of animal management services such as lack of animal medications and grazing areas. The UNHCR (2012) report documented that many of the refugees opted out of the relocation because of a lack of grazing land in Bambasi. Some livestock owners confirmed they are using indigenous herbal medicines and sometimes buy drugs from drug shops and strongly expressed the importance of regular vaccination and animal service program for their livestock.

Different issues of managing animals at the border were raised. All the respondents replied in the same manner that there are different animal species in Sherkolle, Bambasi, and Tongo Camps. These animals include cattle sheep, goats, donkeys, and dogs. There is no controlling mechanism when animals enter into the host country and leave for their country during repatriation. Particularly stressed that "though we know that there is a trans-boundary disease, we can't control or stop the animals' movement or entering with the refugees. This is because there is no national or international regulation that forbids animals entering without being quarantined or vaccinated at the border or entry point. As the country has no controlling mechanism during entrance and repatriation, there is an expectation that indigenous Ethiopian breed could go out of the country without any genetic inspection. There is an exchange of animals between the local community and refugees and no controlling mechanism at the border when the animals are entering into the hosting country, it is difficult to identify whether these animals are coming from the outside or bought from the local community (Figure 2).

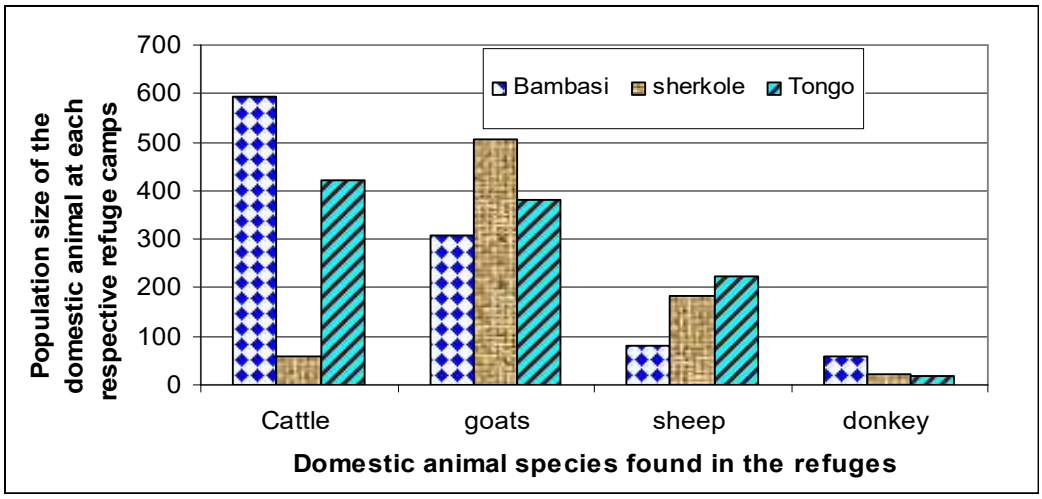

Figure 2. Livestock species and population number at the refuges of Bambasi, Sherkole and Tong

ARRA officers were at the border of Sudan and Ethiopia to know the number of people entering to the refugees while we were collecting data at Sherkole refugee camps. The officers confirmed that the numbers of domestic animals waiting for entrance with people at the Papararo and Homba entrances were greater than the number of people which are indicated in Figure 3.

About 88.2 % of the respondents/ migrants in the refugee camp explained that there are no clear regulations and guidelines for management of livestock both for hosting community and refugee

population. Most of the local community (71.7%) also support the idea of the migrants. All the respondents in the refugee camp (migrants) and the local community agreed that except ARRA, all other international organizations do not allocate funds for livestock management in the refuges (Table 2).

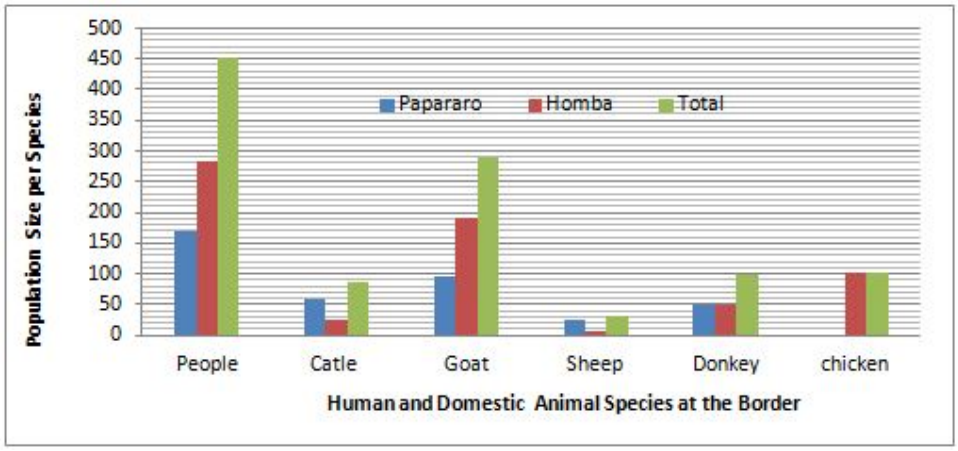

Figure 3. The number of people and domestic animals waiting for entrance at the border

Table 1. : Key unresolved determinants for human and livestock management in the study refuges

No	Key determinants for human and Livestock management	Responses of the respondents (Migrants No = 85 and local community = 92)					
		Migrants			Local community		
		Yes	No	Do not know	Yes	No	Do not know
1	Are there any clear regulations and guidelines for management of livestock both for hosting community and refugee population?	0 (0%)	75 (88.2%)	10 (11.8%)	0 (0%)	66 (71.7%)	26 (28.3%)
2	Do the refuges and local communities know the number and type of livestock came with the refuges?	22 (25.9%)	40 (47.1%)	23 (24%)	0 (0%)	71 (77.2%)	21 (22.8%)
3	Is there a national Livestock Emergency Guidelines and Standards?	0 (0%)	73 (85.9%)	12 (14.1%)	0 (0%)	25 (27.2%)	67 (72.8%)
4	Is there any livestock grazing conflict management guideline in the camp?	0 (0%)	79 (92.9%)	6 (7.1%)	0 (0%)	23 (25%)	69 (75%)
5	Is there any veterinary emergency response plans in minimizing livestock disease risks in the refuges?	5 (5.9%)	57 (67%)	23 (27.1)	0 (0%)	45 (48.9%)	45(48.9%)
6	Is there any control for trans-boundary human and livestock diseases?	0 (0%)	85 (100%)	0 (0%)	0 (0%)	0 (0%)	92 (100%)
7	Do the 8 Organizations* workings in refugee camps allocate money for livestock management? (* ARRA, IRC, UNHCR, IOM, UNICEF, NRDEP, WFP and RADO)	0 (0%)	85 (100%)	0 (0%)	0 (0%)	0 (0%)	92 (100%)

4. Conclusions

Ethiopia does not have policies and regulations that control the entrance of animals with the refugees. Moreover, there is no livestock emergency response intervention and animal management. The critical problems encountered by animals in the refuges were feeding, interbreeding, prevention, and control of animal diseases. Hence, the involvement of hosting governments, animal welfare organizations, and humanitarian organization in the management of animals in the human shelter is crucial for safe health and food security in the refuges.

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