

# Camel and Small Ruminant Based Pastoralism in Ethiopia: Recent Trends and Future Prospects

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## Systematic Review

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# Abstract

In Ethiopia, camel and shoat production are common pastoralism practices in three major pastoralist regions of Afar, Somali, and Borena. This review was aimed to indicate the recent trend and future prospect of camel and small ruminant production and the possible modifiers and the pros and cons of the practices in the pastoral area of Ethiopia. The data was collected from different researches conducted each year. The data was also organized in terms of the number of camel and shoat per household each year (2010-2020) and analyzed using trend and forecasting analysis model by SPSS software. There has been an increment of camel *Tropical Livestock Unit* (TLU) per household from 2.78, 13 and 9 to 37, 28, and 28 between the years 2010-2020 in Borena, Afar and Somali respectively and will increase to 45, 45, and 35 by 2030, respectively. In the whole pastoralist regions, the number of camels TLU per household has increased from 2.8 to 31 between the years 2010-2020 and will increase to 50 TLU per household by 2030. Moreover, the number of goats and sheep has increased from 1.4 and 0.91 TLU per household to 2.45 and 2.46, respectively between the years 2010-2020 and the predicted model indicates that it will increase to 2 and 3.4 TLU per household by 2030. Climate change, drought and adaptation responses were the major drivers. Climate change coping and livelihood income improvements were the pros of the trend, while the reduction of cattle population and impact on the conservation of valuable indigenous cattle were the cons of the practice.

## Introduction

Pastoralists in Africa are found in three natural zones; Mediterranean and Saharan zone, Sub-Saharan tropical and equatorial zone, and southern zone (FAO., 2018) and share 40% of the total continental landmass of Africa (Union, 2013). The way and extent of livestock rearing practice by pastoralists varied in this region mainly depending on the nature and characteristics of the environment (Lagat and Nyangena, 2018). In the drier parts of the regions, pastoralists majorly focus on the rearing of camels and goats, while in areas having a higher rainfall they focus on rearing of cattle, sheep, and goats (El-Hatmi *et al.*, 2015). Besides this, the type of livestock rearing is affected by social prestige (Alhaji and Isola, 2018). East African traditional substances pastoralists fully tends to keep large herds, milk cattle in preferences to eating them (Lombard and Parsons, 2015). In this decade, there is a dynamics and shifting of pastoralists livestock rearing practices in type and extent in Africa (McPeak *et al.*, 2011; Egeru, 2016; Hussein *et al.*, 2016).

The social and economic system on grater cattle production and the increase in environmental aridity through climate change hinder cattle-based pastoralism (Opiyo *et al.*, 2016), as a result of rangeland ecosystem services' degradation (Sala *et al.*, 2019). There is implication and evidence on pastoralists adjust their livestock composition and types in response to environmental extreme and unsuitability (Silvestri *et al.*, 2012; Kimani *et al.*, 2019 Bekele, 2013). Several studies indicate that pastoralists shift from cattle base pastoralism or from grazer to browser livestock rearing practices (Boru *et al* 2014; Dirriba *et al.*, 2020). Cattle-based pastoralism is highly affected by environmental crises such as drought and different socioeconomic factors (Onono *et al.*, 2013; Kimaro *et al.*, 2018). Pastoralists involve adapting to

this environmental problem, especially by changing a livestock composition in type and extent (Opiyo *et al.*, 2015) and by rearing browser and drought resistant livestock (Kagunyu and Wanjohi, 2014).

In Ethiopia, camels and small ruminant production considered as a strategy for coping and adapting drought-related hazards (Galma *et al.*, 2017; Fano *et al.*, 2018). The involvement of camels and small ruminant production in the whole pastoralist region of Ethiopia (Yosef *et al.*, 2018; Aden and Kula, 2020) has increased average income and the risk for the pastoralist community has reduced (Belete and Shishay, 2019). Changing livestock complement through including more camels help the resiliency of community during drought due to several benefit length of lactating, consume some browse species and less frequency of watering and the ability to withstand harsh environmental conditions (Forrest *et al.*, 2014). Studies recommend that boosting the capacity of the community on improving husbandry practices and product utilization as well as developing coordinated efforts for camel diseases, controlling and developing prevention schemes helps to strengthen the capacity of the pastoralists production system (Galma *et al.*, 2017). Small ruminant production among pastoralists is largely undertaken along with large ruminants especially goats for the primary purpose of generating chase and full-filling basic needs. The feeding habit of various shrubs and tree level and acacia species, both during wet and dry season are preferable by pastoralists (Dirriba, 2020). Therefore, this review was focus on trend and future prospect of camels and small ruminant based pastoralism, the possible modifiers and the pros and cons of the practices in Ethiopia. The main objective of this review was to review the recent trend and future prospect of Ethiopian camels and small ruminant based pastoralism practices. More specifically, this review aims: 1) to review recent trends and future prospects of camels and small ruminant raring potentials' in Ethiopia pastoralism. 2) To review the possible modifiers for the involvement of camel and small ruminant based pastoralism in Ethiopia. 3) To review the pros and cons of camels and small ruminant based pastoralism practice shift to other pastoralist practice.

## Method Of Review

The data obtained from literature or research work was organized systematically. Several studies related to this topic were searched from google and google scholar using key terms or phrases and sentences. The number of camels and shoat per household was organized from different studies. The data was organized for each year (2010-2020) and estimated in terms of Tropical Livestock Units (TLU) per household; 0.7 for cattle 1 for camels and 0.7 for goats and sheep. The data was analyzed using trend and forecasting model analysis system.

## Recent Trend And Future Prospect Of Camel And Small Ruminants Based Pastoralism

Camels and small ruminants based pastoralism practices are the common way of life in Ethiopia, especially in the drought-prone regions (Belete and Shishay, 2019; Yosef *et al.*, 2014). It plays an immense contribution to the national economy of the country (Gezahegn *et al.*, 2015), despite the challenge faced due to natural and socioeconomic factors (Zeraye, 2015; Fikru *et al.*, 2017; Shishay and

Mulugeta, 2018). There is a large tendency from pastoralists currently, towards camel and small ruminant-based pastoralism practices (Bekele *et al.*, 2011; Tesfaye, 2017). Individual's preference favor camels and small ruminant based practices relative to cattle (Wossene *et al.*, 2020; Argaw *et al.* 2016). It indicates a shift from cattle-based practices, compared to the past involvement. The perception of pastoralists about the importance of cattle-based and camels and small ruminant-based practices vary from individual to individual (Coppock *et al.*, 2014), but averagely they prefer camels first, followed by goats and sheep as a second option (Minayahel *et al.*, 2016). This may arise from the long-time experiences of pastoralists about the pros and cons of the practices (K. Marshall *et al.*, 2016). Many studies indicate that pastoralists of Ethiopia prefer and involve in livestock production, which are viable and feasible for their uses (Angassa and Berhan, 2015; Dejene, 2015). The national livestock population trend also indicates a large increment of camels and small ruminants in pastoralist areas (Samson and Frehiwot, 2014; Getachew *et al.*, 2015). Several scholars suggest and seen as a panacea for the current alarming environmental crises of drought or climate change (Yosef *et al.*, 2013; Nega *et al.*, 2019; Wassie and Fekadu, 2015; Dejene, 2015). Many studies in Ethiopia, indicates pastoralists shift from cattle-based system to camel and small ruminant based in this decade (Grum *et al.*, 2012; Yohannes *et al.*, 2015).

In three pastoralist regions of Ethiopia (Afar, Borena, and Somalia) there is a large percent of shift from cattle-based system to camel and small ruminant based, but there are a dynamics of up and down, especially in goat ruminants TLU per household (Fig-2), this may be due to the seasonal occurrences of many diseases (Mohammed *et al.*, 2016). According to the trend analysis and forecasting model data from research works between the years 2010-2020, there has been an increment of camel TLU per household in the year 2010 from 2.78, 13, and 9 TLU per household to 37, 28, and 28 in Borena, Afar and Somali in the year 2020, respectively (Fig-1). There will be also an increment of camel TLU per household to 45, 45, and 35 in Borena, Afar and Somali, respectively by 2030 (Fig-1). There was and there will be an increment of goat TLU per household in the last and next 10 years, decade (Fig-1), but there was up and down of goat TLU per household in Afar and Somali pastoralist regions (Fig-1). Sheep TLU per household indicates an increment in the last 10 years and the next 10 years through the whole pastoralist regions (Fig-1).

Camel and small ruminant TLU per household in pastoralist areas of Ethiopia possessed an increasing trend. There has been a large gap between the years 2010-2020 with an increasing trend of the number of camel TLU per household that increases from 8.26 to 31 with large increment in the years 2019 and 2020. The number of goat and sheep TLU per household also has increased despite the dynamics of up and down in different years. The number of goats and sheep TLU per household has increased from 1.4 and 0.914 to 2.45 and 2.46 respectively between the years 2010-2020 (Fig-2).

## Possible Modifiers

### Climate Change Adaptation Potentials

Climate change has an impact on the livestock production of pastoralists in Ethiopia due to several reasons such as feed shortage, water shortage, reducing productivity, decreasing mature weight and lastly decline number of livestock or altering pastoralist livestock holding (Zelalem, *et al.*, 2009). This brings livestock species composition variation because all species are not equally vulnerable to drought (Dejene, 2015 Asamenew *et al.*, 2014). The number and type of species which are left and available during drought are not equally consumed by all livestock species and the extent and potential of adaptation by species vary (Hassanuur *et al.*, 2020). This might be due to the number of TLU species death varies from species to species; cattle are the most victims and lag number of cattle per household mortality than camel and shoat (Fig-3). Because camel and sheep have the capacity to adjust their body temperature or elevated rectal temperature (Abdoun *et al.*, 2012) and they browse species that are available during drought season (Treydte *et al.*, 2017)

This indicates there is a variation on the level of susceptibility to climate change and camels and shoats have the least susceptibility potentials relative to cattle and cattle take the first rank (Fig-4). This brings the shift of pastoralist towards camel and small ruminant production rather herding a number of cattle.

High temperature resulted in heat stress and affects the metabolic performances of cattle and affects breeding practice, feed quality and reproductive managements (Collier *et al.*, 2012). All animals have a range of ambient environmental temperatures termed the thermo-neutral zone, this is the range of temperatures that are conducive to health and performance and upper critical temperature is the point at which heat stress effects begin to affect the animal and this stress occurs when the temperature-humidity index (THI)  $> 72C^0$  (Petzoldt and Seaman, 2006). Animal responses to their thermal environment are extremely varied, it is clear that the thermal environment influences the health, productivity, and welfare of cattle (Lees *et al.*, 2019). In addition to this, it affects not only the availability of fodder but also the rangeland ecosystem services in general (Vrieling *et al.*, 2016). The availability and composition of fodder in the rangeland ecosystem vary with season, the highest composition in rain season while low and poor in the dry season (Fig- 5).

The pastoral system in Ethiopia is not affected only by drought, but also affected by the occurrence of a flood. The occurrence of sediment on rangeland through excessive flood affects the availability of grazing resources and serves as an initiation for agricultural investment, due to the accumulation of fertile soils (Tilahun *et al.*, 2020). The occurrence of high rain and flood affects and damages the landscape and settlements of pastoralists (Gumma *et al.*, 2019). Flood affects pastoralist cattle production directly through mortality and indirectly by affecting grazing land and resources (Thornton and Gerber, 2010).

### **The Existence of Different Constraint for Cattle Production**

Several factors, both social and environmental hinder cattle-based production of pastoralism practices than camels and shoat production (Hanover *et al.*, 2016; Samson and Frehiowt, 2014). The existing rangeland degradation crisis affects the cattle-based pastoralism system in different places (Minyahel *et*

*al.*, 2016). The decline of rangeland ecosystem services affect cattle production than camel, goat and sheep production (Aster *et al.*, 2012), beside, the emergences of diseases following rangeland degradation and drought affect the livelihood of pastoralist worthy that focus or more involve in cattle production than pastoralist involve in camel and shoat or combined with cattle (Bekele, 2013; Temesgen *et al.*, 2014). To cope up with this paradigm pastoralist involve camel and shoat production combined with cattle (Galma *et al.*, 2017).

### **Pastoralist Preferences on Livestock Production**

There is a change in preference of livestock production by pastoralists. Pastoralists prefer livestock production, which is complemented with the existing environmental problems (Galma *et al.*, 2017; Fana and Asnake, 2012), they have their own criteria to prefer or involve in livestock production. The capacity to adapt and cop drought (Hussein *et al.*, 2016; Amare., 2018), the labor requirement and difficulty to manage during drought, the market value and rate, the level and amount of loss during drought, disease susceptibility, accesses to fodder during drought time, and easy to sell and buy from market after and before drought as well as during starvation (Deressa *et al.*, 2010; Zewdie *et al.*, 2017; Dirriba, 2016). Under all these criteria, camel and shoat are preferable by pastoralists. Camel and shoat have a better adaptation capacity than cattle when drought happens (Boru *et al.*, 2014), and it is easy to access fodder for those species than cattle during drought time (Aster *et al.*, 2014; Treydte *et al.*, 2017). The level of susceptibility to disease is low relative to cattle (Vordermeier *et al.*, 2012; Haimanot *et al.*, 2013), but it depends on the type of disease occurred some type of disease harm shoat and camel (Bekele *et al.*, 2012; Sprague *et al.*, 2012). The rate of the seal and market value of camel, goat and sheep are high relative to cattle, especially during drought times (Karanja Ng'ang'a *et al.*, 2016; Hailemichael *et al.*, 2015).

### **Better-off in Income Generation from Camel, Goat and Sheep Livestock**

The potential to generate income from livestock vary from pastoralist to pastoralist and depends on the type of livestock they involve (Berhanu *et al.*, 2013; Getachew *et al.*, 2010). There is a gap in income generation from the seal of livestock between households and they engage in cattle production and camel and shoat production as well as combine the use of cattle, camel and shoat (Eyassu, 2009; Hussein, 2013). The frequency and percent of income from camel, goat and sheep is higher than cattle (Table- 2). Camel and goat take the first and second rank respectively in income-generating (Table- 2).

The income obtained from camel milk and cow milk variety in the amount and continuity (Belete and Shishaye, 2019; Sisay and Awoke, 2015). There is a variation in mike per household and per heads generating during wet and dry season compared to cow (Fig-6). This makes household focus towards camel rather cow to survive during a drought time. Mulugeta, 2018); the number of frequencies in a market seal from goat and sheep is higher in a year compared to cattle seal.

## **Pros And Cons Of Camel And Shoat Production On Pastoralist Livelihood**

## Pros

Pastoralist involvement in livestock diversification majorly by focusing on camel and shoat production, results in a range of benefits. Pastoralists are able to improve their livelihoods. The potential vulnerability as a result of climate change or drought is reduced (Wassie and Fkadu, 2015; Bekele, 2010; Allan, 2011). Many studies indicate that there is a variation between pastoralist households on the potential to adapt to climate change or drought, as a result of the type of focus or involvement on livestock production (Wassie and Fkadu, 2014; Boru *et al.*, 2014; Asheber *et al.*, 2018). Pastoralists involve camel and shoat production in separate or combined with cattle has better adaptation and coping capacity than pastoralist engage only cattle production (Samuel and Treydte, 2017; Ketema, 2015; Mohamed *et al.*, 2020). Individuals involve in camel, goat, sheep and cattle production are more food, more secure than those individuals only involve in cattle production (Indris and Adam, 2013; Tsegaye *et al.*, 2013 ). The different products of meat and milk obtained from the camel and shoat are higher in frequency and amount as well as continuity compared to the cattle (Shishay and

## Cons

The production of camel and small ruminant affects cattle production (Zander and Mburu, 2013). It leads to the reduction of pastoralists' to focus on cattle production (Zander, 2011). Those pastoralist having or involved in a higher number of camels and small ruminant has less number of cattle per household (Kagunyu and Wanjohi, 2014). In the three pastoralist regions (Borena, Somali and Afar), cattle population is decreasing from time to time, while camel population is in increasing trend in arid and semi-arid areas as a result of the combined effects of pastoralists' need and the impact of climate change, which could position the indigenous cattle breed at risk in the near future (Yosef *et al.*, 2013).

## Conclusion And Recommendations

Camel and shoat production in Ethiopian pastoralists indicate a change in increasing trend. The trend and forecasting model from 2010 -2020 and in the next one decade indicates an increasing trend. There is an up and failing of the number of shoats per household in different regions of pastoralists areas. This might be due to vulnerability by pandemic diseases. Climate change and coping or adaptation strategies are the major drivers to focus pastoralists on camel and shoat production. Besides this; the amount, frequency and continuity of income from camel and shoat make pastoralists to shift to this practice. Climate change and drought coping and livelihood improvement are the major pros resulted from the practices, while reduction of cattle population and impact on the conservation of valuable indigenous cattle are the cons of the practices.

The primary focus on camel and shoat production by pastoralists may result fail, in the long future. Because:

- These three livestock species have more or less the same fodder preferences; this may bring niche shortage or competition in the long future, so it needs an investigation about the sustainability of the

practices in the long-lasting.

- This occurrence may global in the whole pastoralist regions and may bring global failure due to some catastrophic event or disease pandemic, so it will be better to investigate the possible consequences that emerged in the future.
- It may bring market failure, the major driver is climate change or drought and this paradigm has happened in the whole pastoralist regions, especially in Africa and may give the same responses by pastoralist users and result in cross border market failure in the future due to the livestock similarity between the regions in type and extent.
- It seems a shift from cattle-based, this also bring an impact on the cattle production sectors, so it needs to investigate the extent of the impact on the sectors.

## **Declarations**

### **Ethics approval and consent to participate**

Not applicable.

### **Consent for publication**

We have agreed to submit for Journal of Agroforestry Systems and approved the manuscript for submission.

### **Availability of data and materials**

The dataset and materials used for this manuscript is available and can be shared whenever necessary. The data was generated by the authors from published articles, books, reports.

### **Competing interests**

The authors declare that there are no competing interests.

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Note applicable.

### **Authors' contributions**

Both authors downloaded the data from Google. They read and arranged the data and wrote the manuscript, both authors prepared and revised the manuscript critically. Finally, both authors read and approved the final manuscript.

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## References

- Abdoun, K.A., Samara, E.M., Okab, A.B. and Al-Haidary, A.I., 2012. A comparative study on seasonal variation in body temperature and blood composition of camels and sheep. *J Anim Vet Adv*, 11(6), pp.769-773.
- Aden, G. and Kula, J., 2020. Prevalence of camel trypanosomosis and associated risk factors in Arero district, Borena Zone, Southern Ethiopia. *Int J Vet Sci Res*, 6(1), pp.014-022.
- Alhaji, N.B. and Isola, T.O., 2018. Antimicrobial usage by pastoralists in food animals in North-central Nigeria: The associated socio-cultural drivers for antimicrobials misuse and public health implications. *One Health*, 6, pp.41-47.
- Allan, D.A., 2011. Transformation of Borana from nomadic pastoralists to agropastoralists and shift of livestock from cattle to include more goats, camels and sheep in Southern Ethiopia. *International Journal of Business and Globalisation*, 6(3-4), pp.292-312.
- Amare, D.M., 2018. Determinants of livelihood diversification strategies in Borena pastoralist communities of Oromia Regional state, Ethiopia. *Agriculture & Food Security*, 7(1), p.41.
- Angassa, T. and Berhan, T., 2015. Assessment of goat production and marketing practices, constraints and opportunities in Yabello District of Borana Zone, Southern Ethiopia. *International Journal of Innovative Research and Development*, 4(11), pp.2278-0211.
- Argaw, A., Zewdie, B., Wondwosen, K., 2017. Resilience Dimensions of the Effects of Recurrent Droughts in Borana Zone, Southern Ethiopia. *Horn of Africa Resilience Innovation Lab (HoA RILab)*, Jimma University, Ethiopia.
- Asamenew, T., Mesfin, S., Ashebir, A., Ayelech, M. and D., 2016. Sero-prevalence of foot and mouth disease in cattle in Borena Zone, Oromia Regional state, Ethiopia. *Ethiopian Veterinary Journal*, 20(1), pp.55-66.
- Asheber, T., Abera, A. and Ademe, F., 2018. The Impacts of Climate Change on Livestock Production and Productivity in Ethiopia. *Irrigation and Watershed Management*.
- Aster, A., Adugna, T., Holand, Ø., Ådnøy, T. and Eik, L.O., 2012. Seasonal variation in nutritive value of some browses and grass species in Borana rangeland, Southern Ethiopia. *Tropical and Subtropical Agroecosystems*, 15(2), pp.261-271.
- Aster, A., Eik, L.O., Holand, Ø., Ådnøy, T. and Adugna, T., 2012. Pastoralists' perceptions of feed scarcity and livestock poisoning in southern rangelands, Ethiopia. *Tropical animal health and production*, 44(1), pp.149-157.
- Ayana, A. Adugna, T. and Atlaw, B., 2006. The effects of physical environment on the condition of rangelands in Borana. *Tropical Grasslands*, 40(1), p.33.

- Bekele M. B., 2013. Climate change, cattle herd vulnerability and food insecurity: Adaptation through livestock diversification in the Borana pastoral system of Ethiopia (Doctoral dissertation, Kommunikations-, Informations-und Medienzentrum der Universität Hohenheim).
- Bekele, M., demelash, B., Fufa, A., Alemayehu, R., Godfroid, J. and Skjerve, E., 2011. Seroprevalence of brucellosis and its contribution to abortion in cattle, camel, and goat kept under pastoral management in Borana, Ethiopia. *Tropical animal health and production*, 43(3), pp.651-656.
- Bekele, M., 2010. An epidemiological study of major camel diseases in the Borana lowland, Southern Ethiopia. Oslo: Drylands Coordination Group.
- Bekele, M., Demelash, B., Fufa, A., Alemayehu, R., Bohlin, J. and Skjerve, E., 2012. Epidemic characterization and modeling within herd transmission dynamics of an “emerging trans-boundary” camel disease epidemic in Ethiopia. *Tropical animal health and production*, 44(7), pp.1643-1651.
- Belete, G. and Shishay, G., 2019. Camel milk production and marketing: Pastoral areas of Afar, Ethiopia. *Pastoralism*, 9(1), p.16.
- Berhanu, T., Merga, B., kelay, b. and Endrias, Z., 2013. Camel brucellosis and management practices in Jijiga and Babile districts, Eastern Ethiopia. *Journal of Veterinary Medicine and Animal Health*, 5(3), pp.81-86.
- Boru, D., Schwartz, M., Kam, M. and Degen, A.A., 2014. Cattle reduction and livestock diversification among Borana pastoralists in southern Ethiopia. *Nomadic Peoples*, 18(1), pp.115-145.
- Boru, D., Schwartz, M., Kam, M. and Degen, A.A., 2014. Cattle reduction and livestock diversification among Borana pastoralists in southern Ethiopia. *Nomadic Peoples*, 18(1), pp.115-145.
- Boru, D., Schwartz, M., Kam, M. and Degen, A.A., 2014. Cattle reduction and livestock diversification among Borana pastoralists in southern Ethiopia. *Nomadic Peoples*, 18(1), pp.115-145.
- Collier, R.J., Hall, L.W., Rungruang, S. and Zimbleman, R.B., 2012. Quantifying heat stress and its impact on metabolism and performance. Department of Animal Sciences University of Arizona, 68.
- Coppock, D.L., Seyoum, T., MARIL, P. and Bedasa, E., Jaldessa, D., Demisachew, T., Derege, T., Nizam, H. and Guru, M., 2014. Sustainable pastoralism in Ethiopia: Preliminary results from participatory community assessments on the north-central Borana Plateau. *Research Brief*.
- Dejene, T. G., 2015. Husbandry practices and utilization of camel products in Borana Zone of Southern Oromia, Ethiopia. *Science Research*, 3(4), p.191.
- Dejene, T.G., 2015. Husbandry practices and utilization of camel products in Borana Zone of Southern Oromia, Ethiopia. *Science Research*, 3(4), p.191.
- Deressa, T.T., Ringler, C. and Hassan, R.M., 2010. Factors affecting the choices of coping strategies for climate extremes. The case of farmers in the Nile Basin of Ethiopia IFPRI Discussion Paper, 1032.

- Dirriba , M., 2016. Impacts of Drought and Conventional Coping Strategies of Borana Community, Southern Ethiopia. *Research on Humanities and Social Sciences*, 6(23), pp.29-37.
- Dirriba, M., 2020. The Conquest of Cattle Dominancy Statuesque in Pastoral Area: A Case of Borana Pastoral in Southern Ethiopia, Ethiopia.
- Dirriba, M., Simbone, T. and Bely , B., 2020. Pastoral farming system and its temporal shift: A case of Borana zone, Oromia National Regional State, Ethiopia. *African Journal of Agricultural Research*, 16(9), pp.1233-1238.
- Egeru, A., 2016. Climate risk management information, sources and responses in a pastoral Region in East Africa. *Climate Risk Management*, 11, pp.1-14.
- El-Hatmi, H., Jrad, Z., Salhi, I., Aguibi, A., Nadri, A. and Khorchani, T., 2015. Comparison of composition and whey protein fractions of human, camel, donkey, goat and cow milk. *Mljekarstvo: časopis za unaprjeđenje proizvodnje i prerade mlijeka*, 65(3), pp.159-167.
- Eyassu, S., 2009. Analysis on the contributions of and constraints to camel production in Shinile and Jijiga zones, eastern Ethiopia. *Journal of Agriculture and Environment for International Development (JAEID)*, 103(3), pp.213-224.
- Fana, K. and Asnake, A., 2012. Traditional coping mechanisms for climate change of pastoralists in South Omo, Ethiopia.
- Fano, D.G., Gebremedhin, G. and Aklilu, B., 2018. Climate Change Risk Management and Coping Strategies for Sustainable Camel Production in the Case of Somali Region, Ethiopia. *Journal of Biotechnology Research*, 4(9), pp.66-75.
- FAO. 2018 Pastoralism in Africa's drylands Reducing risks, addressing vulnerability and enhancing resilience. *Pastoralism in Africa's drylands*. Rome. 52 pp
- Fikru, G., Gizachew, F., Semu, M., Hailegebriel, B., Pal, M. and Kandi, V., 2017. Seroprevalence and Risk Factors of Brucellosis among Camels Belonging to Selected Districts of Afar, Ethiopia: Need for Public Awareness. *American Journal of Microbiological Research*, 5(5), pp.94-100.
- Forrest, B., Bailey, D., Ward, R. and Coppock, D.L., 2014. Can Bush-Clearing, Deferred Grazing, or Camels Help Mitigate Climate-Change and Population Effects for Borana Pastoralists? An Economic Analysis of Potential Interventions. *Research Brief*.
- Galma, W., Menfese, T. and Ayana, A., 2017. Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes*, 6(1), pp.1-12.
- Galma, W., Menfese, T. and Ayana, A., 2017. Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes*, 6(1), pp.1-12.

- Galma, W., Menfese, T. and Ayana, A., 2017. Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes*, 6(1), pp.1-12.
- Getachew, G., Gedlu, M, Demeke, S., Ashebir, A., Mesfin, S., Getnet, A., 2015. Participatory disease surveillance (PDS) of sheep and goats diseases in selected districts of Afar Regional State: Particular focus on Pestes des petit ruminants (PPR) and sheep and goat pox disease (SGP). *Ethiopian Veterinary Journal*, 19(1), pp.83-105.
- Getachew, L. and Mohamadou, F., 2014. Small ruminant value chain development in Ethiopia: Situation analysis and trends.
- Getachew, T., Haile, A., Tibbo, M., Sharma, A.K., Souml, J. and Wurzinger, M., 2010. Herd management and breeding practices of sheep owners in a mixed crop-livestock and a pastoral system of Ethiopia. *African Journal of Agricultural Research*, 5(8), pp.685-691.
- Gezahegn, A., Birhanu, H. and Nuru, S., 2015. Quality Constraints in the Market Chains for Export of Small Ruminants from Afar Pastoral and Agro-Pastoral Areas. *Animal and Veterinary Sciences*, 3(2), p.51.
- Grum, G., Haile, A. and T, Dessie., 2012. Participatory characterization of the Short-eared Somali goat and its production environment around Dire... *Livestock Research for Rural Development*, 24, p.10.
- Gumma, M.K., Tilahun, A., Mezegebu, G., Pinjarla, B., Panjala, P, Gizachew, L., Gebeyaw, T., Van den Akker, E., Berdel, W., Keller, C. and Siambi, M., 2019. Assessing potential locations for flood-based farming using satellite imagery: a case study of Afar region, Ethiopia. *Renewable Agriculture and Food Systems*, pp.1-15.
- Hailemichael, T., Puskur, R., Duncan, A.J. and Jeba, D., 2015. Multi-Stakeholder Processes and Platforms (MSPs) for Addressing Pastoral Livestock Value Chain Development Challenges: The Case of Borena Zone, Ethiopia.
- Haimanot, D.M., Takele, T.A. and Adem, A.H., 2013. A study on Ovine pneumonic pasteurellosis: Isolation and Identification of Pasteurellae and their antibiogram susceptibility pattern in Haramaya District, Eastern Hararghe, Ethiopia. *BMC Veterinary Research*, 9(1), pp.1-8.
- Hanfere M., Nigusie, A. and Patrick, E., 2016 "Cattle and Camel Milk Production and Marketing: The Case Study in Aysaita Woreda, Awsi Rasu of Afar Regional State, Ethiopia."
- Hassanu, H., Beyero, N. and Merga, B., 2020. Estimation of major livestock feed resources and feed balance in Moyale district of Boran Zone, Southern Ethiopia. *International Journal of Livestock Production*, 11(1), pp.43-51.
- Hussein , A.M., 2013. Pastoralists' innovative responses to new camel export market opportunities on the Kenya/Ethiopia borderlands. *Pastoralism and development in Africa*, Earthscan for Routledge, London, pp.98-107.

- Hussein, H.W., Hassan, G.R. and Kaufmann, B., 2016. Responding to mobility constraints: Recent shifts in resource use practices and herding strategies in the Borana pastoral system, southern Ethiopia. *Journal of Arid Environments*, 127, pp.222-234.
- Hussein, T.W., Hassan, G.R. and Kaufmann, B., 2016. Responding to mobility constraints: Recent shifts in resource use practices and herding strategies in the Borana pastoral system, southern Ethiopia. *Journal of Arid Environments*, 127, pp.222-234.
- Indris, S. and Adam B., 2013. Assessment of Food insecurity and coping mechanisms among pastoral households of Afar national Regional state: The case of chifra district, Ethiopia. *Ethiopian Journal of Agricultural Sciences*, 23(1-2), pp.145-156.
- K. Marshall , N. Mtimet , F. Wanyoike , N. Ndiwa , H. Ghebremariam , L. Mugunieri & R. Costagli., 2016. Traditional livestock breeding practices of men and women Somali pastoralists: trait preferences and selection of breeding animals. *Journal of Animal Breeding and Genetics*, 133(6), pp.534-547.
- Kagunyu, A.W. and Wanjohi, J., 2014. Camel rearing replacing cattle production among the Borana community in Isiolo County of Northern Kenya, as climate variability bites. *Pastoralism*, 4(1), pp.1-5.
- Kagunyu, A.W. and Wanjohi, J., 2014. Camel rearing replacing cattle production among the Borana community in Isiolo County of Northern Kenya, as climate variability bites. *Pastoralism*, 4(1), pp.1-5.
- Karanja Ng'ang'a, S., Van Wijk, M.T., Rufino, M.C. and Giller, K.E., 2016. Adaptation of agriculture to climate change in semi-arid Borena, Ethiopia. *Regional Environmental Change*, 16(8), pp.2317-2330.
- Ketema, U., 2015. An Assessment Of The Rangeland Degradation And Its Impact On The Livelihood Of Rural Pastoralists: In The Case Of Yabelo Woreda Of Borena Zone, Oromia Regional State, Ethiopia (Doctoral dissertation, St. Mary's University).
- Kimani, E.W., Ogendi, G.M. and Makenzi, P.M., 2014. An evaluation of climate change indigenous coping and adaptation strategies for sustainable agro-pastoral based livelihoods in Baringo County, Kenya. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 8(8), pp.38-58.
- Kimaro, E.G., Mor, S.M. and Toribio, J.A.L., 2018. Climate change perception and impacts on cattle production in pastoral communities of northern Tanzania. *Pastoralism*, 8(1), p.19.
- Lagat, P. and Nyangena, J., 2018. The effects of climate variability on livestock production in Kenya. *Journal of Agricultural Policy*, 1(1), pp.58-79.
- Lees, A.M., Sejian, V., Wallage, A.L., Steel, C.C., Mader, T.L., Lees, J.C. and Gaughan, J.B., 2019. The impact of heat load on cattle. *Animals*, 9(6), p.322.
- Lombard, M. and Parsons, I., 2015. Milk not meat: The role of milk amongst the Khoe peoples of southern Africa. *Journal of African Archaeology*, 13(2), pp.149-166.

- Mahamed, A. M., 2019. Indigenous adaptation strategies to climate change variability: the case of harshin woreda of somali Region state (Doctoral dissertation).
- Malede, B., 2015. Livestock resource potential and constraints in Somali Regional State, Ethiopia.
- McPeak, J.G., Little, P.D. and Doss, C.R., 2011. Risk and social change in an African rural economy: livelihoods in pastoralist communities (Vol. 7). Routledge.
- Minayahel, T., Ayana, A., Aster, A. and Alemayehu, A., 2016. Perception and attitude of pastoralists on the use and conservation of rangeland resources in Afar Region, Ethiopia. *Ecological Processes*, 5(1), p.18.
- Minyahel, T., Ayana, A., Aster, A. and Alemayhu, M., 2016. Perception and attitude of pastoralists on the use and conservation of rangeland resources in Afar Region, Ethiopia. *Ecological Processes*, 5(1), p.18.
- Mohamed, S., Desta, A.B. and Tessema, Z., 2020. Effect of rangeland vegetation degradation on livestock and socio-economics status of the pastoralists, Afar Regional state, Northern Ethiopia. *Journal of Dryland Agriculture*, 6(3), pp.17-27.
- Mohammed, M., Mindaye, S., Hailemariam, Z., Tamerat, N. and Muktar, Y., 2017. Sero-Prevalence of Small Ruminant Brucellosis in Three Selected Districts of Somali Region, Eastern Ethiopia. *J Vet Sci Anim Husband*, 5(1), p.105.
- Muluken, M., Jordaan, A. and Yoseph, M., 2018. Understanding resilience of pastoralists to climate change and variability in the Southern Afar Region, Ethiopia. *Climate Risk Management*, 20, pp.64-77.
- Nega, D., McNeil, D., Bridle, K. and Mohammed, C., 2019. Adaptation to Climate Change in the Pastoral and Agropastoral Systems of Borana, South Ethiopia: Options and Barriers. *American Journal of Climate Change*, 8(1), pp.40-60.
- Onono, J.O., Wieland, B. and Rushton, J., 2013. Constraints to cattle production in a semiarid pastoral system in Kenya. *Tropical animal health and production*, 45(6), pp.1415-1422.
- Opiyo, F., Wasonga, O., Nyangito, M., Schilling, J. and Munang, R., 2015. Drought adaptation and coping strategies among the Turkana pastoralists of northern Kenya. *International Journal of Disaster Risk Science*, 6(3), pp.295-309.
- Opiyo, F., Wasonga, O.V., Nyangito, M.M., Mureithi, S.M., Obando, J. and Munang, R., 2016. Determinants of perceptions of climate change and adaptation among Turkana pastoralists in northwestern Kenya. *Climate and Development*, 8(2), pp.179-189.
- Petzoldt, C. and Seaman, A., 2006. Climate change and agriculture: promoting practical and profitable responses. *Climate Change Effects on Insects and Pathogens* <http://www.climateandfarming.org/pdfs/FactSheets/III.2Insects.Pathogens.pdf> (Accessed on 28/8/2013).

- Sala, S.M., Otieno, D.J., Nzuma, J. and Mureithi, S., 2019. Drivers of Pastoralists' Participation in Commercial Fodder Producer Groups in Isiolo County, Kenya.
- Samson, L. and Frehiwot, M., 2014. Spatial analysis of cattle and shoat population in Ethiopia: growth trend, distribution and market access. *SpringerPlus*, 3(1), p.310.
- Samson, L. and Frehiwot, M., 2014. Spatial analysis of cattle and shoat population in Ethiopia: growth trend, distribution and market access. *SpringerPlus*, 3(1), p.310.
- Samuel, T. and Treydte, A.C., 2017. Modeling Boran cattle populations under climate change and varying carrying capacity. *Ecological Modelling*, 352, pp.113-127.
- Shishay, G. and Mulugeta, F., 2018. Camel Milk Production, Prevalence and Associated Risk Factors of Camel Mastitis Inaysaita Woreda Afar Regional State, North East Ethiopia. *ARC J Anim Vet Sci*, 4, pp.17-37.
- Shishay, G. and Mulugeta, F., 2018. Camel Milk Production, Prevalence and Associated Risk Factors of Camel Mastitis Inaysaita Woreda Afar Regional State, North East Ethiopia. *ARC J Anim Vet Sci*, 4, pp.17-37.
- Silvestri, S., Bryan, E., Ringler, C., Herrero, M. and Okoba, B., 2012. Climate change perception and adaptation of agro-pastoral communities in Kenya. *Regional Environmental Change*, 12(4), pp.791-802.
- Sisay, F. and Awoke, K., 2015. Review on production, quality and use of camel milk in Ethiopia. *J Fisheries Livest Prod*, 3(145), p.2.
- Sprague, L.D., Al-Dahouk, S. and Neubauer, H., 2012. A review on camel brucellosis: a zoonosis sustained by ignorance and indifference. *Pathogens and global health*, 106(3), pp.144-149.
- T. Yosef, U Mengistu, A Solomon\*, Y K Mohammed and K Kefelegn., 2013. Camel and cattle population dynamics and livelihood diversification as a response to climate change in pastoral areas of Ethiopia. *Livestock Research for Rural Development*, 25(9), pp.1-10.
- Temesgen, G., Aleme, A. and Mulata, H., 2014. Climate change and livestock production in Ethiopia. *Adv Life Sci Technol*, 22, pp.39-42.
- Tesfaye, B., 2017. Livestock Marketing Performance Evaluation in Afar Region, Ethiopia.
- Thornton, P.K. and Gerber, P.J., 2010. Climate change and the growth of the livestock sector in developing countries. *Mitigation and adaptation strategies for global change*, 15(2), pp.169-184.
- Tilahun, A., Van den Akker, E., Berdel, W., Keller, C., Gebeyaw, T., Asmare, D., Gizachew, L. and Hunegnaw, A., 2020. Facilitating livelihoods diversification through flood-based land restoration in pastoral systems of Afar, Ethiopia. *Renewable Agriculture and Food Systems*, pp.1-12.

- Treydte, A.C., Schmiedgen, A., Berhane, G. and Tarekegn, K.D., 2017. Rangeland forage availability and management in times of drought—a case study of pastoralists in Afar, Ethiopia. *Journal of arid environments*, 139, pp.67-75.
- Treydte, A.C., Schmiedgen, A., Gebreyohannes, B. and Kidanie, D.T., 2017. Rangeland forage availability and management in times of drought—a case study of pastoralists in Afar, Ethiopia. *Journal of arid environments*, 139, pp.67-75.
- Tsegaye, D., Vedeld, P. and Moe, S.R., 2013. Pastoralists and livelihoods: A case study from northern Afar, Ethiopia. *Journal of Arid Environments*, 91, pp.138-146.
- Union, A., 2013. Policy framework for pastoralism in Africa: Securing, protecting and improving the lives, livelihoods and rights of pastoralist communities.
- Vordermeier, M., Ameni, G., Berg, S., Bishop, R., Robertson, B.D., Aseffa, A., Hewinson, R.G. and Young, D.B., 2012. The influence of cattle breed on susceptibility to bovine tuberculosis in Ethiopia. *Comparative immunology, microbiology and infectious diseases*, 35(3), pp.227-232.
- Vrieling, A., Meroni, M., Mude, A.G., Chantarat, S., Ummenhofer, C.C. and de Bie, K.C., 2016. Early assessment of seasonal forage availability for mitigating the impact of drought on East African pastoralists. *Remote sensing of environment*, 174, pp.44-55.
- Wassie , B. and Fkadu, B., 2015. Climate variability and household adaptation strategies in Southern Ethiopia. *Sustainability*, 7(6), pp.6353-6375.
- Wassie, B. and Fekadu, B., 2015. Climate variability and household adaptation strategies in Southern Ethiopia. *Sustainability*, 7(6), pp.6353-6375.
- Wassie, B. and Fkadu, B., 2014. The impact of climate change on pastoral production systems: A study of climate variability and household adaptation strategies in southern Ethiopian rangelands (No. 2014/028). WIDER Working Paper.
- Wossene, N., Nuru, S., & Fikru, G., 2020. Assessment and Prioritization of Major Camel Diseases in Selected Areas of Afar Regional State, Samara, Ethiopia.
- Yohannes, M., Getachew., G. and Zeleke, M., 2015. Watering frequency and its impact on camel milk production in selected districts of the Somali Regional state, Ethiopia.
- Yosef, T., Mengistu, U., Solomon, A, Mohammed Y. K., Kefelegn, K. , Tadelle, D., 2014. Husbandry and breeding practices of dromedary camels among pastoral communities of Afar and Somali Regional states, Ethiopia. *J. Agriculture and Environment for International Development*, 108(2), pp.167-189.
- Yosef, T., Mengistu, U., Solomon, A., Mohammed, Y.K. and Kefelegn, K., 2013. Camel and cattle population dynamics and livelihood diversification as a response to climate change in pastoral areas of



Ethiopia. Livestock Research for Rural Development, 25(9), pp.1-10.

Yosef, T., Mengistu, U., Solomon, A., Mohammed, Y. K., Keefelegn, K., Tadelle, D., 2014. Husbandry and breeding practices of dromedary camels among pastoral communities of Afar and Somali Regional states, Ethiopia. J. Agriculture and Environment for International Development, 108(2), pp.167-189.

Zander, K. and Mburu, J., 2013. Compensating pastoralists for conserving animal genetic resources: the case of Borana cattle in Ethiopia.

Zander, K.K., 2011. Attitudes of livestock keepers to breeding strategies-Threats and opportunities for on-farm conservation of the Borana cattle breed. Journal of Agricultural Science, 3(2), pp.3-12.

Zelalem, Y., Aynalem, H, GuerneBleich, E. and Ababa, A., 2009. Effect of climate change on livestock production and livelihood of pastoralists in selected pastoral areas of Borana, Ethiopia. ESAP.

Zeraye, H. M., 2015. The invasion of Prosopis juliflora and Afar pastoral livelihoods in the Middle Awash area of Ethiopia. Ecological Processes, 4(1), p.13.

Zewdie, B., Argaw, A., Negalign, B., Abraraw, T. and Kifle, W., 2017. Understanding resilience dimensions and adaptive strategies to the impact of recurrent droughts in Borana Zone, Oromia Region, Ethiopia: A grounded theory approach. International journal of environmental research and public health, 14(2), p.118.

## Tables

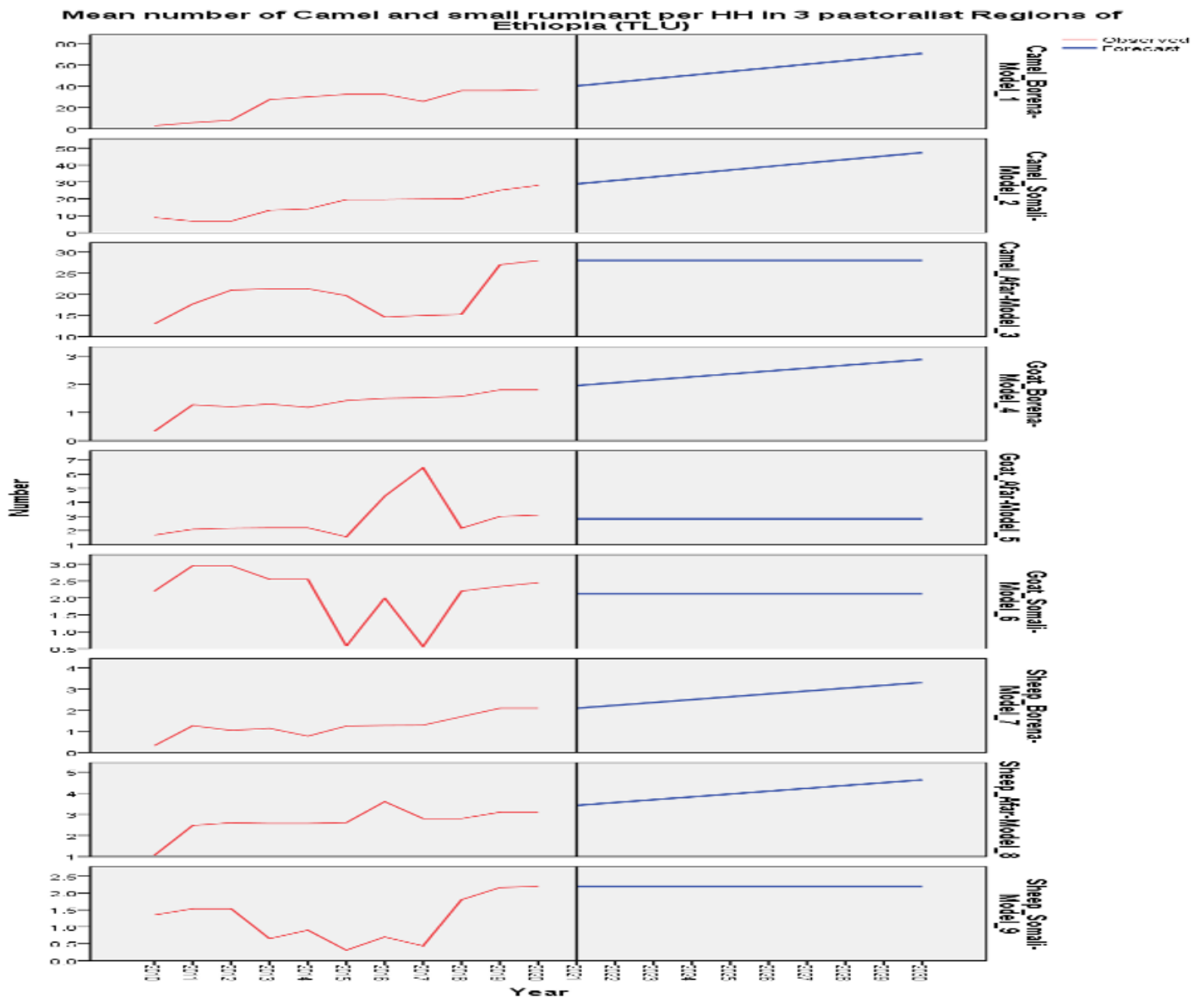
Table 1: Different constraint on cattle production perceived by pastoralist in drought season

Constraints	Percent of respondent
Water scarcity	94.6%
Cattle diseases	92.9%
Range degradation	90.2%
Feed shortage	94.3%
Lack of market outlet	76.4%
Predators	86.1%

Table 2: Frequency, percent and rank of income from different livestock species

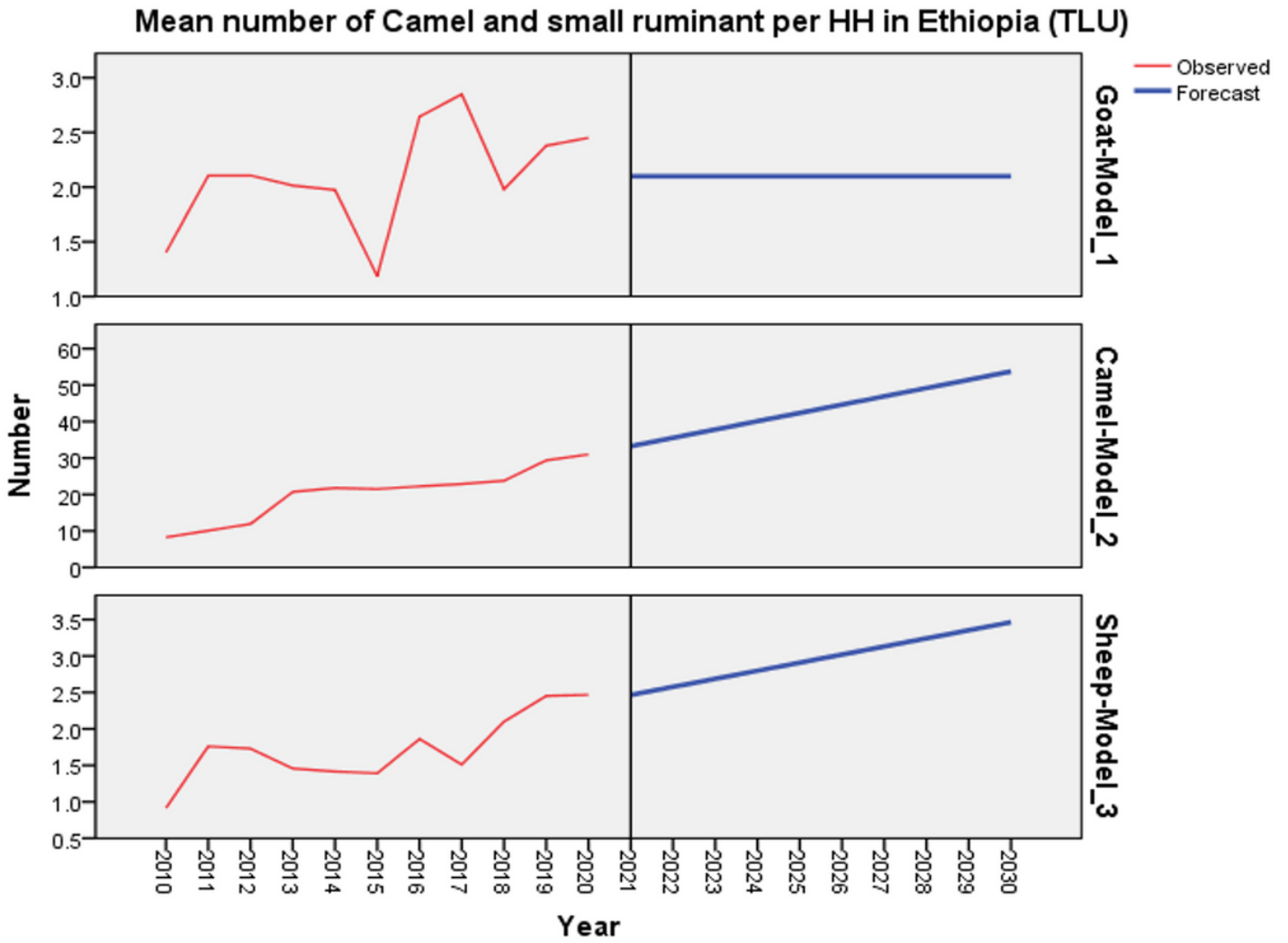
Low income generation from livestock							
District	Frequency	Percent (%)	Rank1	Rank2	Rank3	Rank 4	
Gode	28	96.6	Camel	Goat	Sheep	Cattle	
Jijiga	22	68.8	Camel	Sheep	Cattle	Goat	
Shinille	26	89.7	Camel	Goat	Cattle	Sheep	
Mille	22	73.3	Camel	Goat	Sheep	Cattle	
Amibara	29	100	Camel	Cattle	Goat	Sheep	
Borena(Yabelo)	20	76.9	Camel	Goat	Cattle	Sheep	
Borena(Moyale)	22	88	Camel	Goat	Cattle	Sheep	

# Figures



**Figure 1**

Trend and prospect of mean number of camel and shoat per household in 3 pastoral areas TLU (2010-2030)



**Figure 2**

Trend and prospect of mean number of camel and goat per household in TLU in pastoral household of Ethiopia (2010-2030).

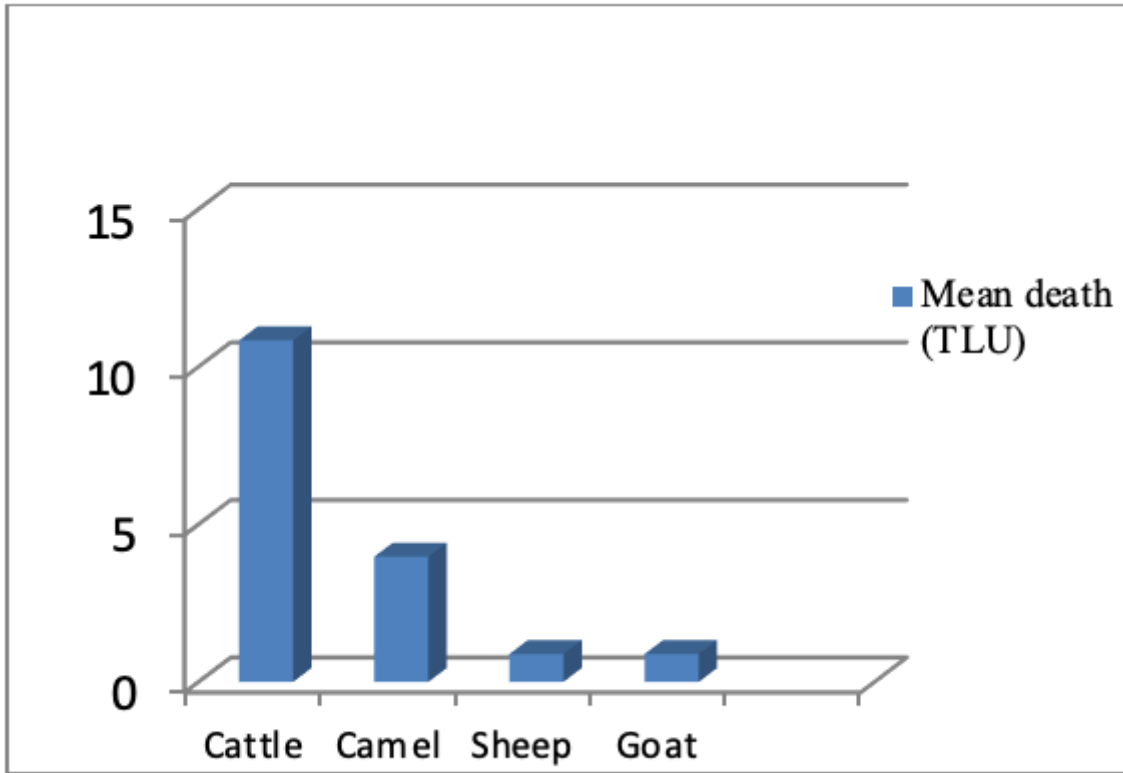


Figure 3

Mean number of deaths per household in TLU by drought

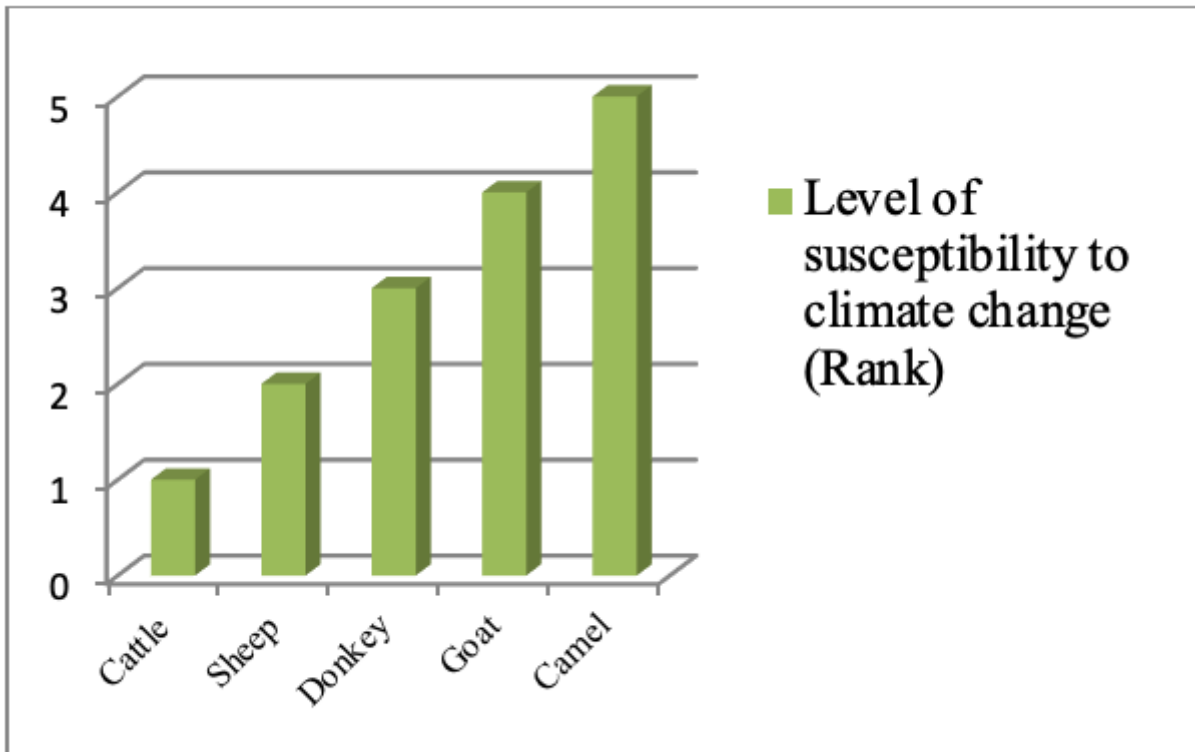
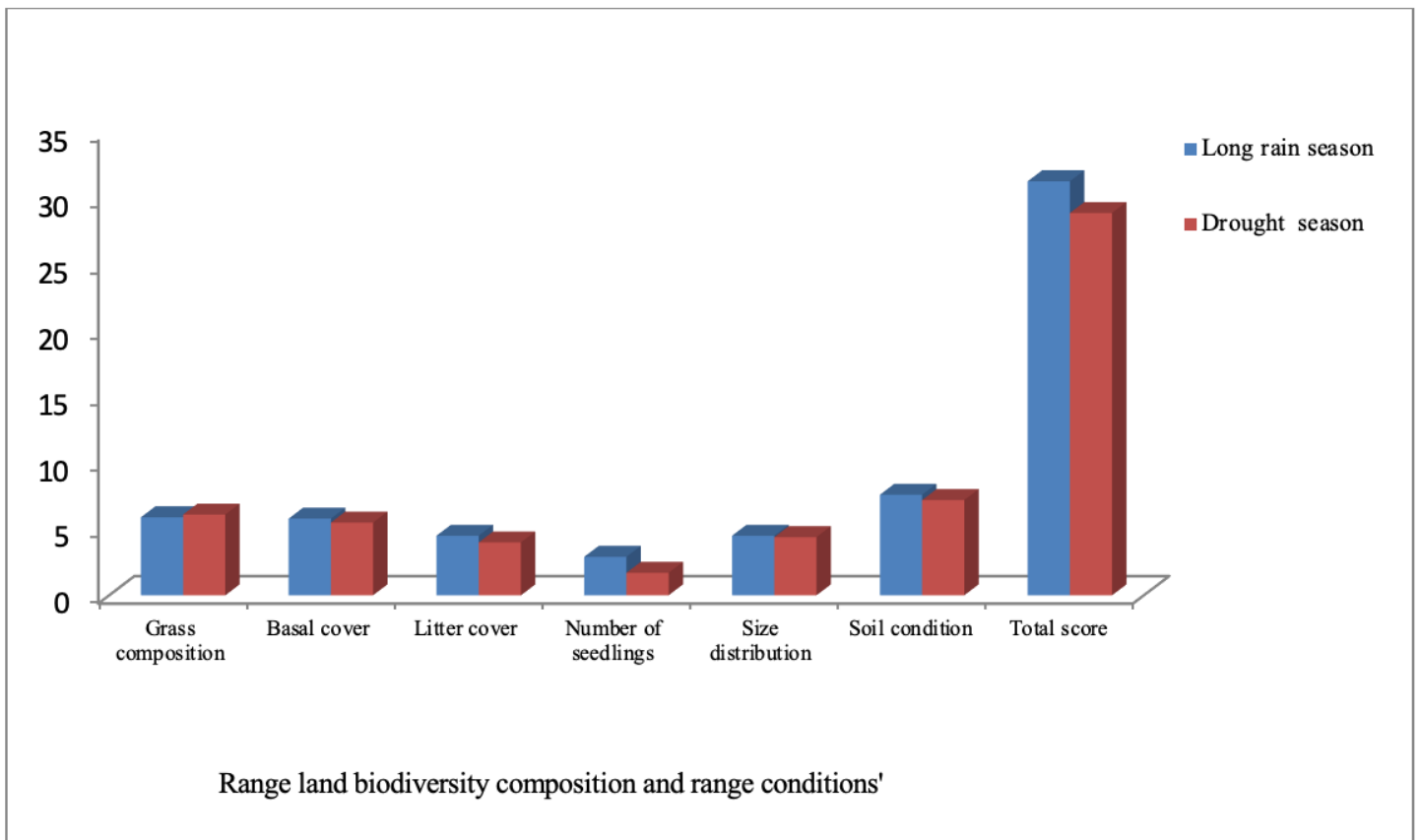


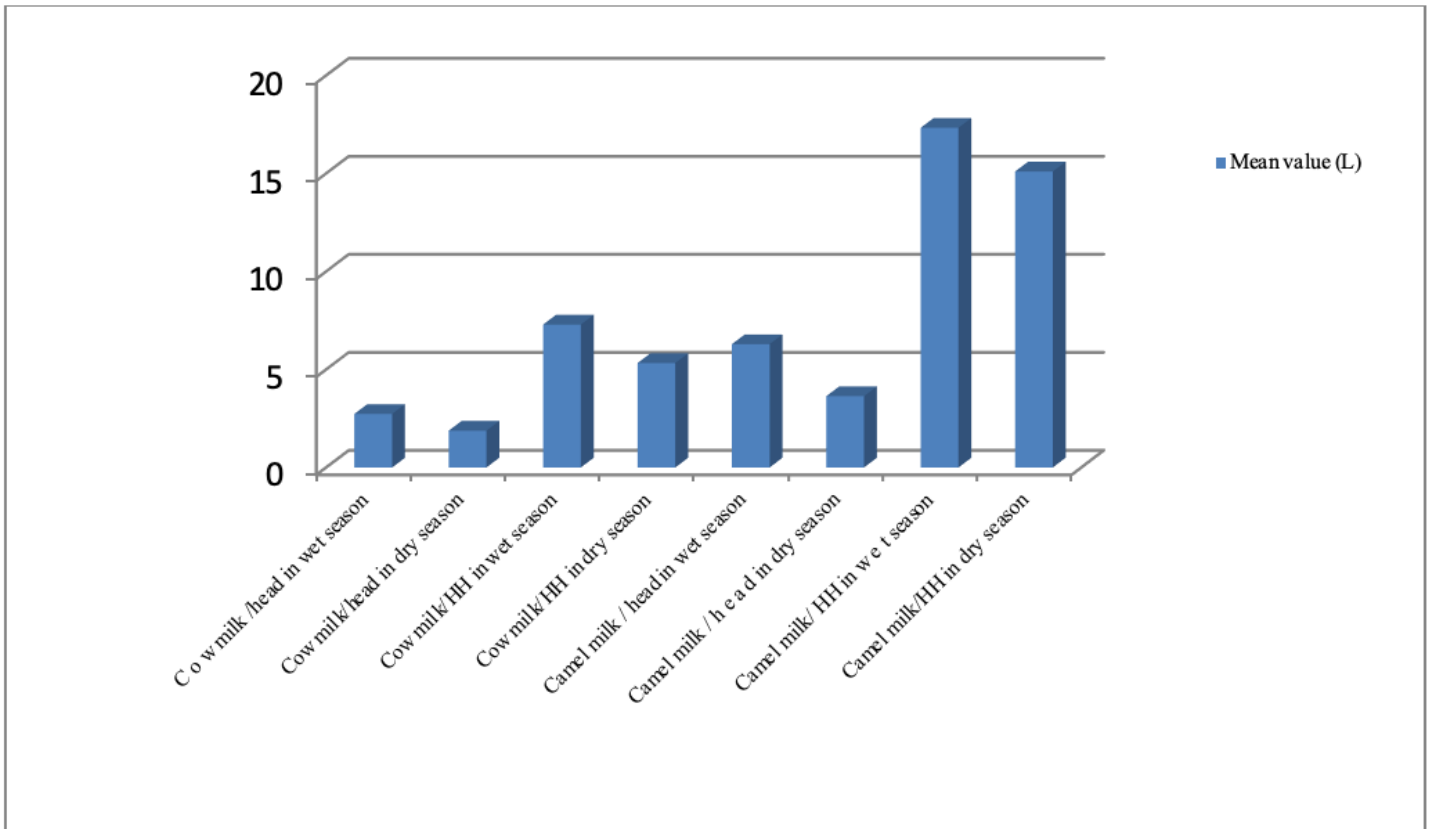
Figure 4

## Level of susceptibility by drought in different livestock species



**Figure 5**

Rangeland biodiversity composition and conditions under different climatic season (Ayana et al., 2006)



**Figure 6**

Mean value of milk per head and per household in different season from camel and cows