MEKELLE UNIVERSITY

Effect of War on Livestock Production and Feed Resources Availability of Smallholder Farmers in Asgede and Tahtay koraro Woredas, Northwestern Tigray, Ethiopia

By

Tsriti Gebremeskel Tareke

A Thesis Research Paper

Submitted in Partial Fulfillment of the Requirements for the Master of Science Degree in Animal production

Department of Animal, Rangeland and Wildlife Sciences

College of Dryland Agriculture and Natural Resources

Mekelle University, Ethiopia

Main Advisor: Solomon Abera (PhD)

Co-Advisor: Mebrahtom Niguse (PhD)

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DECLARATION

I, Mrs. **Tsriti Gebremeskel Tareke,** here by present for consideration by the Department of Animal Rangeland and Wildlife Sciences, within the College of Dryland Agriculture and Natural Resources at Mekelle University, my thesis in partial fulfillment of the requirement for the degree of Masters in Animal Production with the thesis research entitled **"Effect of War on Livestock Production and Feed Resources Availability of Smallholder Farmers in Asgede and Tahtay koraro Woredas, Northwestern Tigray, Ethiopia".** I sincerely declared that this thesis is the product of my own efforts. No other person has published a similar study which I might have coped, and at no stage will this be published without my con sent and that of the Department of **Animal, Rangeland and Wildlife Sciences**.

Name of the student; Tsriti Gebremeskel Tareke Signature and date _____

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ABSTRACT

Livestock and crop production play vital roles at household and national levels in Ethiopia/Tigray. However, these sectors were damaged due to the war that happened in Tigray from 2020-2022. This study aimed to assess the effect of war on livestock production and feed resource availability of smallholder farmers in Asgede and Tahtay koraro woredas in northwestern Tigray, Ethiopia. To collect data a cross-sectional research type was used with a multi-stage sampling procedure involving 152 smallholder households from April 2024 to June 2024. Primary and secondary data sources were gathered through household interviews, focus group discussions and key informant interviews using semi-structured questionnaires. The data were analyzed using SPSS version 28 software. The study revealed the livestock population and crop yield were damaged significantly ($p<0.001$). Before the war, the average livestock holding per household was 18.46 Tropical Livestock Units (TLU) whereas, after the war it dropped to 3.23 TLU. Crop yield at household level also reduced from 22.93 quintals per year to 5.74 quintals after the war. Additionally, the total annual feed supply per household derived from crop residues and grazing lands dropped from 15,591 to 14,727 tonnes of dry matter. The war adversely affected livestock population, accessibility to feed and water sources, market access and extension services, made livestock more susceptible to diseases and led to a decline in overall productivity. It also caused inflation in livestock prices with cattle prices rising by 76.9%, sheep and goats by 78%, donkeys by 68%, camels by 50% and poultry by 50% as compared to prices before the war. This inflation led to decreased consumption of livestock products and reduced household incomes. Moreover, challenges such as insecurity, shortage of income, disease infestations and lack of extension services hindered the restoration of farming activities in the study areas. In conclusion, livestock production and feed resources declined after the war, resulting in starvation and various disease outbreaks among livestock and households. Therefore, immediate support from the government, development agencies, NGOs and other relevant authorities is essential for effective restocking and recovery of the livestock sector.

Key words: Disease, Feed, Household, Livestock, War

BIOGRAPHICAL SKETCH

The author was born in Laelay Machew woreda Central Zone of Tigray Regional State on October 12, 1997. She completed her elementary and junior education at Mayweyni Elementary School (2003-2011) and she attended Suhul Michael Secondary School from 2011 to 2015. In 2015, she enrolled at Axum University, where she earned a B.Sc. degree in Animal Production and Technology from the Department of Animal Science in July 2018. Following her graduation, she worked at Aksum University College of Agriculture. In March 2021, she joined the graduate program in Animal Production at Mekelle University in the Department of Animal, Rangeland and Wildlife Sciences.

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ABBREVIATIONS AND ACRONYMS

AHS	African Horse Sickness
AI	Artificial Insemination
Aw	After War
BL	Blackleg
BoARD	Bureau of Agricultural and Rural Development
Bw	Before war
CBPP	Contagious Bovine Pleuropneumonia
CCPP	Contagious Caprine Pleuropneumonia
CF	Conversion Factor
CIRAD	Centre for International Research Agricultural Development
CRs	Crop Residues
CSA	Central Statistics Agency
DM	Dry Matter
FAO	Food and Agriculture Organization
FIFA	Federation International Football Association
FMD	Foot and Mouse Disease
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
Ha	Hectare
HH	Household
HS	Haemorrhagic Septicaemia
IDP	Internally Displaced Person
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
IPC	Integrated Food Security Phase Classification
Kg	Kilogram
KII	Key Informant Interview
Km	Kilometer
LSD	Lumpy Skin Disease
LV	Livestock
M.a.s.l	Meters above sea level
Mm	Millimeter
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
NCD	Newcastle Disease
NGO	Non-governmental Organization
OCHA	Office for the Coordination of Humanitarian Affairs
PPR	Peste des Petits Ruminants
Qt.	Quintal
RGDP	Regional Gross Domestic Product
SD	Standard Deviation
SGP	Sheep and Goat Pox
SPSS	Statically Package for Social Science
SSA	Sub-Saharan Africa
T	Tonne

TBoARD	Tigray Bureau of Agriculture and Rural Development
T/koraro	Tahtay koraro
TLU	Tropical Livestock Unit
TRHB	Tigray Regional Health Bureau
TSA	Tigray Statistical Agency
UK	Ukraine
UMTR	Urea Molasses Treatment
UN	United Nation
UNICEF	United Nations Children's Fund
WAOARD	Woreda Asgede Office of Agriculture and Rural Development
WHO	World Health Organization
WFP	World Food Program
WTKOARD	Woreda Tahtay Koraro Office of Agriculture and Rural Development
NTOARD	Northwestern Tigray Office of Agriculture and Rural Development

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CHAPTER 1: INTRODUCTION

1.1. Background and Justifications

Livestock plays a crucial role in agricultural systems as a significant source of animal protein, enhancing crop yield through manure and animal traction power, transportation, export commodities, supplying manure for fertilization, household energy, security and a means of wealth accumulation. It also serves as input for agro-processing industries (Adane, 2020; Jin and Iannotti, 2014). Ethiopia has the largest livestock population and ranked first in Africa and fifth in the world with over 70 million cattle, 42 million sheep, 52 million goats, 56 million poultry, 13.3 million equines and 7 million honeybees (CSA, 2020; Desalegn, 2023). This sector contributed approximately 40% to agricultural Gross Domestic Product (GDP), 20% to total GDP and about 20% of national foreign exchange earnings (CSA, 2020). Additionally, the livestock sector provides employment to over 30% of the agricultural labor force.

In Tigray, agriculture, both crop production and livestock farming, serves as the backbone of the regional economy. More than 80% of the rural peoples are primarily engaged in subsistence agriculture (FAO, 2021). The livestock population in Tigray is reported to be 4,908, 964 cattle, 6,317,518 poultry, 4,838,969 goats and 2,097,619 sheep (CSA, 2020). According to Regional Gross Domestic Product (RGDP) data, crop production contributes approximately 65% to agricultural GDP in Tigray, followed by livestock 32% and forestry 3%. Overall, agriculture accounts for 37% of the region's total real GDP (TSA, 2021). The availability and quality of feed resources is critical in livestock production systems directly influencing livestock health, performance and overall production efficiency (Jalal *et al*., 2023). In Tigray, the primary locally available feed resources include native plants, agro-processing byproducts and crop residues (Chisoro and Jaja, 2023).

The previous war in northern Ethiopia has severely impacted the agricultural livelihoods of many farming families. As the war escalated, farmers were prevented from tilling their fields, equipment was stolen, livestock were killed and looted (Muhumuza and Rodney, 2021; Nyssen *et al*., 2021). This had led to adverse effects including food insecurity and starvation due to the destruction of agricultural activities and infrastructure, decreased investments, reduced resilience, increased vulnerabilities, disrupted market access and rising food prices (Ashenafi *et al*., 2023; FAO, 2021; Nyssen *et al*., 2021).

The Tigray Bureau of Agriculture and Rural Development (TBARD) reported that 75% of livestock populations were slaughtered and looted, all poultry out-growers and 85% of the milk processors were interrupted and 65% of livestock feed processors became dysfunctional exacerbating household food insecurity in the Tigray communities. As the war progressed into areas with high livestock populations, including the southeastern, eastern and southern zones of Tigray, the damage and loss to the livestock was very high (TBARD, 2021). Integrated Food security phase classification (IPC) (2021), estimated that 80% to 90% of cattle were looted in parts of the western and central zones. Moreover, limited access to veterinary services has resulted in the spread of livestock diseases and parasites, contributing to high mortality rates (FAO, 2021).

The effect of war on livestock production and feed resource availability in Northwestern Tigray had created complex challenges for the region's agricultural economy and food security for many households. Displacement and loss of access to grazing lands had further limited the availability of feed resources for livestock and long-term sustainability of the agricultural system. This can result in decreased productivity and increased vulnerability to disease outbreaks.

1.2. Statement of the Problem

War strongly affected livestock and its products, feed availability and the marketing system, destruction of various industries leading to lack of feed (FAO, 2023; Yared, 2022). In Tigray both human and livestock were affected and it disrupted the vital livelihood source for smallholder farmers in the region (Mebrahtu *et al*., 2023). In Tigray the war gradually affected both rural and urban households, directly and indirectly influencing their economies concerning the livestock sector and related infrastructures. The chemical released from weapons significantly damaged livestock and feed resources. The war also resulted in the destruction of agricultural markets and raised the prices. This led to farmer displacement, food insecurity, land degradation and deforestation all of which undermine economic stability and community resilience. Moreover, the destruction of crops, grazing lands and feed reserves had led to a critical shortage of animal feed. As a result, the effect of war on livestock production and feed resource availability in Tigray is a multi-dimensional issue that requires comprehensive understanding and evidence-based solutions. However, comprehensive studies which provide inclusive and nexus understanding of the effect of war on livestock production,

marketing, livelihoods of farming communities and other diverse effects have not been yet well documented, particularly in the study areas. This study addresses the lack of studies linking between herd size, feed availability, livestock marketing, disease infestation and households' income to recovery of the economy in the region.

1.3. Objectives

1.3.1. General objective

The general objective of this study was to assess the effect of war on livestock production and feed resources availability in Asgede and Tahtay koraro woredas, Northwestern Tigray, Ethiopia.

1.3.2. Specific objectives

- To assess the changes in livestock population and herd structure at household level in the study area;
- To examine the effect of war on the availability and accessibility of feed resources for livestock at household level in the study area;
- To assess the effect of the war on livestock disease and parasites infestation;
- To assess the effect of the war on livestock marketing;
- To investigate the consequences of war on livestock farmers household income and their livelihood in the study area;
- To investigate major constraints of livestock production systems after the cessation of the war.

1.4. Research Questions

- Did the war affect the livestock holding at household level?
- Which of the major livestock feed resources affected by the war?
- What are the major implications of the war on livestock health?
- What are the major livestock marketing challenges of the households in the study areas?
- What are the effects of war on livestock related household incomes and their liveliho od in the study area?

- What are the major constraints to start livestock production after the cessation of the war?

1.5. Significance of the Study

The findings regarding the effect of war on livestock production and feed resources in Tigray will have significant roles due to its implications for food security, household economy and environmental considerations. It will provide essential insights for formulating policy and develop targeted interventions that support agricultural recovery and enhance food security in the post war recovery phase. Governmental offices, universities, colleges, researchers and other stakeholders can utilize these findings to minimize the constraints that hinder livestock production and access to feed resources. Additionally, this study can serve as baseline information for future research intervention.

1.6. Scope and Limitation of the Study

The aim of this research was to identify the effects of war on livestock production, feed resource availability and livestock farmers' livelihood and income in Asgede and Tahtay koraro woredas, Northwestern Tigray, Ethiopia conducted from April to June 2024. The study involved interviews with 152 households, focus group discussions (FGDs) and consultations with key informants in two representative woredas. However, several limitations should be noted. First, this study may not comprehensively address the broader challenges faced in the Tigray region, as it was confined to only four *tabias* consisting of a relatively small number of households. Additionally, secondary data regarding the study areas were unavailable due to the loss of data sources, including computers, annual reports and other grey literatures, which were looted, destroyed and burned during the war. As a result, the analysis relied primarily on primary data collected from the field, which may further limit the depth and context of the findings.

CHAPTER 2: LITERATURE REVIEW

2.1. Livestock Production Systems

In this East African cattle play a key role providing social security, money, are often required as a dowry and are used in traditional sacrifices. The greater the herd, the more social prestige people enjoy (Heine and Hartwig, 2014). The agricultural sector is a cornerstone of the economic and social value of the people in Ethiopia. Ethiopia has the largest livestock population in Africa, along with a diverse array of livestock genetic resources. The country's varied agro-ecological zones are suitable for different types of livestock production. There are three major livestock production systems in Ethiopia: smallholder mixed crop-livestock production, pastoral and agro-pastoral livestock production and urban and peri-urban livestock production systems (Adugna *et al*., 2012). The livestock is an integral part of the agricultural systems and it is a major source of animal protein, power for crop cultivation, means of transportation, export commodities, manure for farmland and household energy, security and means of wealth accumulation (Jin and Iannotti, 2014). The livestock sector holds the largest portion in the bio-economy and overall food production by enhancing crop productivity through manure and animal traction power supply input for agro-processing industries (Belay, 2020).

According to the CSA (2020a), livestock products and by-products substantially improve the nutritional status of the people. Livestock assets serve as a source of security during crop failure as they are near cash capital. They provide essential inputs and services for crop production, such as draft power and nutrient recycling via manure. Additionally, Aleme and Lemma (2023) stated that livestock, particularly sheep, play a vital role in weed control due to their heavy grazing habits. Manure provides an important organic fertilizer being more cost-effective and readily available than commercial supplies; it delivers approximately 8 kg of nitrogen, 4 kg of phosphorus and 16 kg of potassium per tonne of dry matter (Sansoucy *et al*., 1995).

2.2. Effect of War on Livestock Production and Herd Dynamics

Conflict had severely impacted livestock keeping, often resulting in significant losses for livestock owners (Thys *et al*., 2010). Starvation and poor nutrition are among the most critical issues arising from wars. Sub Saharan Africa (SSA) has been historically disproportionately

affected by violence and war. Such disruptions can significantly impact the agricultural economy by altering supply, demand, pricing structures and market access. Consequently, profits from trade in agricultural products are often used to finance weaponry (Kwasi, 2010). According to George and Adelaja (2021), and Kemmerling *et al*. (2022), agriculture is affected directly through the destruction of outputs, inputs, land, infrastructure and human capital. Indirectly, environmental mismanagement disrupts livelihoods essential for livestock-dependent populations and subsistence fishing grounds. Extensive civil conflicts in northern African nations had devastated the economies of typically pastoral regions that are heavily reliant on livestock. This situation had led to a damaging cycle of poverty and underdevelopment. The losses of livestock extend beyond inadequate supplies of meat, milk and manure, also affecting income from the sale of animals and their products (Addah & Zezebi, 2008). In Somalia, livestock represent a primary source of both individual and national wealth, providing products such as milk, meat, hides and skins, as well as by-products like manure, fuel and draft power. Livestock contribute to food security and act as a form of wealth readily available during crises like crop failures or periods of high costs for tractor services (Candlelight *et al*., 2006).

In South Sudan, the effects of conflict on livestock and livestock owners are deep and complex. Conflicts result in direct losses and injuries to livestock due to looting, as well as restricted access to water and food, leading to overcrowded conditions in secure areas. This had impaired livestock health and reduced their well-being. Furthermore, there were significant losses of animals and their products, decreasing mobility and an increased incidence of livestock theft. Armed groups often use stolen cattle to fund their activities, which heightens the risk of theft and drives herders to arm themselves for protection. This cycle not only affects livestock ownership and distribution but also enriches criminal organizations involved in arms trafficking (Brottem, 2021; Heine and Hartwig, 2014). Moreover, the wealth of cattle-owning communities had declined, resulting in shifts in the distribution of cattle wealth among families and the prevalence of smaller herd sizes (Yacob *et al*., 2016).

In Northern Uganda, significant declines in livestock herd size and value led to reduce household incomes (Portfolios, 2008). Livestock ownership influences agricultural decisions as pack and manure are critical for crop production. There has been a notable shift away from large, grazing livestock, to smaller livestock that can be kept within compounds despite the

positive marginal returns of large livestock. The overall value of livestock herds, which are typically targeted during conflicts, has declined approximately by two thirds (Portfolios, 2008).

According to Yared (2022), war had a stronger effect on milk production, livestock numbers, as well as honey production and total market sale values of forage and livestock products were affected by war. Armed conflicts directly lead to food insecurity and starvation by disrupting food systems, reducing farming populations, damaging infrastructure, decreasing resilience and increasing vulnerabilities, disruptions in access to market, increasing food price or making goods and services unavailable altogether (Aregawi *et al*., 2023).

The livestock population in Tigray is reported to include 4.5 million cattle, 7.5 million sheep, 8.2 million goats, 45,000 camels, 1.2 million donkeys, 6.8 million poultry and 1.3 million and beehives (CSA, 2019/20). Ongoing political instability has posed significant challenges to livestock herding, agriculture and trade in the region. Pastoralists and agro-pastoralists have lost livestock due to looting, displacement and disease, exacerbating the impact of conflict on their livelihood (Bihon, 2015). United Nation (UN) (2021), briefing livestock had been massively looted and slaughtered in northwestern Tigray. Many households with livestock were compelled to sell their animals to generate income for food purchases, which increased market supply but decreased sale prices for herders (IPC, 2021).

2.3. Feed Resource of Livestock in Ethiopia

Feed is the most important for maintenance and maximizing livestock productivity (Dawit *et al*., 2013). In Ethiopia the primary source of feed includes natural pasture, crop residue, lesser extent improved pasture and forage, agro industrial by-products and nonconventional feeds (Dereje *et al*. 2014; Sofanit *et al*., 2018). Natural pasture is the primary feed source and is abundant during the rainy season and often harvested and conserved as hay for dry seasons. Green pasture account (55.2%) and crop residues (30.8%) the available feed type in the country (Zeleke and Lacey, 2021). Crop residues are a major feed, especially in populated countries where the land is converted for crop cultivation. The rapidly growing human population in Ethiopia has increased the demand for cultivable land used for crop production, resulting in reduction of grazing lands. Feed get only from crop residue, grass and fodders are not available in sufficient quantities. In Tigray, crop residues serve as a major feed resource. Although livestock production in this region relies heavily on traditional practices, it faces

challenges related to nutritional stress and limited access to quality livestock feed. According to the Tikabo and Shumuye (2023), the primary sources of livestock feed in Tigray include crop residues, green fodder, hay, improved feed, by-products and others.

2.3.1 Grazing of natural pastures

Natural pastures consist of grasses, legumes, herbs, shrubs and tree foliage that are used as animal feed through direct in situ grazing or browsing or can be harvested and conserved as hay (Dereje *et al*., 2016). In Ethiopia livestock feeding is primarily based on grazing of permanent natural pastures composed of indigenous forage species, complemented by fallow lands crop residues (Girma *et al*., 2018). Free grazing is the most common feeding system in mixed crop-livestock farming areas. Stall-feeding is dominant in urban dairying. Animals graze on pasture along roads, rivers and around homesteads in mixed farming areas (Dereje *et al*., 2014). Stall feeding is common in some places in the mixed farming system and crop residues, forage and weeds are given to the animals (Diriba *et al*., 2014). The productivity and nutritional quality of grazing natural pasture are influenced by several factors including ecological condition and management scheme such as rainfall, soil type and grazing intensity, season of grazing and stage of maturity of the plant.

2.3.2. Crop residues and crop aftermath

Crop residues, by-products of crop production that serve as a vital source of livestock feed in the mixed crop-livestock production system. Cereal crops are the major feed resource during the dry period where rangelands are converted to croplands, crop residues. After harvesting grains intended for human consumption, subsistence farms produce a diverse range of crop residues from various crops including cereals like teff, wheat, barley, maize and sorghum, as well as legumes such as faba beans, chicken peas, haricot beans and field peas. These crop residues can provide a substantial quantity of dry season feed for many farming systems in the country. Additionally, some farmers utilize crop residues for mulching to enhance soil fertility (Dereje *et al*., 2014). According to Adugna *et al*. (2012), crop residues contribute for about 50% of the total feed supply in Ethiopia. However, cereal straw and stovers are typically low in nutrients, high in fiber and have limited digestibility, which results in lower consumption rates by livestock. In contrast, crop residues from leguminous crops tend to have better quality compared to those from cereals (Derbie *et al*., 2019). In Tigray, crop residues and aftermath are the most common livestock feed resources, currently contributing over 50% of the

livestock feed in the region, partly due to the depletion of grazing lands (Misteru *et al*., 2016; Mulugeta *et al*., 2015).

2.3.3. Improved forages

Improved forages are vital in livestock production systems, generally yielding more than natural pastures and having longer productive seasons. They can help fill feed gaps during periods of inadequate crop residues and natural pasture supply and improve the soil's fertility. Furthermore, when grown in mixed stands, they enhance the feed value of natural pastures (Abadi, 2017). However, the development and use of improved forage in Ethiopia remains limited. Factors contributing to the low success rates of improved forage development include land shortages, low adoption rates, technical challenges (such as planting and management methods) and a lack of interest from farmers (Tekalign, 2014). Currently, the contribution of improved forages to livestock feed is minimal, estimated at only 0.22% of the total feed supply, highlighting the need for increased efforts in national extension and research initiatives (Zeleke and Lacey, 2021).

2.3.4. Industrial by-product

Industrial by-products serve as concentrated feeds that are low in crude fiber content but high in protein or energy. These by-products originated from agricultural product processing includes oil seed by-products like cotton seed cake and noug seed cake; flour milling by-products such as wheat bran and wheat middling; sugarcane by-products such as molasses and bagasse; slaughter house by-products such as meat meal and bone meal; and brewery by-products such as brewery malt screening and spent grain. Concentrates feeds are high energy content but low in crude protein such as, cereal grain (corn, sorghum, wheat etc.), cereal grain by-products (wheat bran and corn gluten meal), root and tubers (cassava, potatoes etc.) and industrial by-products (molasses, citrus flesh and brewers by-products). In contrast, protein concentrates have high crude protein content but lower energy, including oilseed meals (soybean, cottonseed, rapeseed, linseed and sunflower meals), grain legumes (beans and peas) and animal proteins (meat and fishmeal). Agro-industrial by-products hold particular value in livestock feeding, especially within urban and peri-urban production systems, as well as in scenarios where animals' productive potential is relatively high and necessitates increased nutritional support (Dereje *et al*., 2016).

2.3.5. Non-conventional feed supplements

Non-conventional feed resources refer to feeds that have not traditionally been utilized for livestock feeding and are not commercially available (Amata, 2014). The types of non-conventional feeds vary according to community feeding habits and agro-ecological conditions, including vegetable residues, sugarcane leaves, enset leaves, fish offal and leftover fruits and vegetables. Their low cost and availability have led to an increased use of non-conventional feed resources such as by-products from local breweries and distilleries, among smallholder farmers (Aschalew *et al*., 2014). Yasin (2022) stated that non-conventional feeds could partially fill the gap in the feed supply, decrease competition for food between humans and animals, reduce feed cost and to self-efficiency in nutrients from locally available feed sources.

2.4. Effect of War on Crop Production and Crop Residues

Conflict had significantly disrupted agriculture-related activities including transportation and credit services including both government organizations and private local service providers (Kimenyi *et al*., 2014). In the UK farmers have faced challenges in employing enough temporary workers to harvest crops and picking fruit and vegetables. To address this seasonal workers scheme was set up to enable businesses to recruit temporary workers from overseas (Malik *et al*., 2022). The common trigger of farmer-herder conflict is crop damage caused by passing livestock. As the rural population has increased dramatically many herders lost grazing lands due to cultivation making their livelihoods more challenging (Brottem, 2021). Nassef *et al*. (2023) reported that for farmers, crop and farmland destruction, combined with issues like overstocking, overgrazing and mismanagement of natural resources, has led to significant damage and degradation. The situation is often exacerbated by struggles over land control and access to natural resources. In Somalia, war has resulted in a lack of supportive agricultural services, including shortages of improved seeds, fertilizers, chemicals and reduced land preparation. Before civil war erupted, government institutions provided extension services to all farmers, occasionally distributing trained animal power at no cost and organizing annual competitions for crop productivity, along with low fees for land preparation services (Consultant, 2016).

Alemayehu *et al*. (2017) stated that rapid population growth, increased food demand and a rising number of internally displaced persons (IDPs) have led to the gradual conversion of

grazing lands into arable land. Before the war, agricultural production in Tigray utilized various technologies including chemical fertilizers, selected seeds or high yielding varieties, irrigation and soil quality enhancing technologies were used in high supply for farmers to enhance the production and productivity of the land (Bihon, 2015). However, due to the war the farmers have limited access to their farms, inputs and services. Currently, the Tigray agricultural infrastructure had been destroyed and was facing a complex humanitarian crisis, with an alarming increase in food insecurity and loss of livelihoods due to armed conflict.

2.5. Effect of War on Availability of Feed Resources

War had influenced the distribution and access of productive resources for livestock. War leads to competition of land, water, natural resources, capturing the dynamic of social, economic and political change that creates inequality, erosion of social relations or unresolved grievances over natural resources (Nassef *et al*., 2023). According to Dimelu *et al*. (2017), livestock herders lost access to local pastures due to the encroachment of fields onto livestock paths and face increasing difficulty moving their animals without causing crop damage and less inclined to avoid causing such damage. In Cameroon, conflict over land control due to increased commercialization of land, which has led to land scarcity issues (Sone, 2012). In Nigeria war had severely reduced the grazing land available to semi nomadic pastoralists unintentionally fuel cycles of militant violence. Herders are increasingly forced into forest reserves, which also serve as hideouts for criminal gangs and extremist groups (Brottem, 2021).

According to Pendle (2017), war had hindered pastoralists' mobility, forcing them to reroute travel based on the need to protect their livestock rather than for resource utilization. During droughts, pastoralists in South Sudan relocate their herds to drier regions with better grazing, leaving behind waterlogged areas. This migration significantly impacts both the livelihoods of herders and the well-being of settled farming communities in the areas they vacate. FAO (2015) also reported that during conflict herders' often choose migration routes based on livestock protection needs rather than feed and water availability.

The war in Somaliland had caused widespread devastation, adversely affected its people, economy and environment. The prolonged presence of nomadic herders in scarce areas led to overgrazing, livestock overpopulation and increased competition for resources, making it difficult to restore the degraded rangelands. This problem has diminished productivity and

disrupted traditional grazing practices in communal areas. Additionally, some pastoralists keep their milking stock near towns, due to dissatisfaction with nomadic movements that have contributed to other issues (Candlelight *et al*., 2006).

In Waghemra zone, due to overgrazing harvesting crops, deforestation of native forage trees, shrubs and degradation of natural pastures (Yared, 2022). The increasing human population has placed huge pressure on natural resources resulting in land degradation (Bossio *et al*., 2007). Land degradation is closely related to the degradation of other natural resources such as vegetation, biodiversity, grazing and water negatively affecting their productivity. During the dry and cropping season, there is severe shortage of feed supplies and its nutritional content is inadequate to sustain essential functions, resulting in decreased livestock production (Andualem *et al*., 2015). In Tigray the increasing number of farmers and the corresponding demand for more cultivated land had led to the dramatic reduction in common grazing land for animals (Edwards *et al*., 2010).

2.6. Effect of War on Livestock Disease and Parasites Infestation

Armed conflicts destroy established health-care systems which typically manifests as a recovery of preventable infectious diseases. The burden of infectious diseases during conflict had long term consequences (Goniewicz *et al*., 2021). The conflict had declined veterinary and agricultural extension causing various losses including theft, starvation and poisoning, indiscriminate killing and disease outbreak. The extensive management system rendered animals vulnerable to stealing, rustling and disease outbreaks (Addah & Zezebi, 2008). Yacob *et al*. (2016) stated that conflict in South Sudan hinders the accessibility, availability, affordability and quality of drugs. Most animal health services and medicines were provided by private entities; however, veterinary care was often inadequate across many regions, with limited services available from NGOs. The common endemic cattle diseases in South Sudan include Contagious Bovine Pleuropneumonia (CBPP), trypanosomiasis, worms, Blackleg (BL), Foot and Mouth Disease (FMD), Lumpy Skin Disease (LSD), Anthrax, Botulism, foot rot, Haemorrhagic Septicaemia (HS) and tick-borne diseases. For small ruminants, key diseases include Peste des Petits Ruminants (PPR) and Contagious Caprine Pleuropneumonia (CCPP) (Yacob *et al*., 2016).

Livestock health is a critical factor in conflict dynamics; the deaths of animals due to diseases can also affect human health (Heine and Hartwig, 2014). East Coast fever, tick-borne disease, was once contained in the Greater Equatorial region but spread into livestock populations in Jonglei and Lakes States, leading to livestock mortality (FAO, 2015; Pendle, 2017). The ongoing conflict has resulted in the emergence of new strains of FMD in Eastern Equatoria and Lakes States, potentially destabilizing the social, economic and political structures of farming communities (Dimelu *et al*., 2017).

Ethiopia is endemic to a number of livestock diseases including contagious bovine pleuro-pneumonia (CBPP), lumpy skin disease (LSD), foot and mouth disease (FMD), bovine pasteurellosis, black leg, anthrax, Newcastle disease (NCD), Peste des petits ruminants (PPR), sheep and goat pox (SGP) and African horse sickness (AHS) (Solomon *et al*., 2021; Zeleke and Lacey, 2021). These diseases reduce income and adversely affect livelihoods at both local and national level. The war disrupted food and water supplies for livestock care and led to animal deaths, malnutrition and suffering. Furthermore, many animals had been subjected to flee and killed during the conflict. The veterinary sector is significantly impacted and veterinarians and animal health workers fleeing the area, further burdening strained (Mebrahtu *et al*., 2023).

During war livestock diseases and limited access to veterinary products and services, coupled declining purchasing power exacerbate the situation (Yared, 2022). According to TRHB (2021), veterinary clinics, breeding centers and pharmaceutical centers have completely collapsed, with veterinary equipment looted by allied forces. Conflicts lead to targeted killing of animals and during such times shortages of veterinary care become common resulting in unnecessary suffering for the animal (Mebrahtu *et al*., 2023). In Tigray, instances of targeted killings and unauthorized slaughter of animals by allied forces have been prevalent. The shortage of veterinary professionals and animal health technicians due to forced displacement and migration has resulted in rampant disease outbreaks. Following the departure of farmers due to war, many animals remain unattended, suffering from a lack of food and water and some are preyed upon by wild animals. In areas with active conflict, the lack of feed, veterinary care and drugs puts livestock at significant risk, leading to outbreaks, deaths due to food and water shortages and abandonment.

2.7. Effect of War on Livestock Marketing and Market Structure

The impact of the war in Ukraine on the broad production system, characterized by disruption of value and supply chains and unpredictability of prices, has effects on the rural population, underlining their interdependence with the country's agricultural economy (Holleman *et al*., 2017). The farmers and food producers are concerned about high pressures of rising input costs on their businesses before war (Malik *et al*., 2022). In developing countries the livestock sector is greatly dynamic, it is evolving to rapidly increasing demand for livestock products and it is stagnating. This changing demand has primarily been driven by human population growth, income growth and urbanization and the production. Livestock production developments in breeding, nutrition and animal health will continue to contribute to increasing potential production and further efficiency and genetic gains (Thornton, 2010).

In Mali the conflict restricted access to markets caused the disappearance and disruptions of markets both input and output markets can be affected. The closure of roads due to safety concerns has hindered transportation, making it difficult for farmers to purchase inputs and sell their produce. Consequently, many farmers have experienced reduced land productivity and income, forcing them to produce food crops solely for subsistence (Masset, 2019).

According to Yacob *et al*. (2016), livestock markets have been changed radically in a negative way due to conflict. These market disruptions had disproportionately affected the livelihoods of livestock producers, traders as well as consumers' access to livestock products. Idris (2018) stated that the war caused elite capture of livestock and that it made pastoralism much harder. In this context, cattle prices were inflated, bride wealth rates had increased and access to quality grazing land became limited. Moreover, there was a lack of clear market information about forage and livestock products, uncontrolled price fluctuation (Yared, 2022)

2.7.1. Market instability

The implications of a dramatic event in a specific area led to unexpected consequences in distant areas resulting in serious and lasting crises. The ongoing conflict in Ukraine disrupted markets and supply chains leading to food security in livelihoods and income losses (Ben Hassen and El Bilali, 2022). According to Malik *et al*. (2022) in the UK many farmers and food producers are currently facing the challenge of steep increases in the cost of their essential inputs, such as energy, fertilizer and feedstuffs for animals. The cost of inputs varies

year to year and is a significant risk to farming economies due to the narrow margins. Additionally, the cost of grains and other agricultural products in the UK could be indirectly impacted as other countries struggle to source produce from the conflict region, further causing instability in global prices. The cost of feed and feeding livestock was raised, with many farmers dependent on feed prices set on a global market. Feed prices for livestock were stable in the first half of 2021, but increased by 18% between August 2021 and April 2022 (Lloyd *et al*., 2022).

2.7.2. Weak market linkages

In northern Mali, the conflict disrupted the livestock industry, affecting all stakeholders along the value chain including herders, traders, butchers and consumers. The war had made it difficult to raise livestock in compounds due to limited access to food for the animals. Moreover, the demands of the rebels for livestock products have driven up market prices (Kimenyi *et al*., 2014). According to Lin *et al*. (2022), conflict can disrupt markets making it difficult for farmers to sell their produce and for consumers to access food. Livestock producers and traders faced enormous security challenges when transportation of their products to market forced many to scale back operations or abandon the livestock trade altogether. Additionally, livestock brokering and taxation exacerbated these issues, crippling the industry and disrupting the marketing process (Kimenyi *et al*., 2014).

Consultant (2016) indicated that the conflict had severely impacted on an extensive network of transportation, refrigerated marine vessels and supporting services such as processing facilities and packaging factories to ensure the production and distribution of agricultural products. Similarly, the conflict block suspension projects caused the release of thousands of technicians and farm labor, decrease and lack of export markets, high price of goods and high wages from farm labor shortages, high transportation cost from rough roads, roadblocks and the like. Additionally, transaction costs were other critical challenges preventing smallholders from marketing their agricultural products (Markelova and Mwangi, 2010). Smallholders often faced the option of receiving below market prices or incurring high costs when searching for better prices (Getaw and Shively, 2013).

2.8. Role of Livestock and Effect of War on Household Income and Livelihoods

Well- functioning livestock sector transforms lives by providing the extremely poor with a means to own and utilize livestock, increasing food security, financial stability and resilience. Livestock can also serve as a safety net in times of crisis, promoting social equality by boosting confidence and independence among marginalized groups (Short, 2011). Livestock products including meat, milk and eggs contribute 15% and 31% of global per capita calorie and protein supply with regional variations (Henchion *et al*., 2021). Furthermore, livestock provides various services, including source of draught power, transportation, organic fertilizer, income generation and diversification and assets which contribute to the overall well-being and resilience of many communities (CIRAD, 2016). Approximately 844 million people globally derive some income from agriculture and the livestock sector contributes about 40% of agricultural value-added (Molina-Flores *et al*., 2020).

Food insecurity affects the lives of millions of people worldwide and conflict and violence caused food crises (Holleman *et al*., 2017). Conflict caused food insecurity due to lack of access to physical and economic resources as well as the loss of livelihoods at the household level. War increases food cost and persistently poverty of people (FAO *et al*., 2017). In Ukraine war had severely affected the livelihoods of households such as, limiting access to basic services and needs and reducing agricultural production and creating an alarming humanitarian situation (FAO, 2022). According to Lin *et al*. (2022), conflict reduces availability of production input and income, leading to prolonged households starvation. Food insecurity may not only be an externality of conflict but also food deprivation may be utilized as a weapon to discourage residency in challenged territories.

Conflict and insecurity is disproportionately a region which depends on agriculture extensively. In Northern Uganda conflict strongly affects rural livelihoods of households with limited income diversification (Portfolios, 2008). During war malnutrition and food insecurity appears in many forms which are under nutrition and micronutrient deficiencies. Masset (2019) also stated that war was a major economic loss by disposing of assets. In Mali animal holdings were the main store of wealth as financial markets and other form of savings are underdeveloped and livestock sales are likely to smooth the economic impact of shocks. However, due to war resulting insecurity and the risk of animal thefts that encourages pastoralists to diminish their stocks and livestock and other assets are permanently disposed

of and deplete in large amounts leading to lose of the ability to withstand further economic shocks and erode their income generating capacity.

In conflict-affected regions (Tigray, Amhara and Afar) over 9 million people need humanitarian food assistance and 83% of the population in Tigray experiencing food insecurity (Abate, 2022). According to Pellet (2021), the Tigray conflict was having a severe impact on rural communities by eliminating critical sources of food and income with overcrowded conditions, inadequate assistance and shortages of medicine and food. Many internally displaced persons (IDPs) rely on host communities for basic needs like food and water, straining already limited resources. Non-farm and wage-related activities have been the most affected, while farm activities demonstrate more resilience (Tesfaalem *et al*., 2022). Households were exposed to food insecurity; they were unable to buy enough staple foods (e.g. teff/injera, wheat/bread, maize and cooking oil (Tesfaalem *et al*., 2022).

2.9. Challenges of Livestock Production

The productivity and economic contribution of the livestock sector fall well below its potential due to various technical and non-technical constraints. The main technical constraints include inadequate feed supply and inefficient feed management and utilization, widespread diseases and poor health and poor breeding practices, poor breeding stock and inadequate livestock policies with respect to credit, extension, marketing and infrastructure are the major constraints affecting livestock performance in Ethiopia (Belay and Geert, 2021). Shimelis *et al*. (2021) stated that constraints in livestock production vary across agro ecology and among production systems; feed shortage, water shortage, disease, market problems and poor breed performance. Underutilizing the productivity are feed and water shortage, disease and poor veterinary services, lack of appropriate technology, limited attention, poor extension and problems related to policy and strategy for livestock development are major challenges (Shapiro *et al*., 2017). The non-technical constraints include low-level human, financial and infrastructural resources (Adugna *et al*., 2012). Limiting institutional factors include poor linkages between technology sources such as research centers and end users and limited extension and financial services.

2.9.1. Feed shortage and water shortage

In Ethiopia the agricultural production and productivity are directly or indirectly affected by the interconnectedness of farming systems. The supply and quality of feed needs to be given

serious attention if the planned targets in the Growth and Transformation Plan (GTP) of the country are to be realized (Adugna *et al*., 2012). Lack of sufficient feed resources as the main constraint to animal production in mixed crop-livestock systems. Due to the increasing human population, grazing areas were converted to cultivation and other businesses (Duguma and Janssens, 2021). Feed shortage, good quality and quantity feed availability is gradually moving to a crisis level leading to low productivity of both livestock and crop agriculture (Shapiro *et al*., 2017).

On the other hand, poorly fed animals cannot generate adequate draught power for traction and other farm operations (Adugna *et al*., 2012). The problem of livestock feed both in quantity and quality is aggravated by tropical regions with scarce and erratic rainfall that limits the growth of herbaceous species and biomass yield in rangelands. Conflict in agricultural communities negatively affects access to grazing fields, lives and property which may lead to abandonment of cattle and relocation of herdsmen. High cost of concentrates and their fluctuating prices, as well as the shortage of feed concentrates and their adaptability to marginal circumstances render them non-competitive with food crops and aggravate the livestock feeding scenario. Improving raised variables to increase livestock productivity and output aids the nation in ensuring food security and reaping profits from the industry (Jabesa *et al*., 2021). Water shortage is also reported as a limiting factor in most lowland areas to a limited extent in mid altitudes.

2.9.2. Health constraints

High prevalence of diseases and parasites were nother serious constraint for livestock production in Ethiopia causing direct economic losses through high mortality of animals and contributing poor productive and reproductive performance of the animals (Aleme and Lemma, 2023). There are several endemic animal diseases caused by bacteria, viruses, protozoa and parasites that compromise the productivity of livestock.

2.9.3. Market and economic constraint

Livestock and livestock product markets are not well developed and organized. Live animal exports are highly affected by the prevalence of different diseases, lack of infrastructures, transportation, marketplace, weighing scale, watering point, stock routes are not well developed yet (Aleme and Lemma, 2023). Shortage of appropriate technology for production,

processing and marketing of animal products and lack of organized institutions to producers and facilitate in markets. Shortage of inputs in terms of technology and services required for the development of livestock. Constraints sustainability of the meat export marketing system and potential expansions in relation to sustainable resource utilization and degree of competition with domestic demand have not been investigated (Danie, 2008). The price of both raw material inputs and products of animal production systems has experienced growing volatility since the year 2000 because of currency fluctuations, spread of diseases. This makes it risky for livestock farmers to invest.

CHAPTER 3: MATERIALS AND METHODS

3.1. Descriptions of the Study Areas

The study was conducted in the Northwestern zone of Tigray, Ethiopia at Asgede and Tahtay koraro woredas in 2024. The Northwestern zone is bordered by the central zone, western zone, Amhara region and Eritrea on the east, west, south and north respectively. Geographically, it is located between 12°-14'50.50" to 14°-53'48.03" latitude and 36° 26'48.74" to 39°-59'-0.09" longitude 14°6'N 38°17'E with an average altitude of 1953 meters above sea level (m.a.s.l). The distance from the Northwestern zone to Mekelle and Addis Ababa is 305 km and 943 km respectively. The zone consists of eleven woredas and its agro ecology is highland, lowland and midland. The total human population of the zone is 736,805 (368,254 males and 368,551 females) with 107,999 urban inhabitants (NTOARD, 2024).

3.1.1. Descriptions of Asgede woreda

Asgede woreda is part of the Northwestern zone of Tigray. Geographically, it is located between 15°-61'-77"N latitude and 37° to 37°-88' 55"E with an average altitude of 850 1150 m.a.s.l. It is bordered by Tsimbla (east) Tahtay koraro (northeast), Laelay adyabo (north) and Tekeze River (west and south). The woreda is divided into seventeen *tabias*.

The woreda is ranked first by its livestock potential from the Northwestern zone. Its total human population is 104,495 (69,143 males and 66,478 females) and 7.46% of them are urban inhabitants. It has a total 90452 heads of cattle, 98250 goats, 6134 sheep, 7685 equines, 573 camels, 111580 chicken, 1254 honeybee colonies (198 traditional hive and 1056 modern hive) in 2024 with total livestock owner household (HHs) of 21,912, out of the total 24,346 HHs.

The annual rainfall ranges from 500-900 mm extending between June and September. Its average temperature is 27.5°C with 30°C maximum and 25°C minimum. The soil type of the area is sandy.

An average land per household is 1.27 ha with a total area 27,406 hectares of which 88.92% was privately owned. In Asgede both large and small scale farmers used a mixed farming

system producing cereals such as sorghum, maize, millet as well as oilseeds such as sesame (WAOARD, 2024).

3.1.2. Descriptions of Tahtay koraro woreda

Tahtay koraro (T/koraro) is a woreda in the northwestern zone of Tigray. Geographically, it is located between 13°-54'1" to 14°-16'11"N latitude and 38°-4'8" to 38°-26' 58" E longitude with an altitude ranging from 1028 to 2462 m.a.s.l. It is bordered by east with Laelay koraro woreda, by west with Asgede, by south and north with Eritrea. The woreda is divided into fifteen *tabias*.

The total human population of the woreda is 80124 (40042 males and 40082 females) and are rural and urban inhabitants. It has total of 87832 heads of cattle, 52985 goats, 23416 sheep, 10524 equines, 609 camel, 122500 poultry, 4174 honeybee colonies (2012 traditional hive and 2162 modern hive) with total livestock owner of 18080 HHs out of the total 20090 HHs.

The annual rainfall ranges from 1402-726mm extending between June and September. The average temperature of the area is 20.5°C with 27.4°C maximum and 14.10°C minimum.

The soil types of the area are composed of sandy, clay, loam and clay loam. The predominant soil is mostly vertisol and cambisols.

An average land per household is 0.85ha with a total area of 11765 hectares of which 91.76% was privately owned. In this area small scale farmers used a mixed production system and produced different cereals such as sorghum, maize, millet and teff (WTKOARD, 2024).

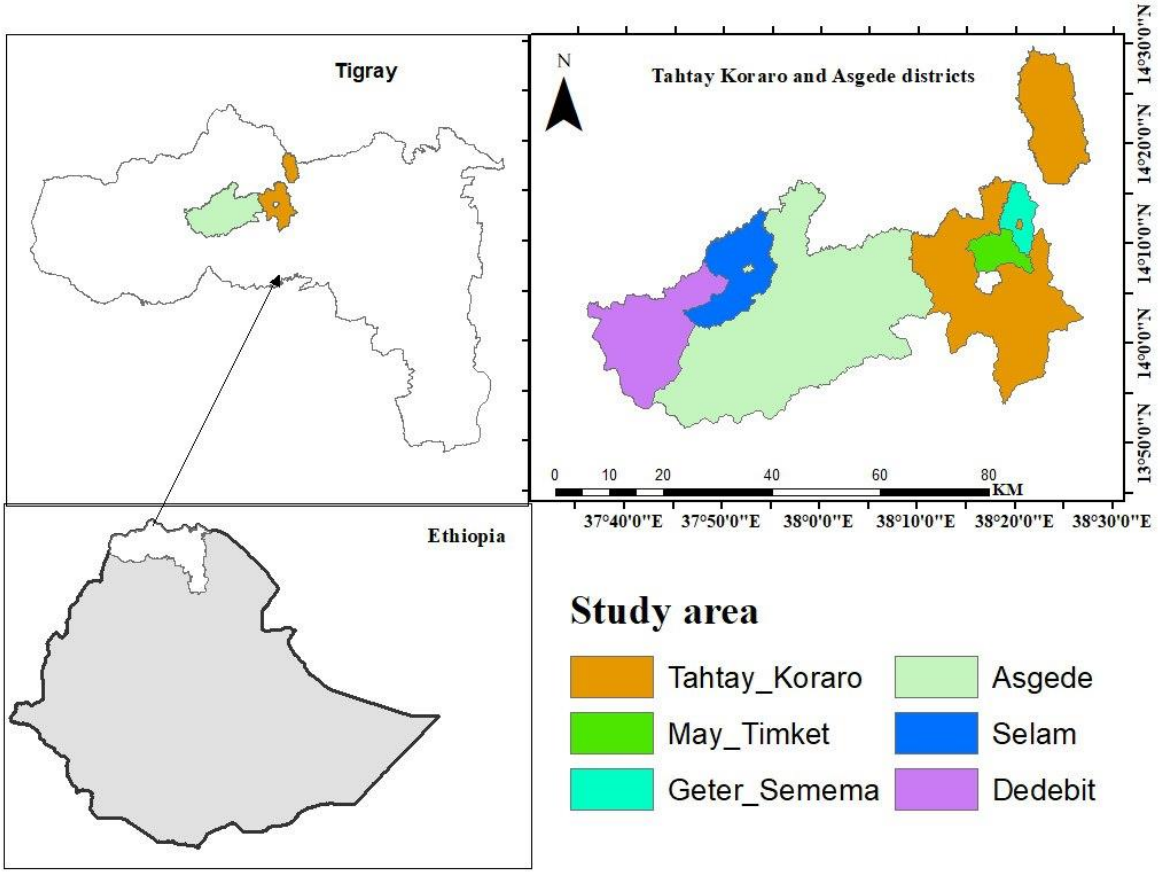


Figure3. 1: Map of the study areas

3.2. Sampling Techniques and Sample Size Determination

The descriptive research employed a cross sectional study with a multi stage sampling procedure. In the first stage, two woredas (Asgede and Tahtay koraro) were selected purposely based on their livestock potential and security from the zone. In the second stage, the *tabias* were stratified into two based on their abundance in livestock population. In the third stage, two *tabias* were selected purposely from each woredas. Then, a total of 152 respondents (86 from Asgede and 66 from Tahtay koraro) were selected using simple random sampling methods for a questionnaire interview. The sample size of the respondent was determined using the formula developed by (Yamane, 1967) 95% confidence from the target population of each woreda.

$$n = \frac{N}{1+N(e)^2}$$ Where, n = the desired sample size,

N = total number households livestock owners' from each woreda,

e = the level of precision which is equal to 0.05.

The proportions of the *tabias* were calculated using the formula from the target population from each *tabias* (Dedebit, Selam, Maytmket and Getersemema; 2742, 2070, 1720 and 1500 HHs respectively).

$$\frac{n*}{N}\text{Total number of livestock owners in each } Tabias \text{ (Asgede and T/koraro)}$$

Then, Dedebit (Tselimoy and Dedebit) = 49, Selam (wahabit maylam and ketema) = 37 May Tmket (Adahno and Sokore) = 37 Getersemema (Egub) =29

3.3. Data Collection Methods

The data for this study was obtained from both primary and secondary sources, incorporating qualitative and quantitative data types. Primary data was collected through field observations, face-to-face interviews, focus group discussions (FGDs) and key informant interviews (KII). Semi-structured questionnaires were employed, consisting of both open and closed ended questions. The data were collected from April to June 2024 by trained data collectors who received short training to ensure they fully understood the data collection techniques. The data collectors were diploma and BSc degree holders in fields related to livestock production and management. The questionnaires were prepared in English and administered to household heads, including both rural and urban households engaged in livestock production. They were designed to gather data on key household characteristics, livestock ownership, purposes of livestock keeping, feed resources, total land coverage and the effects of the war on livestock, feed as well as the household income in the study areas.

The questions for the respondents' face to face interview focused on key points; the demographic profile of the respondents, number of livestock, land size, crop yield, major livestock diseases, challenges in livestock marketing and the income related to livestock before and after the war. Additionally, the interviews addressed the major challenges faced in rehabilitating the livestock sector after the war. The researcher also observed the types of feed and breed used and damaged veterinary clinics. Additionally, FGDs were conducted to further reinforce the data particularly concerning livestock diseases, prevention mechanisms and the major challenges after cessation of hostilities. A total of six FGDs were held, with four from Asgede and two from Tahtay koraro each consisting of seven to nine members for qualitative

survey data. The participants were farmers who had lived in the *tabias* for an extended period and owned several livestock compared to their neighbors. Similarly, these farmers had previously engaged in dairy and fattening farming and model farmer household before the war. Additionally, ten key informants including livestock experts from the zone, woreda and *tabia,* as well as market persistence and veterinary experts were interviewed through face to fa ce interactions, phone calls, Telegram and WhatsApp communications. These Key Informant Interviews (KIIs) focused on various topics, including livestock population, average crop yield, livestock diseases and average livestock prices before and after the war, as well as the challenges faced in the woreda in rehabilitating the sector.

3.3.1 Estimation of feed production

Data regarding crop yield and size of grazing lands were collected from respondents and the crop residues used as a source of animal feed were estimated using conversion factors (CF). Crop residues production was derived from grain yield, which varies with crop type, multipliers of 1.5 for teff, barley and wheat, 2 for sorghum and maize, 2.2 for millet and 4 for oil crops (FAO, 1987). The feed available from grazing land was calculated from private and communal ownership with conversion factors of 3 ton per hectare (t/ha) for private and 2 t/ha for communal grazing lands (Carlowitz, 1986). The feeds obtained from other non-conventional sources such as household wastes, *Atella* (residues of the local brewery), browse plants and mill by-products were not considered during this study.

$$\text{Total annual feed supply (t DM)/year} = \text{crop residues (t DM)} + \text{common grazing lands (t DM)}$$

Additionally, Tropical livestock units (TLU) were calculated with a value of 0.7 for cattle, 0.1 for sheep and goats, 0.5 for donkey, 1.2 for camel and 0.01 for poultry. One TLU is equal to 250 kg of live weight (Jahnke, 1982). Change in herd dynamics and price of livestock were also calculated as;

$$Change\ of\ herd = \frac{livestock\ number\ before\ the\ war\ at\ household - after\ the\ war}{livestock\ number\ before\ the\ war} \times 100\%$$

$$Change\ of\ price = \frac{price\ of\ livestock\ after\ war - price\ before\ the\ war}{price\ after\ the\ war} \times 100\%$$

3.3.2. Ranking methods

The ranking method was employed to determine the major feed before and after the war, major feed sources, livestock diseases, primary purpose of livestock rearing and the key challenges faced by households to restocking their farming activities after the war. The index is calculated using the following formula:

Index=Sum of (n × number of HHs ranked first) + (n-1) × number of HHs ranked second + (n-2) × number of HHs ranked third +… + 1× number of HHs ranked last) for one factor divided by the sum of (n × number of HHs ranked first + (n-1) × number of HHs ranked second +…. + 1 × number of HHs ranked last) for all factors.

Index = (∑Rn*C1+Rn-1*C2…+ R1*Cn)/ (∑Rn*C1+Rn-1*C2…+R1*Cn).

Where, n=the number of factors under consideration.

Rn = sum of the numbers of (n)-ranked items for each subtopic.

C= number of households ranked from first up to n.

3.3.3. Secondary data sources

Secondary data was collected from both published and unpublished literatures, including resources from the Agriculture and Natural Resources Office as well as livestock census data. The information obtained concerning the study areas includes the following: total livestock and human population, total woredas and *tabias*, market persistence of livestock, average crop yield and size of grazing areas before and after the war.

3.4. Data Analysis

The collected data was analyzed using the Statistical Package for Social Sciences (SPSS) software version 28 program. Paired samples T-test statistical method was used for herd size, land size, crop yield and feed resources before and after the war. Descriptive statistics, including frequencies, mean, standard deviation, charts and tables were used to summarize the analyzed data.

CHAPTER 4: RESULTS

4.1. Demographic Information of the Respondents

Among the sampled 152 households, 77.6% of them were males and 22.4% females. The average age of the respondents was 41 years old with a minimum and maximum age of 25 and 80, respectively. The family size of respondents ranged from 2 to 12 with an average family size of 7 per household. Over 70% of the respondents were married. In terms of educational status, most of the respondents were illiterate (41.4%), attended primary school (28.9%), junior school (24.3%) and secondary school (5.6%) (Table 4.1).

Table4. 1: Demographic information of the respondents

Parameter	**Category**	**Frequency**	**Percent (%)**
Gender	Male	118	77.6
	Female	34	22.4
Age group	25-40	46	30.3
	41-56	74	48.7
	57-71	28	18.4
	>71	4	2.6
Marital status	Single	4	2.6
	Married	112	73.7
	Divorce	16	10.5
	Widowed	20	13.2
Education status	illiterate	63	41.4
	primary	44	28.9
	Junior	37	24.3
	high school	8	5.3
Family Size	Minimum	Maximum	Mean
	2	12	6.77

4.2. Household Livestock Holding

All respondents of both in Asgede and Tahtay koraro woredas owned different livestock types; including cattle, sheep, goats, poultry and donkeys. Some households also kept honeybees and camels. The respondents reared local cattle breeds such as Begait, Arado and Holstein Friesian cross breeds, as well as Begait goats, Highland and Begait sheep and Sasso and local chicken breed. The average livestock holding before and after the war, showed statistically high significant differences ($p<0.001$) (Table 4.2). The declines in livestock number of the respondents were attributed to looting, killing, slaughtering and deaths during

the war. On average the livestock holding of respondents before and after the war were higher in Asgede woreda compared to Tahtay koraro woreda. Similarly, there were high potential cattle, goats, sheep, donkeys and poultry populations in Asgede woreda, whereas camels and honeybees were higher in Tahtay koraro woreda.

Table4. 2: Herd size of respondents before and after the war in heads of animals

		Mean ±SD		
Animal Type	Woreda	Before war	After war	P-value
Cattle	Asgede	25.95±24.08	3.03±3.54	
	T/koraro	7.36±4.24	3.15±2.34	<0.001
	Over all	17.88±20.48	3.09±3.07	
	TLU	12.52	2.16	
Goats	Asgede	42.80±33.96	3.56±6.33	<0.001
	T/koraro	27.79±18.76	2.82±4.63	
	Over all	36.28±29.26	3.24±5.65	
	TLU	3.63	0.32	
Sheep	Asgede	9.86±22.79	0.95±2.95	<0.001
	T/koraro	2.33±5.54	0.91±2.04	
	Over all	6.59±17.88	0.93±2.59	
	TLU	0.66	0.09	
Donkey	Asgede	2.12±1.44	0.8±0.76	<0.001
	T/koraro	1.64±1.12	0.86±0.86	
	Over all	1.91±1.33	0.83±0.81	
	TLU	0.96	0.42	
Camel	Asgede	0.36±0.57	0.14±0.41	<0.001
	T/koraro	0.44±0.64	0.23±0.46	
	Over all	0.40±0.60	0.18±0.42	
	TLU	0.48	0.22	
Poultry	Asgede	25.02±14.71	2.7±2.76	<0.001
	T/koraro	16.36±14.12	1.88±3.65	
	Over all	21.26±15.03	2.24±3.31	
	TLU	0.21	0.02	
Honeybee	Asgede	0.13±0.59	0.00±0.000	<0.01
	T/koraro	0.35±0.92	0.05±0.17	
	Over all	0.22±0.77	0.02±0.18	

SD=Standard deviation, P-value= Significance level of difference at 95% confidence interval, T/koraro= Tahtay koraro TLU= Tropical Livestock Unit calculated with a value of 0.7 for cattle, 0.1 for sheep and goats, 0.5 for donkey, 1.2 for camel and 0.01 for poultry. One TLU is equal to 250 kg of live weight (Jahnke, 1982).

4.2.1. Effect of war on livestock number

The effect of war on livestock numbers is presented in Figure 4.1. This result showed that the majority of the livestock were looted by belligerents followed by killing, slaughtering, dying and abandoning in Asgede and Tahtay koraro woredas.

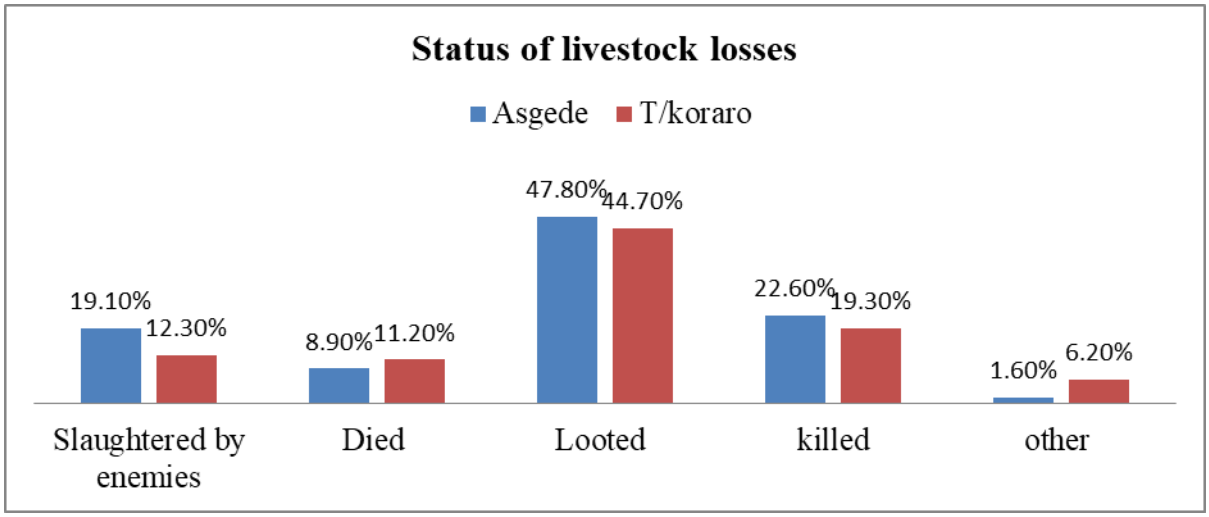
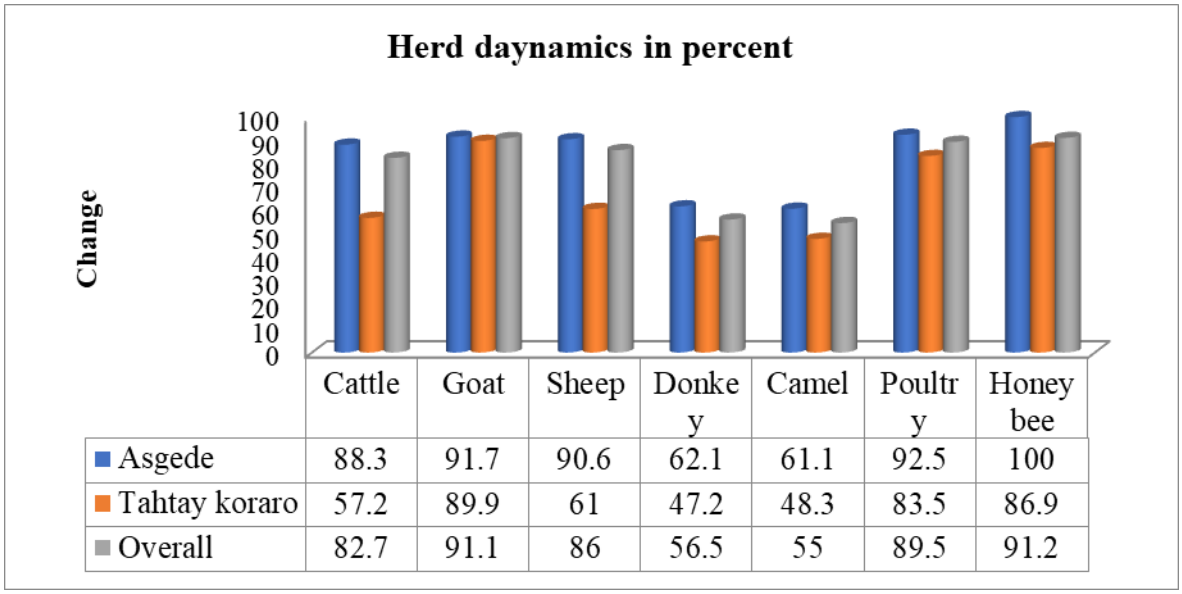


Figure4. 1: Status of livestock losses

4.2.2. Herd dynamics

The present study, the livestock dynamics are presented in Figure 4.2. According to the interviewed respondents and FGDs, all livestock types, livestock age and sex were affected due to the war. The livestock types which were found in Asgede were more affected than Tahtay koraro woreda.



	Cattle	Goat	Sheep	Donkey	Camel	Poultry	Honey bee
Asgede	88.3	91.7	90.6	62.1	61.1	92.5	100
Tahtay koraro	57.2	89.9	61	47.2	48.3	83.5	86.9
Overall	82.7	91.1	86	56.5	55	89.5	91.2

Figure4. 2: Herd dynamics

4.3. Land Holding and Crop Production Systems

4.3.1. Size of land holding

There was a statistically highly significant difference ($p<0.001$) in farm land holding of respondents between before and after the war situation. The farm land holding of respondents before the war was higher on both private and rented land holdings than after the war situation (Table 4.3). The owned land was utilized for rain fed cropping, irrigated agriculture and grazing with the largest proportion for crop production.

Table4.3: Farm land holding of respondents/hectare

Woreda	Private (Mean ±SD)		Rented (Mean ±SD)		P-value
	Before-war	After-war	Before-war	After-war	
Asgede	2.20± 2.06	1.38±1.52	1.54±1.42	0.93±0.97	<0.001
T/koraro	0.88±0.54	0.88±0.56	0.24±0.60	0.21±0.50	<0.001
Over all	1.63±1.72	1.16±1.23	0.98±1.30	0.62±0.87	<0.001

SD= standard deviation, P-value= Significance level of difference at 95% confidence interval, T/korao=Tahtay koraro

4.3.2 Crop yield

Various crops, mainly sorghum, sesame, maize, millet and teff were cultivated in Asgede and Tahtay koraro woredas. All crop types yield had highly statistically significant differences ($p<0.001$) before and after the war (Table 4.4). Before the war, there was higher yield of sorghum, sesame, maize, millet and teff; resulting in a total yield of 22.93 Qt. per year. However, it was dropped after the war situation to a total of 5.74 Qt. per year. In Asgede, the average yields for sorghum, sesame, maize and millet were higher than in Tahtay koraro woreda, while yield of teff was higher in Tahtay koraro woreda. The average yield of crops was 36.3 Qt. and 9.27 Qt. per year in Asgede and Tahtay koraro woreda respectively.

Table4. 4: Yield of major crop type per year (quintal) per household.

		Mean ±SD (yield in Qt/year/HH)		
Crop type	Woreda	Before war	After war	P-value
Sorghum	Asgede	23.13±11.06	6.02 ±4.40	
	T/koraro	2.94±3.17	1.02 ±1.17	<0.001
	Over all	14.36 ±13.19	3.85 ±4.21	
Sesame	Asgede	3.99±2.13	0.93 ±1.12	<0.001
	T/koraro	0.03 ±0.25	0.00 ±0.00	

	Over all	2.27 ±2.54	0.53 ±0.96	
Maize	Asgede	2.95±4.52	0.34±1.02	<0.001
	T/koraro	0.59±0.97	0.30±0.58	
	Over all	1.92±3.64	0.32±0.85	
Millet	Asgede	6.16±5.55	0.97±1.27	<0.001
	T/koraro	1.58±1.18	0.85±0.75	
	Over all	4.17±4.81	0.91±1.07	
Teff	Asgede	0.07±0.34	0.01±0.11	<0.001
	T/koraro	0.40±0.49	0.29±0.42	
	Over all	0.21±0.44	0.13±0.32	

P-value=Significance level of difference at 95% confidence interval, Qt. = Quintal, SD=Standard deviation, T/koraro= Tahtay koraro TLU= Tropical Livestock Unit

4.4. Livestock Feed Sources and Estimation of Feed Supply from Crops

4.4.1. Crop residues

In the current study, crop residues were the major feed resources for ruminants and donkey (Table 4. 5). The available crop residues were derived from different crop types. Before the war, the primary crop residues in Asgede and Tahtay koraro woredas were *gurdi meshela*, maize and sorghum stovers, millet stalks, teff straw and other supplements like cotton seed cake, sesame cake, wheat bran and husks from different crops. There was a high statistically significant difference ($p<0.001$) in the estimated total feed supply per household before and after the war, valued to 5.12 and 1.26 tonnes of DM respectively. Similarly, the total feed supply per household before the war in Asgede was 8.19 and 1.02 tonnes of DM in Tahtay koraro woreda. Whereas, feed supply after the war situation, were 1.86 and 0.32 tonnes of DM in Asgede and Tahtay koraro woredas respectively.

Table4. 5: Livestock feed supply from crops (tonne DM/year)

		Mean ±SD (in tonne DM)		
CR	Woreda	Before war	After war	P-value
Sorghum	Asgede	4.63±22.12	1.21±8.76	
	T/koraro	0.59±6.33	0.20±2.34	<0.001
	Over all mean	2.87±26.38	0.77±8.39	
Sesame	Asgede	1.60±8.51	0.37±4.49	<0.001
	T/koraro	0.01±0.98	0.00±0.00	
	Over all mean	0.91±10.15	0.21±3.84	
Maize	Asgede	0.59±9.04	0.07±2.03	<0.001
	T/koraro	0.01±0.94	0.06±1.16	
	Over all mean	0.39±7.29	0.06±1.70	
Millet	Asgede	1.36±12.2	0.21±2.79	<0.001
	T/koraro	0.35±2.59	0.02±1.65	
	Over all mean	0.92±10.58	0.2±2.36	
Teff	Asgede	0.01±0.50	0.002±0.16	<0.001

T/koraro	0.06±0.74	0.04 ±0.63
Over all mean	0.03±0.66	0.019±0.48

DM= crop yield × CF, DM = Dry matter, CF= conversion factor, CR= Crop residues, P-value= Significance level of difference at 95% confidence interval, SD= Standard deviation, T/kotaro=Tahtay koraro

4.4.2. Common grazing lands

In the present study, ruminants and donkey feeds were obtained from common grazing lands and crop residues. The camels also browse on the grazing areas. The total annual feed supply before the war was 15,591 tonnes of DM; while 14,727 tonnes of DM was obtained after the war, indicating a significant land use change i.e, grazing lands had been allocated for cultivation and settlement. Both before and after the war, the total feed supply in Asgede woreda was higher than in Tahtay koraro woreda (Figure 4.3).

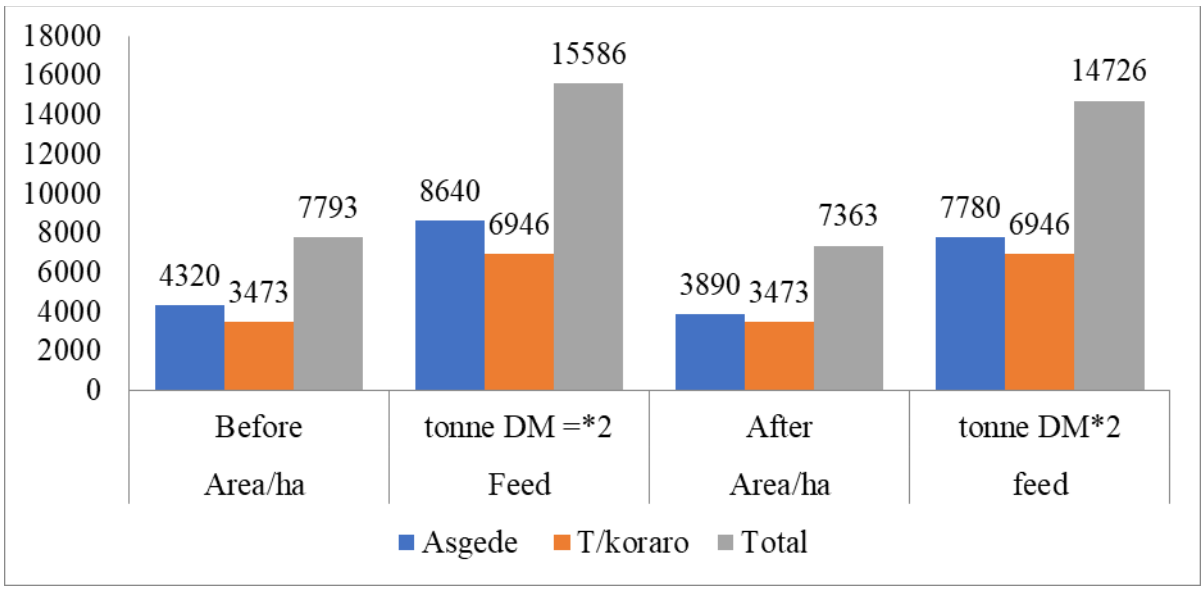


Figure4. 3: Grazing areas in hectare and feed supply in tonnes DM per year

4.4.3. Effect of war on livestock feed sources

From this survey, it was found that the war affected feed and water availability at the household level. The livestock feed availability was affected in various ways including polluted, burned and not harvested due to the war. Consequently, the quality and type of feed for livestock were changed due to different factors including rising costs, shortage of feed supply, limited land access and grazing lands degradation. Water availability emerged as a major challenge as water bodies were controlled by enemies and became polluted caused lack of water. In response to these challenges, many households adopted strategies such as relocating their livestock to safer areas and implementing a cut and carrying system (85.5%).

Conversely, 14.5% of households reported that they have no livestock and have not developed any strategy to cope with the situation (Figure 4.4). This result showed both the quantity and quality of feed were reduced due to poor management practice in collection, transport and storage. In times of feed shortage, farmers would sell livestock and crops to purchase additional feed. However, after the war, available feed resources were primarily crop residues, which were often low in quantity and quality due to not being harvested, lost, contaminated and intentionally burned during the war, because which occurred in the autumn. Furthermore, after the war, almost all farmers had no livestock left to sell, even in the face of a feed shortage.

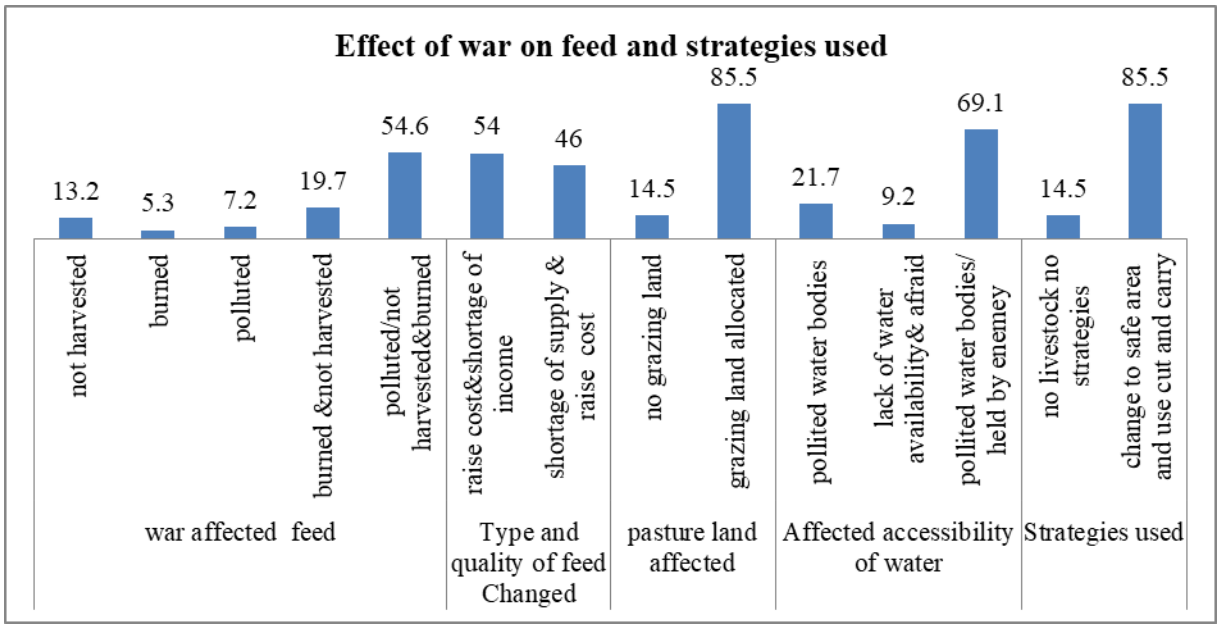


Figure4. 4: Major effect of war on feed and strategies used in the study areas

4.4.4. Effect of war on grazing land

The current result shows that grazing areas serve as the second major source of feed for livestock utilizing both free grazing and cut-and-carry systems. The total estimated feed supply decreased after the war. This suggested the extensive grazing land was still available before the war. Livestock were primarily allowed to graze freely in communal grazing areas that were permanently accessible. Many of these animals came from other woredas and zones. However, during and after the war, these grazing areas deteriorated and the availability of palatable forage species decreased. The war transformed grazing land into battlegrounds, leading to destruction and contamination from military activities, rendering it unsuitable for livestock. As a result, the traditional semi-nomadic livestock production system which relied on seasonal movements was halted. This shift led to overgrazing in some areas as both

livestock and humans became overcrowded in limited areas creating competition for resources and resulting in a high stocking rate.

This study also indicated that pasture and rangelands had been exploited for charcoal and firewood production leading to highly degradation of these resources. As a result, grazing areas deteriorated, becoming overgrown with bushes and shrubs and land encroachment intensified. Following the war access to common grazing lands became restricted with these areas designated for settlement and gradually converted for crop cultivation. This transition not only resulted in the loss of vegetation but also in the cessation of rangeland management. Consequently, pasturelands declined, further limiting land use. This degradation had triggered environmental concerns including deforestation, soil erosion, pollution and increased greenhouse gas emissions all of which negatively affected livestock. The major livestock feeds in the study areas are indicated in Table 4.6. Pasture was ranked first (28%) followed by crop residues (27%) in Asgede woredas; while, crop residues (40%) and pasture (31%) were the first and second ranked feed supplies in Tahtay koraro woreda before the war. However, after the war, the availability of feed resources for livestock was changed.

Table4. 6: Major feed of livestock (index)

Feed type	Study areas							
	Asgede				T/koraro			
	Before-war		After-war		Before-war		After-war	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Crop residues	0.27	2	0.7	1	0.40	1	1	1
Sesame/cotton seed cake	0.10	5	-	-	0.07	4	-	-
Wheat bran	0.17	3	-	-	0.23	3	-	-
Hay	0.17	4	-	-	-	-	-	-
Pasture	0.28	1	0.3	2	0.31	2	-	-

T/koraro= Tahtay koraro

4.5. Effect of War on Livestock Diseases and Parasites Infestation

4.5.1. Major livestock diseases

Many important livestock diseases and parasites in the study areas became prevalent and spread rapidly after the war. Ruminants were primarily affected by anthrax, rabies, lump skin disease (LSD), foot and mouth disease (FMD), peste des petits ruminants (PPR), Pasteurellosis, lung worm and foot root. Camels and donkeys were also attacked by anthrax and FMD, whereas poultry was affected by Newcastle disease (Table 4.7).

Table4. 7: Major diseases type prevalent in the study areas/livestock types

Species	Disease (Asgede and T/koraro)
Cattle	Anthrax, LSD, FMD, rabies, bovine pasteurellosis, Trypanosomiasis, lungworm, abortion, CBPP
Sheep and goats	Anthrax, LSD, PPR, sheep and goat pox, (Ovine and caprine) pasteurellosis, lungworm, foot root
Equine	Anthrax, LSD, rabies
Camel	Anthrax, LSD and rabies
Poultry	Newcastle and avian influenza (bird flu)

CBPP= Contagious Bovine Pleuropneumonia, FMD= foot and mouse disease LSD= lumpy skin disease PPR= peste des petits ruminants

The current study displayed that the transmission of livestock disease occurred through various mechanisms. Sick animals were often moved together alongside healthy animals, facilitating the spread of disease particularly zoonosis disease such as anthrax, rabies, FMD and various parasites. Following the war there was a decline in disease surveillance and the uncontrolled movement of livestock resulting in a surge in disease outbreaks. Furthermore, this study demonstrated several issues affecting veterinary services including the cessation of delivery services, theft and decline of veterinary equipment, interruption of vaccination program and a lack of health experts. Specifically, three veterinary clinics in Asgede and five in Tahtay koraro woredas were declined. Similarly, healthy and sick animals were living, feeding and watering together in confined areas increasing disease transmission and leading to food and waterborne disease. Additionally, animals from other areas entered to the common grazing land and passed through without any treatment (quarantine) allowing diseases to spread. There was a lack of proper inspection and management of dead animals such as burning or burying them. Soldiers slaughtered untested animals which then contaminated water bodies and dispersed animal waste further polluting the environment. This situation increased the presence of disease vectors and hosts making healthy livestock more susceptible to infection.

Furthermore, the current study indicated the war severely interrupted animal husbandry practices such as shelter, feeding, watering and other essential infrastructures. As a result, livestock were exposed to malnutrition and water shortage. The sound of war caused animal stress, injury and trauma. These factors weakened livestock immune systems making them more susceptible and a victim to various diseases and parasites which caused high mortality rate and reduced productivity. This situation also raises animal welfare concerns. As shown in

figure 4.5, the mortality rate of livestock due to different diseases in the study areas was high in poultry, followed by small ruminants, cattle and equine.

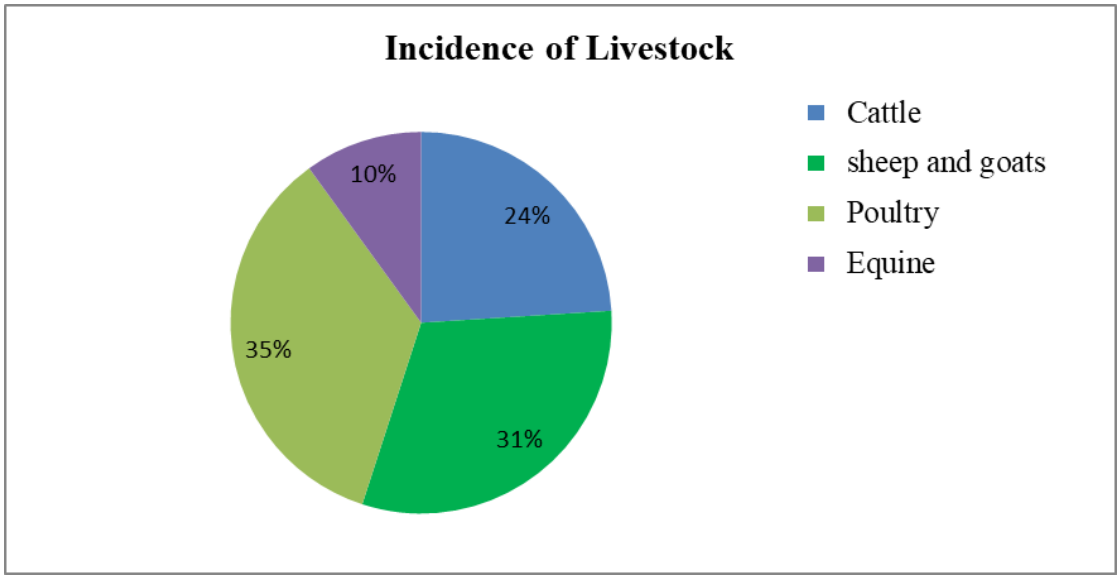


Figure4. 5: Incidence of livestock death in the study areas

The infestations of internal and external parasites in Asgede and Tahtay koraro woredas were given in Table 4.8. The internal parasites primarily affect the internal organs of livestock; with leech infection and worm were the major parasites in both woredas. These parasites were caused by the animals drinking and eating contaminated water and feed. Whereas, the external parasites including tick, mice, fleas and mange mite infestation damaged the external part of the animal.

Table4. 8: Major livestock parasites in the study areas/livestock type

Species	Major livestock parasites in Asgede and Tahtay koraro
Cattle	Leech infestation, tick, lice, worm, mange mite internal and external parasites
Sheep and goats,	Worm, tick, lice and mite infestation
Cattle, sheep and goats, Poultry, equine	Worm, flea infestation
Sheep and goats, equine	Mange mite

Table 4.9: indicates the occurrence of major diseases in the study areas. The primary livestock diseases as reported by the respondents in Asgede woreda were anthrax (30%), rabies (27%), Newcastle (20%), LSD (13%), parasites (10%) and in Tahtay koraro anthrax (31%), rabies

(28%), LSD (18%), Newcastle (15%), parasites (8%) were ranked 1st, 2nd, 3rd, 4th and 5th respectively.

Table4. 9: Occurrence major livestock diseases in the study areas

Major diseases	Asgede		T/koraro	
	Index	Rank	Index	Rank
Anthrax	0.30	1	0.31	1
Newcastle	0.20	3	0.15	4
Rabies	0.27	2	0.28	2
LSD	0.13	4	0.18	3
Parasites	0.10	5	0.08	5

4.5.2. Prevention mechanisms of diseases and parasites

This finding demonstrated that before the war, farmers had access to adequate veterinary care and regular vaccination programs provided by both governmental and non-governmental organizations at a balanced price. However, the war disrupted these services, leading to a decline in animal health and prompting challenges in management. Farmers employed various local methods to mitigate the risks of disease and parasite infestation in their domestic animals. During the wartime period, likely a response to the diminished supply and escalating costs of treatments. The prevention mechanisms of diseases and parasites employed by the respondents during the war are presented in Figure 4.6. They utilized locally available plants a nd traditional techniques such as healing, incisions, cauterize and burning on affected areas, as well as washing with cattle urine, soap and ash as well as remove manually for parasites. Different plant parts such as leaves, roots, fruits and bark were utilized, with crushed leaves being rubbed into wounds. Roots were also shaken for application, proving to be 46.1% effective against diseases and 86.8% effective against parasites.

Additionally, livestock owners used various oils, including sesame oil and hair oil, as well as alcohol, battery lamp powder and even cattle urine for washing and some consumed the leaves. Some respondents reported purchasing expired medicines from both legal and illegal sources to treat their animals and many used isolation methods for sick animals. However, some respondents did not use any mechanism to prevent their livestock. The key informants and FGD discussants indicated that livestock owners were compelled to use traditional methods for prevention and treatment of their livestock because the war disrupted the existing veterinary and extension services. However, it affected the livestock because they used inappropriately dosage.

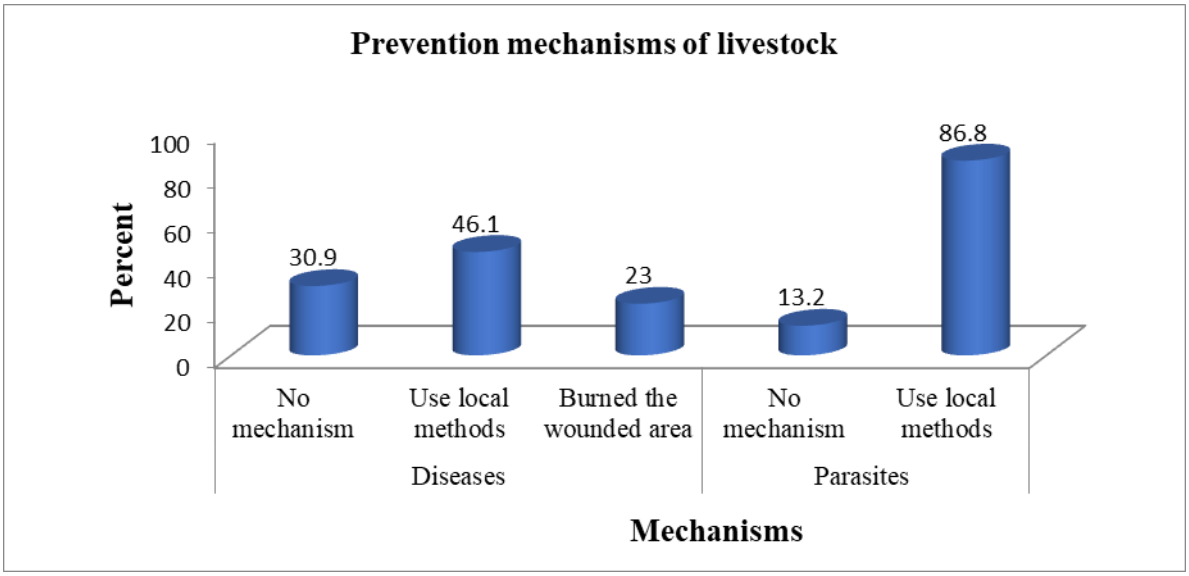


Figure4. 6: Prevention mechanisms of diseases/ parasites at household's level during and after the war

In the study areas farmers used different plants to treat and deworm their animals from disease and parasites traditionally (Table 4.10).

Table4. 10: Plants used for livestock treatment against disease and parasites

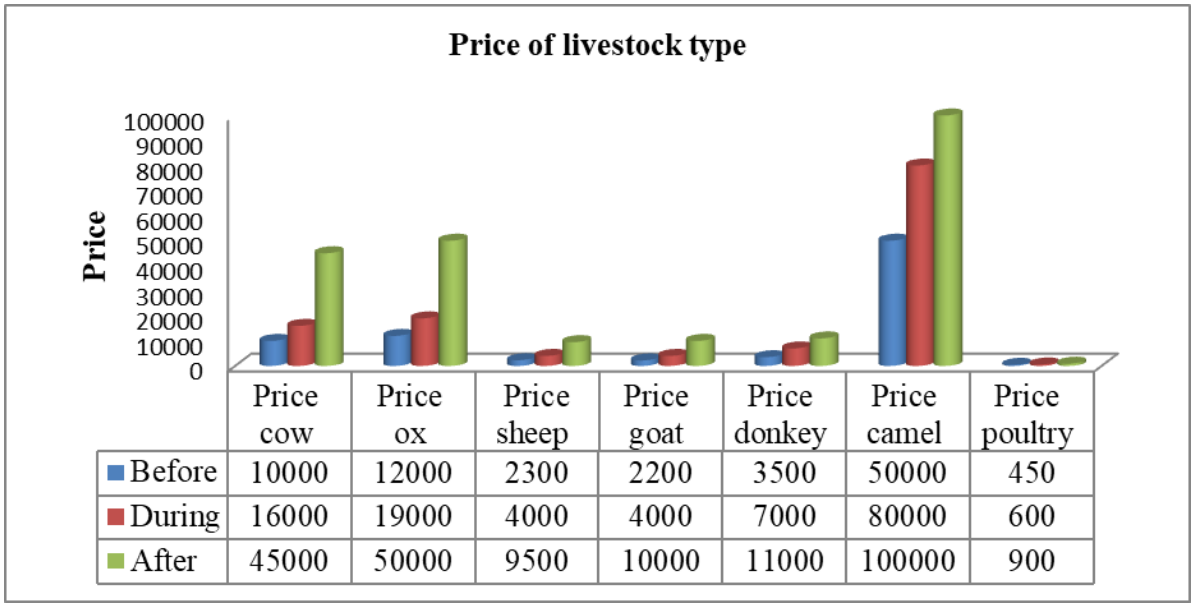
Medicinal plant species Scientific name	Tigrigna name	Diseases-treated	Plant part Used
Lepidium sativum	*Shinfae*	Anthrax, stomach pain, diarrhea	Fruit
Plumbago zeylanica	*Aftuh*	Anthrax, stomach pain, diarrhea and internal parasites	root and leaf
Ricinus communis	*Gulei*	Wounds and internal parasites	Leaf
Ruta chalepensis	*Chena adam*	For all	Leaf
Securidaca longipedunculata Fresen	*Shitara*	Anthrax, stomach pain, abdominal problems and Dermatitis	root and balk
Rhamnus prinoides	*Gesho*	Anthrax and internal parasites	Leaf
Maytenussenegalensis	*Argudi*	Stomach pain	Bark
Ormocarpum pubescens	*Alendia*	Wounds	Root
Otostegia integrifolia Benth.	*Chiendog*	Parasites (poultry)	leaf and stem
Aloe vera	*Ere*	Abdominal pain and internal parasites	Stem

Anogeissus leiocarpa	*Hanse*	Stomach pain, wounds	leaf and bark
Azadirachta indica A. Juss	*Nim*	Parasite infection (leech, tick, flea)	Leaf
Ficus vasta	*Daero*	Anthrax	leaf and bark
Justicia schimperiana	*Simieza*	Anthrax	Leaf
Calpurnia aurea	*Hitsawutse*	Swelling, FMD, mange, tuberculosis and external parasites	root, leaf, fruit
Carica papaya	*Papayo*	Worm	Leaf
Cissus petiolata Hook	*Alke*	Mange, FMD, swelling of cattle, back pain in cattle	Leaf
Clerodendrum myricoides	*Surbetri*	Bovine pasteurellosis	leaf and root
Croton macrostachyus Hochst	*Tambuk*	Rabies, Ovine pasteurellosis and leech infestation	bark, leaf and root
Zehneria scabra	*Hafaflo*	Anthrax, stomach pain/ diarrhea, tuberculosis	Root
Withania somnifera	*Agol*	Anthrax, Swelling/evil spirit, eye disease	leaf and root
Cucurbita pepo L.	*Hamham*	Influenza and dandruff and LSD	leaf and fruit/root
Datura stramonium L.	*Shembewaeta (Mezerbae)*	Anthrax, Mange, black leg, stomach pain and external parasites	leaf and fruit
	Hamat aguala t	Worm and internal parasites	Root
Grewia ferruginea Hochst	*Tsinquay*	Leech	bark and leaf
Solanum incanum L.	*Engule*	Stomach pain, swelling and rabies	root, fruit and bark
Terminalia brownii Fresen	*Weyba*	Diarrhoea	bark and leaf

Verbascu msinaiticum B enth	*Tirnaka*	Bleeding, parasite	leaf, root a nd fruit
Ximenia americana L	*Mileo*	Leech	Leaf
Ormocarpum pubescens	*Alendiya*	Skin diseases	Leaf
	Korsemae	Worm and rabies	Leaf

4.6. Effect of War on Livestock Marketing

Market was another challenge which hindered livestock production and productivity. The prices of live animals and feed were low before the war as compared to during and after the war situation (Figure 4.7). War caused high price inflation on live animals in the study areas with cattle prices rising by 76.8%, sheep and goats by 78%, donkeys by 68%, camels and poultry by 50% as compared to prices before the war. Similarly, war restricted and reduced the flow of goods and services used for livestock production.



	Price cow	Price ox	Price sheep	Price goat	Price donkey	Price camel	Price poultry
Before	10000	12000	2300	2200	3500	50000	450
During	16000	19000	4000	4000	7000	80000	600
After	45000	50000	9500	10000	11000	100000	900

Figure4. 7: Effect of war on livestock Prices (before, during and after) the war

4.6.1 Major market challenges due to the war

This finding showed that the war damaged and disrupted the infrastructure including roads, veterinary services, transportation, telecommunication and abattoirs which were crucial for livestock production. This destruction resulted in disrupted market link and diminished market opportunities for local livestock producers ultimately eroded their capital.

Furthermore, this result revealed that the lack of market opportunities during the war forced livestock producers to sell their products at lower prices to meet their basic needs. Many livestock by-products such as hide and skin were left waste, consumed by dogs and harmed the remaining live animals. However, as the war decreased livestock prices began to rise significantly. The major market challenges at the household level in Asgede and Tahtay koraro woredas illustrated in Table 4.11. Most of the respondents reported that the primary challenges related to market were shortage of transportation, insecurity, shortage of supply and demand of feed, livestock product as well as byproducts and decline in market linkage. These challenges affect the marketing of livestock including live animals, its products and byproducts.

Table4. 11: Market challenges in the study areas

Market challenges	Asgede		T/koraro	
	Index	Rank	Index	Rank
Insecurity	0.27	1	0.29	1
Transportation	0.20	2	0.22	2
Demand	0.18	4	0.16	4
Supply	0.15	5	0.21	3
Market linkage	0.19	3	0.11	5

The respondents had used different methods to sell and purchase feeds, livestock and their products during market challenges (Figure 4.8).

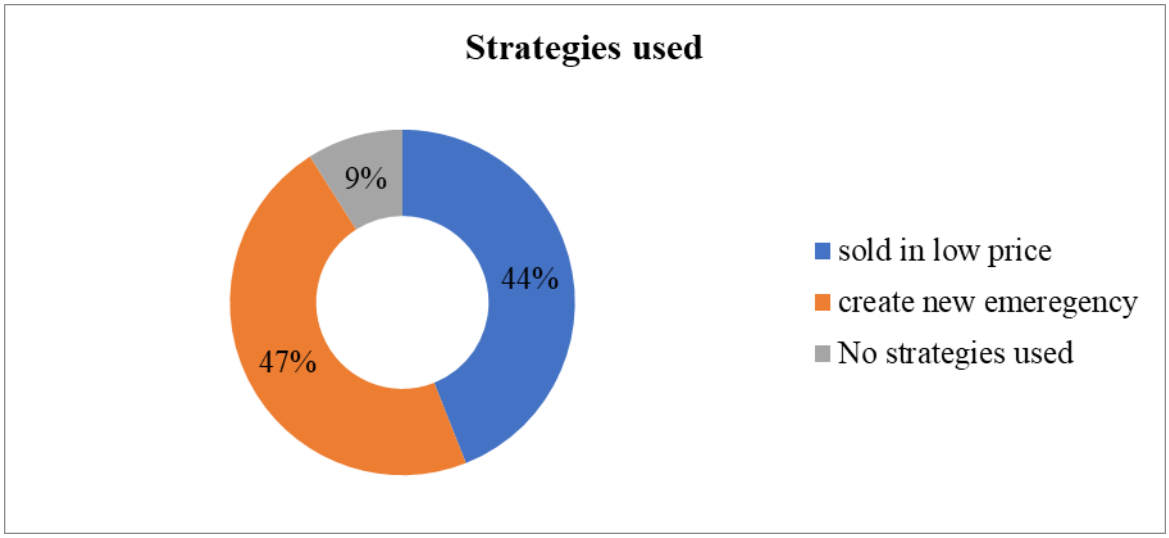


Figure4. 8: Strategies used during market challenges

4.7. Effect of War on Livestock Related Household Incomes

4.7.1. Purpose of livestock production

In the study areas, most farmers engage in both mixed livestock and crop production system. Livestock serve various purposes at household level. According to the survey result, the primary purpose of keeping livestock in Asgede and Tahtay koraro woredas was for food as ranked 1st by 37% and 43% with index value for Asgede and Tahtay koraro woredas, respectively. The second purpose was for income generation, accounting with index value of 33% and 37% Asgede and Tahtay koraro woredas, respectively. Cattle, sheep and goats, equines and camels were also utilized for agricultural practices (20% and 16%) for Asg ede and Tahtay koraro woredas, respectively. Cattle used for plowing, threshing, squeezing/mi lling and providing organic fertilizer (manure). Donkey and camels also used for transportatio n and draft work. Additionally, sheep, goats as well as poultry providing manure. A small percentage of households consider livestock as a prestige and wealth status, with index value 11% and 5%, for each woredas, respectively (Table 4.12).

Table4. 12: Purpose of livestock rearing

Purpose	Study areas			
	Asgede		T/koraro	
	Index	Rank	Index	Rank
Food	0.37	1	0.43	1
Income	0.33	2	0.37	2
Fertilizer	0.20	3	0.16	3
Wealth	0.11	4	0.05	4

T/koraro= Tahtay koraro

4.7.2. Effect of war on livestock farmers household income and their livelihood

The effect of war on livestock related income is presented in Figure 4.9. As the war affected livestock, it resulted in reducing consumption of livestock products, household income. Hence, it declined the ability to meet basic needs, reduced manure and farming activities of the households. In response to these challenges, households employed various strategies to cope up with the situation including begging, borrowing and trading, selling firewood and coal and engaging in daily labor or seeking help from family members.

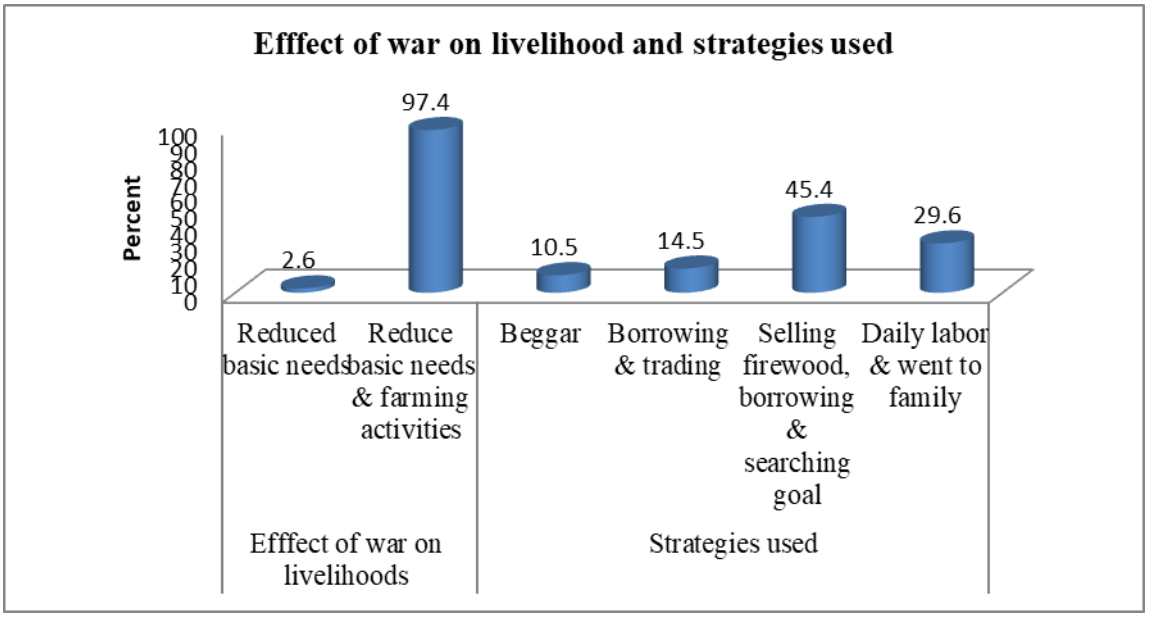


Figure4. 9: Effect of war on livelihood obtained from livestock related activities and strategies used in study areas

4.8. Major Constraints of Livestock Production after Cessation of the War

This study revealed that most farmers needed aid to restore their farming activities, whether in the form of cash, agricultural inputs or credits and they needed advice to help them cope up with the psychological effects of the crisis. To effectively address the crisis and promote long term recovery in Tigray it is essential to achieve peace allowing farmers to return to their farms. The challenges of livestock production as a result of the war are presented in Table 4.1 3. According to the FGDs and interviewed households, the main challenges were identified in cluding shortages of income, inadequate water and feed availability, diseases and parasite occurrence, declining infrastructure, insecurity and insufficient aid. Based on the household responses, security was identified as most critical challenge 26% in Asgede and 27% in Tahtay koraro woredas followed by income concerns 21% in Asgede and 22% Tahtay koraro woredas. Diseases and parasite occurrence and poor infrastructures were r anked 3rd and 4th, while lack of aid and feed shortage were considered less significant.

Table4. 13: Major challenges to restore livestock production

Challenges	Study areas			
	Asgede		T/koraro	
	Index	Rank	Index	Rank
Lack of income	0.21	2	0.22	2
Insecurity	0.26	1	0.27	1
Livestock diseases	0.17	4	0.18	3

Feed shortage	0.06	6	0.1	5
Lack of aid/credit	0.10	5	0.08	6
Infrastructures	0.18	3	0.16	4

CHAPTER 5: DISCUSSION

5.1. Effect of War on Livestock Holding

In the current study, there was a highly significant difference in herd size ($p<0.001$) due to the war in the study areas. This can be attributed to belligerents who stole, killed and slaughtered livestock during the war. This finding aligns with FAO (2021), and Mebrahtu *et al*. (2023), wh o indicated livestock losses were due to target killing, displacement, diseases and unauthorized slaughter by the armed forces in the Tigray region. Additionally, Peters (2020) revealed that livestock and companion animals were significantly affected by armed groups, suffering slaughter, looting, bombing and starvation on a massive scale. Ashenafi *et al*. (2023), reported that 88% of livestock were damaged within stockyard and 12% outside stockyard in Asgede Tsimbla (626 cattle), Medebay Zana (483 cattle) and Tahtay koraro (439 cattle). Likewise, numbers of sheep were lost in Hawzen (709), Ganta Afeshum (568) and Kilte Awlaelo (453) (Ashenafi *et al*., 2023). According to Mebrahtu *et al*. (2023), approximat ely 13,104,779 livestock were lost in the region during the war. Furthermore, in Syria, losses included 3,050 head of dairy cattle, 1,250 bulls, 15,000 sheep and goats, 18,000 beehives and over 600,000 broilers (FAO, 2006). In Ukraine, similar losses were observed, with 238,000 heads of cattle, 544,000 heads of pigs, 131,000 heads of sheep and goats and 131 million heads of poultry lost during the war (Neyter, 2024). This study agrees with findings by Dimelu *et al*. (2017), who reported significant cattle losses due to conflict in Nigeria.

In the present study, livestock deaths were attributed to bombings, feed shortages, lack of veterinary care and other accidental events. Consequently, many people and their remaining livestock were displaced from their habitats, leading to situations where herders were forced to leave their livestock by the roadside, making them vulnerable to predators such as hyenas, tigers, foxes and dogs. This finding is aligned with Yilkal (2022), who reported the war decreased livestock number and productivity due to lack of feed availability. Overall, this result reveals significant direct and indirect effects of war on livestock herds, corroborating other studies that documented the widespread consequences of war on agricultural livelihoods.

5.1.1. Herd dynamics

The current study revealed a significant decline in all livestock types. This decline might be attributed to the absence of effective herd replacement mechanisms, such as breeding centers, artificial insemination (AI), synchronization and reproduction techniques, which had contributed to poor herd management and premature deaths. This finding indicated that livestock looting is strongly associated with decreased herd size and disrupted herd dynamics. This is consistent with Yacob *et al*. (2016), who revealed 46% decrease in cattle and a 52% decrease in sheep and goats for better-off households and similar trends for middle-wealth families. Research conducted in Rwanda also indicated that cattle were lost due to a long-term decline in average cattle holdings per household with herd growth being interrupted by the war (Butt, 2014). Additionally, Maass *et al*. (2012) stated that the total number of livestock species held were very low due to war which led to higher theft incidence in Congo.

In the current study, the livestock were adversely affected by feed and water shortage which increased stress and susceptibility to various diseases. Consequently, these animals caused inbreeding including delay in first mating, repeating breeding cycles and low body weight gains. As a result, the overall livestock population decreased. This finding is in line with Issifu *et al*. (2022), who reported resource scarcity often leads to the destruction of farms and feeds essential for cattle. Similarly, this study is in line with Godde *et al*. (2019), and Kefyalew and Addis (2017), who noted war exacerbated long term climatic change causing precipitation variability that contributed to decreased herd size. Kgosikoma and Batisani (2014), Manjunatha *et al*. (2019), and Welker *et al*. (2022), also reported that drought contributed to declining in livestock populations across various species. In general, herd sizes significantly decreased after the war. Changing climate conditions further threaten the productivity, structure, economic viability and attractiveness of enterprises, impacting the availability, quality and safety of livestock products (Godde *et al*., 2021).

5.2. Effect of War on Availability of Feed Resource and Crop Production

5.2.1. Size of land holding and yield of crops

The result indicated that the average land holding in this study is comparable with other previous studies. CSA and World Bank (2017) stated that in the rural areas of Ethiopia the total land holding per household is 1.48 ha. After the war, the crop productivity reduced significantly as land was repurposed for other such as for settlement, leading to limited

availability for cultivation. The average crop yield after the war was 5.7 quintals, which is substantially lower than 14.83 quintals reported by Ashenafi *et al*. (2023), for estimated crop production from the study households. Before the war, farmers used various agricultural inputs including organic and inorganic fertilizer to improve grain yield. They also applied pesticides and effectively managed weeds. However, after the war, crop yields dropped due to several factors including limited access to fields, lack of labor and improper land management practices such as insufficient plowing, weeding and timely harvesting and irregular rainfall. This result is supported by Adelaja and George (2019); Ben Hassen and El Bilali (2022), Bihon (2015), Candlelight *et al*. (2006), and FAO (2021), who reported the crop yields were reduced due to farmers restricted access to their farms, leading to delays in fertilization and harvesting as well as a lack of necessary inputs and services. Furthermore, agricultural infrastructure was damaged and shortage of human resources and herbicides adversely affected crop yields (Tesfaalem *et al*., 2022). Similarly, FAO (2023) stated that the war in Ukraine affected agricultural assets including stored production, inputs, equipment and infrastructure.

This result also revealed that the challenges faced in crop production, included the theft and burnt out all farm equipment. Irrigation machines were stolen, fruit trees were cut down and crops sustained various damages, including burning and contamination. Consequently, many landowners' abandoned rented lands due to a lack of necessary agricultural inputs, further exacerbate the situation. This result is supported by Ashenafi *et al*. (2023), who stated the agricultural sector suffered significantly during the war, with farm tools being looted and damaged. Essential equipment, such as plows and irrigation systems was deliberately destroyed to undermine future agricultural production. Additionally, crops were destroyed during the war due to looting and intentional spoiling, such as mixing with unwanted materials (Ashenafi *et al*., 2023; Candlelight *et al*., 2006; Lin *et al*., 2022; Maass *et al*., 2012).

Overall, the war resulted in reduced crop yields due to poor management, insufficient labor, limited farming land area and the retention of rented land by the landowners, leading to food insecurity. This result is in line with Tesfaalem *et al*. (2022) and Nassef *et al*. (2023), who stated the crop production and productivity were decreased compared to before-war in the study areas. The war reduced crop production, resulting in higher prices and increased land value due to rising demand for cereal production (ОСТАШКО, 2024; Zachmann *et al*., 2022).

5.2.2. Availability and accessibility of livestock feed resource

In this study the feed resource for livestock is comparable with other previous studies. Crop residues, natural pastures, aftermath and hay were the major feed resources for livestock in the study area (Belay and Geert, 2021; Kassahun *et al*., 2015; Tikabo and Shumuye, 2023). Livestock required sufficient feed, water and supplemented concentrate feeds to produce adequate products. Feeds were also previously purchased from various sources at low prices, enabling high accessibility. This result is supported by Hailemariam *et al*. (2024), who revealed straw and storages fodder were burned during the war as nutritious grasslands became battlefields. According to Yilkal (2022), the war negatively impacted land use particularly pastures land and cropland which affected livestock feeding systems. Addah and Zezebi (2008), noted that during the war, rivers, streams, ponds and other water bodies were infected and destroyed and available feed resources were burnt. In adequate nutrition and competition for resources for both humans and animals were major factors in war affected regions (Dimelu *et al*., 2017; Owen and Jayasuriyat, 1989).

5.2.3. Effect of war on feed supply and grazing land

The current result shows that grazing areas serve as the second major source of feed for livestock utilizing both free grazing and cut-and-carry systems. Due to war led to overgrazing in some areas as both livestock and humans became overcrowded in limited areas creating competition for resources and resulting in a high stocking rate. This result is supported by Candlelight *et al*. (2006), and Issifu *et al*. (2022), who stated war induced migration and displacement of livestock and humans caused a breakdown in pasture management and improper use of natural resources resulting in the degradation and depletion of the these resources and a consequent lack of feed.

This study also indicated that pasture and rangelands had been exploited for charcoal and firewood production leading to highly degradation of these resources. This finding is supported by Candlelight *et al*. (2006), and Kimenyi *et al*. (2014), who reported local communities were compelled to destroy plants and woodlands to meet the demand for charcoal and firewood exaggerated to feed shortages. They sold trees at the expense of their livestock leading to unsustainable livestock production. Yilkal (2022), also noted that natural forest, grazing and shrub land were lost to agriculture and settlement. The current result is similar to the finding of Brottem (2021), who showed grazing areas were converted to cultivated lands due to the war resulting in the displacement of livestock and degradation of

grazing and watering points. The war decreased access to free grazing by 17% and reduced watering and grazing hours per respondent (Idris, 2018). Generally, this finding indicated the consequences of war on grazing land had long-term effects on both the environment and livelihoods.

5.3. Effect of War on Livestock Diseases and Parasites Infestation

5.3.1 Major livestock diseases and parasites

In this study the prevalence of livestock diseases is comparable with other previous literatures. Results in the present study are in line with FAO (2021), who reported the prevalence of PPR and sheep and goats pox in small ruminants, as well as LSD in cattle which caused high mortalities in Tigray. Before to the war major disease affecting ruminants in western Tigray were extensively studied by Getachew *et al*. (2018), who noted PPR, anthrax, LSD, rabies, foot rot, bovine tuberculosis and ovine, caprine and bovine (pasteurellosis) as the main diseases. Additionally, Yacob *et al*. (2016), who stated the endemic cattle diseases in South Sudan, were contagious bovine pleuropneumonia (CBPP), trypanosomosis, worms, blackleg, FMD, LSD, anthrax, foot rot and ticks. In the case of small ruminants the most important diseases were PPR, contagious caprine pleuropneumonia (CCPP) and sheep and goats pox. Following the war, there was an increase in the incidence of anthrax, pneumonia, Newcastle disease and other unusual diseases (Addah and Zezebi, 2008; Large, 2014; Maass *et al*., 2012). The spread of the diseases were exacerbated by difficulties in accessing veterinary services and lack of cold chain facilities for vaccine storage and delivery which rose as a consequence of the war (FAO, 2015). After war animal diseases and zoonosis disease spread, including LSD, FMD, PPR, rabies, influenza, parasites, rickettsia and coronaviruses (Braam, 2022; FAO, 2015; Grace *et al*., 2015). According to Topluoglu *et al*. (2023), emerging and re-emerging infectious disease outbreaks are often associated with war and natural disasters, which increase migration and suffering from endemic and zoonotic diseases and reduce provision of care. Additionally, Idris (2018), and FAO (2015), noted that abnormal migration patterns and the concentration of large numbers of livestock in specific areas for extended periods led to the spread of diseases into new territories and infecting healthy herds. Animal diseases also impact human health approximately 60% of human infectious diseases having animal origins (MoA and ILRI, 2013).

Furthermore, this study demonstrated the war ceased veterinary services. About 88% of veterinary clinics and 83% of veterinary breeding centers were destroyed (Goniewicz *et al*., 2021; Mebrahtu *et al*., 2023). Similarly, FAO (2021) indicated that veterinary services had been disrupted; with an estimated 158 out of 198 veterinary clinics stolen and burned. According to Topluoglu *et al*. (2023), the collapse of healthcare systems and the disruption of disease control programs hinder efforts to detect and respond to disease outbreaks. FAO (2015), and Taban *et al*. (2018), also reported that the war exacerbated the spread of diseases due to increased difficulties in accessing veterinary services and lack of cold chain facilities for vaccine storage and delivery. This result revealed that war increased the presence of disease vectors and hosts making healthy livestock more susceptible to infection. This finding aligns with Kimenyi *et al*. (2014), who noted shortage of veterinary services and insufficient management of infected animals and limited support service such as meat inspection and animal health services during the war contributed to the spread of various livestock diseases.

Additional, the current study indicated that the war severely interrupted animal husbandry practices such as shelter, feeding, watering and other essential infrastructures. This situation also raises animal welfare concerns. This study is supported by FAO (2015), and Mebrahtu *et al*. (2023), who reported the war affected food and water supplies critical for farmers caring for their livestock resulting in animal death, malnutrition and suffering. Aregawi *et al*. (2023) also stated that the war in Tigray affected animal welfare. According to Solomon *et al*. (2021), anthrax emerged as the most significant zoonotic disease. Large (2020), also noted that the conflict heightened animal stress among livestock, decreased production, weakened the relationship between stockholders, worsened cooperation and increased in restricted areas with potential violence.

The major implications of these diseases include loss of household income due to reduced animal productivity, increased mortality rates and zoonotic risks. Additionally, this study showed that the transmission of internal and external parasites, including worms, lice, ticks, mange mites and fleas, increased due to the war. Before the war, farmers obtained medicines and drugs from various pharmaceutical suppliers. However, due to the war, these supply lines were severed, leading to a decline in access and supplies of medicine for farmers to treat their animals. This result aligns with unpublished reports by TRHB (2021), who indicated the lack of medicines and functional veterinary services, disruption of infrastructure and lack of access

contributed to the spread of diseases resulting in a livelihood crisis. During wartime, infectious diseases have been referred to as the “third army” (Sartin, 1993).

5.3.2. Prevention mechanisms of diseases and parasites

This finding revealed farmers resorted to traditional techniques and home remedies to mitigate the risks of diseases and parasites. This aligns with Getachew *et al*. (2018), who noted farmers resorted to traditional methods for their livestock such as incising, smoking coffee ceremony and picking manually for external parasites. Additionally, Yacob *et al*. (2016) noted a decreased reliance on formal veterinary services and traditional healers used during the war.

5.4. Effect of the War on Livestock Marketing

This study indicated that war affected the market of livestock and their products. It disrupted the supply and demand of goods and services resulting in a closed flow of goods and increased prices which led to price instability. This is due to market disruptions, lack of supply. This study is suggested by Ben Hassen and El Bilali (2022), who reported war, caused shortages of raw materials, increased price and both national and international market instability. The essential inputs such as animal feed, fuel and medicines increased by 20.1% which in turn raised household expenditures (FAO, 2022). The war in Ukraine further influenced input prices for farmers, leading to reduced production and increased costs (Neyter, 2024; Zachmann *et al*., 2022).

This finding showed that the war damaged and disrupted the infrastructures. This result is supported by Ben Hassen and El Bilali (2022), and Selby *et al*. (2013), who reported war led to suspension of essential public services such as banking, telecommunication, electricity, market infrastructure and transport services. Cline (2020), and Yacob *et al*. (2016), stated that war had a negative impact on livestock markets characterized by insecurity in trade routes, market closures, decreased demand, the departure of traders and halted exports and increased imports of live animals. Similarly, agricultural production, particularly the cultivation of forage crops used as feed for livestock adversely affected, resulting in a decline in both quality and quantity of available feed. This decline contributed to losses in livestock numbers and reduced production of milk, meat and eggs. Yared (2022) noted that the war led to a reduction in livestock and livestock products along with their feed. This result indicated that at the beginning and during the wartime, many farmers resorted to selling their livestock and

leaving their products due to the outbreak of diseases. Furthermore, the war disrupted market connections between traders and consumers both domestically and internationally which halted the export of live animals, meat, dairy products, wool, hides and skin as well as import of raw materials. Consequently, this disruption resulted in uneven supplies of products and live animals across various regions, leading to increased prices and changes in consumer behavior.

Furthermore, this result revealed that the war began to raise livestock prices significantly. These challenges affected community services like veterinary assistance and transportation. This finding is supported by Verpoorten (2009), who stated during wartime livestock were mainly sold to purchase food due to insecurity while in peacetime sales for reinvestment. Additionally, the livestock market in South Sudan fluctuated, particularly goat prices; which increased significantly by 8% from March to April 2014, while price dropped by 19% in Juba and 17% in the Torit market (Large, 2020). The war inflated cattle prices limited access to good grazing land (Idris, 2018).

Overall, this result indicated that the war interrupted market channels leading to increased livestock and feed and creating economic instability. This could be due to insufficient supply and increased demand and escalating transport costs. This finding is aligned with Mwikali and Nicholas (1945), who reported outbreak second world war, had detrimental effect on the livestock economy. The ongoing war between Russia and Ukraine had rapidly escalated resulting in significant and long-term impacts on prices and resources access (FAO, 2022; Осташко, 2024).

5.5. Effect of War on Livestock Related Household Incomes

This finding indicated that both the livestock and crop sectors serve as primary sources of household income and enable families to enhance their livelihoods. In this study the benefits derived from livestock had diminished due to the war leading to decline in farmers' income from livestock-related activities and contributing to malnutrition. The challenges including loss of crops and livestock, disease outbreak and market closures had driven many households into poverty. This study is comparable with other previous studies. Thys *et al*. (2010) revealed that livestock were mainly kept for food (57.9%) during the crises however during the war it devastated production levels in Congo. Similarly, Hailemariam *et al*. (2024) reported that livestock constitute a vital income source for farming households, providing traction for plowing, crop threshing and transportation. Livestock fulfill various functions, serving as a

form of savings for individuals without access to traditional banking, providing labor for tasks like pulling carts and carrying loads and offering manure that can be used as fuel or fertilize (Aleme and Lemma Zemedu, 2024; Leng, 2008). According to Solomon *et al*. (2021), the loss of oxen and other valuable animals had significantly affected agricultural activities. War facilitated the spread of disease, decreased livestock production and led to cattle losses ultimately resulting in malnutrition households entering livelihood crises (FAO, 2014).

This result shows livestock by-products serve as renewable and nonrenewable fuel source (biogas), organic fertilizers and crucial for traditional activities such as leather crafting, blankets and binding farming implements. These by-products provide indirect income sources, but many of these incomes had been lost due to the war posing economic risks and further entrenching farmers in poverty. This result is supported by Aledin *et al*. (2019); Dereje *et al*. (2014), who reported livestock provided food, draught power, transport, income and other benefits. Similarly, this study is aligned with FAO (2021), and Pellet (2021), noted that agriculture, remains the primary source of food and income for over 85% of the population in Tigray, yet the sector has been severely impacted, leaving many individuals with limited land and food security. The current study revealed that the war reduced diversified job opportunities within the livestock sector due to several factors, including decreased agricultural productivity, diminished crop yields, reduced demand for livestock products, low prices and rising costs. This result is supported by Hailay *et al*. (2021), who reported the Tigray war exacerbated the crisis of food insecurity by destroying crops, preventing farmers from managing their lands and causing the death and theft of livestock.

The current study showed that the war had led to losses in both livestock and crops, reduced production capacity, diseases spread out and restricted market access ultimately resulting in decreasing income and consumption. The war had severely affected households' income levels their income derive from crop and livestock reducing their vulnerability to periodic shocks, undermining source food security (FAO, 2022; Farsund and Daugbjerg, 2015; Hailemariam *et al*., 2024; Kemmerling *et al*., 2022; Large, 2020; Leng, 2008; Neyter, 2024). Similarly, Zeleke and Lacey (2021), who stated integrated crop and livestock farming is critical for providing feed for both livestock and humans; however, the war had prolonged the feed crisis and continuously raised costs. Additionally, the war limited the effective use of crop residues and by-products for animal feed while reducing the availability of animal waste that could serve as organic fertilizer (Aleme and Lemma, 2023). Overall, this survey clearly indicated that the war was a significant factor intensifying food insecurity and poverty both

directly and indirectly. It contributes to hunger, thirst, unemployment, beggary and various psychological problems which are supported by other previous studies. War enhanced severe food insecurity and chronic malnutrition (Guénette *et al*., 2022; Holleman *et al*., 2017).

5.6. Major Constraints of Livestock Production after Cessation of the War

This result indicated that several challenges hindered rehabilitation and sustainability of farms. This finding is supported by Maass *et al*. (2012), who noted the primary challenges in animal production including animal diseases (78%), shortage of feed (60%), lack of money (28%), theft (21%), housing (13%), cost, lack of transportation and predation (10%). According to Tilahun *et al*. (2023), rebuilding critical infrastructure necessitates peace, access to land, provision of seeds and tools, nutrition provision until harvest and securing labor. Heita *et al*. (2024) also stated that livestock production impacts had worsened due to droughts, rangeland degradation, rising instances of theft, predation, diminishing grazing lands, heightened costs and increased reproductive male cattle loss (bulls).

This result demonstrated that feed and water shortages were the significant challenges impeding farmers' recovery to resume their farm activities. These included high feed costs, limited feed availability and insufficient water sources. Similarly, war affected livestock herds, impacting herd size, composition and overall productivity it can lead to destruction of husbandry and difficulties maintaining livestock health. This result is in line with Ahmed *et al*. (2021), who identified various factors influencing farmer herder ranch performance, including a lack of support and cooperation, limited social networking, climate change, insecurity and inadequate supplementary livelihoods.

This study also revealed that most farmers needed aid to restore their farming activities. This result aligns with Cline (2020), and Thys *et al*. (2010), who stated financial resources are critical enabling farmers restarting livestock farming again. In Ukraine, reconstructing and repairing the destroyed agricultural sector require both internal and international support, including livestock herds, creating new production facilities, purchasing the essential inputs and services, as well as securing grants, loans and financial assistance sustainable agriculture prospects (Lohosha *et al*., 2020). To address the risk of conflict between herders and farmers several strategies are essential but the vital components include enhancing security, supporting community-based conflict resolution mechanisms and establishing grazing reserves and encouraging ranching practices and cooperation (Group, 2017). Resilience relies

on five key pillars; income source and levels and food access, assets holdings, availability of basic services and the presence of social safety nets which helps mitigate the effects of shock (d'Errico and Di Giuseppe, 2018). Similarly, in Ukraine, the reconstruction and recovery of agriculture assets necessitate comprehensive support (Neyter, 2024). This finding is consistent with Maass *et al*. (2012), who reported disease, feed shortage, financial constraints and livestock theft represented the primary challenge to restocking farms after conflict. Organization of humanitarian relief, development initiatives and securing permanent peace is essential to rebuilding farmers' livelihoods. This includes capitalizing available local resources for income generation, strengthening local organizations, improving market access, developing farm cooperatives, linking producers programs (Hailemariam *et al*., 2024). Adelaja *et al*. (2020) also stated that improved education, accessibility of assets and safety, these factors play a critical role in enhancing resilience within the sector.

Table5. 1: Major constraints of livestock production after cessation of the war

Major challenges	Solution to restarting farming
Lack of income	Government should provide aid and loan (e.g., livestock, farm inputs and financial assistance
Shortage of feed and water	Enhancing sustainable agricultural practice including reforestation and affor estation, diversification feed resource (silage, UMTR making). Improved drought resistance forage species and disinfect water bodies and collaborating with stakeholders is necessary to achieve these goals
Animal disease	Expand and repair veterinary services, control unwanted movement of animals and burned and bur died animals
Lack of security	Ensure the security and safety of the peoples
Distraction of infrastructure	Revitalization of veterinary services and instruments, clinics and other infrastructure

UMTR= urea molasses treatment

CHAPTER 6: CONCLUSIONS AND RECOMMEN DATIONS

6.1. Conclusions

In conclusion, this study evaluated the effect of war on livestock production and feed resource availability among smallholder farmers. Before the war, the households were more dependent on livestock so far to obtain food and income. However, the war resulted in substantial losses, in the notable decrease in average livestock holdings, particularly cattle, goats, sheep and poultry, attributed to looting, slaughtering and mortality. The crop yield and livestock number was statistically significant differences ($p<0.001$) before and after the war. This situation was further exacerbated by land destruction; reduced crop production and caused instability in livestock marketing leads to fluctuated livestock prices. It exaggerated overall food insecurity, feed shortage. The war also disrupted livestock management practices, resulting in widespread diseases outbreaks due to the disruption of veterinary services and abattoirs. Consequently, household income and overall food security were severely affected. Restocking livestock can be an effective means of promoting food security and alleviating poverty. However, there were challenges to start farming practice. The study underlines the urgent need for coordinated support to restore normal livestock farming practices, emphasizing the interconnectedness of agricultural production, community livelihoods and the socio-economic well-being of the affected regions.

6.2. Recommendations

Based on the results of this study, the following recommendations are forwarded for future intervention and investigation.

- The relevant sector should implement diverse natural resource management practices such as, reforestation, afforestation and soil and water conservation mechanisms to enhance livestock nutrition and productivity.
- To address issues related to livestock health problems, the government should work with veterinary experts to ensure sustainable livestock production practices.
- Urgent repairs to damaged infrastructure, such as veterinary services, water sources, clinics, feed processing industries and other essential facilities are needed to improve and manage animal health.

- The local begait breeds have been severely affected by the war, so implementing genetic breeding strategies is vital for restocking these pure breeds and improving overall productivity.
- The government and development agencies should assist farmers in restocking and reh abilitating their livestock farming as well as provide immediate psychological support.
- Generally, the government should coordinate with relevant authorities and sectors to study the situation and find a visible and critical solution.

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APPENDIX

Read each question carefully and you can jump to any question which is not concerning you.

ID _____

Region Zone Woreda *Tabia* *Kushet*

1. Head Name of respondent……

2. Sex A.M ___, B.F___

3. Age of household head……

A. 25-40 B. 41-56 C. 57-79 D. above 71

4. What is your occupation?

A. Farmer B. Student C. trader D. Other

5. Marital Status

A. Single B. Married C. Divorce D. Widow

6. Family size? _____

7. Educational Status?

A. Illiterate B. Primary C. Junior D. High school E. Diploma F.BSC and above

8. What type of livestock do you own or produce?

A. Cattle B. Cow C. Sheep and goats D. Donkey E. Camel F. Beehive

9. Purpose of livestock production?

A. food B. income C. wealth D. agricultural activities

10. Number of livestock Herd structure of the respondents?

Species	Number of livestock	
	Before War	After War
Cattle		
Goats		
Sheep		
Donkey		
Camel		
Poultry		
Honeybee		

11. Landholding in ha of the respondents?

Land holding	Yield per ha	
	Before war	After war
Cultivated private land		
Cultivated rent land		
Privet pasture (grazing) land		
Communal grazing land		

12. Major crops cultivated in the study area.

Crops	Crop yield	
	Before war	After war
Sorghum		
Sesame		
Maize		
Millet (*daguhsa)*		
Teff		
Others		

13. How has the war affected your livestock production?

A. Shortage of feed B. Shortage of facility C. Shortage of demand of hide and skin D. limit market access

14. How many animals are damaged due to war?

A. Slaughtered B. Wounded in the war. C Shortage of water and grazing (food D. Others

15. The number of livestock lost due to war.

No	Number	Slaughtered	Died	Lost
1				

Appendix 2

16. What are the major feeds for your livestock?

Species	Feed of livestock	
	Before war	After war
Cattle		
Sheep and goats		
Donkey		
Camel		
Poultry		

17. Where did you get the feeds before and after the war?

A .from your farm B. purchased from industry C. from pasture land (private and communal land)

18. How did the war affect the availability of feed resources for your livestock?

A. stolen B. not harvested C. Burned D. polluted E. Shortage of feed supply F. Others

19. How has the type and quality of feed changed due to war?

A. Shortage of supply B. Limitation of land C. Maximize feed cost and shortage of income D. Shortage of supply and maximize feed cost E. Shortage of supply, limitation of land, maximize feed cost and broken feed producing industry

20. How war affected grazing land

A. No grazing land B. Grazing land were degraded, held by IDP and changed to farming enhance competition of resources like fodder and grass

21. Ranking the major feed resources in your area?

22. What strategies were used to ensure adequate feed for LV during war?

A. No livestock no strategies B. They took them to other safe areas and used cutting and carrying system C. Purchased feeds from other areas

Appendix 3: Livestock Health and Well-being

23. Have you experienced diseases in your area since the war began? A=yes B=no

24. Have you noticed challenges in accessing veterinary services and animal healthcare due to the war? A. Yes B. No

29. If yes, please describe the observed changes.

A. Lacks of veterinary services B. Increment of the price of medicine C. Shortage of medicine D. Others.

30. Prevention mechanisms of LV diseases during war?

A. No Livestock no treatment B. local control mechanisms C. there livestock, no treatment

31. Have you observed parasites in your area? A. no B. yes

32. Control mechanisms of parasites? A. nothing B. wash and apply different plants

33. Rank the major diseases in your areas

Appendix 4: Market

34. Have you faced challenges in accessing the market?

35. How has the war affected your ability to market and sell your livestock products?

36. What challenges happened in the market of LV and its products due to war?

37. Why did you sell livestock due to war?

A. All livestock were taken, slaughtered and died B. To generate income C. Lest the enemies take them D. To generate income, lest the enemies take them and so as to not died

38. The major products you lost buyers? A. Livestock product B. Livestock by products C. Live animals D. Livestock products, livestock by products and live animals

39. Price of livestock before and after war?

40. How war affected channels?

41. What strategies were used to improve the livestock marketing during the war?

Appendix 5: Income

42. How has the war affected your income from livestock-related activities?

A. Reduced manure B. Leads to diseases C. Reduced basic needs D. Reduced manure, leads to diseases and reduced basic needs and wealth

43. Have you had to sell or reduce the number of livestock you own due to the war?

44. If yes, please explain the reasons for selling or reducing your livestock.

45. What strategies have you employed to mitigate the effect of the war on livestock production and feed availability?

A. Beggar B. Borrowing, shopping C. Selling woods and coal, borrowing money, searching goal D. Daily labor and Went to family

46. Did you receive any support in restoring normal livestock farming activities after war? A. yes B. no

47. If Q 46 is yes, please describe the type of support received.

48. Rank major constraints of livestock production in your area?

49. How do you solve the problems of feed availability for the future?

50. What method do you use to restore your livestock production for the future?

For Agricultural Extension Officers/Experts

1. How was the availability of feed resources affected by the war?
2. What are the major livestock diseases and prevention mechanisms in your area?
3. Are there any successful programs aimed at addressing the challenges faced by livestock producers in war zones?
4. What are the major challenges faced by livestock producers in war -affected areas in maintaining their herds?
5. What are some effective strategies that can be implemented to support livestock producers after the war?

Appendix I: Feed from grazing areas in tonne DM

Tabias	Area		Area	
	Before war	Tonne DM =*2	After war	Tonne DM*2
Selam	2470	4940	2040	4080
Dedebit	1850	3700	1850	3700
Asgede	4320	8640	3890	7780
M/tmket	1550	3100	1550	3100
G/semema/Egub	1923	3846	1923	3846
T/koraro	3473	6946	3473	6946
Total	7793	15586	7363	14726

Appendix II: Major feed of livestock in the study areas

Major before the war feed	**Asgede**							
	1st	2nd	3rd	4th	5th	Total	Index	Rank

Pasture	46	30	1	3	6	86	0.2829457	1
Sesame/cotton cake	0	2	15	18	51	86	0.1085271	5
Hay	8	7	25	30	16	86	0.1697674	4
Wheat bran	0	18	29	26	13	86	0.1736434	3
Crop residues	32	29	16	9	0	86	0.2651163	2
Total	86	86	86	86	86	430	1	
	T/koraro							
	1st	2nd	3rd	4th	total	Index	Rank	
Crop residues	50	15	1	0	66	0.398	1	
Wheat bran	5	19	25	13	62	0.225	3	
Cotton/sesame cake	0	3	13	6	22	0.066	4	
Pasture	11	29	19	24	83	0.311	2	
Total	66	66	58	43	233	1		

Appendix III: Major Disease in the study areas

Study areas	**Major Diseases**	1st	2nd	3rd	4th	5th	Total	Index	Rank
Asgede	Anthrax	56	18	12	0	0	86	0.3007752	1
	Rabies	26	46	4	8	2	86	0.2666667	2
	Newcastle	4	19	37	26	0	86	0.2007752	3
	LSD	0	1	16	47	22	86	0.1302326	4
	Parasites	0	2	17	5	62	86	0.0992248	5
	Total	86	86	86	86	86	430	1	
T/koraro		1st	2nd	3rd	4th	5th	total	index	rank
	Anthrax	43	21	2	0	0	66	0.3080808	1
	Rabies	23	38	5	0	0	66	0.2848485	2
	LSD	0	7	34	25	0	66	0.1818182	3
	Newcastle	0	0	25	31	10	66	0.1484848	4
	Parasites	0	0	0	10	56	66	0.0767677	5
	total	66	66	66	66	66	330	1	
Over all		1st	2nd	3rd	4th	5th	total	index	rank
	Anthrax	99	39	14	0	14	152	0.304428	1
	Rabies	49	84	9	8	9	152	0.2757576	2
	Newcastle	4	26	71	51	71	152	0.1912967	3
	LSD	0	1	41	78	41	152	0.1393587	4
	Parasites	0	2	17	15	17	152	0.0879962	5
	total	152	152	152	152	152	760	1	

Appendix IV: Major market challenges in the study areas

Woredas	**Market Challenges**	1st	2nd	3rd	4th	5th	Total	Index	Rank
Asgede	Demand	14	13	15	26	18	86	0.1837209	4
	market chain	15	17	13	22	19	86	0.1899225	3
	Security	36	27	19	4	0	86	0.2736434	1
	Transportation	13	18	23	21	11	86	0.2007752	2
	Supply	8	11	16	13	38	86	0.151938	5
	Total	86	86	86	86	86	430	1	
T/koraro		1st	2nd	3rd	4th	5th	total	Index	rank
	Supply	18	12	12	14	10	66	0.2141414	3
	Demand	3	7	19	21	16	66	0.159596	4
	Security	34	26	6	0	0	66	0.2949495	1
	market chain	2	2	4	18	40	66	0.1070707	5
	Transportation	9	19	25	13	0	66	0.2242424	2
	Total	66	66	66	66	66	330	1	

Appendix V: Purpose of livestock production

Asgede	**Purpose**	1st	2nd	3rd	4th	Total	Index	Rank
	Food	56	18	12	0	86	0.369	1
	Income	24	48	14	0	86	0.327	2
	Fertilizer	0	14	48	24	86	0.198	3
	Wealth	6	6	12	21	45	0.106	4
	Total	86	86	86	45	303	1	
T/koraro		1st	2nd	3rd	4th	sum	index	rank
	Food	49	17	0	0	66	0.426	1
	Income	17	47	2	0	66	0.367	2
	Wealth	0	1	2	23	26	0.052	4
	Fertilizer	0	1	42	3	46	0.155	3
	Total	66	66	46	26	204	1	
Overall	Purpose	1st	2nd	3rd	4th	sum	index	rank
	Food	105	35	12	0	152	0.3973	1
	Income	41	95	16	0	152	0.34723	2
	Fertilizer	0	15	90	27	132	0.18072	3

	Wealth	6	7	14	44	71	0.07898	4
	Total	152	152	132	71	507	1.00423	

Appendix VI: Major challenges to restore livestock production response households in the study areas

Asgede (n=82)									
Challenges	1st	2nd	3rd	4th	5th	6th	Sum	Index	Rank
Income	30	28	10	10	4	4	86	0.205980066	2
Insecurity	52	30	4	0	0	0	86	0.264673311	1
Infrastructure	1	15	41	21	7	1	86	0.178848283	3
Feed	0	0	0	4	21	61	86	0.063676633	6
Aid	2	5	0	13	46	20	86	0.104097453	5
Animal diseases	1	8	31	38	8	0	86	0.166112957	4
Total	86	86	86	86	86	86	516	1	
T/koraro (n=66)	1st	2nd	3rd	4th	5th	6th	Sum	index	rank
Income	20	22	12	4	4	4	66	0.217893218	2
Insecurity	44	17	5	0	0	0	66	0.266233766	1
Animal diseases	1	15	28	15	1	6	66	0.177489177	3
Aid	0	0	0	5	28	33	66	0.075036075	6
feed	0	2	5	11	30	18	66	0.101731602	5
Infrastructure	1	10	16	31	3	5	66	0.161616162	4
Total	66	66	66	66	66	66	396	1	
Overall (n=152)	1st	2nd	3rd	4th	5th	6th	Sum	index	rank
Income	50	50	22	14	8	8	152	0.211936642	2
Insecurity	96	47	9	0	0	0	152	0.265453539	1
Infrastructure	2	30	69	36	8	7	152	0.170232223	4
Aid	0	0	0	9	49	94	152	0.082704118	6
Feed	2	7	5	24	76	38	152	0.089566764	5
Animal diseases	2	18	47	69	11	5	152	0.171801067	3
Total	152	152	152	152	152	152	912	1	

Appendix VII: Sample pictures during data collection


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