Analysis of Household Food Security and Determinants in the Face of Conflict and Drought in South Wollo Zone Ethiopia

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Abstract

The study analyses the impact of conflict and drought on household food security and identifies determinant factors and coping strategies in South Wollo Zone, Ethiopia. Descriptive and quasi-experimental research designs were employed for pre-post retrospective data gathered from 422 randomly selected households. Qualitative data collected from key informants, focus group discussants, and related literature complemented the quantitative aspect of the study. Quantitative data was analyzed using regression models in Stata, while qualitative data was analyzed using thematic analysis. The study revealed that conflict and drought significantly undermine household food security. The combined exposure to conflict and drought increases food insecurity, which highlights the compounded nature of these crises. Per capita calorie availability drops from 1,789 kcal pre-conflict to 1,420 kcal post-conflict was observed, below the Ministry of Health recommendation of 2,300 kcal. This decrease was attributed to the individual and combined impacts of conflict and drought on food security, highlighting an increase in food-insecure households from 79% to 87%. In comparison, food-secure households fell from 21% to 13% using a household food balance model in the pre-post periods. The Coping Strategy Index rose as food security deteriorated, with households resorting to a combination of riskier coping mechanisms to cope with food insecurity. Some coping strategies that households consider include dietary changes, rationing, and reliance on community-based support systems like equb, edir, and debo. The regression analysis identified livestock ownership in total livestock units, agricultural

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index, work ratio, and age of the household head as positively associated with food security. In contrast, larger family size, exposure to drought, and exposure to conflict and aid were negatively associated. The study offers policy recommendations to build productive livelihood through asset building and livelihood diversification to foster self-reliance, and integrated recovery programs acknowledging the compounding nature of conflict and drought to improve food security.

Keywords: Conflict, coping strategies, drought, food security, disaster exposure, vulnerability

1. Introduction

Food security has become a global agenda that affects millions of people and is a central focus of Sustainable Development Goals (Birkmann et al., 2022). It is a multidimensional and multi-causal phenomenon that encompasses the availability, accessibility, and utilization of food to meet the nutritional needs necessary for physical and mental development. It also requires stability across these dimensions over time (Calloway et al., 2023; Guiné et al., 2021). In developing nations, food insecurity is closely associated with factors such as drought, political instability, conflict, poor governance, rapid population growth, and disease outbreaks (Delgado et al., 2023; Zhang et al., 2022; Mangaliso & Dlamini, 2018; Fyles & Madramootoo, 2016).

Climate change poses a significant threat to food security in Africa because the region's reliance on rainfed agriculture makes it highly vulnerable to climate variability and extremes (Lemma et al., 2013; Sharmake et al., 2022; Ahmed et al., 2023; Yeleliere et al., 2023). Furthermore, chronic food insecurity and poverty is exacerbated by limited adoption of improved agricultural inputs and technologies (Mohamed, 2017; Arega, 2015). Africa faces diverse conflicts, including electoral disputes, struggles over resource control, civil unrest, religious intolerance, ethnic violence, and territorial disputes (Francis & Vincent, 2021; Gluhbegovic, 2016; Pate, 2014; Christakis, 2013).

The Horn of Africa (HoA), including Ethiopia, remains entrenched in cycles of prolonged crises, resulting in widespread food insecurity (Anbes, 2020; Mohamed, 2017). Despite investments by governments and international

organizations in agricultural productivity, infrastructure, microfinance, extension services, and challenges such as recurrent droughts, conflicts, and political instability have hindered developmental progress (Yigezu, 2021).

Violent conflict exacerbates food insecurity by displacing populations, disrupting agricultural production, and damaging public and private infrastructure, including markets, roads, water facilities, and schools (UN OCHA 2018). For instance, Ethiopia has experienced its worst humanitarian crisis in 2021 since 2016, with millions of people in need of assistance. The northern Ethiopian conflict displaced over three million people, with more than 500,000 people from the Amhara region alone, significantly reducing agricultural production due to abandoned farmlands and crop damages (UNHCR, 2022; FEWS NET, 2021).

The South Wollo Zone in the Amhara region exemplifies Ethiopia's challenges as it faces recurrent drought, population pressure, fragmented farmland, pest infestations, and steep slopes prone to flooding. Known as the “famine belt,” South Wollo suffered devastating famines during 1971–1974 and 1983–1984, described as Ethiopia's “worst tragedy” (Agidew & Singh, 2018; Rahmato, 1991; Mesfin, 1984). The northern Ethiopia conflict further degraded food security by disrupting the region's human, financial, physical, natural, and social capital, forcing communities to abandon crops near harvest and delaying recovery for rain-fed agriculture (FAO, 2021; Justino, 2011).

Conflict impacts food systems by constraining all aspects including production, distribution, and market access. It destroys infrastructure, disrupts institutions, and weakens resilience, creating a vicious cycle in which food insecurity exacerbates conflict, particularly in fragile contexts (Gatdet, 2021; FAO & WFP, 2018). Vulnerable groups, such as children under five, pregnant women, and lactating mothers, face heightened risks in South Wollo owing to unmet energy requirements, increased malnutrition, and exposure to diseases (IFRC & ICRC, 2021). The Productive Safety Net Program (PSNP), a lifeline for many households, was disrupted by looting and insecurity, leaving thousands struggling even after the cessation of active conflict (GEOGLAM, 2022).

The food security situation of the South Wollo Zone experiences severe entanglement, not just because of conflict and drought, but also other factors that interplay with the socioeconomic and demographic makeup of the community. Most of the population in the zone relies on rainfed agriculture and livestock, which are highly vulnerable to climate variability and related shocks. Access to loans is limited, particularly during conflict periods, and the unaffordable collateral requirements make conventional loans and credit services inaccessible to poor and vulnerable households. In addition, limited livelihood diversification restricts the ability of the population to withstand economic and environmental shocks (Agidew & Singh, 2018). Market access was compromised due to the impact of the conflict, which affected household food security and disrupted a supply chain that increased food shortage and food prices (Muhyie et al., 2025b).

In multishock environments, addressing food insecurity requires an understanding of livelihoods, gender dynamics, social contexts, and institutional interactions. Household-level food security assessments provide critical insights into the national and community prevalence of food insecurity, informing targeted interventions (Pérez-Escamilla & Segall-Corrêa 2008).

South Wollo Zone was selected for this study due to its historical vulnerability to drought and the recent impact of the northern Ethiopia conflict, which contributed to food insecurity in the area. The zone is known for recurrent exposure to widespread drought, environmental degradation, and low agricultural productivity, contributing to food shortages (Agidew & Singh, 2018) where the northern Ethiopia conflict has exacerbated the area's vulnerability by disrupting agricultural activities, affecting supply chains, and displacement of people (Seid et al., 2024). The compounded impact of drought, conflict, and other socioeconomic vulnerabilities position the South Wollo Zone as being unique. Furthermore, the zone was relatively accessible for data collection compared to other zones affected by the northern Ethiopia conflict. Also taken into account were the researchers' prior experience, knowledge of the zone, and familiarity with local conditions, all which would allow for a deeper food security analysis.

This study aims to assess the effects of conflict and drought on household food security in South Wollo. It examines how conflict and drought impact household food security, identifies socioeconomic and demographic determinants of household food security and explores the coping strategies employed by households to mitigate food insecurity. The research contributes to the food security literature by offering context-specific insights into the compounded effects of conflict and drought on the food security of vulnerable households in Ethiopia. These findings provide evidence for policymakers and practitioners to design interventions that can rebuild livelihoods and enhance food security in conflict- and drought-affected communities.

2. Materials and Methods

2.1. Description of the Study Area

South Wollo is one of the 11 zones in the Amhara Region of Ethiopia. It is located between 10º10′ N and 11º 41' N latitudes and 38º28′ E and 40º5′ E longitudes (Mekonen et al., 2020). The zone is bordered to the south by North Shewa, to the west by East Gojjam, to the northwest by South Gondar, to the north by North Wollo, to the northeast by the Afar Region, and to the east by the Oromia Special Zone and the Argobba Special Woreda (Seid et al., 2024). The South Wollo zone inhabited 3,435,377 million people with 49.6% and 50.4% represents males and females, respectively. The majority of the population lives in rural areas with only 21.6% reside in urban areas. It covers an area of approximately 17,067 square kilometres with 190 inhabitants per square kilometre (ESS, 2024). The population predominantly lives in rural areas, with less than 12% residing in urban areas. The largest ethnic group reported in the 2007 census was Amhara (approximately 96%), and other ethnic groups comprised no more than 4% of the population. Muslims accounted for more than 55%, followed by Orthodox and Evangelical Christians at 39% and 5%, respectively.

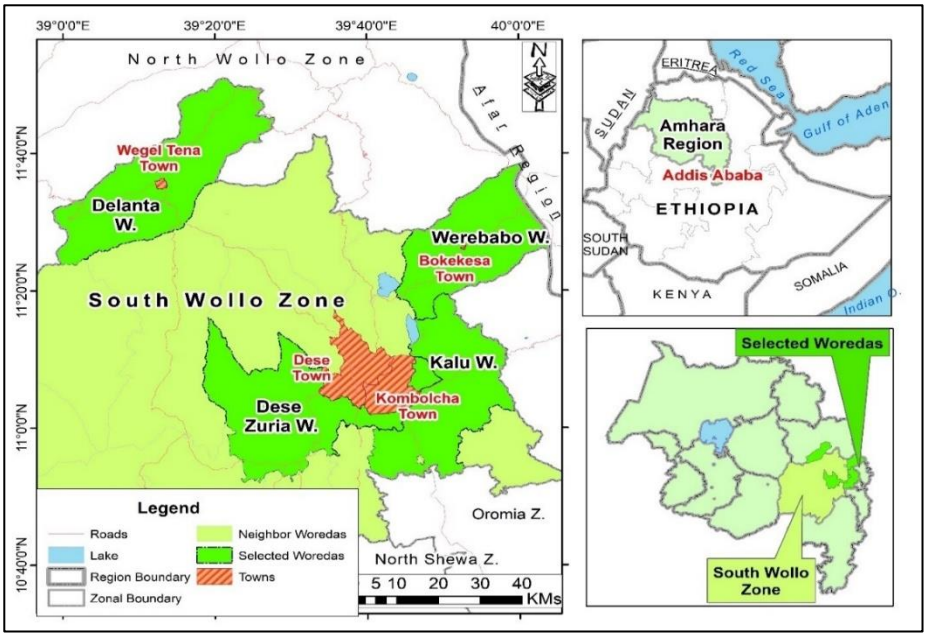

Figure 1: Map of the study area,
Source: CSA (2012) with researcher's adaptation

The population in the zone is poor in terms of resource endowment and hosts vulnerable households. The average agricultural landholding was 0.7 ha per household (Berhanu et al., 2003) which is less than the national and regional average of 1.01 ha and 0.75 ha per household. Agriculture and livestock are the major livelihoods that have been threatened by climate change in the zone (Bereket et *al.*, 2022; Yifru & Miheretu, 2022) with only 10.6% of the population practicing non-farm-related jobs. The South Wollo Zone is a drought risk zone. Delanta, Dessie Zuria, Kalu, and Werebabo woredas are severely affected by the impacts of recurrent drought and devastated by the northern Ethiopian conflict. According to the National Institutes of Health (2024), the South Wollo Zone, particularly the woredas of Delanta, Dessie Zuria, Kalu, and Werebabo, has been severely affected by recurrent droughts between 1983 to 2014. According to Mindat.org (https://www.mindat.org) and tageo.com (https://www.tageo.com), Delanta, Dessie Zuria, Kalu and Worebabo woredas are located between 11° 34' 59" N and 39° 10' 0" E, 11° 10' 0" N and 39° 19' 59" E, 11° 00' 0.00" N and 39° 49' 59.99" E and 9° 07' 00" and 34° 59' 00" latitude and longitude respectively. The northern Ethiopia

conflict started on 03 November 202o in the Tigray region after the Tigray People Liberation Front (TPLF) allegedly attached the north command of the Ethiopian National Defence Force (ENDF) bases in Tigray region. The conflict has then expanded to the neighbouring regions of Afar and Amhara where its impact was extended to cover a wider geography including the South Wollo zone and caused many atrocities and damage to basic infrastructure (Arage et al., 2023).

2.2. Research Design and Approach

A combination of descriptive and pre-post-research designs defined the research methodology. Furthermore, the determinants of food security are identified by establishing causal relationships. Quantitative and qualitative data were collected for the pre-conflict (June 2019 to May 2020) and post-conflict (June 2021 to May 2022) reference periods, which includes the two major cropping seasons, *meher* and *belg*.

In this study, we employed a quasi-experimental design to evaluate the impact of conflict and drought on food security. The reference period for the study was considered the period before the Northern Ethiopia conflict as a pre-conflict reference and after the Northern Ethiopia conflict as a post-conflict reference period. These reference periods are considered for conflict and drought exposure based on respondents' perceptions of the impact of the conflict on food security. Household data was then collected for the pre-conflict reference based on recall at the post-conflict reference period. We collected recall data for similar households for the pre-conflict and post-conflict references. In the case of conflict, all respondents were unaffected in the pre-conflict period, while all were exposed to some degree of conflict in the post-conflict period. As a result, it was not possible to predefine control and treatment groups during data collection. Instead, respondents were categorized after data collection based on the self-reported intensity of conflict exposure (low vs. high), allowing for variation in treatment effects (Ravallion, 2007). Therefore, unlike randomized control trials (RCT), nonrandomized assignment of control and treatment groups was performed using appropriate statistical models due to the difficulty of random

assignment related to contextual and logistic constraints (Duflo & Banerjee, 2008).

Given these constraints and the fact that data was collected from similar respondents for the pre-conflict and post-conflict references, a Difference-in-Difference method considering a fixed effects (FE) model was chosen to control for unobservable household characteristics that remain constant over time (Wooldridge, 2010). The FE model eliminates biases caused by time-invariant factors, such as household location, cultural practices, or socioeconomic background. However, since gender and other fixed household characteristics do not change over time, they are absorbed by the FE model and thus dropped from estimation. To address the omission of these variables from the model, an interaction term with time was introduced to assess whether gender influences food security differently in the post-conflict/post-drought period.

The impact evaluation proposed in this paper assesses the impact of conflict and drought on food security as individual factors and the combined effect of conflict and drought on food security. For the sake of comparison, we recommended using the same control variables across all models (conflict, drought, and combined impact) to maintain consistency, reduce omitted variable bias, and ensure comparability of results (Imbens & Rubin, 2015). By leveraging this quasi-experimental approach, the study captures the causal effects of conflict and drought on food security despite the lack of randomized assignment.

As recall data was used for the study, the potential issue of recall bias as a result of memory decay and the potential consequence of the conflict was assessed using statistical methods called flashbulb memory test method and Common Method Bias (CMB). These tests indicates if recall bias is present in the recall data and if statistical inference is not reliable or not. A complementary question related to a well-known event was included during data collection and accuracy of recall, importance of the event and confidence of respondents in the memory recollection was gathered and statistically analysed by identifying the recall error as dependent variable. The

complementary flashbulb method used regression analysis by including conflict exposure and control variables of age, sex and education of respondents. These complementary methods to deal with recall bias indicated the absence of recall bias in the retrospective data collected for the purpose of the study confirming the reliability of the data for statistical inference. Due to its methodological contribution, the recall bias assessment is organized as a separate manuscript which is under review. The manuscript provides the detail methodology for recall bias analysis using the flashbulb memory test method and Common Method Bias (Muhyie et al., 2025a).

2.3. Methods

2.3.1. Sample Size Determination and Sampling Technique

The sample size was determined using Taherdoost (2016) with a 95% confidence interval (z value of 1.96) with a 5% margin of error (e), where p is the percentage occurrence of a state at 0.5, to maximize the variance that results in the maximum sample size (Bartlett, 2001).

$$n = \frac{p(100-p)z^2}{E^2} = \frac{0.5(1-0.5)1.96^2}{0.05^2} = 384$$

The four woredas were purposively selected in consultation with zonal experts, considering the history of conflict and drought exposure. A random sampling technique was used to select 38 villages, of which 422 households were selected proportionate to the population size, including 10% contingency. The 10% contingency was added to the required sample size to account for potential nonresponse and data loss. Since all responses were valid, the full sample of 422 was used in the analysis.

Considering the fact that the study covers four different woredas in South Wollo zone, a complete list of the sampling frame was not practical and logistically feasible (Levy & Lemeshow, 2013). As a result, we used a multi-stage sampling stratified random sampling techniques. The stratum takes the four study woredas, kebeles and villages within them. The researchers identified the list of kebeles in the four woredas and had consultation with woreda authorities to identify kebeles that were not accessible during data

collection due to ongoing conflict in the study areas. The first step in the multi-stage stratified sampling was to identify 30 – 45% of the kebeles from each woreda using simple random sampling taking into account kebeles that were identified as safe and secure for data collection. After selecting the study kebeles, a list of villages within each kebele was profiled and one village was selected using simple random sampling method from each kebele where 38 villages were identified. Based on the household data that was collected from woreda planning and development offices, the 422 samples were proportionately allocated to each village and a systematic random sampling technique was employed to identify survey participants. While the stratified sampling method helped to manage the diverse nature of the study area by breaking them into smaller stratum – kebeles and villages – the random sampling approach ensure equal chance of representation of respondents and increase generalizability of data (Lohr, 2019).

A non-random, purposeful sampling technique was utilized to select Focus Group Discussion (FGD) and Key Informant Interview (KII) participants with a focus on information-rich samples that can provide specific and specialized information (Shaheen et al., 2016; Nyimbili & Nyimbili, 2024) in the areas of food security, drought, conflict, and coping strategies of communities in the research woredas. Participants were selected purposively due to the need for expert and context-specific knowledge about food security, drought, conflict and socioeconomic situation of the study area and the study population. Individuals who could provide insightful and rich qualitative data were selected from zonal bureaus, woreda and kebele administration officials and technical expertise, elders, and selected respondents who experienced the impact of conflict and drought in the study area. This approach is relevant when maximum and in-depth information is required that assure research richness (Etikan et al., 2016; Palinkas et al., 2015; Tongco, 2007).

2.3.2. Data Sources and Collection Tools

A questionnaire-based survey was administered to 422 households affected by conflict and drought. In qualitative studies, previous research has indicated that the saturation point can be achieved at approximately 10 FGDs and 15

key informant interviews (Guest et al., 2006). Therefore, 10 FGDs and 15 KIIs were conducted with people who had an in-depth understanding of the impact of conflict and drought on household food security in the research area.

2.3.3. Techniques of Data Analysis

A Household Food Balance Model (HFBM), originally developed by FAO and further adapted by Degefa (1996) and Shishay and Gebremichael (2018), was further adapted by the researchers to compute per capita calorie availability in the pre-conflict and post-conflict reference years. Energy gains and losses from production, purchase, aid, and other transfers for major crop and animal products (maize, barley, wheat, teff, rice, oats, sorghum, cowpeas, peas, chickpeas, beans, meat, and milk) were included in the model. The kcal per kilogram of each of these products was used as described by (Tontisirin et al., 2003). The following summarizes the mathematical computation to calculate amount of calorie gained and lost through different mechanisms.

The Total Calorie Availability (TCA) is the total available amount of energy at the household level without accounting for the loss in energy in the reference period. It considers the total kcal availability from production (GP), purchase or buying (GB), food aid (FA), grin from gift (GG), and food for work (FW) accounting all grain and animal products in kilogram obtained in the reference year and multiplied by the equivalent calorie amount per kilogram of quantity (Tontisirin et al., 2003).

$$\text{KcalGP} = \sum(\text{Grain production in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGB} = \sum(\text{Grain Bought in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalFA} = \sum(\text{Grain Food Aid in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGG} = \sum(\text{Grain Gift in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalFW} = \sum(\text{Grain Food for Work in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalMP} = \sum(\text{Meat product in kilogram} * \text{Kcal per kilo } of\ meat)$$

$$\text{KcalDP} = \sum(\text{Dairy product kilogram} * \text{Kcal per kilo } of\ dairy\ product)$$

Where KcalGP is amount of calorie obtained from grain production, KcalGB is amount of calorie obtained from grain purchase, KcalFA is amount of calorie obtained from food aid, KcalGG is amount of calorie obtained from grain gift, KcalFW is amount of calorie obtained from food for work, KcalMP is amount of calorie obtained from meat from product, and KcalDP is amount of calorie obtained from dairy product.

Once the total calorie available is computed for the different components of energy gain in the reference period, Total Calorie Availability (TCA) was computed by summing up the energy obtained from different sources.

$$\text{TCA} = \text{KcalGP} + \text{KcalGB} + \text{KcalFA} + \text{KcalGG} + \text{KcalFW} + \text{KcalMP} + \text{KcalDP}$$

The Total Calorie Loss (TCL) was calculated by measuring the amount of grain used for household purposes other than consumption in the reference period multiplied by the calorie equivalent for the specified grain crops. These consisted of all the energy losses in the reference period as a result of postharvest loss (HL), grain reserved for seed (GU), grain sold (GS), grain gifted for others (GV) and grain used for social events (GSE) and converted to equivalent kcal amount using appropriate conversion.

$$\text{KcalHL} = \sum(\text{Grain Harvest loss in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGU} = \sum(\text{Grain seed reserve in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGS} = \sum(\text{Grain sold in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGV} = \sum(\text{Grain gifted to others in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

$$\text{KcalGSE} = \sum(\text{Grain for social event in kilogram of X grain} * \text{Kcal per kilo } of\ X\ grain)$$

Where KcalHL is amount of calorie loss due to postharvest loss, KcalGU is amount of calorie loss due to grain reserve for seed, KcalGS is amount of calorie loss due to sale of grain, KcalGV is amount of calorie loss due to gift to others and KcalGSE is amount of calorie loss due to grain used for social events.

After computing the energy amount for each category of loss in the reference period, the total calorie loss was computed by summing up the energy losses through different mechanisms.

$$\text{TCL} = \text{KcalHL} + \text{KcalGU} + \text{KcalGS} + \text{KcalGV} + \text{KcalGSE}$$

Once the total kcal availability and total kcal loss is computed, the net calorie availability was computed using the below formula.

$$\text{NCA} = \text{TCA} - \text{TCL}$$

Using the NCA, the daily per capita calorie availability for the members of the household was computed by dividing the NCA by the number of members of the household and 365 days as indicated below.

$$\text{Per Capita Calorie Availability} = \left(\frac{\text{Net Calorie Avaialbaility (NCA)}}{Household\ size}\right)/365$$

The Difference-in-Difference model was computed for the impact of conflict, drought and combined impact on food security using the following mathematical formula and the analysis was conducted in Stata software.

The following mathematical computation provides the formula to compute the impact of conflict on household food security.

$$Y_{it} = \alpha + \beta_1 Post_t + \beta_2 (Conflict\ Exposure_{it} * Post_t) + \gamma X_{it} + \mu_i + \varepsilon_{it}$$

Where:

Y_{it} = Food security outcome which is per capita calorie availability for household i at time t

α = constant term

Post_t = 1 for post-conflict, 0 for pre-conflict period

$\text{Conflict Exposure}_{it}$ = level of conflict exposure (0 for low, 1 for high)

$\text{Conflict Exposure}_{it} * \text{Post}_t$ = interaction term capturing the differential impact of conflict in the post-conflict period

X_{it} = control variables (age, sex, education, family size etc.)

μ_i = household fixed effects (capturing time-invariant characteristics)

ε_{it} = error term

The following mathematical computation provides the formula to compute the impact of drought on household food security.

$$Y_{it} = \alpha + \beta_1 Post_t + \beta_2 (Drought\ Exposure_{it} * Post_t) + \gamma X_{it} + \mu_i + \varepsilon_{it}$$

Where:

$\text{Drought Exposure}_{it}$ = level of drought exposure (0 for low, 1 for high)

$\text{Conflict Exposure}_{it} * \text{Post}_t$ = interaction term capturing the differential impact of drought in the post-conflict period

The following mathematical computation provides the formula to compute the combined effect of conflict and drought on household food security.

$$Y_{it} = \alpha + \beta_1 Post_t + \beta_2(Conflict\ Exposure_{it} * Post_t) + \beta_3(Drought\ Exposure_{it} * Post_t) + \beta_4(Conflict\ Exposure_{it} * Drought\ Exposure_{it} * Post_t) + \gamma X_{it} + \mu_i + \varepsilon_{it}$$

Where:

$Conflict\ Exposure_{it} * Drought\ Exposure_{it} * Post_t$ = interaction term capturing the combined impact of conflict and drought in the post-period

Determinant factors of per capita calorie availability were identified by running multiple linear regression.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_n X_n + e$$

Where Y is the dependent variable, which is per capita kcal available; X is the independent variable; β_0 is the y-intercept; Bs are the regression coefficients; and e is the model's random error (residual) term.

A thematic analysis method was utilized to thematically organize and analyse secondary data from related literature reviews, FGD, and KII. Food security, coping strategies, and drought- and conflict-related themes were thematically organized according to research themes (Naeem et al., 2023) to assist in the interpretation, conceptualization, and understanding of the perspectives of respondents.

3. Results and Discussion

3.1.Demographic Information and Socioeconomic Characteristics

Data were collected from 422 households in Delanta, Dessie Zuria, Kalu, and Werebabo Woredas. The average household size in the research woredas was 5.1 person per household. The below table summarizes the per capita calorie availability for the research woredas. A two-way ANOVA test demonstrated that there was significant difference in the per capital calorie availability across the research woredas with a p-value of 0.0000. in addition, there was significant difference in calorie availability at household level over the pre-conflict and post-conflict reference periods with p-value 0.0002. However, the interaction between woreda and time was found not significant

determining that the change in per-capita calorie availability does not vary over time for the different groups – woredas.

Table 1: List of research woredas, number of respondents and per capita calorie availability

Name of woredas	Number of Respondents	Per capita calorie availability	
		Pre-conflict	Post-conflict
Delanta	89	1,663	1,504
Dessie Zuria	138	2,505	2,023
Kalu	88	1,507	1,309
Worebabo	107	1,204	664
Total/Average	422	1,789	1,420

Source: Survey data by authors

Among the respondents, 64 were female heads and 358 were male-headed. The gender of the household head was found to be an important socioeconomic characteristic that provides a gender differential aspect of household food security. It was found out that the calorie availability for both male and female headed households reduced at post-conflict compared to the pre-conflict reference period. However, there was no statistically significant difference in the mean per capita calorie availability concerning gender of the household head.

Table 2: Gender of household head and per capita calorie availability

Gender of Household Head	Number of Respondents	Per capita calorie availability	
		Pre-conflict	Post-conflict
Male	358	1,809	1,436
Female	64	1,678	1,328
Total/Average	422	1,789	1,420

Source: Survey data by authors

The age of the respondents ranged from 22 to 79 years, with a mean age of 46 years. The below table provides a summary of the average per capita calories available for each age group. A two-way Anova test indicated that there is significant difference in per capita calorie availability between the

different age categories with p-value of 0.0003. in addition, there is also statistically significant difference in the per capita calorie availability of the different age categories across the pre-conflict and post-conflict reference periods. However, there was no statistically significant variation between per capita calorie availability and age categories over a course of time (p-value of 0.9935).

Table 3: Age category of household heads and per capita calorie availability

Age categories for household heads	Proportion of respondents in percent	Corresponding per capita calorie available	
		pre-conflict	post-conflict
20 - 29 years	3.1	2,326	2,269
30 - 39 years	24.2	1,677	1,266
40 - 49 years	37.4	1,685	1,304
50 - 59 years	22.5	1,757	1,424
60 - 69 years	10.4	2,120	1,745
70 - 79 years	2.4	2,743	2,246
Total/Average	100	1,789	1,420

Source: Survey data by authors

In the post-conflict reference, a notable reduction in per capita calorie availability was recorded for all marital statuses except for separated households. Separated households demonstrated increased per capita calorie availability, despite the immense impact of conflict and drought. It was indicated during focus group discussions and from the household survey that separated households has relatively higher work ratio than the other groups. Even though, it was not strongly substantiated in this research, the higher work ration could be attributed to increased workforce that contribute to more income sources which could have a positive outcome of household food security.

Furthermore, statistically significant variations between per capita calorie availability and the different groups of marital status were observed on Anova test. However, these differences do not vary between pre-conflict and post-conflict reference periods nor they interact with time over a period of time as

the interaction term between marital status and the food security outcome was not statistically significant.

Table 4: Marital status and per capita calorie availability

Marital status	Number of respondents	Mean work ratio	Corresponding per capita calorie available	
			pre-conflict	post-conflict
Single	27	0.60	2,092	1,959
Married	327	0.57	1,728	1,367
Divorced	22	0.67	2,620	1,578
Separated	4	0.75	2,618	2,948
Widow	42	0.69	1,556	1,256
Total/average	422	0.59	1,789	1,420

Source: Survey data by authors

The education status of the household heads ranges from zero to 13 years with an average of 3.6 years of education. Among the surveyed communities, 38% of household heads do not have any formal education while 20% attended education between grade 1 – 4, 31% between 5 – 8 and 11% attended high school and above. Even though the per capita calorie availability decreased for all education categories during post-conflict, there was no statistically significant difference in the mean calorie availability between education status in the pre-post reference periods.

3.2.Off-farm Participation

There was evidence of the diversification of livelihoods through off-farm income-generating activities, where 30% of households reported off-farm participation in the pre-conflict reference period. The off-farm livelihood activities practiced in the research areas include tailoring, hairdressing, carpentry, painting, and daily labour activities.

Table 5: Education status and per capita calorie availability

Education status	Number of respondents	Corresponding per capita calorie available	
		pre-conflict	post-conflict

No formal education	162	1742.699	1384.586
Lower elementary (grade 1 to 4)	83	1753.299	1369.983
Upper elementary (grade 5 to 8)	132	1835.513	1454.672
High school and above (grade 9 and above)	45	1886.725	1534.943
Total/average	422	1,789	1,420

Source: Survey data by authors

The per capita calorie availability for households who participated in off-farm activities (1,899 kcal) was higher than for those who did not participate in off-farm activities (1,742 kcal), during the pre-conflict references periods. Households who participated in off farm activity had higher per capita calorie availability which was also higher than the overall average in pre-conflict (1,789 kcal). This demonstrates the contribution of off-farm participation to household food security. Similar studies (Tesfaye & Nayak, 2022; Zelalem & Abate, 2014; Meskerem & Degefa, 2015) have also argued that households that participate in non-farm activities are more food secure. They argued that household's participation in off-farm activities enhance household food security.

Table 6: Off farm participation and per capita calorie availability

Off farm participation	**Number of respondents**	**Corresponding per capita calorie available**	
		pre-conflict	post-conflict
No	296	1,742	1,440
Yes	126	1,899	1,371
Total/average	422	1,789	1,420

Source: Survey data by authors

However, the situation in the post-conflict scenario was different. Households who participated in off-farm activities during and early after the cessation of the northern Ethiopian conflict were reduced (1,371 kcal) compared to those who did not engage in off-farm activities (1,440 kcal). This is a result of the

disruption of business activities and the loss of opportunities as a result of conflict. This was also reported by other studies which was attributed to the impact of conflict on market disruptions, displacement affecting people participation in off farm activities, damage to infrastructure and markets disruption due to the conflict that led to diminishing income from non-agricultural activities (UN OCHA, 2023; World Bank, 2023; FAO, 2023).

Labor work was identified as a major alternative livelihood that supports household food security. FGD participants indicated that the major source of labour activity is related to agricultural activities of planting, weeding, and harvesting periods during *meher* and *belg* seasons. Mining (particularly opal mining in Delanta woreda) and construction sectors are also major contributors to labour opportunities.

3.3.Exposure to Climate-induced Disasters: a perception assessment

Exposure to disasters is defined as exposure to climate-related calamities, such as drought floods, snow, and pests. 75% of respondents were exposed to at least one of the climate-related impacts during the pre-conflict period, while 74% reported similar exposure during the post-conflict reference period. A Pearson's chi-square test shows that there was no significant difference in the exposure of respondents between the pre-conflict and post-conflict reference periods. However, agroecology has been found to play a significant role in disaster exposure. More than 60% of the respondents indicated that the impact of climate-related disasters on food systems was medium and high during both reference periods.

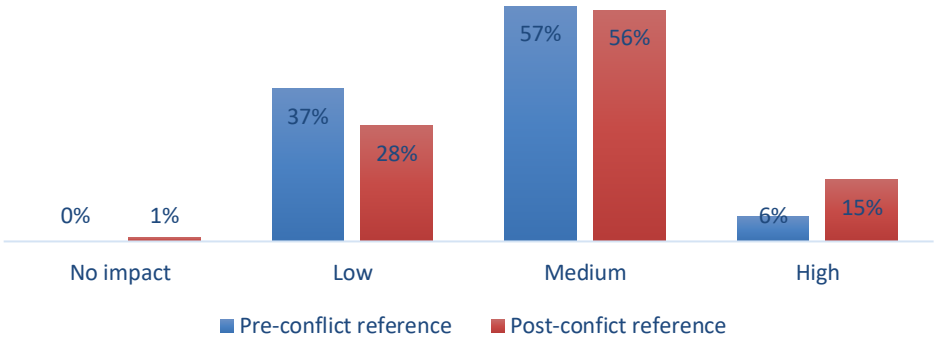

Figure 2: Perception of respondents on level of climate change impact on food systems; Source: Survey data by authors

3.4.Household Food Security

3.4.1. Household Food Balance Model (HFBM)

The mean per capita energy availability (average kcal/person/day) during the pre-conflict reference period was 1,789 Kcal while the per capita energy availability during the post conflict reference period was 1,420 Kcal/person/day.

Table 7: Two-sample t-test for calorie available for pre-conflict and post-conflict reference periods

Group	N	Mean per capita calorie availability	Standard Deviation (SD)	t	df	p-value
Pre-conflict	422	1789	1523	3.85	842	0.0001
Post-conflict	422	1420	1253			

Source: Survey data by authors

Based on a two-sample t-test with equal variance, there was a significant difference in the mean per capita calorie availability for the pre-conflict reference (M=1,789, SD=1,523) and post-conflict reference (M=1,420, SD=1,253) with conditions of t=3.85 and p = 0. 0001. The conflict increased household food insecurity by limiting calorie availability. The multifaceted impact of conflict on food systems has contributed to the reduction of household food security. Other studies (George et al., 2020; George &

Adelaja, 2022; Kafando & Sakurai, 2024) have also argued that conflict, through its widespread impact, negatively affects household food security. Considering the MoH (2022) cut-off of 2,300 kcal/person/day, 79% of households were food insecure, while food secure households accounted for only 21% of households before the conflict. Food insecure households increased to 87%, while the proportion of food secure households decreased to 13% after the conflict.

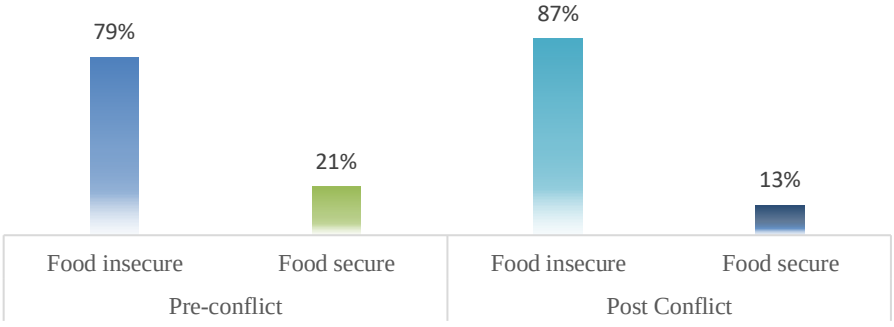

Figure 3: Categories of food security status on the basis of HFBM, Source: Survey data by authors

The study analysed the impact of conflict and drought on household food security using Fixed Effect (FE) Difference-in-Difference statistical model. Treatment variables were intensity of exposure to conflict and drought described as low and high based on self-reported household data. The time considers the reference period which is a year before the northern Ethiopia conflict and a year after the northern Ethiopia conflict pertaining the research zone. Interaction variables were set up and relevant statistical tests like presence of multicollinearity was checked using the Variance Inflation Factor (VIF) which shows less than 10 determining absence of multicollinearity problem. In addition, model appropriateness was tested using Hausman test to determine whether Fixed Effect (FE) or Random Effect (RE) was the most appropriate model. The test indicated that FE was the best with significant probability. Furthermore, the pre-post data was collected from similar respondents which also necessitates the use of FE due to the inconsistency of RE models in such scenarios.

The determinant factors of household food security were identified using multiple linear regression model for per capita calorie availability. The data

were tested for the regression assumptions of linearity of the relationship between the dependent variable and each independent variable, no multicollinearity, normality of the error term, and no heteroscedasticity. Moreover, the necessary data adjustment and model specification tests were conducted for omitted variables. All tests confirmed the fulfilment of the assumptions of linear regression, and relevant inferential statistics were assessed.

3.4.2. Impact of Conflict and Drought on Household Food Security

A DiD model run to identify the impact of conflict on household food security expressed as per capita calorie availability. In the pre-conflict reference period, all respondents were not affected by conflict. The DiD model indicated that there was an overall negative impact of conflict on household food security which is expressed in terms of per capita calorie availability. The DiD analysis revealed that there was no evidence of differential impact of conflict between households exposed to different intensity of conflict. We found out that conflict reduces significantly household food security between the pre-post reference despite intensity of conflict exposure. Conflict reduced per capital calorie availability by 229.99 units during post-conflict reference.

Table 8: Estimates of the Overall Impact of conflict (Pre vs. Post) on per capita calorie availability

Variable	Coefficient	Std. Error	p-value	95% Confidence Interval	
Post conflict (post=1)	-229.99	75.95	0.003	-379.28	-80.70
Total livestock unit	169.56	74.95	0.024	22.23	316.89
Age	13.37	4.96	0.007	3.63	23.12
Total off farm income	0.01	0.004	0.045	0.002	0.171
Agriculture index	263.05	100.63	0.009	65.26	460.84
Wealth index	-163.25	413.11	0.693	-975.267	648.76
Constant	579.21	299.13	0.054	-8.77	1167.19
Individual FE	Yes				
Time FE	Yes				
Observations	844				
R-squared	0.13				

Other researches confirm that conflict reduces household food security. Evidence from Ethiopia and Malawi (Muriuki et al., 2023) reported that conflict reduced food consumption score by more than six units while Mekonnen and Mitiku revealed that conflict significantly reduce household food security where about 85% of household experienced food insecurity (Weldegiargis et al., 2023). These studies complement and support our finding that conflict reduces household food security significantly. The overall impact of drought was estimated using the DiD model. The impact analysis highlighted that drought reduced per capital calorie availability by 268 units in the post-conflict reference period based on self-reported drought exposure data. Similar to the conflict exposure, there was no evidence of differential impact of conflict among different intensity of drought the study area.

Table 9: Estimates of the Overall Impact of Drought (Pre vs. Post) on per capita calorie availability

Variable	Coefficient	Std. Error	p-value	95% Confidence Interval	
Post drought (post=1)	-268.24	75.13	0.000	-415.92	-120.57
Total livestock unit	155.82	77.64	0.045	3.20	308.43
Age	13.02	4.97	0.009	3.25	22.78
Total off farm income	0.01	0.004	0.050	0.000	0.016
Agriculture index	192.89	104.45	0.066	-12.43	398.20
Wealth index	156.86	385.92	0.685	-601.71	915.42
Constant	677.49	317.6	0.033	53.21	1301.77
Individual FE	Yes				
Time FE	Yes				
Observations	844				
R-squared	0.15				

Source: Survey data

In order to analyse the combined impact of conflict and drought, we created a modified variable that shows the combination of post-conflict and post-drought exposures. This was due to multicollinearity issue where the combined effect was not possible to run using the DiD model. The problem arose due to the fact that all respondents were not affected by conflict during pre-conflict and most of drought affected households were also affected by conflict during the post-conflict period that resulted in collinearity issue. In order to mitigate this challenge and to provide an understanding of how the combined effect of conflict and drought is analysed using DiD, we created a variable that combines post-conflict and post-drought interaction terms. The new variable is categorized to have 3 groups: the first group is for those households who reported post-conflict exposure but not post-drought exposure, the second group are those who reported post-drought exposure but not post-conflict exposure and the third group is for those who reported both post-conflict and post-drought exposure. Once the categorical variable was created, we run the DiD model to understand the combined effect of conflict and drought on household food security.

Table 10: Estimates of the Overall Combined Impact of Conflict and Drought (Pre vs. Post) on per capita calorie availability

Variable	Coefficient	Std. Error	p-value	95% Confidence Interval	
Post combined (post=1)					
Post-conflict only	-229.18	216.44	0.290	-654.62	196.25
Post-drought only	-288.87	102.65	0.005	-490.64	-87.10
Post-conflict_drought (both)	-269.47	86.13	0.002	-438.76	-100.18
Total livestock unit	140.79	74.79	0.060	-6.21	287.81
Age	12.59	4.96	0.012	2.84	22.34
Total off farm income	0.01	0.003	0.041	0.000	0.016
Agriculture index	182.99	102.99	0.071	-19.46	385.44

Wealth index	161.46	383.53	0.674	-592.42	915.33
Constant	743.87	307.01	0.016	140.40	1347.34
Individual FE	Yes				
Time FE	Yes				
Observations	844				
R-squared	0.15				

Source: Survey data

As indicated in the above table, the interaction between exposure in conflict and drought provides an understanding of the combined effect of conflict and drought on household food security. It is noted that this interaction was generated through modification of variable and interpretation should be made with caution. While the individual impact of conflict and drought are provided in the previous sections, the interaction between the two could provide a different result and interpretation may not be taken directly.

The first group of respondents who were exposed to conflict but not to drought in the post-conflict reference, the interaction between conflict and drought exposure was found to be not significant. This interaction does not have significant influence on household food security. Whereas, households who were exposed to drought but not conflict in the post-conflict exposure, the interaction between conflict and drought exposure resulted in reduction in per capita calorie availability by about 288.87 units which is higher than both the individual overall impact of conflict (229.99) and the individual overall impact of drought (268.24).

Furthermore, households who were exposed to both conflict and drought in the post-conflict reference period demonstrated a significant reduction in household food security. The interaction between conflict and drought for these groups of respondents resulted in a reduction per capita calorie availability by 269.47 units which is higher than the individual impact of both conflict and drought. Looking at the interaction of conflict and drought, it is generally indicated that drought exposure resulted in higher reduction in household food security than conflict exposure in both individual impact analysis and considering the interaction between the two.

3.4.3. Determinants of Food Security: Multiple linear regression analysis

The following table indicates the names and description of variables that have been used in the regression analysis alongside with the type and direction of expected change in regards to the outcome variable which is the per capita calorie availability.

Table 11: Description of variables and expected direction of change against the dependent variable

Variables	Description of variables	Type of variable	Expected direction of change
outcome	Per capita calorie availability	Continuous dependent	Not applicable
ast_tlu	Total livestock unit	Continuous independent	Positive
age	Age of the household head	Continuous independent	Negative
offincom_tot	Amount of total off farm income in birr	Continuous independent	Positive
ast_agrindex	Agriculture index	Continuous independent	Positive
ast_wealthindex	Wealth index	Continuous independent	Positive
time	Pre=post reference (0 for pre-conflict and 1 for post-conflict)	Binary independent	Negative
loan_yn	Access to loan	Binary independent	Positive
aid	Amount of aid received	Continuous independent	Positive
edu_head	Education of the household in years	Continuous independent	Positive
sex_head	Gender of the household head (1 for male headed and 2 for female headed households)	Binary independent	Negative
fam_size	Total family size	Continuous independent	Negative

work_ratio	Work ration expressed as ration of working force in the household	Continuous independent	Positive
liv_mark	Distance to livestock market	Continuous independent	Negative
marital	Marital status of the household head	Categorical independent	Negative
disaster	Exposure to disaster (drought)	Binary independent	Negative

A linear regression model was used to identify the interaction between independent variables to determine the outcome variable which is per capita calorie availability. Considering that the data is a pre-post data, a dummy variable showing the pre-conflict and post-conflict reference has been included as independent variable and a joint regression for the pre-post data was undertaken to identify determinant factors using multiple linear regression model.

The multiple linear regression indicates that total livestock unit (ast_tlu), agriculture index (ast_agrindex), time (pre-post reference), family size (fam_size), work ratio (work_ratio), and exposure to disaster like drought were found to be significant determinant of household food security expressed in terms of per capita calorie availability at p-value less than 0.005. In addition, age of the household head (age) and amount of humanitarian aid (aid) were significant at p-value of 0.1.

These determinant factors and the association more broadly with household food security and in particular with per capita calorie availability are discussed in the below sections. We grouped the significant variables into impact of livelihoods assets, demographic characteristics and effect of shocks and external assistance.

Total livestock unit, a crucial livelihood asset played significant role in determining household food security expressed as per capita calorie availability. The TLU was found to have a positive and statistically significant effect on household food security ($p < 0.05$). with a unit increase in TLU, per capita available calorie increases. This result aligns with existing literature

emphasizing the central key of livestock as both a source of income and a coping mechanism during crises (Little et al., 2006; Gebreegziabher et al., 2012). In South Wollo, key informants and focus group participants reported that the conflict severely disrupted livestock-based livelihoods through theft, displacement, and market closures (FAO, 2022). However, despite the challenge that the livestock sector faced during the conflict period, households that retained their livestock were more resilient, using animals for food, labour, or emergency cash through distress sales. Awoke et al. (2022) argued that in addition to other predictors, tropical livestock units, livelihood diversification, agricultural income, and farm size determine household food security status.

Table 12: Determinant factors of household food security using multiple linear regression

Variables	Betas	Standard Error	t	P>|t|	Confidence Interval (95%)	
					Lower	Upper
ast_tlu	310.079	50.215	6.170	0.000*	211.514	408.643
age	7.920	4.530	1.750	0.081**	-0.972	16.811
offincom_tot	-0.001	0.003	-0.320	0.746	-0.008	0.006
ast_agrindex	252.440	108.018	2.340	0.020*	40.419	464.460
ast_wealthindex	343.855	431.977	0.800	0.426	-504.043	1191.753
time	-180.790	90.268	-2.000	0.046*	-357.971	-3.608
loan_yn	-118.891	86.069	-1.380	0.168	-287.830	50.049
aid	-167.948	86.189	-1.950	0.052**	-337.121	1.226
edu_head	12.543	12.888	0.970	0.331	-12.754	37.840
sex_head	4.199	211.856	0.020	0.984	-411.638	420.036
fam_size	-271.864	37.347	-7.280	0.000*	-345.169	-198.559
work_ratio	893.092	258.490	3.460	0.001*	385.720	1400.464
liv_mark	0.071	0.746	0.090	0.925	-1.394	1.536
marital	-96.949	74.422	-1.300	0.193	-243.028	49.129
disaster	-215.854	104.258	-2.070	0.039*	-420.494	-11.213
constant	1853.850	378.407	4.900	0.000*	1111.100	2596.600

* Significant predictors at 95% confidence interval, ** significant predictors at 90% confidence interval; Source: Survey data by authors

Similarly, the agriculture index, a proxy for agricultural performance and diversification through the use of improved fertilizer, pesticide and agronomic practices, was positively associated with food security ($p < 0.05$). During the conflict, agricultural activities were significantly hampered by violence, the destruction of farming inputs, and the displacement of labour (UN OCHA, 2022). Nonetheless, households that managed to sustain agricultural practices—either due to relative safety or access to early recovery support—experienced improved food security, underscoring the critical role of local food production in post-conflict recovery (WFP, 2021).

The work ratio, defined as the proportion of working-age individuals in the household, was also positively associated with food security ($p < 0.05$). In the aftermath of conflict, labour availability became a key determinant of household resilience, with working-age members enabling income diversification through casual labour. This finding is consistent with Headey and Taffesse (2014), who highlighted the role of labour capacity in rural household welfare under crisis conditions.

The age of the household head was positively associated with food security at a 10% significance level. This may reflect the cumulative benefits of experience, social capital, and better adaptation strategies among older heads. In Ethiopian rural settings, older household heads often have stronger community networks and more diversified livelihood strategies, enabling them to better navigate crises (Berhane et al., 2014). In addition, according to focus group discussants, the younger community category was directly involved in the conflict more than the aged groups. This might also one reason for this interpretation.

Conversely, family size was negatively associated with food security ($p < 0.05$), indicating that larger households faced greater food insecurity. During the conflict, larger families were more likely to experience resource strain. The conflict affected households by limiting their participation in agricultural activities, loss of businesses and due to displacement. Due to the general impact of the conflict in the research woredas, with limited availability of livelihood options, larger families faced higher level of food insecurity. This finding echoes earlier research by Tafere and Taffesse (2010), which found

that household food resources decline on a per capita basis as family size increases, particularly in rural Ethiopia.

A key finding of this study is that the post-treatment time period—capturing the conflict-affected phase—was significantly associated with a decline in per capita calorie availability at household level ($p < 0.05$). This reinforces reports from humanitarian agencies that the Northern Ethiopia conflict had devastating impacts on household welfare, particularly in South Wollo Zone, where markets were disrupted, farms abandoned, and humanitarian access restricted (FSIN, 2023; WFP, 2022).

Paradoxically, aid was found to be negatively associated with food security ($p < 0.1$). This may reflect the fact that aid is targeted to the most food-insecure households, creating a selection effect. Additionally, during the height of the conflict, aid distribution was inconsistent due to insecurity, looting, and logistical breakdowns. As Maxwell et al. (2012) argue, humanitarian aid in protracted crises can have limited impact when delivery mechanisms are compromised or delayed.

Finally, exposure to drought was significantly associated with lower food security ($p < 0.05$). South Wollo is a drought-prone area, and the recent conflict overlapped with below-average rainfall years, creating a compound crisis. As reported by FEWS NET (2021), the combined impact of conflict and drought severely undermined local coping mechanisms, resulting in widespread food shortages. This finding reinforces the importance of understanding food insecurity as the result of intersecting shocks rather than isolated events.

3.5.Major Constraints to Food Security: A Perception-based Review

Violent conflict, drought, flood, frost, crop, and animal diseases are the major challenges that constrain food security in the research areas. A key informant from Delanta woreda food security coordination office noted that, “non-conflict disasters affect some of the food systems depending on the vulnerability of different sectors within the food system. However, violent conflict has been identified as a complex disaster that affects the entire food system.”

This was coupled with a lack of sufficient agricultural land and the complete absence of land for young people, limited access to irrigation, population growth resulting in fragmentation of farmland, and traditional agricultural practices limiting the availability of food. In addition, there are cultural and traditional factors that compromise food security. Unnecessary and extravagant spending during social and cultural events such as weddings, mourning for the dead, birth, and other events leads to debt burdens that affect food security and livelihoods.

Focus group participants reported that the lack of appropriate toilets and poor hygiene practices that lead to open defecation contribute to hygiene-related diseases that directly contribute to malnutrition, a manifestation of food insecurity. Lack of proper utilization of natural resources, poor distribution and timing of rain, crop and livestock disease, and other climate-induced disasters jeopardize production ability.

3.6. Coping Strategies and Community Support Mechanisms

The CSI score was calculated by multiplying the frequency of occurrence of the 12-coping strategy-related questions by the weight assigned to each behaviour, as in Maxwell et al. (2003). Accordingly, the mean CSI of the respondents was approximately 22.4.

Table 13: Affirmative responses to the coping strategy index questions

Coping strategies		Number of affirmative responses	(% yes) *
1.	**Dietary change**		
a.	Rely on less preferred and less expensive foods	375	89%
2.	**Short-term measures to increase household food availability**		
b.	Borrow food, or rely on help from others	222	53%
c.	Purchase food on credit	173	41%
d.	Gather food from garbage or collect from leftovers	22	5%

e.	Do labour work for friends, relatives, neighbours in exchange for food	102	24%
3.	**Decrease Numbers of People**		
f.	Send household members to eat elsewhere	52	12%
g.	Send household members to beg	27	6%
4.	**Rationing Strategies**		
h.	Limit portion size at mealtimes	275	65%
i.	Restrict consumption by adults for children to eat	185	44%
j.	Feed working members at the expense of non-working members	67	16%
k.	Reduce number of meals eaten in a day	282	67%
l.	Skip entire days without eating	73	17%

** % yes, was calculated against the total number of observation (422) who affirmatively answered the CS; Source: Survey data by authors*

As indicated in the above table, 'severely food insecure' households have the highest mean CSI, which is even more than the overall average. This indicates that the higher the household food insecurity, the higher the chances of the household considering severe and negative coping strategies.

Table 14: Food security categorization on the HFBM categories and corresponding CSI scores

HFIAS Prevalence (Categories)	Summary of mean CSI	Standard deviation of CSI scores	Frequency of respondents
Food insecure	22.893	19.129	366
Food secure	18.911	15.648	56
Total	22.365	18.737	422

Source: Survey data by authors

The food insecure households often lack the asset and resources to cope up with adversities like conflict and drought and their compounded consequences. This increases their vulnerability and force them to exercise dangerous and often negative coping strategies. The below table summarizes

key socioeconomic and demographic factors and provide comparative analysis which shows food insecure households have less livestock ownership, agriculture index, work ratio, agricultural landholding and received less amount of money from off farm activities. Conversely, food insecure households have higher family size and more dependent on external assistance.

Table 15: Key household characteristics for food insecure and food secure households

Socioeconomic and demographic factors	Mean value of socioeconomic and demographic factors per food security status	
	Food insecure	Food secure
Total livestock unit	1.68	2.35
Agriculture index	0.56	0.66
aid	0.31	0.19
Family size	5.26	4.23
Work ratio	0.58	0.69
Agricultural landholding	3.04	4.03
Amount of off farm income	2455.00	3977.00

Source: Survey data by authors

The coping strategies were classified into four important categories: dietary change (#1), short-term measures to increase household food availability (#2, #3, #4, and #5), a decrease in the number of people (#6 and #7), and Rationing (#8, #9, #10, #11, and #12). Some households deployed a combination of strategies to respond to food insecurity situations, as reflected in the figure below.

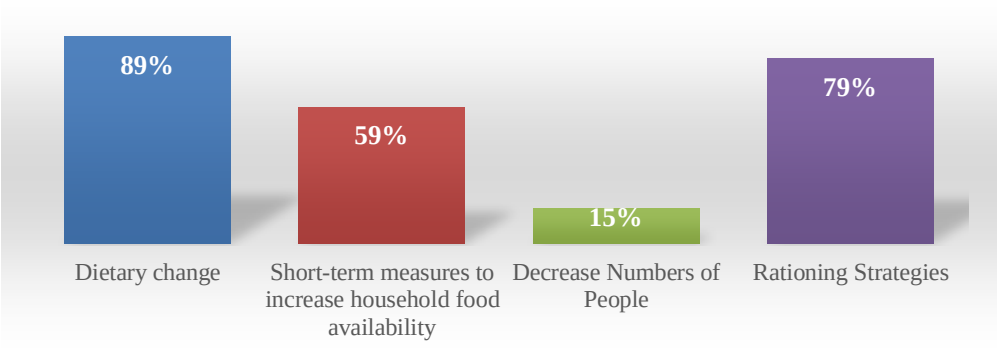

Figure 4: Proportion of households deploying different coping strategies; Source: Survey data by authors

According to the KII and FGDs, communities consider different coping strategies during shortfalls of food stock or lack of financial means to buy it. These include selling valuable household items and productive assets, sending children to engage in labour activities, taking loans to bridge gaps in household food security, and begging in the worst-case scenario for some households. Furthermore, the migration of young people to other parts of the country and the Middle East for labour was identified as a very important strategy. Mohamed (2017) found similar coping strategies deployed by households to cope with adversities that constrain household food security.

Prior to the northern conflict, some of the coping mechanisms at times of disasters for the community included going to another area for labour, selling valuable assets including livestock, collecting firewood and charcoal, eating inexpensive food, and borrowing from relatives and friends. However, during conflict, coping mechanisms have changed significantly. People have demonstrated more severe and dangerous comping strategies to cope with the compounded impacts of conflict and drought. The conflict also restricted the movement of people from place to place, in fear of their lives.

Among the different community structures, *equb*, *edir*, and *debo* were the most important. These structures helped the community facilitating borrowing of money, weddings, and mourning events and pull labour resources to each other. In addition to the aforementioned local structures,

kebele-level multipurpose service cooperatives provide basic items on a credit basis to poor people.

KIs indicated different opinions regarding the contribution of assets and livestock in mitigating conflict impacts. Fixed assets and livestock play an important role in mitigating the impact of conflict by providing a source of income and guaranteeing access to family loans. However, some studies have reported that livestock and fixed assets play a negative role, as it led to deliberate targeting during the conflict. As a result, assets and livestock are considered liabilities. However, they played an undeniable role in reducing the extra suffering of households despite the parties involved in the conflict targeting assets and livestock.

4. Conclusion and Recommendations

This study investigated the impact of conflict and drought on household food security using a difference-in-differences (DiD) approach, complemented by multiple linear regression analysis to identify key socioeconomic and demographic determinants of household food security. It also assesses the different consumption-related coping strategies that households employ to cope with food shortage during crisis periods. The results reveal that both conflict and drought significantly reduced household food security which is expressed in terms of per capita calorie availability. Furthermore, the combined exposure to both shocks in the post-conflict period had the most severe impact, suggesting a compounding and mutually reinforcing relationship between these crises.

The multiple linear regression analysis indicated that livestock ownership expressed in terms of total livestock unit (TLU), agriculture index expressed in participation in agriculture activities with a focus on improved agronomic practices, work ratio, and the age of the household head positively influenced household food security. In contrast, larger family size, disaster exposure, and aid was negatively associated with food security. The negative relationship between aid and food security suggests that while aid targets vulnerable populations, its structure and delivery may not be sufficient to improve resilience or ensure long-term food access. Besides, during the conflict,

humanitarian aid including the productive safety net programme was interrupted, untimely and insufficient which could have reduced the effectiveness of aid for the particular context of the study.

In general, the multiple linear regression results highlight the important interaction between household assets, demographic characteristics, and exposure to shocks in determining per capita calorie availability in conflict-affected settings. Households with stronger asset bases—such as livestock and agricultural productivity—managed better, while those exposed to large-scale shocks like conflict and drought experienced heightened vulnerability. A post-conflict recovery strategy that prioritizes support for rebuilding agricultural and livestock sectors, restoring market functionality, and expanding livelihood opportunities for working-age members to enhance household food security are required in South Wollo zone. Additionally, humanitarian assistance must be more predictable, equitable, and responsive to compounding crises like conflict and drought. Strengthening resilience to both conflict and climate shocks is essential for sustainable food security in this and similar fragile regions of Ethiopia.

In response to the conflict and drought shocks, households adopted a wide range of coping strategies to manage food insecurity, often using multiple strategies simultaneously. These strategies included dietary changes, reducing meal frequency and portion sizes, rationing food among family members, and short-term actions aimed at increasing food availability. As food insecurity worsened, households increasingly resorted to more extreme and potentially harmful coping mechanisms, as reflected in rising Coping Strategy Index (CSI) scores. Food insecure households had the highest CSI demonstrating that they resort to dangerous coping strategies due to deteriorated food security. Social institutions and informal networks, such as *equb*, *edir*, and *debo*, emerged as critical community-based mechanisms for managing crises as described by focus group participants. These traditional systems provided a foundation for mutual aid and resource mobilization, particularly during the generalized impacts of conflict and drought though the scope and effectiveness has reduced due to the conflict which had caused immense livelihood challenges for everybody. Even when the entire

community was affected, these structures played a pivotal role in supporting the most vulnerable, though their capacity was often constrained under widespread distress.

This study contributes to the growing body of evidence on the intersection of conflict, drought, and household food security, particularly in fragile context. By combining a difference-in-differences (DiD) impact evaluation with a determinants-based regression framework, it provides a very good understanding of both the causal impacts of shocks and the underlying household-level factors shaping food security outcomes. Moreover, the inclusion of coping strategies offers important insights into the behavioural and social responses to compound crises—an area often overlooked in quantitative food security research. The findings enrich the scientific dialogue on resilience and vulnerability by emphasizing the compounded effects of conflict and drought, the limitations of current aid modalities, and the critical role of local institutions. These insights are intended to inform not only academic discourse but also the design of more responsive, context-sensitive policy and programming in humanitarian and development settings. This research also provides an understanding of different methods to the use of retrospective data in post-conflict food security study by highlighting key steps in dealing with recall bias.

In light of these findings, several key recommendations are proposed. First, it is essential to strengthen both individual and community-level coping mechanisms. Policymakers and development actors should invest in transforming short-term, erosive strategies into adaptive practices that build resilience over time. This includes expanding access to livelihood assets, supporting livelihood diversification, and reinforcing traditional support systems like *equb* and *edir*, which play a vital role in mobilizing community resources. Second, recovery and resilience programs should integrate responses to both conflict and drought, acknowledging the compound nature of these shocks. Targeted support to livestock and agricultural sectors will be crucial in improving household food access and stability.

Aid interventions must also be re-evaluated to ensure they are timely, appropriately targeted, and linked to sustainable development outcomes.

Effective aid programs that foster self-reliance and build productive capacity may be more effective than traditional handouts. Furthermore, promoting labour participation and creating employment opportunities, especially for youth and women, can reduce vulnerability and enhance household food security. Investment in early warning systems and crisis preparedness is also necessary to help communities anticipate and mitigate future shocks.

Finally, future research should investigate the long-term impacts of different coping strategies, distinguishing between those that are adaptive and those that may further exacerbate existing vulnerability. A further exploration into the structure, delivery mechanisms, and outcomes of aid programs, particularly in the context of violent conflict, will provide valuable insights for designing more effective food security interventions in complex emergency contexts.

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