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Research Article

Rural Household Perception of Drought Occurrence and Its Influence on Livelihood Strategy in Northeast Ethiopia

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Globally, drought is occurring more frequently today, which is considerably affecting rural households' agricultural productivity and socioeconomic development. Understanding households' perceptions of drought is thus important for resilience-building work because people act based on their views, and the resilience of people is tied to their views, knowledge, culture, and attitudes. This study analyses the rural households' perceptions of drought occurrence and its influence on livelihood strategies in northeast Ethiopia. This was achieved through a mixed-methods approach with a concurrent research design. The quantitative data were collected from 354 randomly selected household heads, whereas the qualitative data were collected from purposefully selected household head focus group discussions (FGDs) and key informants. The quantitative data were analyzed using descriptive statistics, whereas the qualitative data were analyzed using thematic data analysis techniques. The results show that climate variability and drought occurrence were perceived by the households as decreasing rainfall, increasing temperature, variations in rainfall onset and cessation, variations in heat waves and cold waves, heavy rainfall events, changes in sporadic rain, a lesser coverage of clouds, and adverse weather events. Within the last 25 years, households have perceived the number of extreme, severe, or moderate droughts to be increasing. Household perceptions of temperature changes match meteorological records, but their perceptions of rainfall changes do not. The drought hampered income sources, brought food shortages, and threatened family well-being. It increased water stress, livestock morbidity and mortality, insect invasions, fire outbreaks, grazing resource depletion, abnormal migration, school dropout rates, and human health problems. The findings have important policy implications to mitigate drought risk, enhance drought adaptation, and develop pathways out of drought vulnerability, so it is worthwhile to harmonize the household perceptions with climate change policy.

1. Introduction

Over half of the world's population is affected by drought, which has made it a global phenomenon [1, 2]. Droughts have struck all continents nowadays, influencing vast regions of Europe, Africa, Asia, Australia, South America, and North America [2–4]. When quantified by the overall number of people jeopardized, drought ranks first among all natural risks globally [4]. People in poverty-stricken nations are more vulnerable to drought than people in the advanced nations because of their dependence on rain-fed agricultural systems [1, 5]. Ethiopia, including the study's area, is extremely vulnerable to various hazards; however, drought is the primary cause of livelihood fragility and humanitarian crises [6–9]. Because rural people are environmentally conscious, being cognizant of their perceptions can help to mitigate droughts and associated risks. A key philosophy of grassroots intervention is to comprehend [10, 11] the cognitive, affective, psychological, physiological, and experiential ways that people perceive and react to the environmental issues.

In this regard, Gebru and Beyene [12] examined rural household livelihood strategies in Tigray's drought-prone areas. Melka et al. [13] examined the effect of drought-risk perception on local people's coping decisions in the Central Rift Valley of Ethiopia. Menghistu et al. [14] investigated farmers' perceptions of drought and its socioeconomic impact in Tigray and Afar. Hermans and Garbe [15] explored droughts, livelihoods, and human migration in the northern Ethiopia. Adamseged et al.

[16] investigated rural livelihood dynamics and rainfall variability in Ethiopia's Northern Highlands. Hermans and Garbe [15] investigated droughts, livelihoods, and human migration in northern Ethiopia. Maru et al. [17] studied the vulnerability of smallholders' livelihoods to drought in Ethiopia. Tora et al. [18] explored rural communities' perceptions of drought vulnerability and food security status in southwest Ethiopia. Behailu et al. [19] studied a comparative analysis of meteorological records of climate variability and farmers' perceptions in Sekota Woreda. Tora et al. [18] investigated drought-prone area vulnerability perceptions and understandings in southwest Ethiopia. Gebrehiwot and van der Veen [20] researched Ethiopian farmers' drought experiences, risk perceptions, and behavioral adaptation intentions.

Nevertheless, Gebru and Beyene [12], Melka et al. [13], Menghistu et al. [14], Hermans and Garbe [15], Adamseged et al. [16], Hermans and Garbe [15], Maru et al. [17], Tora et al. [18], Gebrehiwot and van der Veen [20] disregarded the ways that households perceive drought, its occurrence, and its degree of severity. Additionally, all previous studies overlooked how households perceive the impact of the drought on key components of livelihood strategies such as nonfarm income sources, commercial activities, family well-being, education, health, and natural resources. Furthermore, the vulnerable rural households' livelihood strategies in the study area were not the subject of discussion in any of the studies mentioned previously. This study addressed knowledge gaps untouched by the previous scholars and provided information on how households perceived drought and its occurrence, how it influenced them, and their livelihood strategies. The perceptions are synergized with climate-related studies and the long-term meteorological data of the study area.

The novelty of this study is twofold. First, it provides an accurate picture of reality regarding households' perceptions (based on agro-ecology-based indigenous knowledge) of drought occurrence and climate variability. It provides broad insights into how people view drought, climate variability, and drought occurrence and how they influence their way of life. Studying how people view environmental issues helps researchers connect with, probe, and uncover issues. Second, using a relative importance index, the study provides a systematic analysis of how households perceive the influence of the drought on their livelihood strategies. Therefore, this study opens the door for policy intervention in terms of developing viable approaches to mitigation and decreasing vulnerability and the spread of poverty; advances knowledge and opens new avenues for research; and because the study's findings relate to the most prominent development theories, it has theoretical implications.

2. Perception: Mental and Cognitive Models

Taylor et al. [21] noted that the overall impacts of upcoming droughts would depend predominantly on how households prepare for and respond to the drought-related hazards. The households' actions, in turn, are heavily influenced by how they perceive and interpret the drought; hence, favorable adjustments and adaptation measures are capable of reducing the influence of the drought, whereas inappropriate actions are capable of aggravating it. This implies that understanding the influences of drought necessitates an understanding of human perception and behavior. In this case, perception [21, 22] is a range of judgments, beliefs, and attitudes about climate-related extremes and environmentally friendly adaptation actions and is significantly employed where cognitive representations of reality might be more appropriate to dig out local realities [23]. Investigating humans' cognition and/or perception as regards environmental issues is a fundamental approach to determining human decisions and choices. These decisions lead to actions that affect the environment as well as human responses to the environmental conditions that affect people [24, 25].

The theoretical debates on cognitive models have opened the door for discussions about the manner in which to understand how people interact with the outside world, use resources ethically, and gain insight into environmental and other global issues as a whole. According to Jones et al. [26], mental models are cognitive representations of the reality of what is genuinely happening in the real world. Mental models are intrinsically private, inward-looking, and present in the mind of the person who uses them. The inability to physically inspect or quantify them is the result of this [26]. Therefore, it follows that mental models function as information filters, interpreters, and organizers, as well as cognitive schemata that humans use to frame their activities [27]. As stated by Downs [28], humans can develop generalizations and then apply those generalizations to the various settings depending upon their reasoning and predicting abilities that they derive from their cognitive schemata. However, despite the fact that mental models tend to be subjective and unique to each individual, Jones et al. [26] found that relationships and networks make up a significant portion of the way individuals reason and predict.

The study of environmental perception is based on the assumption that behavior is influenced by the subjective images of the environment, attitudes, goals, feelings, and beliefs [21]. It is not always easy or straightforward to connect people's views with their behaviors. A person's behavior in a specific situation depends upon the perceived range of alternative actions and the information available to the person about the alternatives and environmental conditions causing the need to act. It is possible to conclude that perception of the environment is a very important factor among several factors that should be taken into account in assessing human response to the environmental change. A person's response may be tempered more by conditions he or she perceives than by objectively measurable changes in the external environment [21]. Therefore, subjective factors of risk and adaptive capacity play important roles in understanding the adaptation behaviors [29, 30]. In fact, combining objective and subjective factors would help deepen the knowledge base and, hence, reduce uncertainty in the adaptation planning [26, 31].

3. Perceptions of Drought

Drought is a slow-onset climate-related hazard, causing wide-reaching and prolonged impacts, and various studies rank

drought first among all climate-related hazards by the seriousness of its influences on ecosystems, people's livelihood resilience, and the overall development of a country [31–34]. The negative effects of drought often persist long after the precipitation returns to normal levels. The causes of droughts are essentially natural, but climate change increases their severity, frequency, duration, and spatial extent. The impacts of droughts are also strongly exacerbated by anthropogenic activities such as deforestation, overgrazing, soil degradation, and water mismanagement. The consequences of these activities are also aggravated by drought, which creates a vicious cycle of ecological degradation and human misery [35]. The creeping nature of drought makes it difficult to precisely determine its onset and end. Meteorological, hydrological, agricultural, and socioeconomic droughts directly affect agriculture through declining crop yields and livestock production, thereby increasing food insecurity and livelihood susceptibility [2, 36–38]. It disrupts the supply chain, impacts businesses and essential services, and accelerates land degradation and the depletion of water resources. It may even widen social inequalities, create social conflicts, and trigger human migration [39, 40]. Opinions among the public on such significant environmental and socioeconomic threats are not always straightforward and occasionally deviate from the scientific data, even in spite of the widespread scientific agreement regarding their incidence and consequences [34, 41].

The survey research by Shrestha et al. [34] examined how local people in Nepal accurately perceived the shifts in temperature, which converged with meteorological records; however, their perceptions of precipitation did not change. In Lake Victoria Basin [42], the perceptions of rural households on climate change were partially consistent with the physical science of climate change. According to Howe et al. [43], public attitudes, thoughts, and perceived risks have a big impact on public support for the climate change policies. The way that people view climate change frequently reflects their concerns about the particular effects that it would have on their daily lives [44]. In addition, an individual's perceptions may affect their ability to adapt and decisions about how to build livelihood resilience to drought [45]. The resilience of individuals is tied to their perceptions, knowledge, culture, and attitudes [45]. Note that the public perception of climate change is an essential step in understanding climate change adaptation problems and delivering potential solutions [41]. Incorporating a variety of perceptions with scientific observations would help to deepen knowledge and help policymakers in establishing appropriate strategies for the drought-resilient livelihoods [31, 33]. In addition, in many parts of the world where meteorological records of climate are inadequate, public perceptions provide a strong basis and supplementary information for determining changes in climate variability [22]. Public perceptions can also provide evidence about the impacts of climate-related risks on people's livelihoods, ecology, and economy [22].

4. Materials and Methods

4.1. Description of the Study Area. This study was conducted in Raya Kobo district, northeast Amhara region (Figure 1). Its town, Kobo, is about 727.2 km away from Addis Ababa. The Logiya River separates the study district from the Habru and Guba Lafto districts in the south; Gidan in the west; the Tigray region in the north; and the Afar region in the east [46]. As indicated in Figure 1, the study district's agro-ecology is divided into three: Dega, highland (7.9%), Woina-Dega, mid-highland (37.2%), and Kolla, lowland (54.9%). The district is under moisture stress characterized by seasonality, poor distribution, and erratic rainfall, with a mean annual rainfall of 670 mm. The temperature varies from a minimum of 19°C to a maximum of 33°C annually. It has a relatively hot climate and a mean annual temperature of 23.1°C [47]; Raya Kobo District Agriculture Office, 2022. Four classes of soils are common in the study district [47, 48]: acrisols, cambisols, leptosols, and vertisols. The dominant soils that cover 71.8% of the study area are leptosols, vertisols (21%), cambiosols (7%), and acrisols (0.2%).

Based on the population projection data, there are 365,603 people in the district, with 186,788 (51%) males and 178,815 (49%) females (Raya Kobo District Agriculture Office, 2022). Of the total population of the study area, 82% is Ethiopian Orthodox Christian, with 16% being Muslim and the rest being Protestant. The majority of people in the district speaks Amharic as their first language. As noted by Zeleke et al. [48], the settlement pattern of the north Wollo zone, including the study district, is widely dispersed, with most of the population residing on hillsides, which are highly vulnerable to the flood risks. The settlement patterns as well as the population density of the dwellers in the study district differ from area to area. This is due to the availability of livelihood assets, more specifically physical and natural capital. Mixed farming (crops and livestock farming) is the main income source for the residents. Nonfarm activities like firewood and charcoal selling, trade, and migration are also significant income sources (Raya Kobo District Agriculture Office, 2022).

4.2. Research Approach and Design. The study's objective was achieved by employing a mixed-methods research approach and collecting data from both quantitative and qualitative sources. Data requiring quantification, such as households' perceptions of drought occurrence, climate variability, the status of the drought, and 5-point Likert-scale items that measure respondents' perceptions of the drought's influence on their livelihood strategies, were collected quantitatively. In addition, interview guideline questions were prepared for data requiring qualitative collection, such as household heads perceptions about drought and its occurrence, severity, and overall influence on their livelihood strategies. A mixed-method approach [49] has many advantages, such as that it facilitates the use of multiple data collection methods, provides a more accurate picture of reality, provides strengths to offset the weaknesses of quantitative or qualitative methods, and accurately addresses the research problems.

The concurrent mixed-methods research design was also employed because it enables data collection from quantitative as well as qualitative sources simultaneously. First, the quantitative data from survey respondents, such as questionnaires on households' perceptions of drought occurrence,

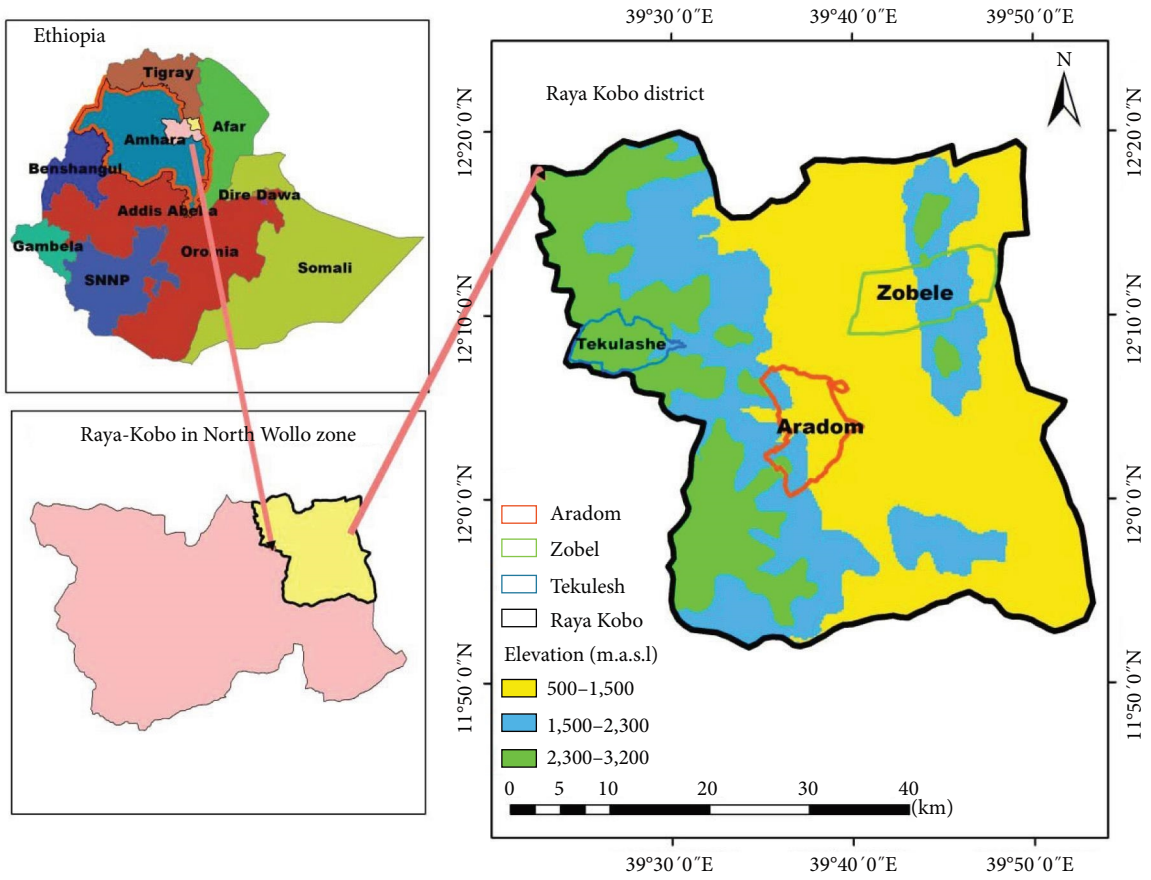

Figure 1: Study area map (accessed from https://www.diva-gis.org/gdata).

climate variability, the status of the drought, and its influence on their livelihood strategies, and the qualitative data from focus group discussion (FGD) and key informant (KI), such as in-depth interviews regarding household heads perceptions of drought and its occurrence, severity, and overall influence on their livelihood strategies, were collected concurrently. Second, the quantitative and qualitative data were analyzed independently by employing quantitative methods of analysis, such as descriptive statistics, and qualitative methods of analysis, such as descriptions and direct quotations in each major and subtheme. Third, the quantitative and qualitative data were compared and integrated in order to validate the results and obtain a full understanding of the issue under study. Concurrent mixed-methods research design [49] has many advantages, such as giving equal priority to quantitative and qualitative data, proving strengths to offset the weaknesses of the other type, and allowing for result comparison between the two databases.

4.3. Sampling and Data Sources. The study district was chosen purposefully given that it is prone to climate-related risks such as severe drought, and climate variability, to which the livelihood strategies of the residents are increasingly susceptible. In the study area, increased ambient temperatures, unpredictable rainfall patterns, and adverse weather conditions resulted in the environmental degradation, disparities in society, social unrest, and human migration. A stratified sampling was employed to divide the study area into Kolla, Woina-Dega, and Dega, with elevations of 500–1,500, 1,500–2,300, and greater than 2,300 m above sea level, respectively. Because households in similar agro-ecologies virtually have similar experiences with drought and its influence on their livelihood strategies.

Three kebeles (one from each agro-ecology) were chosen by a stratified random sampling method. Tekulesh from Dega, Zobel from Woina-Dega, and Aradom from Kolla were chosen (Table 1). The reason why only one kebele was selected from each stratum is that a single kebele in Dega agro-ecology, for example, can represent other kebele in the same agro-ecology because it possesses relatively similar population density, geographic coverage, climatic conditions, and farming systems. Note that the rationale behind choosing the stratified random sampling method was that every household in the population has a nonzero probability of being selected; it guarantees that the sample fairly represents each segment of the population. This means that stratified random sampling offers more comprehensive coverage of the population and gives the researchers the ability to regulate the subgroups to guarantee that each is represented in the sample. In addition, sample household heads were chosen using a proportional stratified random sampling technique. It is a fact that different household members [50] have different perceptions of resilience and the effects

Table 1: Summary of sample kebele administrations and number of total and sample households by agro-ecology.

Rural kebeles administrations	Agro-ecology	Total households	Sample households	Questionnaires not returned for analysis
Tekulesh	*Dega* (highland)	2,139	120	2
Zobel	*Woina-Dega* (mid-highland)	2,162	121	3
Aradom	*Kolla* (lowland)	2,172	122	4
	Total	6,473	363	9

of climate change. This is true, but in the current study, only household heads were selected because, in Ethiopia [47], household heads are the main decision-makers and more likely to be active in local community meetings. The sample size was determined using Kothari's [51] sample size determination formula because the population is large and a large sample size is required to analyze the proportion. The Formula (1) is as follows:

$$n = \frac{z^2.p.q.N}{e^2\ (N-1) + z^2.p.q}, \quad (1)$$

where n represents sample size, z is confidence level, p stands for estimated proportion, q is $1-p$, N is population size, and e stands for allowable error. As noted by Cochran (1963), cited in Israel [52], if no study is taken in the empirical locations, it is recommended to give a 50% chance (0.5) as the maximum sample proportion, and the range of acceptable errors that can be tolerated comprises 1%–10%. Thus, $N = 6{,}473$ (population size), a 50% (0.5) maximum sample proportion (p), a 5% (0.05) maximum allowable error (e), and $z = 1.96$ (as per the table of area under the normal curve for the given confidence level of 95%) were computed to get the study's total sample size. Accordingly, $n = 1.96^2(0.5)(1-0.5)(6{,}473)/0.05^2(6{,}473-1) + 1.96^2(0.5)(1-0.5) = 363$. Therefore, the total number of sample household heads was 363, and this total number of samples was divided for each sample kebele administration according to the size of the population, i.e., 120 for Tekulesh (Dega), 121 for Zobel (Woina-Dega), and 122 for Aradom (Kolla).

The questionnaires on households' perceptions of drought occurrence, climate variability, the status of the drought, and the drought's influence on households' livelihood strategies were distributed to 363 household heads, but only 354 were returned for analysis. The researchers, supervisors, and enumerators, all of whom speak the local language, participated actively in this section. The enumerators were experts from the fields of agriculture, health, and education. Six enumerators were selected in total, two from each field. Then, for each agro-ecology, two enumerators were assigned. This was done after the researchers obtained approval from the heads of the district agriculture, health, and education offices. Finally, the enumerators were instructed by the researchers on how to present each question to the respondents. Besides, three supervisors were involved, one for each agro-ecology. The supervisors were Woldia University lecturers and researchers.

In addition, in-depth interviews with purposefully chosen model farm household heads (life history narratives) were carried out to share their personal histories, given that these individuals have more in-depth knowledge of their surroundings and experience dealing with climate change. In addition, these individuals are more knowledgeable about how droughts occur and the terrible effects they have on people, agriculture, ways of life, and socioeconomic development. In terms of composition and number, six household heads were selected, two from each sample of agro-ecology. With regard to the selection of participants in life history narratives, information was obtained from group interviews (before the formal interview was held, a group interview with the community was conducted during their meeting to discuss local security issues, religious associations, and farmer meetings in the farmers training center). The participants were model farmers who have received regional recognition. These individuals are also coordinators of the local organizations, are more actively involved in the local initiatives, and have better livelihood achievements. In addition, FGDs were held with purposefully chosen, knowledgeable, and concerned discussants to obtain information about household heads' perceptions of drought and its occurrence, severity, and overall influence on their livelihood strategies. In terms of composition and number, there were two FGDs per agro-ecological area, so six FGDs were conducted overall. In each group, eight household heads participated. With regard to the selection of FGD participants, information was obtained from group interviews (before the formal FGD was held, a group interview with the community was conducted during their meeting to discuss local security issues, religious associations, and farmer meetings in the farmers training center) and KIs. Accordingly, active participants in local activities and those who had prior experience with interviews and group discussions were chosen. The discussants were model farmers who received regional recognition. These individuals are also coordinators of the local organizations and are more actively involved in local initiatives. The discussants were informed and communicated for discussion through Kebele administrators and development agents. Finally, appropriate locations and times were chosen, and FGD with discussants and in-depth interviews with participants in life history narratives were conducted using video recording and note-taking methods. As well, meteorological data for the study area came from primary sources. There were also research reports and internet sources.

4.4. Data Analysis Techniques. Data analysis techniques were chosen based on the nature of the data and the type of

research questions, so both quantitative and qualitative data analysis techniques were employed. In view of that, upon the completion of the data collection, the data were coded, edited, and entered into the SPSS software, version 20; combined with STATA 14.2; and analyzed with the help of descriptive statistical techniques since quantitative data analysis helps tabulate, interpret, and summarize empirical and numerical data for the purpose of describing or generalizing the population from the samples. The quantitative analysis included respondents' perceptions of drought occurrence, climate variability, drought status, and 5-point Likert-scale items on respondents' perceptions of the drought's influence on their livelihood strategies. As a result, the findings are presented in the form of descriptions, tables, percentages, and graphs. The qualitative data on the topic at hand, such as household heads' perceptions of drought and its occurrence, severity, and general influence on their livelihood strategies, were also thematically analyzed through the development of major and subthemes. As a result, the findings are presented in the form of descriptions and direct quotations concurrently with quantitative data. Finally, the quantitative and qualitative data were compared, integrated and triangulated to make the analysis more comprehensive, and the discussion of the results was supported by scholarly works and related literature.

4.4.1. Issues of Reliability and Validity. A reliability test (pretesting and piloting) was conducted with 30 respondents to ensure the study's reliability. For example, the reliability test on the topic of household perceptions of drought's influence on livelihood strategies shows that the prepared questions were reliable, with a Cronbach α value of 0.8019. The person who designed the study, the report's readership, and experts in the field also checked for validity. The researchers checked the trustworthiness (credibility, transferability, dependability, and confirmability) of the data. Trustworthiness was also measured by the member-checking method. In addition, personal observations were used to validate the results. Predominantly, the quantitative findings were triangulated with the qualitative findings and scholarly works.

5. Results and Discussions

The respondents' demographic characteristics as well as the findings pertaining to rural households' perceptions of the occurrence of drought and its influence on livelihood strategies in the study area are presented in this section. The perceptions are grounded in households' prior experiences and understandings of their environment, drought occurrence, climate variability, and climate-related risks, and they are compared with the study area's recorded long-term meteorological data.

5.1. Respondents' Demographic Characteristics. In all studied agro-ecological zones, 61.6% were male respondents, while 38.4% were female. Of the respondents, 6.2% were below the age of 25, 10.7% were between the ages of 46 and 55, 19.5% were between 36 and 45, 17.8% were between 56 and 65, and 7.6% were older than 65 years. Regarding the respondents level of education, 61.9% were illiterate; 20.6% could read and write; 13.8% were in Grades 1–4; and 3.7% were in Grades 5–8. Besides, 3.9%, 74.6%, 9.6%, and 11.9% of the respondents were single, married, divorced, and widowed, respectively. Of the respondents, 23.2% had a total family size of less than 3, 33% had 3–6, 29.7% had 7–10, and 14.1% had more than 10 (Table 2).

5.2. Households' Perceptions of Drought Occurrence and Climate Variability. The respondents had broad perceptions and varied experiences of the occurrence of drought and climate variability. In any case, the perceptions suggest that in the study area, the climate has varied over the last 25 years. For example, respondents (70.3%, 73.7%, and 83.9% in Dega, Woina-Dega, and Kolla, respectively) perceived that rainfall did not come on time during the *Keremet* and *Belg* seasons. In certain instances, there is a small amount of rainfall at the beginning of the rainy season, but it is not enough. Mainly, the rainy season in the study area is characterized by slow rain that ends later than anticipated. For instance, a large percentage of respondents (79.7%, 75.4%, and 83.1%) in Dega, Woina-Dega, and Kolla agreed that the rain did not stop on time. All of this highlights the fact that there are significant variations in the times of rainfall onset and cessation during the *Keremet* and *Belg* seasons in the study region (Table 3).

The climate has changed; for example, 93.2%, 95.8%, and 96.6% of respondents in Dega, Woina-Dega, and Kolla perceived the dry season temperature as growing exponentially, whereas 98.3% of respondents in Kolla and 96.6% in Dega and Woina-Dega perceived that the winter rainfall is decreasing. The majority of respondents understood that the *keremet* and *Belg* seasons' temperatures had changed over the previous 25 years across all sample agro-ecologies. It denotes that, over the past 25 years, temperatures have risen during the two rainy seasons while rainfall has decreased. The study area also experienced shifts in heat and cold waves, as well as sporadic and heavy downpours, which resulted in varying levels of drought. In a nutshell, the respondents' perceptions of climate variability and drought occurrences demonstrate that temperatures are rising, rainfall is falling, heat and cold waves are occurring more frequently, sporadic rainfall is changing, and heavy rainfall events are occurring sometimes. All this attests to the fact that in the study area, the climate varies and the drought occurs more frequently (Table 3).

In all sample agro-ecologies, 89% of respondents observed an increase in temperature, whereas 5.4% observed no temperature changes, 3.4% perceived a decrease in temperature, and 2.3% experienced an unusual temperature trend (Table 4). It is possible to draw the conclusion that over the past 25 years, the temperature has risen in all sample agro-ecologies. This indicates that a significant percentage of households in the study area have an awareness of the issue of climate change and episodes of drought and are able to predict an increase in temperature with a high degree of accuracy.

Over the previous 25 years, 89% of respondents observed a decrease in rainfall overall in all agro-ecologies, whereas 5.4% observed no rainfall changes, 3.4% perceived an increase in rainfall, and 2.3% experienced an unusual rainfall trend (Table 5). It infers that over the past 25 years, rainfall has

Table 2: Respondents' demographic characteristics.

Demographic characteristics	Dega ($N=118$)		Woina-Dega ($N=118$)		Kolla ($N=118$)		Total ($N=354$)	
	N	%	*N*	%	*N*	%	*N*	%
Gender								
Male	74	62.7	68	57.6	76	64.4	218	61.6
Female	44	37.3	50	42.4	42	35.6	136	38.4
Age								
<25	7	5.9	6	5.1	9	7.6	22	6.2
25–35	44	37.3	48	41	43	36.4	135	38.1
36–45	25	21.2	18	15	26	22.1	69	19.5
46–55	11	9.3	13	11	14	11.9	38	10.7
56–65	20	16.9	24	20.3	19	16.1	63	17.8
>65	11	9.3	9	7.6	7	5.9	27	7.6
Education								
Illiterate	81	68.6	74	62.7	64	54.2	219	61.9
Read and write	21	17.8	25	21.2	27	22.9	73	20.6
Grade 1–4	13	11	15	12.7	21	17.8	49	13.8
Grade 5–8	3	2.5	4	3.4	6	5.1	13	3.7
Grade 9–12	—	—	—	—	—	—	—	—
Marital status								
Single	4	3.4	4	3.4	6	5.1	14	3.9
Married	96	81.4	86	72.9	82	69.5	264	74.6
Divorced	9	7.6	12	10.2	13	11	34	9.6
Widowed	9	7.6	16	13.5	17	14.4	42	11.9
Family size								
<3	32	27.1	28	23.7	22	18.6	82	23.2
3–6	35	29.7	39	33.1	43	36.4	117	33
7–10	34	28.8	33	28	38	32.2	105	29.7
>10	17	14.4	18	15.2	15	12.7	50	14.1

decreased in all sample agro-ecologies. This also suggests that the households in the study area are aware of the major indications of climate change, such as variations in rainfall in the rainy season and an overall decrease in rainfall.

The last 25 years have seen a severe drought in the study area, which has resulted in unstable livelihoods. The trigger for this is climate variability, which in itself is caused by climate change. Gissila et al. [53] underline that *Belg* and *Keremet* are Ethiopia's two main rainfall seasons. The *Belg* season, which extends from February to May, brings rain for farming and pasture for livestock. Approximately 10% of Ethiopians are entirely reliant on this rainy season. The *keremet* rains are more reliable and run from mid-June to mid-September, providing water mainly for agriculture. Therefore, droughts are typically defined by a lack of total rainfall during one or two of the rainy seasons. Berlie [54] further emphasizes that it is a good harvesting season for farm households if there is enough rain in *Keremet* and *Belg* seasons. When there is no rain in these seasons, there tends to be a low harvest or there may be no harvest, resulting in income collapse, a shortage of food, widespread poverty, and livelihood vulnerability. This is referred to as a bad harvesting season or drought season.

In a similar vein, the majority of the respondents reported that the rain has not come on time in the *Belg* and *Keremet* seasons, but some respondents pointed out that the rain has rarely rained on time in the *Belg* and *Keremet* seasons for the past 25 years. Furthermore, a significant percentage of respondents concurred that neither the beginning nor the end of these rainy seasons in the study region were marked by adequate rainfall. This succinctly shows the varied climate and the frightening pace at which droughts are occurring in the study area. Climate variability and the occurrence of drought increased in the study area, as evidenced by increases in temperature, decreases in rainfall, heat and cold waves, and changes in sporadic rainfall.

As a result, respondents identified three levels of drought severity: extreme drought, severe drought, and moderate drought. In Dega, Woina-Dega, and Kolla, 18.6%, 27.1%, and 50% of respondents are vulnerable to extreme drought. Besides, 63.5%, 55.9%, and 44.1% of respondents are susceptible to severe drought in the Dega, Woina-Dega, and Kolla. In Dega, Woina-Dega, and Kolla, 9.3%, 9.3%, and 5.9% of respondents are exposed to moderate drought. Nevertheless, 8.4% in Dega and 7.6% in Woina-Dega responded that there was no drought (Table 3). Overall, 31.9% of respondents' experienced extreme drought, 54.5% severe drought, and 8.2% moderate drought across all agro-ecologies studied; however, 5.4% were not affected by the drought (Table 6). Generally, despite the fact that its severity varies depending

Table 3: Respondents' perceptions of drought occurrence and climate variability.

Options	Dega		Woina-Dega		Kolla	
	N	%	*N*	%	*N*	%
Did rainfall come on time during the *rainy (keremet* and *Belg*) seasons?						
Yes	35	29.7	31	26.3	19	16.1
No	83	70.3	87	73.7	99	83.9
Have you seen enough rain at the start of the rainy season?						
Yes	22	18.6	25	21.2	15	12.7
No	96	81.4	93	78.8	103	87.3
Did the rain stop on time in your locality?						
Yes	24	20.3	29	24.6	20	16.9
No	94	79.7	89	75.4	98	83.1
Do you think the climate in your area has varied in the last 25 years?						
Yes	118	100	113	95.8	118	100
No	—	—	5	4.2	—	—
How has the winter (dry season) temperature changed over the last 25 years?						
Increased	110	93.2	113	95.8	114	96.6
Decreased	8	6.7	5	4.2	4	3.4
How has the winter rainfall changed in the last 25 years?						
Increased	4	3.4	4	3.4	2	1.7
Decreased	114	96.6	114	96.6	116	98.3
How has the summer temperature changed in the last 25 years?						
Increased	108	91.5	115	97.4	115	97.5
Decreased	10	8.5	3	2.6	3	2.5
How has the *keremet* and *Belg* season rainfall changed over the last 25 years?						
Increased	5	4.2	7	6	—	—
Decreased	113	95.8	111	94	118	100
How have the variations in extreme heat waves affected you over the last 25 years?						
Increased	118	100	116	98.3	118	100
Decreased	—	—	2	1.7	—	—
How have the variations in extreme cold waves affected you over the last 25 years?						
Increased	118	100	118	100	118	100
Decreased	—	—	—	—	—	—
How have you observed changes in heavy rainfall events in the past 25 years?						
Increased	13	11	15	13	9	8
Decreased	105	89	103	87	109	92
How have you experienced the changes in sporadic rain in the past 25 years?						
Increased	118	100	118	100	118	100
Decreased	—	—	—	—	—	—
How have you experienced the changes in the drought over the past 25 years?						
Increased	118	100	118	100	118	100
Decreased	—	—	—	—	—	—
How do you perceive the status of the drought in your area?						
Extreme drought	22	63.5	32	27.1	59	50
Severe drought	75	9.3	66	55.9	52	44.1
Moderate drought	11	8.4	18.6	9.3	7	5.9
No drought	10		119	7.6	—	—
Do you feel the frequency, duration, and severity of droughts have increased?						
Yes	118	100	118	118	118	100
No	—	—	—	—	—	—

Table 4: Respondents' perception of temperature changes.

Options	Number of respondents	Percentage
Increase	315	89.0
Decrease	12	3.4
Remain the same	19	5.4
Irregular pattern	8	2.3
Total	354	100.0

Table 5: Respondents' perception of rainfall changes.

Options	Number of respondents	Percentage
Increase	12	3.4
Decrease	315	89.0
Remain the same	19	5.4
Irregular pattern	8	2.3
Total	354	100.0

Table 6: Respondents' perception of the status of the drought.

Drought status	Number of respondents	Percentage
Extreme drought	113	31.9
Severe drought	193	54.5
Moderate drought	29	8.2
No drought	19	5.4
Total	354	100.0

on agro-ecologies, the overall results reveal that the drought, which is getting extremely worse, is threatening virtually all respondents. This further indicates that a significant percentage of households in the study area are aware that droughts do occur

The qualitative findings that support the previously reported quantitative findings with regard to households' participants of climate variability and the occurrence of drought are also presented below. For example, household heads of FGDs in Kolla shared the following:

> We noticed an increase in the frequency, duration, severity, and geographic extent of droughts. A decrease in rainfall, an increase in temperature (with increasingly hot days and nights), an increase in cold days and nights, and variations in extreme heat and cold waves were all observed in our area. We typically associate drought with lesser coverage of clouds, warm weather, precipitation deficiency, water shortfall, dryness, adverse weather events, and insect pandemics.

In Woina-Dega, a female KI participant shared the following experience:

> Because I spend more time outdoors and care about the planet's health, I thoughtfully perceive variations in the weather and drought events as an increase in the ambient temperature and a decrease in precipitation, plus water stress, crop failure, livestock morbidity and mortality, and disease outbreaks. I perceived that there is sporadic rain and sometimes changes in heavy rainfall events, which causes waterlogging that damages land, plants, and animals. Since I amalgamate my indigenous knowledge of the drought with what I hear from experts, the media, and conversations, I essentially experienced each of these events as being related to the drought. I noticed that severe problems like dry spells and extreme weather happened every year.

Participants in the FGD in Dega further shared the following perceptions:

> It is unquestionably true that our area is still at risk from drought. Today's droughts are more frequent, last longer, and are more intense due primarily to deforestation and soil degradation, overgrazing, poor governance, climate variability, and inadequate knowledge on mitigation measures. Excessive consumption of natural assets, poor resource management, trends in settlement (scattered settlement), increasing population density, and conflicts over resources are all causes of the varying climate and frequent drought in our locality. This had a detrimental effect on our agricultural earnings and way of life. In 2015, 2016, 2017, 2018, 2019, and 2020, there were notable droughts that adversely affected water bodies, grasslands, agricultural yield, infrastructure, and economic, social, and cultural assets.

In the Kolla agro-climatic zone, a household head KI participant also shared the following experiences:

> Irrigation, I can honestly say, is my life. I use irrigation to grow fruits, vegetables, and crops. Irrigation provides me and my family with the food we eat, the water we drink, and the income we need to survive. In good years, for example, I earn around 400,000–600,000 ETB two times a year from the sale of crops, vegetables, and fruits. Nonetheless, climate variability and regularly occurring droughts disrupt irrigation systems and water availability, making the water scarce and dry, which is going to greatly lower my food production and availability. For example, my crop, vegetable, and fruit sales income dropped to around 90,000–100,000 ETB in the 2007–2008, 2010, 2011, 2016, 2018, and 2020 drought years. If only it would rain and if only it would not drought, this would not have happened.

A discussion was held with focus group participants in the Woina-Dega agro-eology with regard to the occurrence of drought and climate variability. The participants reported the following details:

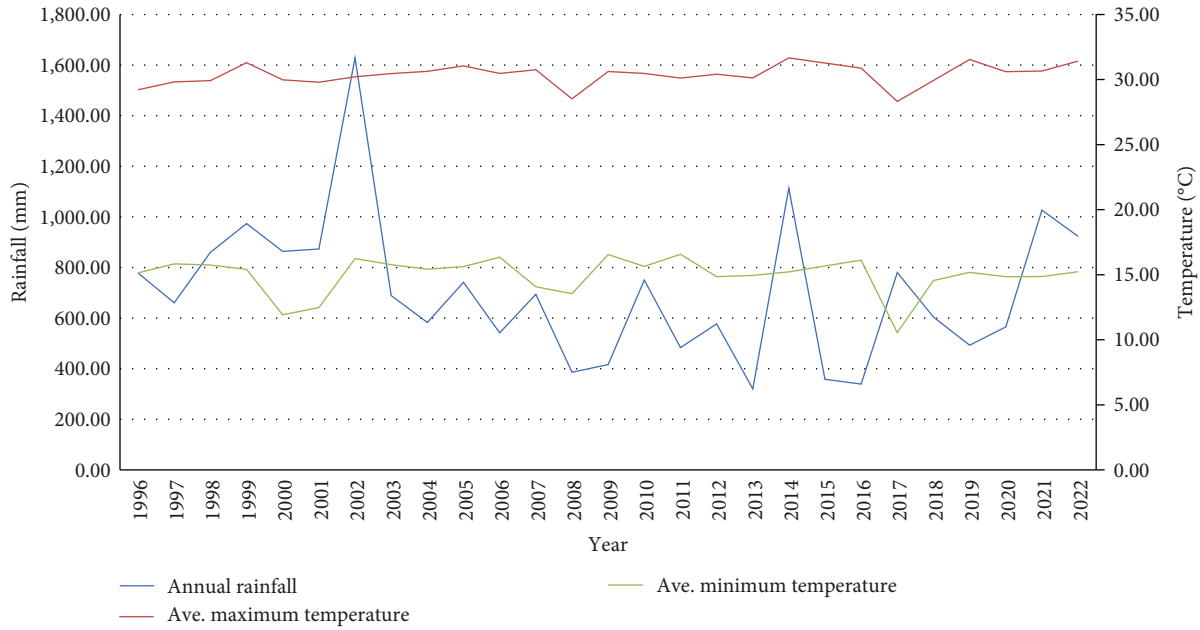

Figure 2: Long-term meteorological data of the study area (1996–2022); source: Ethiopian Meteorological Agency (2022).

Regretfully, we live in a resource-limited but highly populated region. For example, we have very limited land for farming, grazing, or other agricultural activities such as beekeeping. As a result, we have very limited agricultural production, thereby being unable to resist the frequently occurring droughts. It is obvious that our locality has incrementally deteriorated because of anthropogenic and natural factors such as climate variability. Consequently, our agricultural production and livelihood suffer significantly. We vividly recall the recent drought of 2018, when locust outbreaks devastated crops, and production has declined ever since. We are still seeking solutions by engaging in various income sources to bounce back and escape the hardship.

5.3. Meteorological Data of the Study Area. Long-term (1996–2022) meteorological data show that the study area experienced climate variability, which includes changes in temperatures and rainfall patterns. According to this long-term meteorological data, there has been an unpredictable pattern of rainfall and increasing minimum and maximum temperatures in the study area (Figure 2). Both the meteorological data and households perceptions indicate an increase in temperature in the study area. However, the meteorological data shows unpredictability in patterns of rainfall, whereas the households' perceptions indicate a decline in rainfall in the past 25 years.

In general, the quantitative and qualitative results so far attest that a large percentage of households accurately perceived that the study area experienced frequent droughts and climate variability, which are caused by anthropogenic and natural factors like climate change. This indicates that a large percentage of households in the study area are aware of the issue of climate variability and the occurrence of droughts. From the households' perceptions, the two climate attributes, such as rainfall and temperature, have been decreasing and increasing over the last 25 years, respectively. According to the study area's meteorological data, temperatures have been rising over the past 25 years, which is consistent with what households have perceived. The meteorological data show the study area has been experiencing unpredictable rainfall patterns in the last 25 years, which is in contrast with what households have perceived. The study's findings are discussed with related scholarly findings at both the regional and global levels as follows:

In a study done by Mekonen [55] in Ethiopia's northeastern highlands, 75.2% of households perceived climate variability and drought occurrences as decreasing rainfall, whereas 87.5% noticed rising temperature trends in the past 20 years. In the present study, households also perceived climate variability and drought occurrence based on fundamental climate attributes such as decreased rainfall and increased temperature over the past 25 years. This study's findings are also in line with those of Marie et al.'s [56] study findings, in that in northwest Ethiopia, over the past 30 years, 78% of farmers perceived climate variability and drought occurrence as decreasing rainfall patterns, whereas 81% perceived increasing temperature trends. The same authors further argued that the farmers in northwest Ethiopia are aware of the main indicators of climate-induced drought in terms of the fluctuation of the rainy period, which are linked with the current findings.

In line with the current findings, a study conducted in Bangladesh by Rakib and Anwar [57] reveals that more than 80% of farmers perceive the climate has gotten warmer and more than 90% perceive the timing of the rainfall has

Table 7: Likert scale items.

Drought brought low crop yields, crop losses, and food shortages (strongly agree, agree, undecided, disagree, strongly disagree)
Insect infestations destroyed my crops and domestic animals (strongly agree, agree, undecided, disagree, strongly disagree)
Drought resulted in grazing resource (pasture) depletion, deforestation, and soil degradation (strongly agree, agree, undecided, disagree, strongly disagree)
Drought has killed my livestock and greatly reduced their product (strongly agree, agree, undecided, disagree, strongly disagree)
The frequency of fire outbreaks increased (strongly agree, agree, undecided, disagree, strongly disagree)
Water availability has decreased significantly compared to the past (strongly agree, agree, undecided, disagree, strongly disagree)
My nonfarm income sources (natural resource and property income) diminished (strongly agree, agree, undecided, disagree, strongly disagree)
People's health decreased (strongly agree, agree, undecided, disagree, strongly disagree)
My forced livestock sale increased (strongly agree, agree, undecided, disagree, strongly disagree)
I have family members who have migrated (strongly agree, agree, undecided, disagree, strongly disagree)
My children were forced to drop out of school (strongly agree, agree, undecided, disagree, strongly disagree)
Because of the drought, my commercial activities have dwindled (strongly agree, agree, undecided, disagree, strongly disagree)
My food insecurity status increased (strongly agree, agree, undecided, disagree, strongly disagree)
My family's well-being reduced (strongly agree, agree, undecided, disagree, strongly disagree)
My locality's natural resources are depleted (strongly agree, agree, undecided, disagree, strongly disagree)
The severity of the drought in 2022 increased, putting my livelihood at risk (strongly agree, agree, undecided, disagree, strongly disagree)

changed, resulting in frequent droughts. The current findings are also associated with Berlie's [54] and Shrestha's et al.'s [34] study findings that households perceived drought occurrence and climate variability in terms of unpredictable rainfall, rising temperatures, heat waves, flood events, and wind speed. Droughts [54] occurred at 2–5-year intervals in Lay Gaint district, and this scenario may continue in the future, which was not the case for the previous 20 years. The same is true of this study: droughts are serious issues not only for today but also for the future, and there is a vastly increasing trend compared to the last 25 years. Nonetheless, this finding differs slightly from his in that it shows that droughts occur every year in the study area, despite their severity varying.

In agreement with the current findings, Falaki et al. [11] confirm that most farmers in north-central Nigeria perceive climate variability and the occurrence of droughts in terms of a rising trend in temperature and rainfall unpredictability. The same authors highlight that anthropogenic elements like burning and tree cutting are among the major contributors to climate variability and the occurrence of droughts. Consistent with the current findings, Behailu et al. [19] found that the majority of farmers in sekota woreda perceived drought occurrence and climate variability in terms of the rise in temperature (82%), and the reduction in rainfall (87%). Similarly, all respondents are also aware of the increment in erratic rainfall onset and cessation over the last two decades [19]. Likewise, Sertse et al. [58] found that households (98%) perceived significant changes in the climate, such as an increase in temperature, a decline in precipitation, and altering patterns of rainfall, which resulted in climate-associated risks such as droughts.

With regard to the meteorological data, Behailu et al. [19] and Sertse et al. [58] confirm that meteorological records demonstrate increases in minimum and maximum temperatures and reductions in rainfall trends, which are in agreement with households' perceptions. However, the present findings show that households' perceptions of temperature increments are in line with the meteorological data, but households' perceptions of reductions in rainfall are inconsistent with the meteorological data. According to Falaki et al.'s [11] findings, farmers' perceptions and meteorological records prove that rainfall and temperature are on an increasing trend in their study area, which partially agrees with the present finding in that meteorological data and household perceptions show an increasing temperature. Similar to the current findings, Shrestha et al. [34] found that people in Nepal accurately perceived shifts in temperature, which converge with meteorological records, but their perceptions of rainfall change did not converge with the meteorological records.

5.4. Household Perceptions of Drought's Influence on Livelihood Strategies. The following section provides households' perceptions of the drought's influence on their livelihood strategies in the study region. Table 7 conveys 5-point Likert-scale items that measure respondents' perceptions of the drought's influence on their livelihood strategies.

The descriptive statistics for the provided Likert-scale items are presented in Table 8. This is helpful in determining the variation and severity of the drought's influence on household livelihood strategies. Table 8 also includes the relative importance index for Likert scale items, which ranges from zero to one and indicates the ranks of the items that respondents gave greater weight.

Scaling and quantifying the responses is critical for interpretation. The responses are strongly agree, agree, undecided, disagree, and strongly disagree, with ranges of 4.21–5.00, 3.41–4.20, 2.61−3.40, 1.81–2.60, and 1.00–1.80, respectively. These responses are verbally interpreted as "very high, high, moderate, low, and very low. For example, 42.1%, 34.7%, 6.8%, 10.2%, and 6.2% of the respondents perceived the drought's influence on crop yields and food availability as

Table 8: Respondents' perceptions of drought influence and vulnerability types.

Likert items	Likert scale										Total score			RII	Rank
	SA (5)		A (4)		U (3)		D (2)		SD (1)						
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	Total	Total (*N*)	*A* × *N*		
Low crop yields	149	42.1	123	34.7	24	6.8	36	10.2	22	6.2	1,403	354	1,770	0.792	6
Pasture depletion	133	37.6	131	37	21	5.9	36	10.2	33	9.3	1,357	354	1,770	0.766	10
Livestock death	129	36.4	172	48.6	12	3.4	26	7.3	15	4.2	1,416	354	1,770	0.800	5
Fire outbreaks	123	34.7	182	51.4	7	2	19	5.4	23	6.5	1,425	354	1,770	0.805	3
Influence nonfarm income	159	44.9	127	35.9	15	4.2	22	6.2	31	8.8	1,423	354	1,770	0.803	4
Influence people's health	129	36.4	152	42.9	20	5.6	30	8.5	23	6.5	1,396	354	1,770	0.788	7
Forced livestock sale	154	43.5	147	41.5	10	2.8	23	6.5	20	5.6	1,454	354	1,770	0.821	1
Abnormal migration	124	35	148	41.8	7	2	44	12.4	31	8.8	1,352	354	1,770	0.763	11
Drop out of school	133	37.6	147	41.5	16	4.5	29	8.2	29	8.2	1,388	354	1,770	0.784	8
Insect infestations	112	31.6	143	40.4	54	15.3	26	7.3	19	5.4	1,365	354	1,770	0.771	9
Influence water availability	97	27.4	152	42.9	57	16.1	25	7.1	23	6.5	1,337	354	1,770	0.755	12
Influence commercial activities	102	28.8	122	34.5	66	18.6	36	10.2	28	7.9	1,296	354	1,770	0.732	14
Food insecurity	153	43.2	132	37.3	27	7.6	20	5.6	22	6.2	1,436	354	1,770	0.811	2
Influence family well-being	114	32.2	118	33.3	61	17.2	40	11.3	21	5.9	1,326	354	1,770	0.749	13
Resources depletion	104	29.4	121	34.2	61	17.2	36	10.2	32	9	1,291	354	1,770	0.729	15
2022 drought severity	93	26.3	118	33.3	79	22.3	42	11.9	22	6.2	1,280	354	1,770	0.723	16
Average score	125	35	140	40	33	9	31	9	25	7	1,371	354	1770	0.774	—

very high, high, moderate, low, and very low, respectively (Table 8). FGDs and KIs further described that, within a severe drought, households not only find themselves less capable of growing crops and generating income from subsistence farming, but they are also less able to meet their households' basic food, health, and sanitation needs. Shrestha et al. [59] also made similar findings to the current findings, in which farmer households in western Nepal believed drought had a significant impact on agricultural output and household income and exacerbated other financial consequences.

Similarly, in the Lake Victoria Basin [42, 58], climate variability and drought are critical risks that significantly reduce crop yield, increase food insecurity, and amplify livelihood vulnerability. Likewise, owing to the El Nino-induced drought [7, 9, 60], in 2015, 10-million people needed food aid in all regions of Ethiopia since it brought successive crop failures and widespread livestock deaths. Additionally, meteorological, hydrological, agricultural, and socioeconomic droughts [2, 35, 37, 61] drastically affect people's livelihoods and regional development in rainfed agricultural systems. Drought damages crops, thereby increasing food shortages, unstable livelihoods, and poverty. Menghistu et al. [14] also found that the major impacts of drought perceived by farm households included crop failure, an increase in food prices, and famine. In the same way, climate change and severe droughts have a major effect on crop yields and food availability in Africa in general and Ethiopia in particular [20]. Drought declines crops, which results in increased food shortages, unstable livelihoods, and poverty [39, 40, 62].

A large percentage of respondents (48.6%) agreed that drought episodes increase livestock deaths and highly reduce their productivity (Table 8). According to household heads' FGDs in Kolla:

> The drought that followed a poor rainy season in 2020 and 2021 had a significant impact on pasture and water resources, potentially causing unexpected waves of migration, deteriorating livestock bodies, and diminishing their resistance. This brought about a rise in illnesses, internal and external pests, and an increase in mortality risk.

In Dega, a female head household KI reported, "Drought caused a decline in cattle milk supply and negative returns in donkeys, camels, sheep, and goats, which amplified severe livelihood vulnerability." Likewise, drought [18, 63] caused livestock losses and reduced their products, which are more prevalent among poorer and marginal landholding farmers in north-west Balochistan and the Gamo lowland. The El Nino-induced drought [9] in Ethiopia in 2017 decimated about half the livestock population in the Somali Region. In line with the current finding, Menghistu et al. [14] found that farm households perceived the impacts of drought as loss of livestock, poor health of animals, and a decline in livestock prices.

Furthermore, 37.6% of respondents strongly agreed that drought had a very high influence on grazing resources (Table 8). This means that the drought depleted pasture in the rangelands and caused land degradation and a decrease in livestock fodder and livestock production. Drought caused grassland depletion and deforestation that aggravated soil degradation as per FGDs and KIs. KIs in Kolla noted that this had a massive effect on the pastures since the quantity and quality of the soil tend to diminish, blocking the germination of the fodder. KIs in Dega and Woina-Dega reported this brought a lack of pasture, migration with cattle, a decrease

in livestock income and nutrition, and an increase in livelihood susceptibility. Joy et al. [64] further discovered that drought would reduce the quality and quantity of pasture and be associated with irreversible soil degradation processes, failed fodder growth, and low-livestock productivity. According to Udmale et al. [62], Indian farmers perceived drought as having detrimental environmental impacts like rising average atmospheric temperatures and degeneration of pasture forests and water resources, which supports the current finding.

Besides, 40.4% of respondents agreed that drought-induced insects, such as locust outbreaks, had a high impact on their crops and livestock (Table 8). FGDs in Woina-Dega were also reported as follows:

> Insects brought on by the drought, primarily locust invasions and grasshoppers, affected our area. For instance, we still undoubtedly recall the hazardous migratory locust invasion that wreaked havoc on grasslands, plants, and crops in November 2020. What began as a small outbreak turned into an upsurge and eventually spread throughout a wider area, raising serious questions about the situation with regard to food security and livelihoods.

A participant in Kolla agro-ecology who is the head of a household reported the following:

> The migratory locust of 2020, which was triggered by severe drought and originated in our neighbors' drought-stricken areas in the Afar region, is something I still vividly recall. It appeared in the Woina-Dega and Dega geographical areas and expanded into a large part of the Kolla areas, where we live. It was the most devastating kind of insect. The locust swarms wiped out all my fruit-bearing plants, vegetables, and food crops. When the locusts first appeared, I remember that it was in the middle of November 2020. The tiny swarm quickly expanded across a large region and gave rise to numerous groups of locusts that ravaged fields, forests, grasslands, and crops. Despite our best efforts, we were unable to protect it. To your surprise, it was a year of hunger for both my neighbors and me.

Congruently, widespread insects [9] harmed Ethiopia's rural livelihood strategies, such as the agriculture sector, due to the 2017 El Nino-induced drought. Likewise, desert locusts threaten vast regions of pastures, significant and extensive agricultural crop losses, and food security [65]. In a recently published article conducted by Zeleke et al. [48], locust epidemics and unpredictable patterns of rainfall have made farmers' livelihoods vulnerable in lowland geographic regions of the North Wollo Zone.

Additionally, 44.9% of respondents strongly agreed that the drought's influence on nonfarm income sources (natural resource and property income) is very high (Table 8). It suggests households' nonfarm income sources dwindled owing to the drought. In Kolla, a female KI noticed that:

> When the drought happened in 2017–2021 and income from nonagriculture, such as natural resources (wood and charcoal selling) and other nonfarm income sources such as trading and waving, was drastically reduced, my family's livelihood vulnerability was much higher than usual.

One FGD participant viewed the drought in Woina-Dega as "having an influence on income sources and making households powerless, impoverished, and vulnerable." In rural Ethiopia [9], drought results in a reduction in water resources and agricultural and income losses, all of which frequently cause serious household food shortages, hunger, and livelihood insecurity. Likewise, drought [5] is a persistent, sluggish natural disaster in developing countries that has generated a financial burden and an unstable climate. Drought is a slow-onset natural disaster with long-term effects on people income sources, livelihoods, and socioeconomic development [5, 35, 66].

The result also shows that the drought influenced people's health. The drought brought health-related problems and considerably affected households' livelihoods. Respondents (42.9%) agreed that drought highly influenced their health (Table 8). FGDs in Kolla also revealed that as the temperature rose, so did the incidence of malaria in the labor force.

Household heads of FGDs in Woina-Dega discussed and raised critical points about their perceptions of overall drought-related issues. Participants stated the following:

> It is shocking to see how severely depleted our natural resources are. Our level of agricultural productivity plummeted drastically. The temperature in our area is rising, while the amount of rain is falling less frequently. Our skilled workers left the country. We can say that each of us has two immigrant families in Saudi Arabia. Just now, we are telling you how severe the drought is. Imagine for a moment how hazardous it is. Not only this, but we also have others, such as water resources being drained, our assets being depleted, and the price of food going up, which prevents us from getting nutrient-rich foods and results in health issues. We are still telling you about how droughts are getting worse and influencing us. Let us say one more thing and wind up our discussion. Due to droughts, our drinking water is heavily polluted, which further increases the risk of transmissible diseases such as cholera, typhoid, and diarrhea. This had a significant impact on the most productive age group.

Similarly, the health implications of droughts are straightforward [18, 67, 68], which are linked to an increase

in nutrition issues, illness, and death. According to Udmale et al. [62] and Menghistu et al. [14], farm households perceived that drought caused poor human health, which is consistent with the present finding. Similarly, a study conducted in Nepal by Mishra et al. [69] reveals that due to climate variability and droughts, 50% of the respondents perceived an increase in the number of diseases during the summer, 46.5% perceived an increase during the rainy season, and 48.8% during the winter.

The drought also increased the number of children dropping out of school. Respondents (41.5%) agreed that the drought has had a high impact on their children's education and forces them to drop out (Table 8). FGDs and KIs also reported that during severe droughts, income drops (due to agricultural and livestock collapse) and there are food shortages; therefore, parents have no opportunity to invest in their children's schooling. Consequently, the number of children forced to drop out of school grows, which may cause a lack of skilled labor within the household and future livelihood vulnerability. Due to declining incomes and an inability to smooth consumption [62, 70], drought-affected households have been forced to reduce investment in child education. Additionally, 41.8% of the respondents agreed that drought had a very high influence on family members' migration (Table 8). Due to the drought, the number of family members who have abnormally migrated has increased. A female KI in Woina-Dega, close to the Afar region, was further reported as quoted underneath.

> Periodic shocks made my family's life worse. Droughts are becoming more common, and rainfall variability is increasing. Drought had the possibility to endanger livelihoods, as evidenced by the deaths of my cattle, camels, goats, donkeys, and sheep in 2020. Consequently, chronic household food insecurity and poverty grew. My children migrated to Saudi Arabia, while my husband and I moved with herds in search of pasture and water. My roles in community, reproduction, and production were hampered.

Likewise, droughts [62, 67, 68] cause displacement and abnormal migration. Drought increases food shortages, unstable livelihoods, and poverty. It hastens environmental degradation, further entrenches disparities in society, sparks social unrest, and finally it triggers human migration [39, 40]. Moreover, 51.4% of respondents agreed that drought increases fire incidents and has a very high impact on natural resources (Table 5). FGDs in Woina-Dega and Kolla reported that the drought usually causes a fire hazard in dry lands when people burn thorny plants for foraging. The fire spreads into grasslands and forests by storms, then devastates natural assets and reduces related outcomes. Drought was also perceived to have an effect on water supplies, commercial activities, food security status, family well-being, and natural resources by respondents (Table 8). Similarly, the Gamo lowland community [18] has perceived drought as natural resource degradation (55.4%), food insecurity (52.4%), and livelihood insecurity (43.5%).

The results (Table 8) also indicate that the 2022 drought is slightly worse than previous years' droughts, which highly influenced households' livelihood strategies. Respondents (33.3%) agreed that the severity of the drought in 2022 increased, putting their livelihoods at risk. Household heads with FGDs in Kolla described how the recent drought, officially called "the most severe drought ever" due to its severity, duration, and extent, resulted in fodder shortages, insect outbreaks, livestock morbidity and mortality, poor soil fertility, crop failure, and completely destroyed sources of livelihood. Heads of households in KIs in Dega and Woina-Dega confirmed that the livelihood strategies of households are becoming increasingly susceptible to drought. Droughts triggered by climate change are actually happening at faster speeds, leaving no time for pastures, natural resources, and livelihoods to get better.

A female household head KI in Woina-Dega shared her experience as follows:

> My way of life has been put at risk by unpredictable rainfall and frequent droughts. In the previous 25 years, I have perceived an increase in rainfall variability and a change in the seasonal rainfall calendar, with late onset and earlier cessation in the summer season, which have affected agricultural yield and the surroundings. Such variation has influenced my decision to sow, plow, and harvest. I am worried that future rainfall will remain unpredictable and irregular. I have noticed that temperature variation is also getting more unpredictable, which increases the risk of drought-related events such as water shortages, infectious diseases, inefficient agricultural earnings, food shortages, livelihood insecurity, and psychological stress.

6. Conclusions and Implications

Households in various agro-ecologies of the study area provided valuable insights into the occurrence of drought and its influence on the livelihood strategies in light of their understanding and previously acquired knowledge. Households perceived climate variability and the occurrence of drought in terms of decreasing rainfall and increasing temperature, shifts in the start and end of the rainy season, variations in extreme heat waves and cold waves, changes in heavy rainfall events, and shifts in sporadic downpours. Households also perceived drought occurrences in terms of a lesser coverage of clouds, an increase in cold days and nights, a water shortfall, adverse weather events, and insect pandemics. Within the last 25 years, households have perceived the number of extreme, severe, or moderate droughts to be increasing. The frequently occurring drought was perceived by households as having severely damaged their livelihoods, a variety of

sources of income, natural assets, and the well-being of family members. All of this proves that the study area's households are aware of the issue of climate change, the occurrence of droughts, and the effects these have on their way of life.

The study presented herein reveals that understanding the way households perceive a problem's seriousness at grassroots levels offers a solid foundation for determining changes in the drought-related factors. In addition, integrating indigenous knowledge (household perceptions) with meteorological records and a scientific understanding of climate-induced drought has the potential to produce more accurate and pertinent drought analyses and make better-planned adaptations possible. This study presents an important contribution to the climate change literature. It also has theoretical implications since its findings relate to the most prominent development theories. This study further provides basic information for those nations whose economies rely on rain-fed agriculture so they can be aware of the frequently occurring droughts and their devastating effects on the people's livelihoods. The study has important policy implications as well; in order to design appropriate adaptation strategies, household perceptions should be harmonized with climate change and drought policies. Diversified livelihoods are significantly less vulnerable to drought than the undiversified livelihoods, so working on initiatives that promote diversification and the building of household assets should be a policy concern.

7. Limitations and Propose Directions

The data used in this study are cross-sectional, collected in August and September 2022, and depict drought's influence on rural livelihood strategy in northeast Ethiopia at a point in time. The study provides insights into the real household overall perception of droughts influence on their livelihood strategies during data collection; however, it does not show the households livelihood scenarios under drought conditions repeatedly over a period. Therefore, we recommended future researchers show household livelihood strategy scenarios under drought conditions using longitudinal data. Additionally, further research on similar issues in different districts is needed to provide a more comprehensive understanding of rural livelihood strategies under drought conditions because this study focused only on Raya Kobo district, northeast Ethiopia.

Data Availability

Data for this research article will be made available on request.

Conflicts of Interest

We declare that we do not have any known competing financial interests or personal relationships that could appear to have influenced the work reported in this study.

Authors' Contributions

Sisay Demeke Molla contributed in the conceptualization, formal analysis, investigation, and writing-original draft. Menberu Teshome Zeleke and Sisay Misganaw Tamiru contributed in the methodology and writing–review and editing.

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