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Production preference barriers and lowland-appropriate strategies of sustaining local food systems in drought-affected southern Ethiopia

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Abstract
A key element of food systems that look for significant inputs to ensure food security is food production. The production process is adversely affected by impermanent climates, particularly in places where droughts occur recurrently. In southern Ethiopia's drought-prone Gamo lowlands, this study explores lowland-friendly strategies and challenges to food production choices. A cross-sectional survey design centered on households was utilized. Primary and secondary sources of data were used in the data collection process. The study's primary data sources were the survey participants. The main methods used for gathering data were field observations, key informant interviews, focus group discussions, and surveys. Both qualitative and quantitative methods were employed in the data analysis. Numerous obstacles stand in the way of food production preference, according to the results of the household-level study. The most often mentioned ones were low professional support, rising production input costs, inadequate professional support, and traditional agriculture methods. The methods that were found included improving access to basic production resources like farmland and oxen as well as managing production costs to a reasonable level in order to alleviate these constraints. Furthermore, it was discovered that reevaluating the trends in production that are transitioning from food crops to cash crops is a major problem in the Gamo lowland environment. With growers paying less attention to valuable food sources—root crops in particular—the move toward cash crops is one that should be closely monitored. As a result, it is advised that local food systems need to be sustainable in view of changing climate and a growing populace.

Keywords Barriers · Drought-prone · Food in/security · Gamo lowlands · Strategies

1 Introduction

Among the many aspects of food security, one that is frequently brought up is food production. The changing climate greatly hinders food production at many scales and increases the susceptibility of food systems [1, 2]. In this regard, it has been discovered that feeding the world's expanding population is a difficult undertaking and contentious goal with ramifications for equitable development [3]. However, other academics contend that since food production is a primary driver of the global economy, it must be continuously prioritized in light of the world's rapid population expansion AAFC, 2011 as cited in [4, 5] about the Sustainable Development Goals (SDGs) of eradicating hunger. Among the various elements impacting food production are markets, differences in demand for food, and advancements in technology, all of which contribute to the fulfillment of food preferences through production. Agricultural production suffers the most in both urban and rural contexts in climate-prone locations where events like droughts reoccur, with a significant number

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of people experiencing negative effects [4, 6]. Undoubtedly, these circumstances play a role in the growing challenges of ending hunger, food insecurity, and overall malnutrition [7].

The barrier-free sustainable food systems are among the crucial issues of human beings. When the required production and consumption standards are not met, both the producers and buyers are situated in limited scenarios [8]. Besides, agriculture, particularly crop production, is constrained by the natural as well as human-oriented (administrative systems) yielding poverty among the resultants [9]. In this regard, climate change is reported as a risk of food security impacting both animal and crop productions [10] where vulnerabilities are common in the light of agriculture-dependent economies. Scholars with this view advocate the appropriate implementation of climate change adaptation and vulnerability assessment to enhance agricultural production in an integrated manner [11].

In the continent of Africa, food security is reviewed as a worldwide challenge where millions suffer from hunger as a universal disgrace [12]. The drought-affected areas are commonly acknowledged for susceptibility to food insecurity. The unfavourability of weather trends and varying climates with negative implications on the countryside households' agricultural production are among the identified drivers of insecure food situations [13]. Feeding the continent basically through cereal production was found problematic as a result of yield gaps despite the engine hood of agriculture for growth where major cereals such as sorghum, millets, wheat, maize, and rice are grown over an area of 98.6 million ha in which 162 million tons of production is harvested [14]. More recently, scientific communities have investigated that Sub-Saharan agricultural production is at a meager status compared with other parts of the world due to both natural and anthropogenic drivers [15].

In Ethiopia, the food security situation is recently reported with the combined problems driven by the COVID-19 global pandemic and the desert locust infestation [16]. Drought-driven shocks and a copious harvest on the other hand dynamically influence cereal crop production, basically, maize, in the country wherein the national markets are adversely impacted [17]. In the country, multiple drivers of food insecurity were reported including the lack of farmland, production means, and large-sized families with dependent members [18]. Particularly in the Gamo highlands, the culturally appropriate food source, namely, the *Qoltso (*Arisaema shimperianum*)* is also identified with a declining tendency of production and productivity. This condition was induced by the shift of the households to the improved varieties and the lack of professional support for the smallholders that aggravated food insecurity [19].

In the low-lying pastoral agro-ecological areas of Ethiopia, drought, among the climatic drivers was identified as a crucial barrier to people's preferences for a healthy diet. It is driven by inadequate or low production of food items in the local context [20]. In the drought-prone Gamo lowlands, on the other side, people's shifting trends to cash crops have become another driver of food insecurity wherein food crops particularly, the production of root crops such as sweet potato and taro have been neglected among the earlier food sources. This condition was found to be crucial and necessitated a further quest for a food security pillar in the drought-affected lowland communities' setup [21].

It is essential to reevaluate how one responds to the current literature-based questions in light of local community food systems and productions. Hence, 'which type of food production to ensure food security?' [22] is among the questions prioritized in this survey based on empirical data. This query is explained as the literature-focused motivator for the start of this project. Besides, the practices and scarcities of investigations in line with desirable dietary options [23] signal additional study. As a result, this study was conducted with the gaps in food production that need to be addressed. The preferences for food production, the obstacles to it, and the effects it has on food security were the main areas of investigation for the local and cultural food production systems in this work.

Therefore, the objectives of the study were (1) to investigate the barriers to the local households' food production preferences in the drought-prone lowland setup and (2) to explore the lowland-friendly strategies pursued by the local communities against the challenges of food production preferences. Therefore, it is thought that the study will be important in providing new information and understanding about the obstacles to food production and how they affect the state of food insecurity. This factor was taken into consideration when setting up the rural lowland communities that were at risk of drought and scaling up the techniques to the other relevant locations where food systems would be maintained. Furthermore, the study serves as a reminder of the deteriorating food culture in the areas where cash crops are replacing root crops in food production. Such a shift is supposed to be a wrong scenario that negatively influences the local and cultural appreciation of the food systems across the study communities, particularly, in the Mirab Abaya district. So, to enhance food security through food production preferences in the local set up, this investigation was conducted in the drought-prone lowland context.

2 Materials and methods

2.1 The study area

The Gamo zone in southern Ethiopia, which currently contains fourteen rural districts and six town administrations, was the deliberate location for this study. The Gamo zone is home to 1,678,008 people, of which 831, 432 were men and the remaining 846, 546 were women. Its area is 667,081.37 hectares. A total of 193, 888 people live in the examined districts of Mirab Abaya and Boreda, which together contain 97, 166 male and 96, 722 female residents [24]. The Gamo zone is located astronomically at 5º 43′ 30″ N-6º 46′ 30″ N and 37º 10′ 30″ E-37º 52′ 30″ E (Fig. 1).

The lowlands are the largest parts of the sample districts in Boreda (> 53%) and Mirab Abaya (62%) in terms of elevation-based classification. The agroecological facets of the districts are categorized into three, namely, highland (*Dega*), midland (*Woina Dega*), and lowland (*Kolla*). In terms of the landform and climatic parameters, the studied districts are differentially characterized (Table 1).

Mixed farming is the main livelihood source of the people in which cultivating crops and raising animals are extensively pursued [25]. This living system was found congruent to the report of [26] that specified the agro-oriented sustenance strategies of the Black Volta River communities in Ghanaian exposed to the varying climate. Typically, the respondents are resettlers with differential origins both from inside and outside the Gamo zone as well as other regions of the country.

2.2 Research methodology

2.2.1 Design and approach of the study

A household-based cross-sectional survey research design was used in this investigation. A mixed-methods approach was used in the research, accounting for the correlation between the qualitative and quantitative research data.

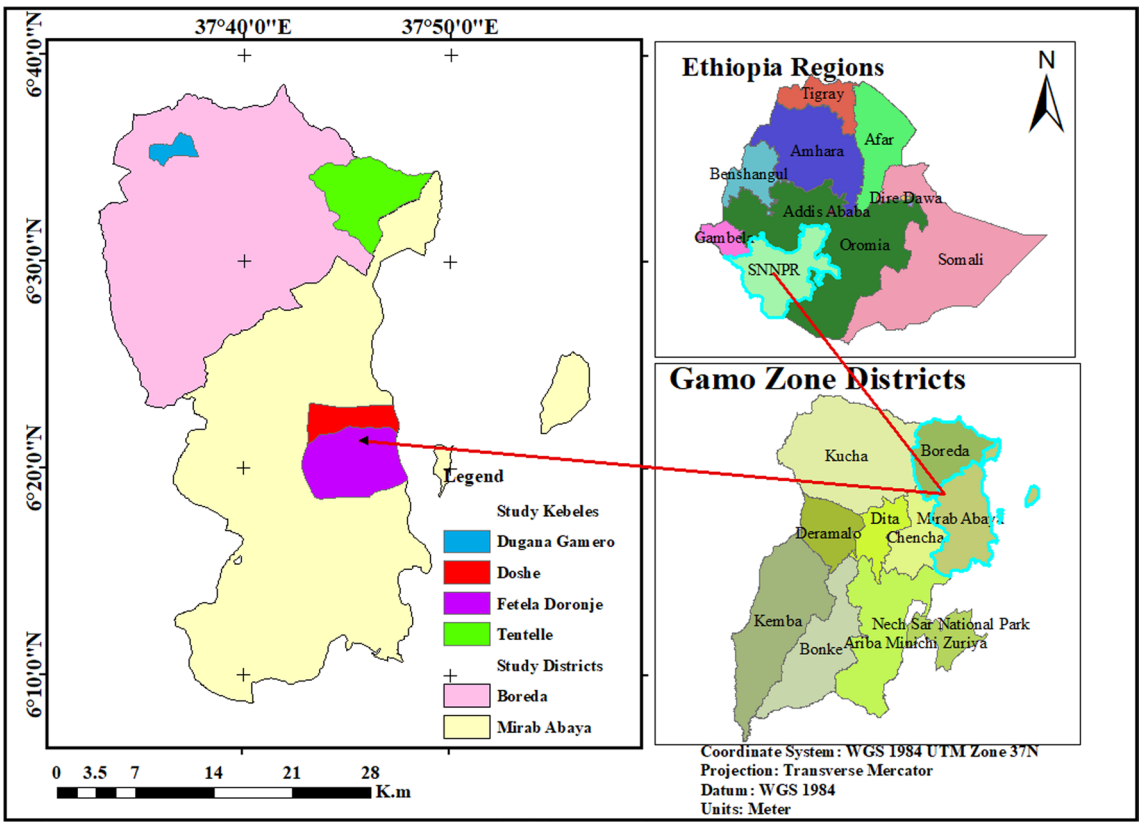

Fig. 1 Map of the study areas Note: *Kebele* is the lowest administrative tier in Ethiopia equivalent to a county

Table 1 The landform and climatic characteristics of the study districts

Characteristics	Study districts	
	Mirab Abaya	Boreda
Annual temperature	Highest 25 ℃ Lowest 23 ℃	Highest 27 ℃ Lowest 15 ℃
Annual precipitation	Highest 1600 mm Lowest 800 mm	Highest 1200 mm Lowest 500 mm
Landform	Hills 25% Plains 35% Plateaus 40%	Hills 29% Valley (gorges) 16% Plateaus 55%

Since this method has the ability to provide deep and comprehensive information beyond the scope of individual approaches, it has been made necessary due to the nature of the data required. This approach is also a commonly used inquiry mode that gives researchers the option to choose how their work is designed [27–29].

2.2.2 Sampling procedure and proportional allocation of the sample respondents

To select the required study households, a multi-stage sampling technique was employed. Purposively, the districts with more extent of drought hazard recurrences were prioritized from the Gamo lowland areas. Four stages were deployed to reach the sampled representatives.

- The first stage: The identification of the districts with vulnerable *kebeles* from the Gamo lowland areas. In the newly structured Gamo Zone since January 09, 2019, there are 9 rural administrative districts, namely, Arba Minch Zuria, Kucha, Kucha Alpha, Dera Malo, Boreda, Mirab Abaya, Geressie, Kamba, and Martha Garda which are comprised of the lowland *kebeles* with varying extent of drought vulnerability among the 14 rural districts [30].
- The second stage: It was done to identify rural *kebeles* that were at risk. Fifteen out of the twenty-three rural *kebeles* of the Mirab Abaya district are located in low-lying areas. Some of these *kebeles* engage in small-scale traditional irrigation practices; however the degree of application varies, which helps them manage vulnerability and livelihood security-related restrictions in comparison (Mirab Abaya District Farming and Natural Resource Development Office, 2020). Fetele Doronje, Doshe, Korga Geramo, Yayike, and Kolla Barana are among the district's *kebeles* that are persistently affected by drought. Fetele Doronje and Doshe were given priority due to the intensity of their susceptibility. Since the early 1960s, WDRP has been able to access the expanding consequences of drought among other hazards in these *kebeles* (National Disaster Risk Management [21, 25, 30, 31].

Thirteen of the twenty-eight rural *kebeles* in the Boreda district are located agro-ecologically in lowland areas that are vulnerable to drought. Tentelle, Dugana Gamero, Gumgumuta, and Dubana Bulo are the rural *kebeles* that are more vulnerable to the effects of drought and its perils. The first two were sampled to serve as the research *kebeles*. These *kebeles* are shown in the NDRMC database profile as having experienced drought and livestock and human diseases since 2008, with 2015 being the worst year. Samples of the endangered lowland *kebeles* from both districts were purposefully taken, including Fetele Doronje, Doshe, Tentelle, and Dugana Gamero [30]. These *kebeles* are thought to be intentionally prioritized by population homogeneity. The characteristics of homogeneity include living in a lowland agro-ecology, relying on similar livelihood activities (subsistence mixed farming), relative accessibility, drought susceptibility, and water shortage. Additionally, these *kebeles* were among the ones that were among the primarily focused *kebeles* for drought-affected students in disaster responding strategies like school feeding programs [30].

- The third stage: The targeted population identification. From both Mirab Abaya and Boreda districts, the study populations from the top vulnerable rural lowland *kebeles* were selected,
- The fourth stage: The sample size determination was conducted finally [30]. Schematically, the stages followed are shown below (Fig. 2).

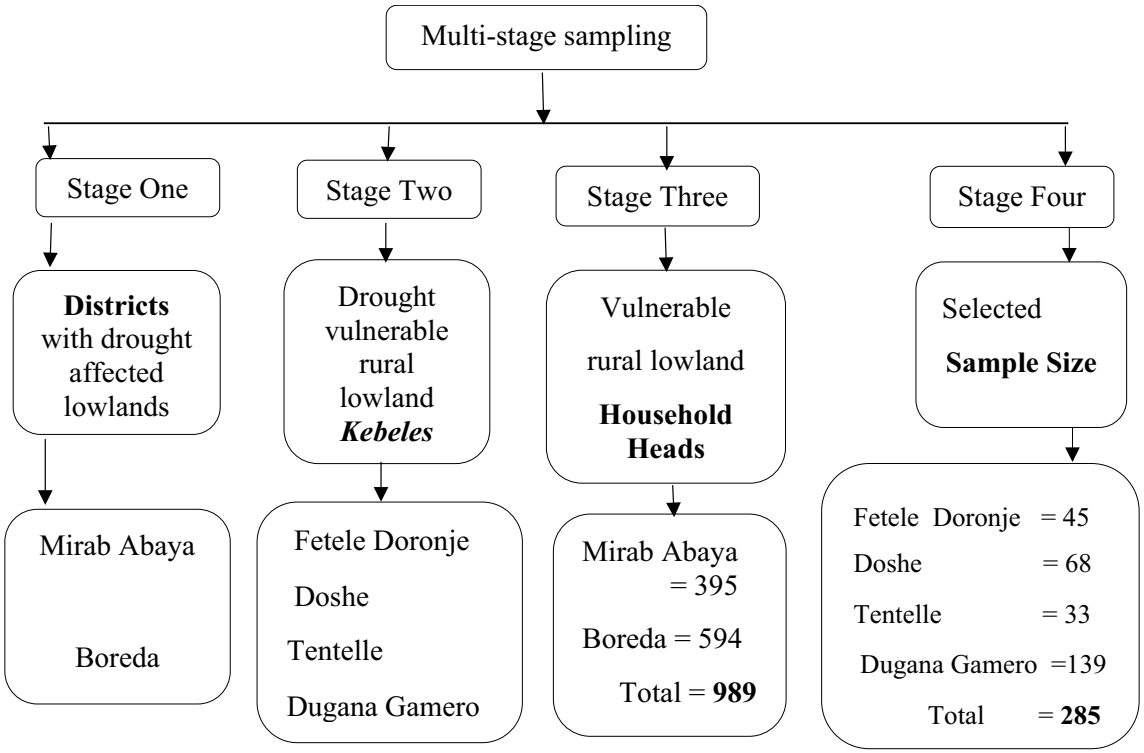

Fig. 2 Schematic summary of multi-stages used in sampling procedure. Source, Own construction (2023)

The considered sample frame was the list of households found in each rural *kebele* administrative office. A total of 285 households were selected from the four sample *Kebeles* [30] using the formula of [32] that is suitably used at a 95% confidence interval for a known and finite population. Accordingly, the formula:

$$n = \frac{N}{1 + N(e^2)} \tag{1}$$

was used to decide the sample size at the 95% confidence interval wherein 'n' represents the sample size being calculated, 'N' is the population of the area. '1' is the constant, and 'e' is an error margin considered to be 0.05. Accordingly, 285 sample households were selected from the entire 989 households of the four study sites [30]. Allocating the calculated sample respondents proportionally into each study *kebele* was done by the researcher's own proportional respondent allocation formula which is:

$$pp = nc / NT \times 100 \tag{2}$$

where pp = Percent of proportion for allocating sample respondents selected from each *kebele* and summed for equivalence with the calculated sample.

nc = The calculated sample size selected proportionally from the targeted study sites.

NT = The total number of households in each targeted sample site accessed from the sample frame. Consequently, the calculated 285 sample respondents of the selected drought-vulnerable rural *Kebeles* were allocated proportionally (Table 2).

2.2.3 Data types, sources, and collection instruments

The primary and secondary data were obtained from various sources. The primary data came from 285 survey participants, 19 agricultural office specialists (10 specialists in food security and disaster risk reduction), and the 9 development agents in the *kebeles* who were on hand. Additionally, the sources for the primary data generation were the 14 key informants, which included non-sampled community elders, model farmers, two district administrative organs, *kebele*

Table 2 Proportional allocation of sample households

Study kebeles	Total households (NT)			Percent of proportional allocation (pp)	Selected Sample		
	M	F	T	28.81	M	F	T
Fetele Doronje	138	20	158		39	6	45
Doshe	201	36	237		58	10	68
Tentelle	102	11	113		30	3	33
Dugana Gamero	467	14	481		135	4	139
Total	908	81	989		262	23	285

Source, modified from [30, 33]

NB The number of female-headed respondents both in the total and sampled households was decided per their availability in the sample frame

level administrative bodies with four representatives each, and focus group participants [30]. In addition, field observations conducted via transect walk over the locations were also utilized as a means of obtaining primary data. Face-to-face administration of the pilot-tested questionnaire survey was conducted at locations ranging in distance from 55 to 127 km from the town of Arba Minch, the administrative center of the Gamo zone. Five male enumerators with training who were proficient in both the author's native tongue and the local ones conducted the enumeration. Both open-ended and closed-ended questions that were created in accordance with the planned study objectives were included in the survey questionnaire. At the study locations, four focus group discussions took place. The households that were not included in the household survey and were not sampled were the participants. The selection was done with the considered key figures (gatekeepers) who played a crucial role as they were familiar with the participants in light of the recruitment criteria [30, 33]. Each group of conversations featured 6–8 participants, including both males and females. Following careful selection, a total of 29 focus group discussion participants took part in the four study locations. Focus groups were held at each of the study sites for between sixty and ninety minutes. Various selection criteria were taken into consideration when choosing the participants in the focus group discussions and the key interview informants. The participants' knowledge of the *kebeles*, the capacity to describe the current conditions in the communities, and their socioeconomic and demographic statuses in accordance with the guiding checklist were among the criteria that were heavily considered [30, 33].

A variety of topics pertaining to the study's goals were covered in the interview and group discussions. The socio-economic and environmental circumstances of the areas, the difficulties lowland households encountered, the barriers to food production preferences, and the methods the households employed to lessen the barriers to their production preferences were all comprehensively examined. Furthermore, the checklist for focus group discussions and the interview guides included additional information on the reasons for food shortages and constraints on food production capacity. The suggestions received were taken into account in order to validate the survey questionnaire results. The relevant published and unpublished resources provided access to the secondary data. Multiple data collection tools such as the structured household survey questionnaire, agricultural experts' structured questionnaire, key informant interview, focus group discussion, and field observations through transect walks were employed to collect the required primary data [30, 33].

2.3 Methods and procedure of data analysis

In order to complete the study, inferential statistics were performed after the descriptive statistics using the sociodemographic characteristics of the households. The household survey data were therefore subjected to a quantitative analysis utilizing descriptive statistics like mean, frequencies, and percent. The results of the quantitative data were also summarized using tables and graphs. The relationship between respondents' preferences for food production at each study site and their lowland location was investigated using correlation analysis. The binary logistic regression model was used to evaluate the households' preferences for food production, and the hypothesis was tested by the application of inferential statistics.

The hypothesis for this purpose was 'The lowland households produce their food preferences to contribute to food security'. To validate the quantitative data produced from the survey households, qualitative data analysis techniques were deployed. Verbal description, narration, annotation, and discussions on objective-based responses of the participants

were among the qualitative techniques applied. The findings of qualitative data were linked to the statistical outputs of the structured household survey questionnaire. This was accomplished by adding qualitative information from key informants, field observations, and focus group discussants to the quantitative data findings [30, 33].

3 Results

3.1 The main characteristics of survey households

Wide arrays of households' demographic and socioeconomic characteristics were investigated in this study. The studied households had a mean age of 46 with a maximum of 90 and a minimum of 20 [30, 33]. This demographic result showed a divergence, with the mean age of the farming families being 49.79 years in consideration of the minimum and maximum ages of the rural Nigerian households being 25 and 105 years, respectively [34]. In terms of education, the survey results demonstrated the low level of respondents' education, with households with more than 68% having functional adult literacy (FAL), attending just grades 1–4, and having no reading or writing skills. All resettled residents with varying origins from the other Gamo zone districts, the former neighboring Southern Nations, Nationalities, and People's Regional State zones, as well as from other regions of Ethiopia like the Amhara Regional State, comprised the studied households. The family size of the households was found out to be large with an average value of 6.7 persons wherein the lowermost was 1 and the highest was 17 [30, 33]. The average family size of the surveyed respondents was found divergently much greater than the mean rural household members (3.84) of the Azuay Province, Ecuador [35] and the southern Iranian farmers [36].

The other primary feature of the respondent households examined in this study was sex. The results revealed that, of the survey participants, 90.5% were men and the remaining 9.5% were women. This attribute was discovered to be at odds with the publication of [37], which stated that the average age values for families headed by men were 80% and those headed by women were 20%. The extent of the farm holdings was another crucial socioeconomic characteristic of the households. The results of the survey showed that households had varying levels of access to the farmland, with an average of 3.43 ha and the lowest at 0.125 ha and the maximum at 19 ha. Such large-gaped farmland ownership of the studied rural households was proven to be among the sources of rural vulnerability, particularly food insecurity, in the Gamo lowlands. The seasonal migrations to near and distant destinations as livelihood diversification or vulnerability managing stratagem are also employed by the Gamo lowland communities, especially, by the young sections of the households' family members [21]. Aside from this, there was ethnic diversity in the populations under study across the four locations, with the Gamo people making up the majority. Six ethnic groups, representing about 11% of the former Southern Nations Nationalities and Peoples Region (SNNPR) of Ethiopia and more than 65% of the country's ethnic diversity, were represented in the sample houses (Table 3).

3.2 Types of food crops produced by the Gamo lowland households

The investigated households produced a variety of food crops throughout the research areas. This example shows that, among the major food production limitations of the Gamo lowland villages, households struggle to achieve food security. The study participants cultivate a range of crops to supplement their food intake, including root crops and bowls of cereal. Despite this, there were differences in the productivity of the crops being produced between the research sites and between households (Table 4). The reason for investigating the crops opted by the households was to respond to the question, namely,

Table 3 The ethnic diversity of respondent households

Ethnicity	Number (N)	Percent
Gamo	227	79.6
Wolaita	38	13.3
Amhara	10	3.5
Oromo	6	2.1
Giddicho	3	1.1
Sidama	1	0.4
Total	285	100

Table 4 Statistical summary of food crops produced by the households in kg (2018/19)

Statistics	Maize	Sorghum	*Teff*	Chickpea	Soya bean	Haricot	Sweet potato
N	285	285	285	285	285	285	285
Mean	7.4	0.56	1.15	0.21	0.62	0.28	0.53
Range	50	12	8	11	10	5	12
Minimum	0	0	0	0	0	0	0
Maximum	50	12	8	11	10	5	12
Sum	2108	159	327	61	176	80	150

'which type of food production is pursued to ensure food security?' in the Gamo lowland setup. As can be seen in Table 4, the survey finding indicates a meagre amount of food crops produced with implications for a household-level local food security. This condition was found cognate with the problematic food security statuses of the Gamo lowland households assessed by multiple food security measures. The measures embraced the adapted Household Food Balance Model (HFBM), Household Dietary Diversity Score (HDDS), and the Food Insecurity Experience Scale (FIES). These indicators showed insecure household-level food situations for a vast majority of the drought-affected Gamo lowland households [21]). It was found of vital importance to explore households' food production in consideration of the drought-prone rural areas which was found consistent with the report of scholars on rural food insecurity indicating people's socioeconomic circumstances [38].

The investigation of households' food production is believed to enhance the further understanding of the implications in line with attaining rural lowland households' food security. It was also fair to explore the local people's food production and the related restraints that serve as a route toward secured food situations [39].

4 Discussions

4.1 Households' food production preferences and implications for food security in the Gamo lowlands

Across the study areas, households' food production preferences were assessed. The survey question 'Do you produce the food types you prefer to produce?' was provided to all respondents of the survey. Consequently, the survey findings revealed that 57% of the households do not produce the food types they prefer in the setup of the drought-prone Gamo lowlands (Table 5).

Moreover, it was necessary and carried out in accordance to look at the preferences for food production and the implications for food security. Important outputs from the binary logistic regression model were considered after it was run. Based on the used model outputs, the framed study hypothesis, namely, "The drought-prone lowland households produce their food preferences to contribute to food security" was tested. Both the output (dependent) and the predicting (independent) types of variables were taken into account when running the deployed logit model. The survey respondents' preferences for food production were found to be influenced by their lowland residence at the time of field data collection. The food production preferences of the households dichotomously had two response options (Yes–No) being dictated by the lowland residential locations of the households.

Binary logistic regression analysis was performed on the quantitative data collected via a questionnaire survey. Testing the formulated basic hypothesis was the goal. To evaluate the model's fit to the data, several techniques were used. The model fits the data, as shown by the classification table (plot), with an overall percentage of cases and non-cases that the estimated model was able to classify as appropriately as 78.9%. On the other hand, the probability value was shown by the Hosmer and Lemeshow Test to be insignificant (above the predefined p-value of 0.05 at a 95% confidence interval). This indicates that the computed model fits the data well enough to support the null hypothesis in a reasonable manner. This is as a result of the test's value being determined to be statistically not significant in the Chi-square significance. Additionally, a variance in the lowland location of families adds, with an odds ratio of 2.745, to the growing preferences for food production. It was

Table 5 Descriptive statistics of households' food production preferences

Do you produce the food types you prefer to produce?	Frequency	Percent
Yes	123	43
No	162	57
Total	285	100

Table 6 The logit model goodness of fit test

HLTV and Pseudo-R2			Coefficients (Log odds)	
Classification Table	Hosmer and Lemeshow	Model Summary (Nakelkerke's Pseudo-$R^{2)}$	B	Exp(B) (OR)
78.9%	20.530	0.323	1.010	2.745

NB Hosmer and Lemeshow Test Values

Table 7 Correlation of households' lowland locations with food production preferences

Variables considered	Respondents' location	Do you produce food types you prefer to produce?
Respondents' location		
Pearson Correlation	1	0.510**
Sig. (2-tailed)		0.000
N	285	285
Do you produce food types you prefer to produce?		
Pearson Correlation	0.510**	1
Sig. (2-tailed)	0.000	
N	285	285

**Correlation is significant at the 0.01 level (2-tailed)

found that 32.3% of the variations in households' preferences for food production could be accounted for by their lowland locations. (Table 6).

Additionally, the correlation upheld between food production preferences as indicative of food security and participants' present rural residence was assessed through the correlation analysis in the SPSS version 23. The output divulges that the correlation result is significant at a p-value of 0.01. This is observed from the Pearson correlation coefficient which was found to be 0.000 (Table 7). It infers that there is a significant tie between the addressed study variables viz. households' recent residential locations and their food production preferences as an indicator of food security.

4.2 Food production preference barriers identified in the Gamo lowlands

Several obstacles to food production were found throughout the Gamo lowlands, as shown below. The survey findings revealed a variety of hurdles impeding households' choices for food production, which has a major influence on food security. The research participants detailed numerous barriers that hinder the choices for food production among the various possibilities offered. The topics pertaining to household awareness receive the most iteration. In the context of the research locations, communities' understanding of food security was frequently and publicly stated, both independently and in conjunction with the other possibilities offered. The results of the survey also revealed additional limitations that put the preferences for food production at each study site under even more pressure (Table 8). Therefore, the circumstances demand that decision-makers, agricultural experts, and other stakeholders raise community knowledge of food security. In the Gamo lowlands, where drought is a common occurrence, this recommendation is deemed essential for enhancing resilience and eradicating food-related problems, specifically food insecurity and its associated corollaries.

The aforementioned food production issues are supplemented by inputs from other sources such as the agricultural technocrats, key informants, and focus group discussion participants. Among other things, these enhancements support the ongoing cultivation of landholdings and the varying capacities of farming households. Additionally, the combined effects of drought or irregular rainfall, the availability or lack of a supportive labor force, and other factors impede communities' ability to produce food as a whole. These situations were discovered to be consistent with the position of [40], which outlines the factors that limit rural residents' ability to participate more broadly in food production in order to ensure food access.

Furthermore, examining the obstacles to family food production was logically converging with the claim of production sustainability techniques that suggest the difficulties [41]. However, the field observation inputs also confirm the

Table 8 Barriers to food production preferences across the Gamo lowlands

Identified barriers	Frequency	Percent
Low awareness of food security	95	33.3
No extra farmland, traditional practices, low awareness, and inadequate professional support	40	14.0
Poor technological access	37	13.0
No extra farmland and low awareness of food security	22	7.7
No extra farmland	21	7.4
Low awareness and many costly inputs of production	17	6.0
Poor technological access and inadequate professional support	13	4.6
No extra farmland and poor technological access	12	4.2
Old age and no extra farmland	2	0.7
No extra farmland, low awareness, many costly inputs, and administrative problems to plant food for self-consumption	9	3.1
No labour force to support food production	8	2.8
Traditional practices and many costly production inputs	5	1.8
Traditional practices and poor technological access	2	0.7
No extra farmland, traditional practices, low awareness, and poor technological access	2	0.7
Total	285	100

existence of environmental and socioeconomic constraints that limit the choices made about food production and, consequently, affect food security. The respondents who were approached informally also provided additional scenarios that support the area-specific conditions about food production choices. Among the often mentioned concerns by the respondents were the low perceptions of food security held by the local population and the inconsistent actions done to remove production constraints. These inputs provide additional context for policy disputes pertaining to local food systems, production barriers, and the food security of lowland communities. The lessons learned from these inputs can be applied to other similar contexts and essentially address the trend of shifting production to cash crops at the expense of more staple foods like root crops.

4.3 Lowland-friendly strategies to ameliorate food production preference barriers

The Gamo lowland households engage in a variety of activities that are appropriate for locations that are susceptible to drought in order to address the difficulties brought on by restrictions on food production preferences. The study households assert that alternatives relevant to the area should be taken into account in order to address the constraints on food production. As a result, the families forwarded intervention measures designed to tackle the constraints pertaining to food production preferences. The following figure schematizes the discussed implementation approaches that are thought to improve local food systems in the Gamo lowland area (Fig. 3).

The aforementioned survey results are reinforced by additional information received from field observations, focus group discussion participants, key informants, and agricultural office experts. The transition from food crops (root crops like sweet potatoes) to cash crops (bananas, tobacco, etc.) is a topic of much discussion, especially in the Mirab Abaya district. This was frequently seen in the *kebeles*, which practice small traditional irrigation systems. The above-mentioned decline in attention to root crops puts at risk the food crops that are acceptable locally and culturally. It was determined that this was not necessary since it jeopardizes community preferences for food production and affects household food security throughout the research areas. This Gamo lowland situation was discovered to be at odds with the Debark district in northwest Ethiopia, where biocultural diversity creates a chance for fragile food systems [42].

Hence, it urges to enhance the communities' awareness not to ignore the available food sources and preferences that can help build community resilience in the Gamo lowland setup. Besides, most of the above-illustrated alternatives of food production preferences are found consistent with the report of the [43] that acknowledges agricultural sustainability as a remedy for food security through wider roles of the rural youngsters. This mechanism is advanced by Maffra [44] as a solution for global starvation and changing climate. With respect to the targeted Gamo lowlands, the study findings revealed how lowland people's food production preference statuses and production restraining

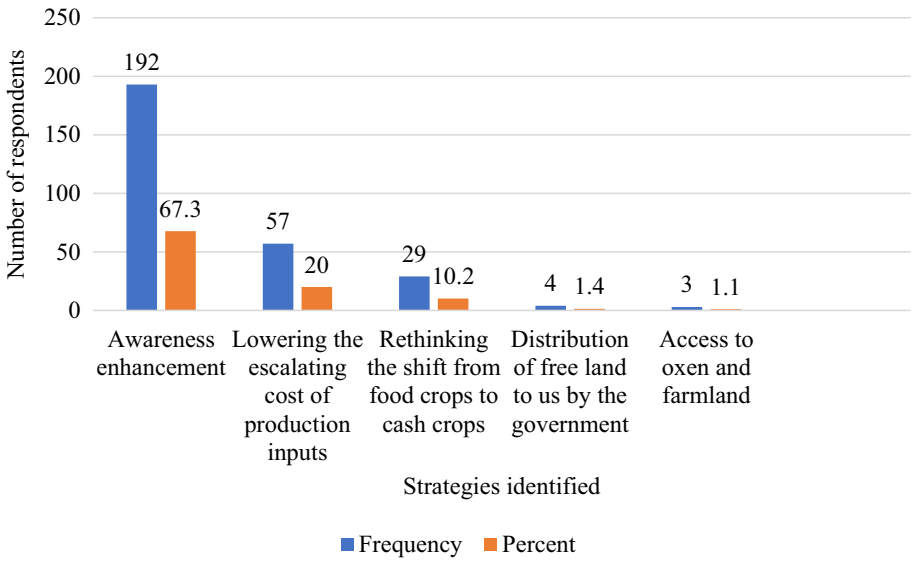

Fig. 3 The lowland-friendly strategies against food production preference barriers

barriers are tied to localized food systems and food security. This condition has due implications/lessons for future food system-related interventions by the concerned bodies to be revisited.

5 Conclusions and the way forward

This study aims to explore the barriers that influence food production preferences and the actions taken to improve sustainable food systems in the context of lowland droughts. Several obstacles that lead to food shortages were found in the Gamo lowland households' options for food production. Traditional farming methods and family food security awareness-related factors are frequently discussed in relation to their impact on household food security. The rising cost of inputs for agriculture, the scarcity of resources for production, and the availability of supportive laborers were also identified as barriers to food production preferences.

The current food varieties that are recognized locally and culturally, especially the root crops, are being neglected, which has negative effects on the rising cost of food. Strengthening the solutions that work in the current environment is necessary to address the limits on food production in the Gamo lowland setting, which is affected by the recurrent drought hazard. The majority of these corrective measures are devoted to raising community awareness of ongoing production difficulties and food security. Modernizing farming methods and improving access to resources and inputs for production are also important lowland-appropriate ways to improve local food systems and better ensure food security.

Thus, it is recommended that all parties involved take a broad approach to raising community knowledge of food security and removing obstacles to production. It also strongly requires improving our understanding of food security in order to implement sustainable production preferences. This is considered necessary to ensure the food targets associated with the Sustainable Development Goals, particularly the goal of eradicating hunger, which is to be achieved through sustainable food production with appropriate attention to the local food systems that are in decline.

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Data availability The survey data used in this study can be available through a reasonable request from the author.

Declarations

Ethical approval and consent to participate The name of the ethics committee is Research Ethics Committee of Arba Minch University. All researchers including the PhD candidates in Arba Minch University mandatorily abide under the rules of this committee. The protocol was approved by Research Ethics Committee of Arba Minch University in accordance with the guidelines and regulations of Research Ethics Committee of Arba Minch University addressing the research participants. The main participants were household survey respondents who were contacted during the survey enumeration. At that time, purpose clarity, objective of the study and other related issues were clearly stated before the activities. Besides, the attendees of focus group discussions and key informant interviews were the other participants of this study. Confidentiality of data collected from these participants before collecting the data was stated describing that the data collection was only for the research purpose through which the informed consent of respondents/participants was approved ahead of the data gathering. The ways of handling the participants and their responses are among the duly considered research guidelines of the study.

Consent for publication Not applicable.

Competing interests The author declares no competing interests.

References

1. Abafita J, Kim K. Determinants of household food security in rural Ethiopia: an empirical analysis. J Rural Dev. 2014;37(2):129–57.
2. Porter JR, Xie L, Challinor J, Cochrane K, Howden M, Iqbal M, Lobell B, Travasso I. Food security and food production systems. In: Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL, editors. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, New York: Cambridge University Press; 2014. p. 485–533.
3. Grote U, Fasse A, Nguyen TT, Erenstein O. Food security and the dynamics of wheat and maize value chains in Africa and Asia. Front Sustain Food Syst. 2021;4:617009.
4. Campbell ID, Durant DG, Hunter KL, Hyatt KD. Food production. In: Warren FJ, Lemmen DS, editors. Canada in a changing climate: sector perspectives on impacts and adaptation. Ottawa: Government of Canada; 2014. p. 99–134.
5. Giller E, Delaune T, Silva V, Descheemaeker K, van de Ven G, Schut T, van Wijk M, Hammond J, Hochman Z, Taulya G, Chikowo R, Narayanan S, Kishore A, Bresciani F, Teixeira M, Andersson A, van Ittersum K. The future of farming: who will produce our food? Food Secur. 2021. https://doi.org/10.1007/s12571-021-01184-6.
6. Sam T, Khoi N, Thao T, Nhi T, Quan T, Hoan X, Nguyen T. Impact of climate change on meteorological, hydrological and agricultural droughts in the Lower Mekong River Basin: a case study of the Srepok Basin, Vietnam. Water Environ J. 2018. https://doi.org/10.1111/wej.12424.
7. FAO, IFAD, UNICEF, WFP, WHO. (2022). The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome: FAO. https://doi.org/10.4060/cc0639en.
8. Peterson H, Selfa T, Janke R. Barriers and opportunities for sustainable food systems in Northeastern Kansas. Sustainability. 2010;2:232–51.
9. Quddus A, Kropp D. Constraints to agricultural production and marketing in the lagging regions of Bangladesh. Sustainability. 2020;12:3956.
10. Food Agriculture Organization of the United Nations. Climate change and food security: risks and responses. 2015.
11. Huang N, Wang J, Song Y, Pa Y, Han G, Zhang Z, Ma S, Sun G, Liu C, Pan Z. The adaptation mechanism based on an integrated vulnerability assessment of potato production to climate change in Inner Mongolia, China. Mitig Adapt Strateg Glob Change. 2022;27:24.
12. Sasson A. Food security for Africa: an urgent global challenge. Agric Food Secur. 2012;1(2):1–6.
13. Ngcamu S, Chari F. Drought influences on food insecurity in Africa: a systematic literature review. Int J Environ Res Public Health. 2020;17:5897.
14. Macauley H, Ramadjita T. Cereal crops: rice, maize, millet, sorghum, wheat. 2015.
15. Bjornlund V, Bjornlund H, Van Rooyen F. Why agricultural production in sub-Saharan Africa remains low compared to the rest of the world—a historical perspective. Int J Water Resour Dev. 2020;36:S20.
16. Peng Y, Hirwa H, Zhang Q, Wang G, Li F. Dryland food security in Ethiopia: current status, opportunities, and a roadmap for the future. Sustainability. 2021;13:6503.
17. Yami M, Meyer F, Hassan R. The impact of production shocks on maize markets in Ethiopia: implications for regional trade and food security. Agric Food Econ. 2020;8(8):1–25.
18. Tefera M. Causes of rural household food insecurity: a case from Kuyu district, central Ethiopia. J Sustain Dev Afr. 2009;11(4):286–304.
19. Abera U, Tarekegne S, Degefa T. The effect of production decline of Qoltso on food security in Gamo Highlands, South-west Ethiopia. GeoJournal. 2019. https://doi.org/10.1007/s10708-019-10087-1.
20. Gebremichael B, Asfaw A. Drivers of food choice among pastoral/agro-pastoral community in Somali regional state, eastern Ethiopia. Adv Public Health. 2019. https://doi.org/10.1155/2019/1472487.

21. Thomas TT, Degefa TD, Abera UU. Drought vulnerability perceptions and food security status of rural lowland communities: an insight from Southwest Ethiopia. Curr Res Environ Sustain. 2021;3:100073.
22. Desmarais A. The gift of food sovereignty. Special Issue: Mapping the Global Food Landscape. Can Food Stud. 2015;2(2):154–63. https://doi.org/10.15353/cfs-rcea.v2i2.115.
23. Thiemann L, Roman-Alcalá A. Fast food sovereignty: contradiction in terms or logical next step? J Agric Environ Ethics. 2019;32:813–34. https://doi.org/10.1007/s10806-019-09800-4.
24. United Nations Office for the Coordination of Humanitarian Affairs, OCHA Ethiopia. 2022. https://data.humdata.org/dataset/cod-ps-eth?. Accessed 16 Feb 2022.
25. Thomas TT, Degefa TD, Abera UU. Schematizing vulnerability perceptions and understanding of drought-prone Gamo lowland communities: an evidence from Southwest Ethiopia. Int J Clim Change Strateg Manage. 2021;13(4/5):580–600. https://doi.org/10.1108/IJCCSM-04-2021-0034.
26. Yiridomoh YG, Sullo C, Bonye ZS. Climate variability and rural livelihood sustainability: evidence from communities along the Black Volta River in Ghana. GeoJournal. 2020. https://doi.org/10.1007/s10708-020-10144-0.
27. Terrell SR. Mixed-methods research methodologies. Qual Rep. 2012;17(1):254–80.
28. Creswell WJ. Research design: qualitative, quantitative, and mixed methods approaches. 4th ed. Thousand Oaks: SAGE Publications Inc.; 2014.
29. Almalki S. Integrating quantitative and qualitative data in mixed methods research-challenges and benefits. J Educ Learn. 2016;5(3):1927–5269.
30. Thomas T, Degefa T, Abera U. Schematizing vulnerability perceptions and understanding of drought-prone Gamo lowland communities: an evidence from Southwest Ethiopia. Int J Clim Change Strateg Manag. 2021;13(4/5):580–600.
31. National Disaster Risk Management Commission. 2019.
32. Yamane T. Statistics: an introductory analysis. 2nd ed. New York: Harper and Row; 1967.
33. Thomas T, Degefa T, Abera U. Impacts of livelihood assets on livelihood security in drought-prone Gamo lowlands of southwest Ethiopia. Geogr Sustaina. 2022;3:58–67.
34. Ogunniyi AI, Omotoso SO, Salman KK, Omotayo OA, Olagunju OK, Aremu OA. Socio-economic drivers of food security among rural households in Nigeria: evidence from smallholder maize farmers. Soc Indic Res. 2021;155:583–99. https://doi.org/10.1007/s11205-020-02590-7.
35. Cordero-Ahiman OV, Vanegas JL, Franco-Crespo C, Beltrán-Romero P, Quinde-Lituma ME. Factors that determine the dietary diversity score in rural households: the case of the Paute River Basin of Azuay Province, Ecuador. Int J Environ Res Public Health. 2021. https://doi.org/10.3390/ijerph18042059.
36. Yazdanpanah M, Moghadam T, Savari M, Zobeidi T, Sieber S, Löhr K. The impact of livelihood assets on the food security of farmers in southern Iran during the COVID-19 pandemic. Int J Environ Res Public Health. 2021. https://doi.org/10.3390/ijerph18105310.
37. Ashrit R, Mamta Thakur K. Is awareness a defining factor in the adoption of sustainable agricultural practices? Evidence from small holder farmers in a southern state of India. SN Soc Sci. 2021. https://doi.org/10.1007/s43545-021-00222-6.
38. Cordero-Ahiman OV, Vanegas JL, Beltrán-Romero P, Quinde-Lituma ME. Determinants of food insecurity in rural households: the case of the Paute River Basin of Azuay Province, Ecuador. Sustainability. 2020. https://doi.org/10.3390/su12030946.
39. Peter B. Food sovereignty an alternative framework to the narrower concept of food security. Cirencester: Royal Agricultural University; 2017.
40. Burdock R, Ampt P. Food sovereignty: the case and the space for community led agricultural autonomy within the global strategic framework for food security and nutrition. J Agric Sci. 2017;9(5):1.
41. El-Nour S. The challenges of food sovereignty in the Arab region: the case of Egypt Alternative Economy Series. 2017.
42. Ruelle L, Kassam K, Morreale J, Asfaw Z, Power G, Fahey J. Biocultural diversity and food sovereignty: a case study of human-plant relations in northwestern Ethiopia. Food Secur. 2019;11:183–99. https://doi.org/10.1007/s12571-019-00888-0.
43. International Movement of Catholic Rural Youth (MIJARC Europe). A sustainable agriculture for food sovereignty? Role and place of rural youth building the future agriculture. 2010. www.mijarc.info. Accessed 20 Aug 2022.
44. Maffra L. Food sovereignty: sustainable solution to world hunger and climate change. Ámbitos. 2017;37:1–11.