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Special Issue - Food Justice and Food Sovereignty in the context of the Right to Food

DETERMINING FOOD INTAKE, THE REQUIREMENT, AND WEIGHING THE RELATIVE RISK BETWEEN FOOD SECURE AND INSECURE HOUSEHOLDS IN RURAL AREAS OF ETHIOPIA: THE CASE OF WEST HARARGHE ZONE

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ABSTRACT

The severity of food insecurity in Ethiopia is among the worst globally, with record-breaking food assistance needs by various factors. This study tries to uncover various aspects of food security related to food availability, food access, food utilization and food stability dimensions of food security. The study was executed in the west Hararghe zone of the Oromia region of Ethiopia. Its main objective was to determine the food security status of households, with specific objectives aiming at computing individual daily kilo calorie intake, determining the average food requirement, comparing the relative risk between food secure and insecure households and identifying factors that affect household food security status. A multi-stage sampling procedure, involving the purposive selection of; the Zone and Woreda, and a simple random selection of households, to draw the required number of representative sample respondents, was adopted. Hence, from 4163 total households, 134 were selected for collecting primary data. Data were analyzed using descriptive statistics, relative risk analysis using Cohorts and independent tests using ANOVA. Food security status was measured using the Household Food Balance Model (HFBM). Using this model, the study obtained 1973 kilo calories per individual per day intake and 2108 kilo calorie as their requirement, which indicated households were energy deficient by 135 kilo calorie with $_{2\text{-sided}}$-value < 0.1 critical level (t= -1.747, df =133 & $sig_{2\text{-sided.}}$ 0.083). Independent test results showed that farm income (at p-value < 0.1), gross product (at p-value < 0.05), age of household head (at p-value < 0.1), years of owning land (at p < 0.1) and family size (at p-value < 0.1) contributed significantly to food security status. Cross-tabulation showed a linear relationship between food security and higher education level (at p-value < 0.05), which urges a concern in improving farming societies' literacy to the desired level. In the study areas, about 91.8% of the population produces crops depending on the seasonal rainfall and their daily kilo calorie consumed depends on it; this is statistically correlated with the food insecurity problem at p-value < 0.1 critical level (lambada = 1.75 & sig. = 0.08). Therefore, to tackle the food insecurity problem, alternative method of crop production should be devised such as the establishment of irrigation schemes, water harvesting structures, and water conservation practices, among others.

Key words: food security, calorie requirement, food availability, relative risk

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INTRODUCTION

The World Food Program (WFP) specified that food insecurity in Ethiopia is aggravated by limited market access, health and nutrition services interruption, household displacement and instability due to conflict, inadequate potable water supply, as well as irregularity or delay of general food distributions [1]. Above all, the WFP emphasized that conflict-induced displacements in different parts of the country would negatively affect access to food, income, and humanitarian assistance [1]. In Ethiopia, about 11.7 million smallholder households account for approximately 95% of agricultural Gross Domestic Product (GDP) and 85% of employment. From the total area of 1.13 million square kilometers, about 51.3 million hectares is arable land that has tremendous potential for agricultural development. The agricultural sector accounts for roughly 43% of GDP, and 90% of exports. Nevertheless, food security remains a critical issue for many households and the country [2]. According to the World Bank [3], there is no problem of underdevelopment more serious than food insecurity or more important than studying food security. Analyzing food consumption patterns in poor countries, such as Ethiopia is, therefore, critical in designing national policies which would promote food security.

Several studies were conducted on various regions of Ethiopia. Some of the research used the level of income spent on food items as an indicator of food insecurity [4, 5, 6] and other use dietary diversity as an indicator of household food insecurity [7]. However, this research primarily engaged in quantifying the net kilocalories consumed from own farm production, food items received from donor agencies and during emergency periods, food received from relatives as a charity, food received from merchants as loans, and commercially purchased food items. Secondly, to make comparisons in food deficiency, the study computed the kilocalorie requirements specific to the study area based on the average basal metabolic rate estimation method. The main objective of the study was to determine the food security status of households in the West Hararghe Zone of Oromia regional states of Ethiopia. The specific objectives were to: compute kilo calorie intake per individual per day and determine the average food requirement.

Operational Definitions

Representatives of governments during the 1996 World Food Summit declared that food security exists when all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life [8]. Food security has four components. These are food availability ([8], food access [8], food utilization [9] and food stability [9].

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MATERIALS AND METHODS

Geographical setting Western Hararghe zone is one of the four zones of the Oromia National Regional State and located between 7.55' – 9.33' N latitude and 40.01' – 41.39' E longitude, with an average altitude of 1,900 meters and ranges between 1100 and 3100 meters above sea level (m.a.s.l.). Chiro Woreda is bordered to the North and North East by the Somalia National Regional State, North West by Afar National Regional State, to the West and South West by the Arsi zone, to the south by the Bale zone and East by the Eastern Hararghe zone of the Oromia National Regional State. Western Hararghe zone covers approximately a total area of 17,230 square kilometers (4.9% of the total area of the Oromia Regional State) and is divided into 14 districts which are further divided into smaller administration units called Peasant Associations[1] (PAs) [10]. The capital of West Hararghe Zone, Chiro town, is found 325 kilometers from Addis Ababa on the main road to Harar and Dire Dawa.

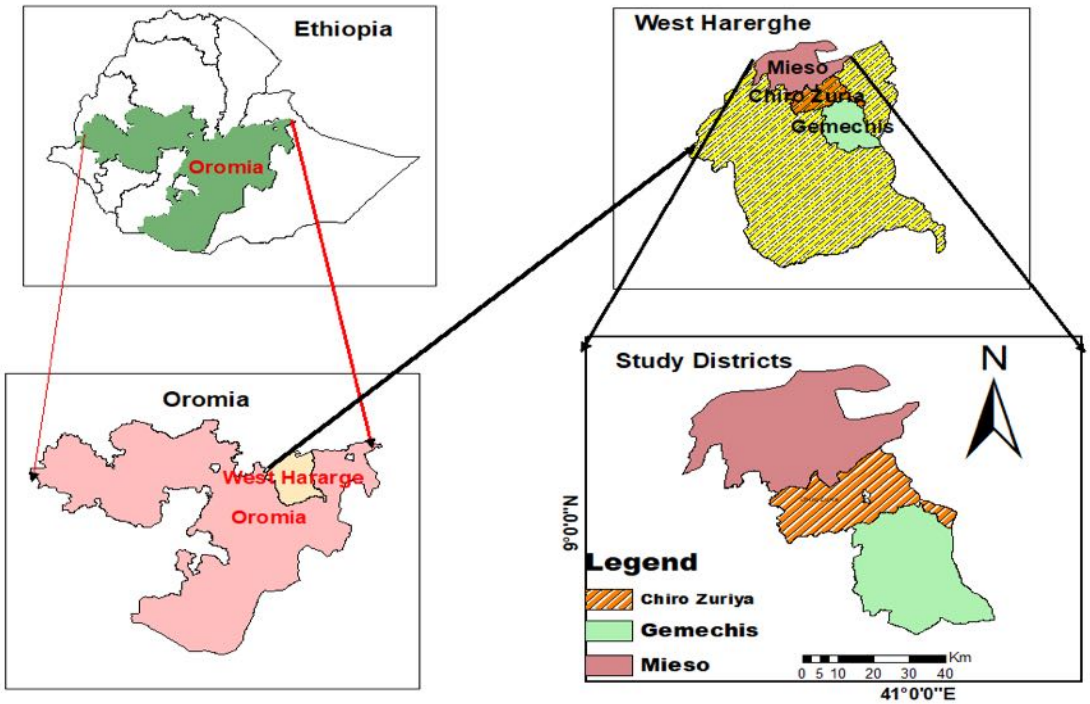

Figure 1: Map of the research region

Sample and Sampling Procedure

[1] Peasant association is the smallest administrative type in Ethiopia that is built upon villages residing near each other

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Respondents were sampled through a series of multi-stage procedures. First, the west Hararghe zone was selected purposively. Secondly, out of 14 Woreda under the Zone, three were selected purposively based on geographic location and differences. Agro-ecologically Chiro belongs to sub-humid, Gemechis belongs to humid and Mieso lies under a desert area. Thirdly, out of the selected Woreda, two Peasant Associations from each Woreda were selected purposely because of the existence of customary institutions, their local and regional importance to food insecurity problems, and infrastructure availability. Fourthly, a simple random sampling was performed to select household respondents for individual questioning purposes.

Sample Size determination

This study applied a simplified formula for populations that are large as provided by Cochran [11], to obtain a representative sample for proportions to determine the required sample size at a 95% confidence level, the degree of precision (d) or the margin of error that is acceptable at 0.05 level of error [12].

$$n = \frac{Z^2(pq)}{d^2} \ldots \ldots \ldots \ldots \ldots \ldots \quad (1)$$

Where n = the original sample size
Z = standard normal deviate
p = the proportion of the population
q = 1-p
d = the level of statistical accuracy
N = the total population

Using this formula, among a total of 4163 households, 134 households were considered enough to obtain representative samples provided that p = 0.1 and q = 0.9 (Table 1).

Methods of Data Collection

This study used both primary and secondary data sources through combinations of structured interviews, and personal observation. Secondary data collection considered government reports, publications, and books. Questionnaires intended to acquire data on socio-economic, and demographic dynamics, and parameters for measuring nutritional status and their challenges. The questionnaire included both open and close-ended questions. Data collection was done by enumerators. Enumerator selection considered their capacity, previous experience on such duties and knowledge of local languages (primarily Oromic). In addition, the enumerators underwent training for two days. The training content addressed: the objectives of the survey, the roles of each member, how to use local measurements and their conversion to standard measurements, interview techniques as well as the ethics

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required during data collection. Key informant interviews were pure purposively used in consulting individuals who had a wider concept and engagements on the issue under study. Thirdly, individual experts were from regional and Woreda-level departments, experts from the Agricultural and Pastoralist office and experts from humanitarian aid assistance and Non-Governmental Organizations (NGOs).

Data Analysis

The analysis process involved the use of Statistical Package for Social Sciences (SPSS) version 23. The major statistical tests used include ANOVA (independence test), cohort (for relative risk analysis), chi-square test (to test variances among nominal values), t-test (to test mean differences), Household food balance model (to calculate food security in kilo calorie) and descriptive statistics such as mean, percentage, minimum, maximum, and standard deviation.

Household Food Balance Model

A modified form of a simple equation termed as "Household food balance model," used by Degefa [13], was originally developed by the Food and Agriculture Organization (FAO) and henceforth used by different researchers in the field. The model was used to calculate the food availability. Generally, the computations of the daily calorie intake involved the following steps:

Step one – convert the net food available in kg into equivalent kilocalories. Since various crops provide different amounts of food energy (calories), their respective conversion factor is used for each crop.

Step two- calculating the net grain food available

$$NGA = (GP + GB + GG) - (HL + GR + GS + GV) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

NGA = NET GRAIN AVAILABLE
GP = TOTAL GRAIN PRODUCED PER YEAR PER HOUSEHOLD
GB = TOTAL GRAIN BOUGHT PER YEAR PER HOUSEHOLD
FA = QUANTITY OF FOOD OBTAINED FROM AID PER YEAR PER HOUSEHOLD
GG = TOTAL GRAIN OBTAINED THROUGH GIFT OR REMITTANCE
HL = POST HARVEST LOSS
GR = AMOUNT OF GRAIN RESERVED FOR SEED PER YEAR PER HOUSEHO
GS = TOTAL AMOUNT OF GRAIN SOLD PER YEAR PER HOUSEHOLD
GV = GRAIN GIVEN TO OTHERS

Step three - determining the kilocalorie consumed per annum. It is the value obtained by dividing the total kilocalories calculated in step 2 by the total number of household members.

Step four - converting the kilocalorie per annum into average daily kilocalorie intake. This value is obtained by kilocalories obtained in step 3 by the number of days of a year (365).

In this research, using individual interviewing the amount of production in kilograms consumed at home was measured but, the net amount of cereals consumed was taken and converted into kilo calories for each cereal type produced. In addition, other sources of food such as purchases, food from aid, and food received as a gift were measured and computed in their kilocalories.

Relative Risk Ratio

The relative risk (RR) or risk ratio is the ratio of the probability of an outcome in an exposed group to the probability of an outcome in an unexposed group. Together with risk difference and odds ratio, relative risk measures the association between exposure and outcome [14]. Under this research, various dichotomous variables and food security status were used akin to exposure and outcome groups. Particularly, the relative risk ratio had been used to measure the relative strengths between percentage compositions in dichotomous attributes such as sex of household head, access to credit, access to non-farm income and education levels.

The relative risk (RR), its standard error and 95% confidence interval, according to Altman [15], are calculated as:

$$RR = \frac{a/(a+b)}{c/(c+d)} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)$$

Where RR is relative risk and a, b, c, and d, are the number of frequencies in 2x2 contingency table.

$$SE\{\ln(RR)\} = \sqrt{\frac{1}{a} + \frac{1}{c} - \frac{1}{a+b} - \frac{1}{c+d}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5)$$

Where, SE is standard error

$$CI = \exp(\ln(RR) \pm 1.96 \times SE\{\ln(RR)\} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (6)$$

Where CI is 95% confidence interval

According to Deeks and Higgins [16] and Pagano and Gauvreau [17], at times where zero causes problems with the computation of relative risk or its standard error, 0.5 is added to all cells (a, b, c, d).

Odds Ratio

The odds ratio is the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. The term is also used to refer to sample-based estimates of this ratio. These groups might be men and women, an experimental

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group and a control group, or any other dichotomous classification. If the probabilities of the event in each of the groups are p_1 (first Group) and p_2 (second group), then the odds ratio is:

$$OR = \frac{p_1}{1-p_1} \div \frac{p_2}{1-p_2} = \frac{p_1}{q_1} \div \frac{p_2}{q_2} = \frac{p_1 q_2}{p_2 q_1} \quad \text{..... (7)}$$

Where, $q_x = 1 - p_x$

An odds ratio of 1 indicates that the condition or event under study is equally likely to occur in both groups. An Odds ratio greater than 1 indicates that the condition or event is more likely to occur in the first group and an odds ratio less than 1 indicates that the condition or event is less likely to occur in the First group. The odds ratio must be non-negative if it is defined. It is undefined if p_2q_1 equals zero, meaning that if p_2 equals zero or q_1 equals Zero [18].

RESULTS AND DISCUSSION

Characteristics of the Population

Under this research, the average age of household heads was found to be 37 years. The average family size in Mieso, Gemechis, and Chiro- Zura was six, five and six, respectively. The average family size of Mieso, Gemechis and Chiro-zuria was about five persons per family in 2019.

Education in Ethiopia remains less than satisfactory. In rural areas, facilities are often thinly spread and there are wide disparities between the poorest and richest children, especially at the primary level [19]. The Symmetrical curve (in Figure 2) illustrates that Chiro study area has extension from the reference line (x=2.5) towards right axis indicating the area's advantage to education than the other two areas. Cross tabs between those areas also indicated Chiro area to have significant advancement in education than the other two areas p-value < 0.1 critical level (λ= 1.649 and approximate sig. = 0.099).

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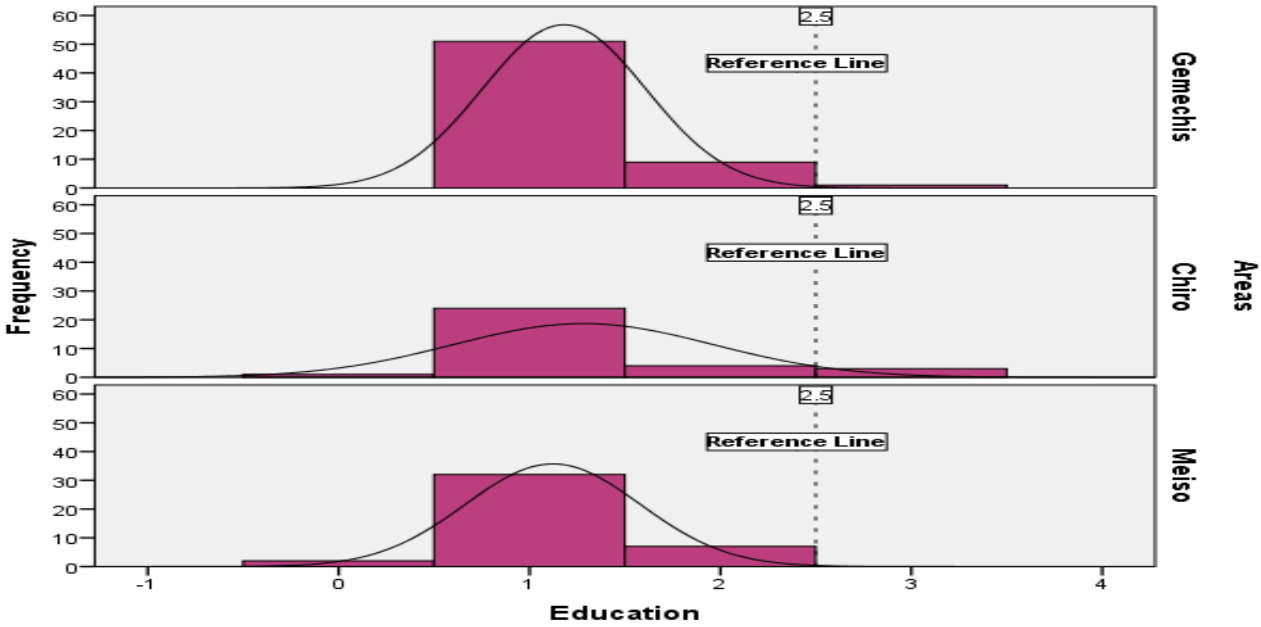

Figure 2: Symmetric distribution curve for education

Correlation indicated that a higher level of education was associated with abrupt decline in numbers of households and this is significant at a p-value < 0.05 critical level (kappa = -.816 & sig. =.014).

The number of male-headed households that were randomly selected was 91.8% of the total respondents. T-test indicated that the number of male-headed households outweighs female-headed households at p-value < 0.05 level of significance (t = 3.45, df = 133 and sig. = .015). According to CSA [20], North Shewa had a population of 2.16 million, of which 50.5% are male and 49.5% are female. Most households included in this research were Muslims. Of the total number, 109 (80%) were Muslims, 21 of them (15.7%) were Orthodox Christianity followers and three in number (7.3%) were Protestants. T-test showed that there exists a significant difference at 5% in number of Muslim followers from Protestant followers and Orthodox followers (t = 6.16, df = 2 and sig. = 0.025) at p-value below 0.05 critical level of significance. Also, correlation indicated high degree of similarity in religion distribution among Gemechis, Chiro and Meiso at a p-value < 0.05 critical (r^2 = .99 and sig. = .040).

Dependency Ratio (DR): Dependency ratio refers to the proportion of economically inactive labor force, less than or equal to 14 and greater or equal to 65 years of age to the active labor force between 15 and 64 years of age [21].

$$\mathrm{DR} = \frac{\text{age below } 15 + \text{age equal to or above } 65}{\text{age eqaul to between} 15 \text{ to } 64} \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

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A low dependency ratio means that sufficient people are working who can support the dependent population [22]. A higher ratio indicates more financial stress on working people and possible political stress [23, 24]. In this study, the average dependency ratio of 1.41 indicated the severity of financial stresses on household survival (test value = 1, t = 5.38, df = 3 and sig. = 0.013). Majority of the farm households practice mixed farming system. In sum, 27.5% in Gemechis, 2.4 % in Miso, and 70.1% in Chiro were crop-only growers. Kappa measure of agreement indicated a high degree of similarity of the household as both crop and livestock growers at p-value < 0.1 level (kappa = 0.25 and sig. = .083). Out of the total percentage of households, 0.7% depended on irrigation, 91.8% depended on seasonal rainfall and 7.5% depended on both methods, particularly in producing crops. Pearson correlation indicated that the study areas have similar patterns in their cropping system significantly at p-value lower than 0.05 critical level (average r^2= .99 and sig. = .045). Symmetric measurement using lambda showed the dependency of kilocalories produced and consumed (λ = 1.75 and significance = 0.08) on cropping pattern that highly relied on seasonal rainfall at p-vale lower than 0.1 critical level. Land in rural areas is a crucial asset for householders. Some farmers have as large a farm size as 4.5 hectares and some farmers have no land at all. Those who have no land at all constituted 6.6% of the total householders in Gemechis, 12.5% in Meiso and 2.4% in Chiro study areas. The overall average land size per household was 0.83 hectares (Table 4). A t-test made at 0.5-a hectare cut-off point (meaning from what is considered the country's average land holding in farming communities) indicated that the areas considered in this study have a greater average size in land holding at p–value < 0.05 (t = 9.45, df =2 and sig. = 0.022).

Kilo calorie intake and the Requirement

Since the average requirement for each area was computed based on sex, and household number, it was different from location to location. In Gemechis Woreda, the average female and male kilocalorie requirement was 2012 kcal per person per day but the actual intake was 1951 kcal per day per person. This area during the study period exhibited an energy shortage of 151 kcal per day per person from local specific energy requirements. In Mieso Woreda, the average requirement per person per day was 2065 kcal. The average actual intake per person per day for that specific year was 1933 kcal. This area scored energy deficiency by 131 kcal on each person. In Chiro Woreda, the average daily calorie requirement per adult was 2248kilocalories per day per person and the actual daily intake per person was 2011 kcal and when compared to the requirement was deficient by 237 kcal/per day per person.

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The average daily requirement per person was 2108 kcal and the actual intake was 1973 kcal. When the requirement and the intake were compared the individuals were energy deficient by 135 kilocalorie. A test conducted to evaluate the statistical significance in kilocalories deficiency from the dietary requirement and the actual intake showed no significant difference at p-value < 0.05 food insecurity (t= -1.747, df = 133 & sig. = 0.083). The minimum amount of energy in Ethiopia as predetermined by Ministry of Finance and Development (MoFED) was about 2200 kilo calorie [25]. Thus, the actual kilo calorie taken was lower by 249 kilocalories, 267 kilocalories, 189 kilocalories and 227 kilo calories in Gemechis, Meiso, and Chiro and from the overall study areas average, respectively. The result by Gemechu [26] revealed that 32.9 and 67.1% of sample households were food secure and food insecure, respectively and the average calorie intake in Mechara was 2069 kcal, which is lower than the national average of 2,100 kcal. In a partial fulfillment thesis at Adaberga Woreda, West Shoa Zone of Ethiopia, Mequanint [27] had found the mean energy intake of all sample/ households as 2216 kcal. His t - value (21.68) confirmed that there is a significant mean difference between food insecure and secure households at p < 0.01. Household calorie acquisition was also analyzed to measure the status of household food security by Gemechu [26]. Million and Muche [28] obtained the percentage of food-secured and insecure households at 57.5%, and 42.5% respectively, the mean value energy available for food insecure and secure households 1418 Kcal/AE/day and 3366 Kcal/AE/day, respectively.

Relative Risk Analysis

Together with risk difference and odds ratio, relative risk measures the association between exposure and outcome [29]. The relative risk (RR) or risk ratio, in this research context, was used to test the ratio of the probability of an event or categorical variable responses in food secure households were compared against the probability of similar categorical response sets in food insecure households.

Access to Credit (CRACS): household responses indicated 6.7% and 12.7%, respectively from FSEC (Food Secured) and not food secure households (FINSEC) have access to credit while, 32.8% and 47.8% from FSEC and FINSEC households, respectively lack the access to credit (N=134). Food secure households (relative risk = 0.17) have lower access than food insecure ones (relative risk = 0.21) by 0.04 points (0.21 - 0.17) or 4%. Results by Eneyew [30] in his study have found 28.6 % of respondents failed to use credit due to fear of repayment, whereas 71.4% of them complained that they lack a credit institution at their locality.

Access to Non-Farm Activities (NFAC): regarding the access to non-farm activities, from which households incur additional income, 17.2% from FSEC and 20.9% from FINSEC responded to have the access and 22.4 % from food secure, 39.6% from food insecure responded not to have the access (N =134). Regarding the access to

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non-farm activities, FSEC households have better chances than the FINSEC ones (Odds Ratio = 1.45). Also, the subtraction of relative risk ration between FSEC and FINSEC households yield FSEC households to have access by more than 8.8%. According to Million and Muche [29] study, 65% of food insecure households and 57 % of food secured households get income from non-farm activities. However, their chi - square analysis shows no significant relationship between food insecurity and other sources of income.

Sex of Household Head (SXHH): from the total households, 37.3% and 54.5 % of males belonged to FSEC and FINSEC groups, respectively and 2.23 and 6% of females belonged in FSEC and FINSEC group, respectively. The relative risk of being food secure was larger to male household heads than female household heads (relative risk =1.047). Chi-value analysis test by Million & Muche [28] showed that male-headed households have a better chance to be food secure than female-headed households in this study area. Most empirical evidence including this one suggests that sex has a positive and significant effect on food security, contrary to a case study by Fikire [31] in Dodota District Oromia region in Ethiopia which reveals male-headedness to have a negative and insignificant effect with coefficient -1.0288 and p - value of 0.339.

Education Level[2] (EDLV): from the whole sample, 43% from FSEC and 67% of respondents from FINSEC had low level literacy level and 10% from FSEC and 14% from FINSEC belonged to medium level literacy. Relative risk estimation indicated that food-secure households have a better chance to educate than insecure ones by 2.1% (relative risk = 1.092). Regarding efficiency, competency, diversifying income, adopting technologies, becoming visionary in creating a conducive environment, and ensuring better living conditions literates outsmart the illiterate ones [32]. However, the statistical analysis of the t-value showed that there was no significant association between the educational status and food insecurity of the households in the study area [30]. From the total, 53 % of sample respondents were illiterate, of which the food insecure constituted 69%. On the other hand, 76% of the food-secure households were literate and the chi-square parameter (36.5) showed a significant association of educational attainment of the households to food security status at less than 0.1 probability level [30].

Test for Independence

Usually, the groups in a two-sample t-test are fixed by design, and the grouping variable has one value for each group. However, there are times when assignments

[2] Education level as a dichotomous variable rearranged for ratio analysis easiness. In such education levels: lower than secondary and high school level category levels ass low and the others as medium

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to one of two groups can be made based on an existing scale variable. In this study, this had been made using the household food security above and below 2200 kcal as the independent groups.

Family Size (FMSZ): the descriptive mean for family size of food insecure households was 5.42 and that of the food secure were 5.27 (Table 8). The standard mean difference (0.6) between the two groups showed inequality in family size among food-secure and insecure households, significantly at p-value < 0.1 level (t = 1.68, df =132 and sig. = 0.096). Family size, according to Dagne [32], is negatively associated with food security status and is significant at a probability level of 1%. A study by Fikre [21] indicates the probability of securing food decreases as family size increases and is significant at p-value < 0.05 probability level. On the contrary, using a t-test, Million and Muche [28] found statistical differences among food secure and insecure households that show family size has a positive relationship with the state of a household's food insecurity.

Farm Income[3] (FINC): the average income from the sale of cereal crops and milk per annum was 12,937 for food insecure and 13,067 for food-secure households (Table 8). The value of money incurred by FSEC and FINSEC group had a descriptive mean difference of 130 birrs. The standard mean-variance test resulted in inequality between the two groups, significantly at p-value < 0.05 critical level (F = 6.28 and sig. = 0.013).

Total Income[4] (TOIN): On average food, insecure household earned 13,654 birrs annually and the food secure household earned 13,835 birrs annually (Table 13). The standard mean-variance between the two categories was significantly different at p-value below 0.05 critical level (F = 6.6 and Sig. = 0.011). Describing the average household food consumption per head of different farm groups, Niemeyer and Hoorweg [33], in Western Kenya, had identified that resident tenants with specialized income sources consumed 2494 kcal/day per head.

Gross Product[5] (GPV): in average, FINSEC produced outputs accounting for 27,496 birr and the FSEC produced outputs accounting for 25,805 birr (Table 8). These standard mean Gross Product variance (10,137 birrs[6]) between FSEC and FINSEC groups showed variation reliably at p–value below 0.05 (F = 5.99 and Sig. = 0.016).

[3] Farm Income here represents the income farmers obtain from selling cereal crops and milk
[4] Total income is the sum results of incomes from farm production and income obtained from non-farm activities
[5] Gross product refers to the total to put produced per family per year (includes consumed and sold produced items in monetary terms)
[6] One United States Dollar (USD) is Equivalent to 55 Ethiopian birr

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Age of Male Household Head (AGMH): the mean age of the male household head of the FSEC was 33.3 % and FINSEC was 36.2%. Food-secure households were younger than food-insecure ones. F-test indicated age difference has contributed its part to food security at p–value below 0.1 critical regions (F = 3.283 & Sig. = .072). Years of Owning Land[7] (YROL): The descriptive mean for food insecurity and food security was 19.6 and 18, respectively (Table 13). The group variance in Years of owning land between FSEC and FINSEC groups displayed variation in food security trend significant at probability lower than p-value of 0.1 (t = 1.62, df = 132 and sig. = 0.081).

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The research above intended to measure the food security status of households and then compare households on various underlying factors. Hence, statistical analysis was conducted and the results were computed. The symmetrical curve of education levels depicts diminishing size towards its right tail, indicating that the number of households continuing to attend higher education was going to smaller. Also, the declining trend line between education level and frequency of household further assures this fact.

Food-secure households have a lower family size than food-insecure households and F-test indicated this factor is inseparable from food security status. In the study area, about 91.8% of the population produces crops relying on the seasonal rainfall. Correlation indicated households' daily kilocalorie consumed much depends on the seasonal rainfall (significantly at $p < 0.1$). This refers to the inevitability of occurrence of seasonal food insecurity if season of rainfall shift irregularly. The Minimum Daily Recommended Allowance in Ethiopia is 2200 kilo calorie per individual per day. But, households in the study area consumed 1973 kilo calories per individual per day. The mean difference between the Minimum Recommended Daily Allowance and the kilo calorie consumed by the study sample is 227 kilo calories. This difference tested by T-test and flagged was significant at 95% probability level. The average income (from farm activity and non-farm activities) of food-secure households is 13,654 birrs (about 248 USD) annually. The average income (from farm activity and non-farm activities) for food-insecure household was 1383 birrs annually. The mean difference between income of food secure and insecure household is significant at $p < 0.05$ critical level.

[7] Years of owning land indicate the number of years the household head guarantees the land as private property

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Correlation results indicate a positive association between food security and education level. Therefore, efforts must be made to upgrade farmers' education. There existed a negative correlation between food security and family size therefore, interventions such as family planning are required. The dependency of farmers on rainfall was high, this indicates production of food is faced with uncertainties therefore, contingencies (in form of irrigated farms) are needed to cope in times of anomalies of seasonal rainfall.

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Availability of data and materials

The data supporting the conclusion of this article are included within the article.

Authors' contributions

Firew H and Aman Kiniso (PhD) conceived, designed the research proposal, and defended the proposal successfully to grant the funds needed from Oda Bultum University. Data collection, analysis and writing-up the manuscript was done by Firew Hailemariam.

Consent for publication

A consent letter was also sent by the co- author (Aman Kiniso) for approval of the final version of the manuscript to AJFAND editorial assistance board.

Competing interests

The authors declare that they have no competing interests.

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Table 1: Sample size of households

Location	Household size	Proportion	Adjusted	Woreda
Kuni Segeriya	1207	0.3	39	Gemechis
Legelfto Soro	686	0.2	22	
Husse Sodoma	485	0.1	16	Meiso
Husse Menidera	508	0.1	16	
Yabdo Shembeko	714	0.2	23	Chiro
Wachu Efa Bas	563	0.1	18	
Sum	4163	1	134	

Table 2: The educational level of household heads

Level	Areas			Total
	Gemechis	Chiro	Meiso	Frequency
No education	0	1	2	3
Primary level	51	24	32	107
Secondary and high school	9	4	7	20
Preparatory level	1	3	0	4

Table 3: Dependency Ratio of the study areas

Dependency ratio	Average	Meiso	Gemechis	Chiro
DR	1.41	1.39	1.46	1.19
SR	0.99	0.99	0.67	1.52
Mean test: Test value = 1; t = 4.28; Df = 2; Significance = 0.05				

Where, DR is Dependency Ratio and SP is Support Ratio

Table 4: Land holding

Research area	Range	Mean	Std. Deviation	Mean test
Gemechis	4.5	0.82	0.623	Test value = 0.5
Meiso	1.5	0.78	0.447	t = 9.45
Chiro	1.75	0.9	0.392	DF = 2 Significance = 0.022

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Table 5: Kilo Calorie Intake versus the Requirement

Statistics	Gemechis (2012kcal)		Meiso (2065kcal)		Chiro (2248kcal)		Sum	
	F	%	F	%	F	%	F	%
Food secure	27	44.3	13	40.6	14	34.1	54	40.3
Food insecure	34	55.7	19	59.4	27	65.9	80	59.7
Mean (kcal)	1951		1933.2		2011		1973	
Std. deviation	864.6		880.7		953		895.2	
Minimum	255		264		631		255	
Maximum	3978		3240		5214		5214	
N	61		32		41		134	

Table 6: Descriptive of Dichotomous Variables

Variables		Food secure (>=2108kcal)		Food insecure (<2108kcal)	
		Frequency	Percent	Frequency	Percent
Credit access	Yes	9	17.0	17	21.0
	No	44	83.0	64	79.0
	Total	53	100	81	100
Education	No education	1	1.9	2	2.5
	Primary	42	79.2	65	80.2
	High school	7	13.2	13	16.0
	Preparatory	3	5.7	1	1.2
	Total	53	100	81	100
Non-farm access	Yes	23	43.4	28	34.6
	No	30	56.6	53	65.4
	Total	53	100	81	100
Sex	Male	50	94.3	73	90.1
	Female	3	5.7	8	9.9
	Total	53	100	81	100

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Table 7: Risk and Odds Ratio Estimation

Description	Statistics		
	Value	Lower	Upper
Odds ratio $CRAC_1$(yes /no)	0.77	0.31	1.88
Relative risk $CRAC_1$(yes /no)	0.809	0.399	1.679
Odds Ratio for $NNFA_1$ (yes / no)	1.45	0.71	2.95
Relative risk $NNFA_1$ (yes / no)	1.255	0.187	1.928
Odds ratio $SXHH_1$(male /female)	1.826	0.13	3.53
Relative risk $SXHH_1$ (male /female)	1.047	0.949	1.154
Odds Ratio for $EDLV_1$ (moderate/low)	1.11	0.45	2.73
Relative risk for $EDLV_1$ (moderate/low)	1.092	0.524	2.274

Keys: Cohorts with subscript '1' indicated variables representing the food insecure categories and cohorts with subscript '2' indicated variables categorized as food secure households
SXHH – Sex of Household Head, CRAC- Credit Access, NNFAC- Nonfarm Access, EDLEV- Education Level

Table 8: Test of Independence

Variable's designation	Descriptive		Independence test
	Mean	Std. Deviation	Test results
$FMSZ_1$	5.42	1.42	T = 1.68, df =132 & Sig. = 0.096
$FMSZ_2$	5.27	1.35	
$YOLD_1$	19.65	8.52	T= 1.62, df = 132 & Sig. = 0.081
$YOLD_2$	18	9.57	
$FINC_1$	12937	21712	F = 6.28 & Sig. = 0.013
$FINC_2$	13067	17780	
$TOTI_1$	13654	22068	F = 6.6 & Sig. = 0.011
$TOTI_2$	13835	17967	
GPV_1	27496	31937	F= 5.99 & Sig. = 0.016
GPV_2	25805	26589	
$AGHH_1$	36.2	14.5	F = 3.283 & Sig. = .072
$AGHH_2$	33.3	17.2	

Keys: Cohorts with subscript '1' indicated variables representing the food insecure categories and cohorts with subscript '2' indicated variables categorized as food secure households
FANSZ- family size, YOLD – years of owning land, FINC – farm income, TOTIN - total income., GPV- gross product value, AGHH – age of household head

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