*Sumerianz Journal of Biotechnology, 2022, Vol. 5, No. 2, pp. 34-42*
*ISSN(e): 2617-3050, ISSN(p): 2617-3123*
*Website: https://www.sumerianz.com*
*DOI: https://doi.org/10.47752/sjb.52.34.42*



Original Article Open Access

# Determinants of Household Dietary Diversity of Peri-Urban Modern Small-Scale Irrigation Project Beneficiary Female-Headed Households in Kobo Town, Ethiopia

**Goitom Sisay**
Department of Geography and Environmental Studies, Kotebe University of Education, Addis Ababa, Ethiopia
Email: sisaygoitom@gmail.com

**Article History**
**Received: 7 March 2022**
**Revised: 15 May 2022**
**Accepted: 20 May 2022**
**Published: 25 May 2022**

**How to Cite**
Goitom, S., 2022. "Determinants of Household Dietary Diversity of Peri-Urban Modern Small-Scale Irrigation Project Beneficiary Female-Headed Households in Kobo Town, Ethiopia." *Sumerianz Journal of Biotechnology*, vol. 5, pp. 34-42.

## Abstract
Background: Dietary diversity as a complex and multi-dimensional issue is accredited to a range of interconnected factors. The general objective of this study was to identify determinants of Household Dietary Diversity of peri-urban modern small-scale irrigation project beneficiary female-headed households. Methodology: To achieve this objective, a cross-sectional survey method was used on 333 randomly selected households. Descriptive, inferential, as well as econometrics techniques, were employed to analyse the data. Accordingly, the binary Logit model was used to identify the determinants of Household Dietary diversity. Result: The model output publicized that household dietary diversity was significantly and positively determined by households' active family labour force, aggregate per capita agricultural produces, bank saving account and access to remittance. On the contrary, the family size was significantly and inversely associated with household dietary diversity. To improve diversified dietary feeding practices, intervention in controlling family size, improving agricultural production and productivity, and diversifying households' income ought to be strengthened.
**Keywords:** Binary logit model; Household dietary diversity; Nutritionally adequate; Nutritionally inadequate.

## 1. Introduction
Dietary quality correlates directly with nutritional diversity and is inversely associated with malnutrition [1-3]. The higher the dietary diversity score, the more food groups are consumed, the more diverse the diet, and therefore the more nutritious the diet.

Poor access to nutritionally sufficient along with a quality diet which is essential to human health poses a major challenge, especially to the poor in developing nations where household food security is inadequate. Their diets are defined by starchy staple foods that contain inadequate animal products, as well as few fresh fruits as well as vegetables [4-6]. The poor nutritional status of smallholder farming households in Ethiopia has always been a problem [7]. In Ethiopia, about 60% and 40% of the households had low and medium diet diversity scores respectively [8]. Around 58% and 30% of the Ethiopian households consumed four as well as three food groups out of seven respectively [9]. The result of the study by CSA and World Bank [10] also disclosed that three food groups (cereals, edible oils and legumes) dominate the Ethiopian meal dish. The same study also divulged that cereals are the most commonly consumed food items with 90% of households reporting an average consumption of 6 or more

out of 7 days. Moreover, a study by Kassie, *et al.* [11] publicized that in Ethiopia cereal flour made baked flatbread (*injera*) was commonly consumed wrapping a sauce prepared from a pulse/vegetable crop/meat alone/ less regularly combination of the two/more of these.

For achieving household food security and alleviating poverty, the present Ethiopian government is escalating and prioritizing modern small-scale irrigation projects. Consistent with this, as the study area is acknowledged among the moisture-deficit, drought-prone and people are food insecure, as of 2003 attempts have been made to spread the practice of modern small-scale irrigation projects [12].

There is little evidence of a link between small-scale irrigation projects and the pathways to achieve nutritional outcomes [13]. In addition, the existing literature on the impact of commercialization on food consumption and nutrition has shown complex and controversial results, where the supporters claim that by exploiting comparative advantage, commercialization could enhance farm incomes and improve nutrition [13-17]. Opponents, on the other hand, argue that malnutrition cannot be reduced if the resources used to produce export crops are instead used to produce food for the local economy [5]. The empirical study findings of Degeye, *et al.* [8] revealed that households with access to irrigation were encouraged to produce and allocate disproportionally more land to risky perishable crops commanded in the market and less land to staples. However, the risk of selling these crops ultimately jeopardized their nutritional status. Similarly, a study by Haile [18] found that 89% of sample farmers in northern Ethiopia produce onions based on deep good irrigation.

In an Goitom [12] empirical study, onion and tomato production accounted for more than 90% and 8% of the irrigated land, respectively in a modern small-scale irrigation project surrounding Kobo town. In addition, the result of dietary diversity scores (HDDS) in the same household found that 68.2% and 31.8% of sample households had low levels of HDDS (nutritionally inadequate dietary diversity) and medium HDDS (nutritionally adequate dietary diversity), respectively. The survey result also further discovered that 43.4% and 80.9% of irrigation participants and non-participant households had nutritionally inadequate dietary diversity, respectively. The findings of this study exposed irrigation-beneficiary female-headed households' nutritionally inadequate diets.

Empirical evidence for factors contributing to low dietary diversity hardly exists [19, 20]. Nutritional diversity as a complex and multidimensional phenomenon stems from a range of interrelated social, economic and biophysical factors as well as ecological, technical and institutional factors. As to Taruvinga, *et al.* [21] participation in irrigation projects, gender, income, education, access to home gardens and ownership of small livestock were identified as factors in the attainment of high diversity. Moreover, the extent of technology related to food production, processing, cooking and storage has been identified as a determinant by Keding, *et al.* [22].

Even in Ethiopia, the determinants of household dietary diversity are very complex and are attributed to a variety of factors. For example, available empirical evidence analyzing key factors associated with household dietary diversity in different parts of Ethiopia has identified a variety of social, economic, physical and environmental factors [8, 19, 23-28].

Identifying determinants of household dietary diversity is important to devise policy options and interventions which in turn will help to achieve food and nutrition security [26]. Moreover, as far as I know, no empirical research has been done on the raised issue yet. Therefore, the purpose of this study is to identify determinants of peri-urban modern small-scale irrigation project beneficiary female-headed households' dietary diversity status in Kobo town, Ethiopia.

# 2. Materials and Methods

## 2.1. Research Methodology

Both primary and secondary data sources were used to achieve research objectives. Employing a structured questionnaire, primary data was collected from sample household heads through trained assistants and by the researchers after performing appropriate tests on the questionnaires. A two-step sampling procedure was used to select the sample household. First, the study town was chosen specifically because of the existence of a modern small-scale irrigation project beneficiary female-headed households and the familiarity of the study town to the researcher. Due to their accessibility, proximity to the study town, and the number of irrigation project beneficiaries, 15 irrigation sites from 41 modern small-scale irrigation projects situated in the study area were specially selected in the second phase. Of the selected irrigation sites, approximately 2367 households are reported as beneficiary households, of which 1619 (68.40%) are male and 748 (31.60%) are female [12]. To obtain a representative, the sample size was calculated using the online sample size determination software from Creative Research Systems [29]. The sample size was calculated with a 95% confidence level and a 4% margin of error. As a result, 333 households were included through a simple random sampling technique.

To analyse the data, descriptive and inferential statistics as well as econometrics techniques were used. Using cross-tabulations, bivariate analysis was also done to recognize the association between HDDS and potential explanatory variables. As a result, t-test and chi-square were used to test the statistical significance of the mean of continuous and dummy variables, respectively. The binary logit model was also used to investigate the statistical relationship between the independent variables and the HDD. The dependent variable (HDD) had a value of 1 if the household was nutritionally adequate and a value of 0 otherwise.

Household Dietary diversity as a multidimensional concept is determined by a complex set of variables. It is held that the selection of determinant explanatory variables in empirical HDD studies is often assumed to lack solid rationale. Subsequently, HDD can be regarded as being determined by a host of interrelated factors. Knowing this, the independent potential Explanatory variables were selected through extensive relevant literature reviews, previous empirical findings, experts' opinions, and the knowledge and familiarity of the researcher on the status of household

dietary diversity in the study area. The study then considered the following possible explanatory variables, as shown in Table 1 below.

**Table-1.** Description of HDDS Potential Explanatory Variables with their hypothesis

| Variables | Description and Measurement | Expected signs |
|---|---|---|
| Age of household head | Number of years | +/- |
| Health Status of Household head | Number of Months in a year households reported to fell healthy | + |
| Literacy status of Household head | 1 For literate ( read and write) and 0 otherwise | + |
| Family Size | Household members in Adult Equivalent | - |
| Active Family labour Force | Number of Active Labour force in the household | + |
| Participation In Irrigation Projects | 1 For Yes and 0 Otherwise | + |
| Livestock Ownership | Total Livestock Units (TLU) | + |
| Farm Land holding Size | Total Cultivated farmland holdings in Hectare | + |
| Per Capita Agricultural Produces | Total Annual Grain Produces in Quintals | + |
| Access to Remittance | 1 For Yes and 0 Otherwise | + |
| Access to Credit services | 1 For Yes and 0 Otherwise | +/- |
| Access to Bank Saving Accounts | 1 For Yes and 0 Otherwise | + |

To organize and statistically analyse the collected quantitative data SPSS and STATA software was used.

## 3. Results and Discussion

To measure the availability and accessibility components of food security, household dietary diversity scores (HDDS) was validated as a qualitative method [30]. Accordingly, employing HDDS, [12] computed sample households' dietary diversity. HDDS corresponds to the number of food groups or foods that the household has consumed in the last 24 or 48 hours [30]. Consequently, using [31] HDDs of 7 or more food groups, 4 to 6 food groups, and 3 or fewer food groups as high, medium, and low HDDS cut-off points respectively, households were again clustered into nutritionally inadequate with low HDDS and nutritionally adequate with medium and high HDDS.

Household heads are one of the demographic variables that can influence household heads' human capital and wealth accumulation which in turn may influence household dietary diversity. As shown in Table 2, the average age of the sample household head was 49.53 years. In addition, the average ages of nutritionally adequate and inadequate household heads were calculated to be 45.16 and 51.57 years respectively. The computed average age of a nutritionally inadequate household head is greater than the nutritionally adequate household head. Therefore, households that are headed by younger heads tend to enjoy more diverse meals than older ones. However, the results of the statistical associations of the independent samples did not show significant household head age differences between nutritionally inadequate and adequate households.

The health status of the household head is an element of human capital that can determine a household's human resources. A healthy household head will inevitably be able to do their job well and make a living effectively. Therefore, the researcher tried to estimate the number of months when the head of household felt healthy and actively participated in various income-generating activities in the year previous to the survey. As shown in Table 2, the average number of months that the head of household felt healthy and actively engaged in various income-generating activities was calculated to be 8.77 months. In addition, the calculated average number of months the head of household felt healthy and actively participated in various income-generating activities for nutritionally adequate and inadequate heads of household was estimated to be 10.01 months and 8.20 months, correspondingly. The independent sample test had a statistically significant effect $t\ (284{,}347) = 4{,}978$, $p < 0.01$ at the 99% significance level. The significant value of this test ensured that nutritionally adequate and inadequate households were headed by households of various health conditions. Therefore, it was found that householders who were less likely to get sick in the year previous to the survey and were not forced to be absent from income-generating activities benefited from a more diverse diet than their counterparts.

Family size has been identified as one of the most important demographic variables in determining household food security. Therefore, the family size of the sample household was converted to the adult-equivalent household size using a standardized adult-equivalent conversion factor that takes into account the age and gender of each family member of the household. As a result, as shown in Table 2, the calculated average Adult equivalent family size for the sample households was 2.28. In addition, nutritionally adequate and inadequate sample households also showed deviations in the calculated mean adult equivalent family size; where 2.20 and 2.32 were for households with nutritionally adequate or inadequate respectively. The independent sample test had a statistically significant effect; $t\ (244.262) = 0.864$, $p < 0.05$ at the significance level of 95%. The significant value of this test shows that

nutritionally adequate and inadequate households varied family sizes. Households with inadequate nutrition had a relatively large family size compared to households with sufficient nutrition.

The number of active family forces in the household as a factor of human capital and a demographic variable determines the effective execution of the household's livelihood, which again affects the household's nutritional security [32, 33]. Therefore, an attempt was made to estimate the number of economically active families in each sample household. As shown in Table 2, the average number of working households in the sample households is calculated to be 1.37. In addition, there was a difference in the number of the active family labour force between well-nourished and poorly-nourished households; 1.78 and 1.17 were the calculated mean active family labour forces respectively. The independent sample test had a statistically significant effect t (168.830) = 5.912, $p< 0.01$ at the 99% significance level. The significant value of this test showed that nutritionally adequate and inadequate households were staffed with different active family labour force sizes. As a result, nourished households had a relatively large number of active family labour forces who can carry out various income-generating activities and improve their nutritional status.

Livestock and their by-products are the basic means of livelihood in mixed farming communities. Therefore, livestock ownership is considered to be seen as an indicator of prosperity and household food/nutrition security [34-36]. According to the Total Livestock Unit (TLU) record, Table 2 shows that the calculated average TLU of the sample households is 1.27. In addition, discrepancies in mean TLU values were observed between nutritionally adequate households (2.07 TLU) and nutritionally inadequate households (0.90 TLU). The Independent sample test was found to have a statistically significant effect t (157.448) = 5.859, $p< 0.01$ at the 99% significance level This significant value of the t-test designated that nutritionally adequate and inadequate households possessed different sizes of livestock. As a result, nutritionally adequate households have more livestock than nutritionally inadequate households and are likely to have better access to a variety of dairy products, which helps to diversify their daily diet.

The size of farmland is an essential resource that fundamentally determines the quantity and type of household grain production, income and food security [32, 33]. The land was an important factor in food diversity, and households with larger agricultural areas had higher nutritional diversity scores [37]. As shown in Table 2, according to the survey results of this study, the average cultivated area per capita was less than 1 hectare (0.75 hectares). It was also found that the average calculated farm sizes for nutritionally adequate and inadequate households were 0.81 hectares and 0.72 hectares, respectively. The average farm size of nutritionally adequate households is slightly larger than that of nutritionally inadequate households, so households with a large per capita tract of cultivated land enjoy a diversified daily diet than their counterparts. However, the results of the independent samples t-test did not show a significant difference in Farm Land Holding Size between nutritionally inadequate and adequate households.

Africa's food insecurity is due to both low agricultural produce and low income [38]. Aggregate production deals with the availability component of food security and is the most important factor of household food security/insecurity in rural areas of developing countries [32]. Since the livelihoods of sample households are highly dependent on agriculture and their main food source comes from their production, attempts have been made to estimate the total annual yield of agriculture per capita. The survey results as shown in Table 2, revealed that the average annual total grain production per capita was 6.27, 9.54, and 4.74 quintals for all sample households, nutritionally adequate households, and inadequate households, respectively. The independent sample test had a statistically significant effect t (133,750) = 7,366, $p<0.01$ at the 99% significance level. The results of an independent sample t-test confirmed that there was a significant average annual total amount of product per capita among households with sufficient and insufficient nutrition. From this, it can be inferred that during the year before the survey, the total per capita production of nutritionally adequate households was relatively high compared to nutritionally inadequate households**.**

**Table-2.** Descriptive Statistics Summary of HDDS explanatory continuous variables

| **Continuous Variables** | **Total** | | **Households' Dietary Diversity Score** | | | | ***t-value*** |
|---|---|---|---|---|---|---|---|
| | | | **Nutritionally adequate** | | **Nutritionally inadequate** | | |
| | Mean | SD | Mean | SD | Mean | SD | |
| Household Head's Age in Years | 49.53 | 10.76 | 45.16 | 10.76 | 51.57 | 10.16 | 5.156 |
| Household Head's Health Statius in Months | 8.77 | 3.61 | 10.01 | 2.66 | 8.20 | 3.85 | 4.978*** |
| Family Size in Adult Equivalent | 2.28 | 1.21 | 2.20 | 1.05 | 2.32 | 1.27 | 0.864** |
| Number of Livestock in TLU | 1.27 | 1.60 | 2.07 | 1.84 | 0.90 | 1.32 | 5.859*** |
| Farm Land Size in Hectares | 0.75 | 0.17 | 0.81 | 0.17 | 0.72 | 0.17 | 4.366 |
| Aggregate agricultural produces per capita in quintals | 6.26 | 5.03 | 9.54 | 6.30 | 4.74 | 3.37 | 7.366*** |
| Household's active family labour force | 1.37 | 0.86 | 1.78 | .936 | 1.17 | 0.74 | 5.912*** |

** and *** refer to significance at 5% and 1% probability levels respectively, SD- Standard Deviation

Literate Households heads are more likely to be aware of the necessity of a diversified diet for the physical and cognitive development of their household members. In this study, sample household heads were divided into literate and illiterate (who cannot read and write). As a result, as shown in Table 3, the calculated average literacy rate of the

sample household heads was 40.8% (of which about 52.8% and 35.2% were nutritionally adequate and -inadequate households respectively). The existing significant differences in literacy status among sample households headed with adequate and inadequate nutritional status were found to be significant in the chi-square test of association $x^2(1, N = 333) = 9.251$, $p < 0.01$ at the significance level of 99%. Therefore, compared to illiterate households, educated household heads diversified their household diets. This might be attributed to the fact that better-educated household heads with better nutritional awareness can diversify their work environment and through higher earning potential can diversify their household dietary diversity. Similarly, a study by Ochieng, *et al.* [37] showed that the education of heads of a household has a significant and positive impact on the nutritional diversity of households, children and women.

In the study area, the survey revealed that households who did not cultivate their cultivated land were forced to lose half of their income due to sharecropping arrangements. As can be seen from Table 3, of the 333 sample households, only 113 (33.9%) participated in peri-urban modern small-scale irrigation projects, and the remaining 220 (66.1%) did not participate. Those non-participants were forced to sharecrop out their irrigable farms on a half-half basis, losing about half of the yield in the process. As a result, HDD survey results show the prevalence of household nutritional security status inequality between participant and non-participant households. Of the sample households, 64 (60.4%) and 49 (21.6%) were a nutritionally adequate participant and non-participant households respectively. The chi-square test statistical association was found to be significant $x^2(1, N = 333) = 48.501$, $p < 0.01$ at the 99% significance level. This significant value of the chi-square test explained that there was a significant difference in nutritional security status between participant and non-participant households. Households who participate in irrigation projects reported the cultivation of grains, vegetables, fruits and other cash crops all year round. From this, it can be concluded that participating households are more likely to have better access to a balanced diet than non-participating households. Similarly, an empirical study in Afghanistan by Kawsary, *et al.* [16] assured the positive correlation between irrigation facilities and diversity of food intake. In addition, another study by Passarelli, *et al.* [13] using data from a cross-sectional household survey collected in Ethiopia and Tanzania showed the contribution of small-scale irrigation systems in improving diets by improving both household income and the variety of crops produced by farmers.

Saving in modern financial institutions as a self-insurance financial capital means that households have the money to save, which in turn is the economic feasibility of households, and has a significant positive effect on food security and livelihood [33]. Therefore, an attempt was made to investigate the savings habits of sample households in modern financial institutions. As shown in Table 3, the survey results show that 35.7% (119) of the sample households had savings accounts in the year before the survey and saved some of their income at modern financial institutions. In addition, the findings also showed differences in savings experience between nutritionally adequate and inadequate households. 67 (63.2%) and 52 (22.9%) nutritionally adequate and inadequate households indicated their saving practice in modern financial institutions respectively. Differences in savings practices were shown by the significant chi-square test $x^2(1, N = 333) = 51.101$, $p < 0.01$ at the significance level of 99%. Thus, a household with adequate nutritional status saves a share of its income compared to a household with inadequate nutrition.

Literature on food / nutritional security and livelihoods has shown that household access to credit services as financial capital provides an opportunity to participate in activities that generate a variety of incomes. This will strengthen household purchasing power and avoid the risk of household food insecurity in the event of a food shortage [33]. In line with this view, attempts were made to classify sample households with and without access to microfinance credit services. As a result, as shown in Table 3, only 96 households (28.8%) were able to use the credit services in the previous year of the survey. Of these, 38 (35.8%) and 58 (25.6%) were nutritionally adequate and inadequate households respectively. The chi-square test statistical association was found to be significant $x^2(1, N = 333) = 3.735$, $p < 0.10$ at the 90% significance level. This significant value of the chi-square test confirmed that nutritionally adequate and inadequate households showed a significant discrepancy in access to credit services. Therefore, it can be concluded that well-nourished households are more likely to benefit from local credit services to diversify their diets when compared to undernourished households.

Remittances that households received on a regular or irregular basis as social capital from people living domestically or internationally are one of the most important elements of urban and rural livelihood strategies [38]. As to ILO [39], the study area was identified due to its high incidence and historic emigration to Gulf countries. Therefore, the researcher asked the head of household about their access to remittances in the year previous to the survey. As shown in Table 3, 86 (25.8%) of the sample households testified that they received the remittance. Of these, 41 (38.7%) and 45 (19.8%) were nutritionally adequate and inadequate households respectively. The chi-square test statistical association was found to be significant $x^2(1, N = 333) = 13.411$, $p<0.01$ at the 99% significance level. This significant value of the chi-square test confirmed that households with adequate and inadequate nutritional Status did not have equal access to remittances. As a result, it can be concluded that well-nourished households are more likely to be remittance recipients than undernourished households.

**Table-3.** Descriptive Statistics Summary of HDDS explanatory discreet variables

| Discrete Variables | Total | | Households' Dietary Diversity Score | | | | Chi-Square Value |
|---|---|---|---|---|---|---|---|
| | | | Nutritionally adequate | | Nutritionally inadequate | | |
| | Number | % | Number | % | Number | % | |
| **Household heads' Literacy Status** | | | | | | | |
| Literate | 136 | 40.8 | 56 | 52.8 | 80 | 35.2 | 9.251*** |
| Illiterate | 197 | 59.2 | 50 | 47.2 | 147 | 64.8 | |
| **Participation in Irrigation** | | | | | | | |
| Yes | 113 | 33.9 | 64 | 60.4 | 49 | 21.6 | 48.501*** |
| No | 220 | 66.1 | 42 | 39.6 | 178 | 78.4 | |
| **Remittances** | | | | | | | |
| Yes | 86 | 25.8 | 41 | 38.7 | 45 | 19.8 | 13.411*** |
| No | 247 | 74.2 | 65 | 61.3 | 182 | 80.2 | |
| **Saving Accounts** | | | | | | | |
| Yes | 119 | 35.7 | 67 | 63.2 | 52 | 22.9 | 51.101 *** |
| No | 214 | 64.3 | 39 | 36.8 | 175 | 77.1 | |
| **Credit Facilities** | | | | | | | |
| Yes | 96 | 28.8 | 38 | 35.8 | 58 | 25.6 | 3.735* |
| No | 237 | 71.2 | 68 | 64.2 | 169 | 74.4 | |

*** and * refer significant at 1% and 10% probability levels respectively.

# 4. Result of the Regression Analysis

The collected data was checked for multi-co linearity issues before the model parameters were estimated. Multi-co linearity occurs when at least one of the independent variables shows a linear combination with the other variable [40]. The effect of multi-co linearity was investigated using the Variance Inflation Factor (VIF) and Contingency Factor (CC) of continuous and discrete variables, respectively. The rule of thumb with a VIF value of less than 10 considers it to be non-multi-co linearity, but if the VIF value is greater than 10, it causes problems and should be excluded from the model. On the other hand, the value of CC is between 0 and 1. A value of 0 justifies no association between variables, and a value close to 1 allows a high degree of association. Variables with a CC score of less than 0.75 specify weak associations, as per the district rule, and higher values indicate stronger associations between variables [40]. However, in this study, the calculated VIF (mean VIF value of 2.71) and CC value (less than 0.75) ensured that there were no problems with multi-collinearity. Therefore, all the hypothetical variables were included in the model.

The goodness of fit of the model was measured by count $R^2$. This shows the number of sample observations reasonably predicted by the model [40]. As shown in Table 4, the pseudo $R^2$ of the maximum likelihood estimation of the logit model was computed to be 0.3380. This means that about 33.80% of the probability that a household is nutritionally adequate is explained by the model's independent variables. In addition, an estimated log-likelihood estimate of -137.92 and a very significant chi-square value (140.81) at $p < 0.001$ also establish the quality of the model and its strong explanatory power. Therefore, this model fits well with this study.

As displayed in Table 4, the output of the binary logistic model shows five variables of the 12 explanatory variables that are likely to determine the HDD, which were found to be statistically significant determinants. These variables were family size, active family labour force, per capita agricultural output, savings, and remittances.

**Table-4.** Binary model result about Household Dietary Diversity Determinant variables

| Variable | Coefficients | Odd ratio | p-value |
|---|---|---|---|
| Participation in irrigation | 0.1354341 | 1.145034 | 0.817 |
| Family size (Adult Equivalent) | -1.148611 | .317077 | 0.000*** |
| Aggregate Agricultural Production (Quintals) | 0.1969307 | 1.21766 | 0.000*** |
| Age of household head (Years) | -.0368459 | .9638247 | 0.261 |
| Health status of household head (months) | -.1500031 | .8607053 | 0.131 |
| Farmland holding size (Hectares) | .3058925 | 1.357836 | 0.776 |
| Total Livestock Unit | .1482964 | 1.159857 | 0.290 |
| Educational status of household head | -.0916786 | .9123983 | 0.786 |
| Access to remittance | 1.098175 | 2.998688 | 0.002*** |
| Access to credit services | .3663088 | 1.442401 | 0.410 |
| Savings | .6969789 | 2.007678 | 0.082* |
| Active family labour force (Number) | .8853359 | 2.423798 | 0.013** |
| Constant | 1.121926 | | 0.659 |
| Number of observations 333 | | | |
| Pearson Chi-Square (13) 0.0000 | | | |
| Log-likelihood -137.92012 | | | |
| $R^2$ 140.81 | | | |
| Pseudo $R^2$ 0.3380 | | | |

*, ** and *** refer significant at 1%, 5% and 10% probability level respectively.

The model results for this study publicized in Table 4, show that there is a significant negative relationship between household size and HDDS. The reverse relationship shows that the odds ratios that support the probability of being nutritionally adequate decrease as the size of the family measured in adult equivalents increases. Other determinants of HDD remain constant, as the size of the family increases by one unit equivalent to an adult, the odds ratio for a nutritionally adequate household declines by a factor of 0.317077 at a !% probability level. Together with degraded and fragmented farmland and the occurrence of frequent droughts, large families with a large number of economically inactive families are putting pressure and competition on limited resources and household food baskets. Therefore, large households were often nutritionally inadequate than nucleated households. The results of this study promote widespread practice of family planning programs targeted to reduce rapid population growth. Consistent with this finding, [23] acknowledged a significant negative association between large family size and dietary diversity.

As hypothesized, the results of the model presented in Table 4 show that HDDS is significantly and directly determined by the availability of active family members in the household. Positive correlations indicate that the odds ratios in favour of the probability of being nutritional adequate increase with an increasing number of active family workers in the household. If the number of the active labour force in the household is increased by one active person, ceteris paribus, with a 5% level of probability, the odds ratio in favour of being nutritional adequate will increase by a factor of 2.423798. Therefore, households with a large number of active family workers tended to be nutritionally adequate and vice versa. A credible justification is that households with a large number of active family workers engaged in various income-generating activities may be provided with additional income to meet their family's food needs and escape the problem of undernourishment.

Consistent with the hypothesis, the econometrics results of the model displayed in Table 4confirmed that the probability of being nutritionally adequate was determined by holding a savings account significantly and positively. The Positive association indicates that the odds ratio in favour of the probability of being nutritionally adequate increases as households' savings bank account ownership increases. If a household's savings account holdings increase by 1 unit with a 10% level of probability and the other determinants of HDDS remain constant, the odds ratio in favour of being nutritional adequate increases 2.01 times. Households with savings in the year previous to the survey are more likely to buy a variety of foods and eat more diverse meals than households without a bank account. This finding supports the results of empirical research by Girma, *et al.* [19].

Regarding the impact of a household's access to remittance on HDDS, the model results shown in Table 4 confirm the previous expectations, with a significant and positive association between household access to remittance and household dietary adequacy. The Positive association indicate that as a household's access to remittances increases, the odds ratio in favour of the probability of being nutritionally adequate increases. While other determinants of HDD remain constant, at a 1% level of probability of increasing access to household remittances by one unit increases the odds ratio in favour of being nutritionally adequate increases by a factor of 2.9987. This is because increased access to remittances leads to changes in food spending. Therefore, households' access to income from remittance in the year before the survey increases the likelihood of household nutritionally adequacy. In contrast to this discovery, [24] Using Poisson regression found a significant and negative relationship between HDD and household access to remittance.

The results of the econometric model of this study, shown in table 4, also show that per capita aggregate products are significantly and positively related to HDDS. Positive associations indicate that the odds ratios in favour of the probability of being nutritionally adequate increase with an increasing household aggregate per capita production. With a 1% level of probability, an increase in per capita production by one unit (100kg), the odds ratio in favour of being nutritionally adequate increases 1. By 21766 times, but other determinants of HDD remain constant. Therefore, households that produce more per capita aggregate produce were more likely to be nutritionally adequate than their corresponding households. The potential justification for this direct connection may be due to the heavy reliance of households on self-production to meet their food demand.

# 5. Conclusion

The results of this study depicted that nutritionally adequate and inadequate households had statistically significant disparity regarding household heads' educational and health status, family size, active family labour force, total livestock holding, total per capita agricultural production, participation in irrigation**,** access to credit services, savings and remittance. Consequently, household heads who are undernourished were found to be relatively illiterate, sharecrop out their irrigated lands for others, commonly sick and obliged to be absent from any income generating activities in the year-earlier to the survey. Furthermore, a household with nutritionally adequate diets was also found to have relatively nucleated families, furnished with a large number of economically active labour forces, possessed a larger livestock population, harvest large per capita agricultural produces, save their share of income in modern financial institutions, beneficiaries of remittances as well as rural credit services.

The output of the binary logistic model shows that family size, active family labour forces, per capita agricultural produces, savings in modern financial institutions and remittances are statistically significant determinants of household dietary diversity. Thus, household nutritional diversity was significantly and positively determined by the active family labour force, aggregate agricultural production, bank saving account and access to remittance. In contrast, the family size was significantly and inversely related to household dietary diversity. Hence, to improve diversified dietary feeding practices, the government and public health officials should give due emphasis to the above-identified determinants. To this end, intervention in controlling family size, improving agricultural production and productivity, and diversifying households' income ought to be strengthened.

This parcel of information is imperative for policymakers in the intervention projects of food insecurity as well as poverty reduction.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflict of interest

The author declares that there are no conflicts of interest

## References


[1] Azadbakht, L., Mirmiran, P., and Azizi, F., 2005. "Dietary diversity Score is favourably associated with the metabolic syndrome in Tehranian adults." *International Journal of Obesity*, vol. 29, p. 11.

[2] Becquey, E., Martin, P., Traissac, Y., Dembele, P., Bambara, B., and Deipeuch, A., 2010. "The household food insecurity access scale and an index-member dietary diversity score contribute valid and complementary information on household food insecurity in an urban west -African setting." *The Journal of Nutrition*, vol. 140, pp. 2233-2240.

[3] UNICEF, 2009. "Tracking progress on child and maternal nutrition: A survival and development priority."

[4] Arimond, M. and Ruel, M., 2002. *Summary indicators for infant and child feeding practices: An example from the ethiopia demographic and health survey 2000", food consumption and nutrition division discussion paper*. Washington, D.C.: International Food Policy Research Institute.

[5] Babu, S. and Sanyal, P., 2009. *Food security, poverty and nutrition policy analysis; statistical methods and applications*. Elsevier Inc.

[6] FAO, 2008. *Water for the rural poor; Interventions for improving livelihoods in Sub-Saharan Africa. In Faures JM and Santini G (eds)*. Rome: Food and Agriculture Organization.

[7] CSA, 2011. *Demographic health survey*. Addis Ababa, Ethiopia.

[8] Degeye, G., Belay, K., and Mengistu, K., 2013. "Measuring diet quantity and quality dimensions of food security in rural Ethiopia." *Journal of Development and Agricultural Economics*, vol. 5, pp. 174-185.

[9] CSA and WFP, 2014. *Comprehensive food security and vulnerability analysis (CFSVA)*. Addis Ababa, Ethiopia.

[10] CSA and World Bank, 2017. *LSMS-integrated survey on agriculture ethiopia socio economic survey (ESS) 2015/16*. Addis Ababa, Ethiopia.

[11] Kassie, G. T., Asfaw, W., Zeleke, G., and Scott, D., 2008. *The nexus of migration, HIV/AIDS and food security in Ethiopia. Global mountain programme of the CGIAR*. Addis Ababa, Ethiopia.

[12] Goitom, S., 2017. "Food security status of peri-urban modern small scale irrigation project beneficiary female headed households in kobo town, Ethiopia." *Journal of Food Security*, vol. 5, pp. 259-272.

[13] Passarelli, S., Dawit, M., Elizabeth, B., and Claudia, R., 2018. "Evaluating the pathways from small-scale irrigation to dietary diversity: evidence from Ethiopia and Tanzania." *Food Security*, vol. 10, pp. 981–997. Available: https://doi.org/10.1007/s12571-018-0812-5

[14] Hossain, M., 2009. *The impact of shallow tubewells and boro rice on food security in bangladesh. International food policy Discussion Paper 00917*. Research Institute: Washington, DC.

[15] Hussain, I. and Wijerathna, D., 2004. *Irrigation and income poverty alleviation: A Comparative analysis of irrigation systems in developing Asia*. Colombo: International Water Management Institute.

[16] Kawsary, R., Giacomo, Z., and Bhavani, S., 2018. "the role of irrigation in enabling dietary diversity in afghanistan. lansa working paper series."

[17] Namara, R. E., Upadhyay, B., and Nagar, R. K., 2005. *Adoption and impacts of micro- irrigation technologies: Empirical results from selected localities of maharashtra and gujarat states of India*. Colombo: International Water Management Institute.

[18] Haile, T., 2008. *Impact of irrigation development on poverty reduction in Northern Ethiopia. A PhD unpublished Thesis*. Cork: Department of Food Business and Development, National University of Ireland.

[19] Girma, N., Melkie, E., Degnet, T., Amanuel, N., and Rigbe, W. M., 2015. "Dietary diversity and associated factors among rural households in South Gonder zone, North West Ethiopia." *Feed the future –research award*, The U S Governments Global Hunger and Food Security Initiative."

[20] Karisa, D. and Samson, G., 2019. "Dietary diversity among children aged 6–23 months in aleta wondo district, Southern Ethiopia." *Journal of Nutrition and Metabolism*, Available: https://doi.org/10.1155/2019/2869424

[21] Taruvinga, A., Muchenje, V., and Mushunje, A., 2013. "Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa." *International Journal of Development and Sustainability*, vol. 2, pp. 2233-2247.

[22] Keding, G. B., Msuya, J. M., Maass, B. L., and Krawinkel, M. B., 2012. "Relating dietary diversity and food variety scores to vegetable production and socio-economic status of women in rural Tanzania." *Food Security*, vol. 4, pp. 129-140.

[23] Admassu, T. H. and Beneberu, A. W., 2019. "Determinants of household dietary diversity in the Yayo biosphere reserve of Ethiopia: An empirical analysis using livelihood framework." *Cogent Food and Agriculture*, vol. 5, Available: 10.1080/23311932.2019.1690829

[24] Dereje, D., Degefa, T., and Abrham, S., 2021. "Household dietary diversity in rural households of Oromia regional state, Ethiopia" a cross sectional study." *Journal of development and agricultural economics,* vol. 13, pp. 304-313.

[25] Direslgne, M., Begosew, M., and Gistane, A., 2016. "Household dietary diversity and associated factors in Mirab Abaya wereda Southern Ethiopia 2016; community based cross sectional study." *Diversity and Equality in Health and Care,* vol. 13, pp. 293-296.

[26] Geremew, M. J., Akalu, D. S., and Beneberu, A. W., 2019. "Determinants of household dietary diversity in Yayu Biosphere Reserve, Southwest Ethiopia." *Ethiop. J. Sci and Technol,* vol. 12, pp. 45-68.

[27] Getnet, M., Yalewsew, W., and Tilahun, T., 2017. "Household dietary diversity and associated factors among residents of Finote Selam town, North West Ethiopia: a cross sectional study." *BMC Nutrition,* vol. 3, p. 28.

[28] Tefera, B. and Tilahun, Y., 2007. "Dietary diversity among people 40 years and above in Jimma town, South West Ethiopia." *Ethiop J. Health Sci.*, vol. 17, pp. 115-120.

[29] Creative Research Systems, 2012. "Sample size formulas for our sample size calculator." Available: http://www.surveysystem.com/sample-size-formula.htm

[30] Cordero-Ahiman, O. V., Santellano-Estrada, E., and Garrido, A., 2017. "Dietary Diversity in rural households: the case of indigenous communities in Sierra Tarahumara, Mexico." *Journal of food and Nutrition research,* vol. 5, pp. 86-94.

[31] FAO, 2011. *Guideline for measuring household and individual dietary diversity*. Rome, Italy: Food and Agriculture Organization of the United Nation.

[32] Degefa, T., 2005. *Rural livelihoods, poverty and food insecurity in ethiopia, a case study at erenssa and garbi communities in oromiya zone, amhara national regional state. Unpublished PhD Thesis*. NTNU, Trondheim: Department of Geography, Norwegian University of Science and Technology.

[33] Yared, A., Yigremew, A., Degefa, T., Alfonso, P. C., and Peter, D. L., 2000. "Food security and resource access; a final report on the community assessments in south wello and oromiya zones of Amhara Region, Ethiopia."

[34] Abafita, J. and Kim, K. R., 2014. "Determinants of household food security in rural Ethiopia: An Empirical Analysis." *Journal of Rural Development,* vol. 37, pp. 129-157.

[35] Bogale, A. and Shimelis, A., 2009. "Household level determinants of food insecurity in rural areas of dire dawa, Eastern Ethiopia." *African Journal of Food and Agriculture, Nutrition and Development,* vol. 9, pp. 1914-1926.

[36] Kelilo, A., Ketema, M., and Kedir, A., 2014. "The contribution of Small-scale irrigation water use to household food security in Gorogutu district of Oromiya Regional State. Ethiopia." *International Journal of Economics and Empirical Research,* vol. 2, pp. 221-228.

[37] Ochieng, J., Afari-Sefa, V., Lukumay, P. J., and Dubois, T., 2017. "Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania." *PLoS ONE,* vol. 12, p. e0189022. Available: https://doi.org/10.1371/journal.pone.0189022

[38] DFID, 2001. *Sustainable livelihoods guidance sheets. 94 victoria street*. London SW1E 5JL.

[39] ILO, 2011. *Trafficking in persons overseas for labor purposes the case of ethiopian domestic workers*. Addis Ababa: ILO Country Office.

[40] Gujarati, D., 2004. *Basic econometrics*. 4th ed. New York: McGraw Hill/Irwin.