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HOUSEHOLD DIETARY DIVERSITY AND ASSOCIATED FACTORS IN MAJOR *TEF* GROWING AREAS OF CENTRAL ETHIOPIA

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This study aimed to assess household dietary diversity and associated factors among residents in major *tef* growing areas of Central Ethiopia. Data were collected from 240 randomly selected rural households from Minjar Shenkora and Ada'a *woredas* of Central Ethiopia. The ordered probit model was used to identify the associated factors of explanatory variables on the dependent variable. Only 30% of the total respondents, as evidenced by their consumption of seven or more different food groups during the previous 24 hours, had high dietary diversity. More than 70% of households were found with inadequate dietary diversity. Results further indicated that several factors associated with household dietary diversity, including household size, livestock ownership, credit availability, off-farm activity, and market distance. Therefore, local institutions and regional governments ought to give households access to education so they may increase their understanding of the health and nutritional advantages of a varied diet, as well as promote and encourage the availability of home gardening strategies, expand access to agricultural technologies, and thus diversify rural households' diets. Market infrastructure should be enhanced to facilitate household access to markets, which could help improve dietary diversity.

***Keywords*: dietary diversity, determinants, Central Ethiopia**

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1. INTRODUCTION

All nutrients can't be found within a single food item (Mansour et al., 2021). The more food types in one's daily diet, the more likely one is to achieve nutrient requirements (Labadarios et al., 2011). Therefore, a well-balanced diet may indicate nutrient sufficiency (Kennedy et al., 2009). A household's economic ability to access a variety of meals through obtaining many different food groups consumed over a set period is linked to a diversified diet (Huluka et al., 2019). In other words, dietary diversity is linked to socioeconomic status and food security in the household. Dietary diversity is widely recognized as a key dimension of diet quality. Evidence from developed countries showed that dietary diversity is strongly associated with nutrient adequacy (Mekuria et al., 2017).

Dietary diversity is defined as a rise in the range of foods accessible within and between dietary groups that can give the optimal intake of essential nutrients for optimum health, physical development, and mental development (Arimond & Ruel, 2002). Having a diverse diet might be difficult for rural communities in underdeveloped nations like Ethiopia. Fresh fruits and vegetables, starchy grains, and little animal protein make up the majority of their diets (Taruvinga et al., 2013). One of the major challenges faced by poor populations in resource-constrained nations is a lack of access to a sufficient and varied supply of food, which can lead to a variety of nutritional inadequacies (Ekesa et al., 2011). Some of the most important nutritional problems that women of reproductive age deal with include chronic energy shortage, inadequate energy intake, and micronutrient deficiencies (Kemunto, 2013). Another difficulty in many developing country settings is meeting basic dietary quality standards in areas where household food security is low, and is frequently not given enough priority (Mekuria et al., 2017; Kennedy et al., 2011). In addition to the three dimensions of undernutrition (wasting, stunting, and underweight), micronutrient deficiencies, and excess nutrition, the "triple burden of malnutrition" increasingly plagues developing nations like Ethiopia. A diversified diet should be emphasized in food security policies in addition to calorie intake. A varied diet enhances the body's ability to absorb different nutrients, which lowers the risk of many diseases.

Although household dietary energy supply has improved, the dietary diversity remained low in Ethiopia (Jebessa et al., 2019). According to the Central Statistical Agency, average energy consumption increased from 2,200 kcals per capita per day in 2000 to over 2400 kcals per capita per day in 2011 (FMoH, 2016). However, the survey's dietary patterns showed minimal change from 2005 to 2010, indicating a widespread lack of dietary diversity. For instance, less than 4% of children in rural Ethiopia were fed with four or fewer of the seven dietary groups (EDHS, 2011). The average child consumes 1.46 food categories each day, according to a study done by the International Food Policy Research Institute in five Ethiopian regions: Amhara, Oromia, South Nations Nationalities People (SNNP), Somalia, and Tigray (IFPRI, 2015). Additionally, in Ethiopia, 60 and 40% of households, respectively, had low and medium scores for dietary diversification (Goshu et al., 2013). Lack of variety in nutrition can have negative consequences on a person's health, happiness, and development, mostly by reducing physical capabilities and infection resistance.

Tef (Eragrostis tef (Zucc.) Trotter) is one of the major cereal crops in Ethiopia as well as in the study areas where it plays a vital role in achieving food security in terms of production, consumption, and cash crop value (Chanyalew et al., 2019; Paff and Asseng, 2018). Furthermore, it is the most commercialized crop in the cereal sector, where it accounts for approximately 30% of the products sold (Hassen et al., 2018). The crop is annually grown by more than 7.1 million farmers on 24.1% of the national grain area and it is ranked first in terms of area coverage and second most-produced cereal, accounting for 17.1% of the total production in the category (CSA, 2020). It also accounts for approximately 15% of all calories consumed and provides 66% of daily protein intake in the country (Crymes, 2015).

Numerous studies in Ethiopia prioritized individual dietary diversity and the factors influencing household dietary energy intake at the expense of household dietary quality and diversity. It is crucial to concentrate on the aspects of dietary diversity at the household level as a result. Thus, the objective of this study was to evaluate household dietary diversity in the study areas as well as the factors that contribute to it. The results of this study will add to the literature by identifying factors that contribute to dietary diversity at the household level, where *tef* production and consumption are the main sources of income. Hence, this study is important to understand the associated factors of household dietary diversity and, thus, it is vital for designing possible interventions to address those factors. This study differs from the majority of the other studies since it takes into account the important *tef*-growing areas of Minjar Shenkora and Ada'a *woredas*[2] and considers it a staple meal. The assessment of household dietary diversity and related characteristics in the research areas is another contribution made by this study to the scant empirical knowledge at the local level.

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[2] *woredas* are composed of a number of *Kebeles* which are the smallest administration unit of local governments in Ethiopia.

2. METHODOLOGY

The study woredas' setting

The research was carried out in the Central Ethiopian *woredas* of Minjar Shenkora and Ada'a. Minjar Shenkora is a *woreda* in the North Shewa Zone of Amhara Regional State. Arerti is the *woreda's* administrative center. It is located in the southern section of the North Shewa Zone, some 135 kilometers southeast of Addis Ababa, Ethiopia's capital (Hailu, 2022). The *woreda* is made up of 30 kebeles, 27 of which are rural and the rest are urban. *Tef,* wheat, sorghum, and maize are among the cereal crops farmed in the *woreda*, while chickpea and lentil are among the pulses. Ada'a is a *woreda* in the Oromia Regional State in Central Ethiopia's East Shewa Zone. Bishoftu, the *woreda* administrative town, is 45 kilometers east of Addis Ababa. The *woreda's* altitudes range from 1,500 to over 2,000 meters above sea level. Ada'a *woreda* is a mixed-farming, crop-growing, and livestock-raising region. *Tef*, wheat, barley, maize sorghum, chickpea, horse bean, ground nut, root crops, and vegetables are among the crops farmed in the *woreda* (Hailu, 2022).

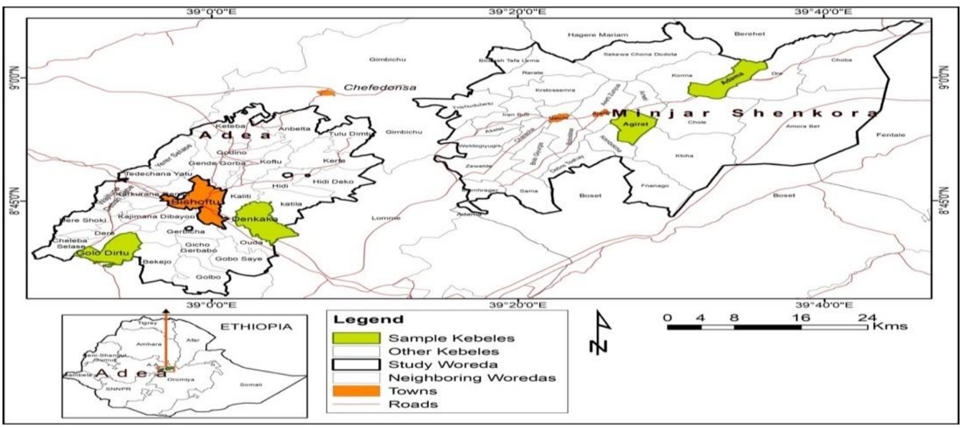

Figure 1. Location maps of Minjar Shenkora and Ada'a *woredas*

Data source, collection, and sampling procedure

The study employed a mixed-methods approach, including both quantitative and qualitative data gathering and analysis. The data used for this study are derived from a farm household face-to- face interview in Minjar Shenkora and Ada'a *woredas* conducted during the period June – September 2020 to assess the household dietary diversity and identify the factors influencing it (Hailu et al., 2021). Eight separate focus group discussions, each group comprising

6-10 participants were held with households and community elders. Key informants were conducted with *woredas* agriculture offices, development agents, farmers' organizations, traders, and community elders (Hailu, 2022). In this study, we focused on *tef* plots because *tef* is the largest cereal commodity in the study areas in terms of its share of total cultivated area, total production, and role in direct human consumption.

A multistage sampling procedure was employed to draw sample households in the study areas. In the first stage, two *woredas*, Minjar Shenkora and Ada'a *woreda* were selected based on their *tef* production potential (Hailu et al., 2021). In the second stage, four kebeles from high- and low- producing areas were randomly selected. In the third stage, representative households from each sample *kebeles* were determined by using a formula suggested by Yamane (1967). This simplified formula required sample size at 95% confidence level, degree of variability = 0.5, and level of precision = 5% (Adam, 2020; Kovshov et al., 2019). Based on proportionate random sampling, 240 households were selected by the lottery method from the list obtained from the respective *kebeles*.

Table 1. Distribution of sampled households in the study area

Woredas	Sample *Kebeles*	Total household heads			Sample household heads		
		Male	Female	Total	Male	Female	Total
Minjar Shenkora	Agirate	635	67	702	51	5	56
	Adama	633	83	716	51	7	58
Adaa	Denkaka	822	115	937	65	10	75
	Golo Dertu	520	106	626	42	9	51
Total		2,610	371	2,981	209	31	240

Method of Data Analysis

Data gathered from quantitative and qualitative sources have been analyzed using a variety of approaches and tools. Both descriptive and inferential statistics were used to analyze quantitative data. The descriptive analysis includes frequency, percentage, mean, standard deviation, and cross-tabulation. Continuous data were analyzed via one-way ANOVA and t-test while categorical data were analyzed using the Chi-square test (Stapor, 2020). The Ordered probit model was used for analyzing the quantitative data while qualitative data generated from key informants and focus group discussants were categorized, summarized, narrated, and then interpreted and discussed.

Measurement of Dietary Diversity

A household dietary diversity score (HDDS) is a consumption indicator that directly captures the score of diets consumed over the last 24 hours as reported by the households. HDDS are created by adding up the number of different foods or food groups that were consumed during the reference period, which is often 24 hours. We can classify households as low dietary diversity (DD) (≤ 3), medium DD (4 ≤ DD ≤ 6), and high DD (≥ 7). HDDS was used to analyze the food security status of the sample households. According to FAO (2011), food was divided into 12 groups. If any member of the household ingested a food item from a given group over the preceding 24 hours, that group's score was added to the household score. The 12 food groups included in the HHDS reflect a mix of both, even though the indicator is labeled "household dietary diversity"; it was initially intended to quantify both the quantity and quality of food access. Two food groups capture consumption of staple cereals, roots, and tubers; eight food groups capture consumption of micro-nutrient-rich fruits, vegetables, meat, dairy products, nuts, and seeds; and three food groups capture consumption of energy-rich foods (sweets, oils, and fats, and condiments and beverages). Thus, simple scores have been created to assess dietary diversity at the household or individual level in situations when the use of comprehensive dietary assessment techniques, such as direct weighing or 24-hour dietary recall, is precluded by a lack of resources.

According to Kennedy et al. (2011), we can classify households as low DD, medium DD and high DD based on their food security status. We refer to households with inadequate DD when they have low and medium DD scores, and we refer to households with adequate DD when they have high DD. Households with low DD ingest three or fewer food groups, those with medium DD consume four to six food groups, and those with high dietary diversity consume seven or more food groups.

Econometric Estimation: an ordered probit model

For such ordered discrete variables, ordered probit or logit models perform well, whereas multinomial logit or probit models would not take the dependent variable's ordinal character into account (Greene, 2012; Maddala, 1983). While the logit assumes a logistic distribution, the probit assumes a normal distribution for the error term. The logistic and normal distributions yield results that are similar in practice. On the other hand, the most popular model for ordered replies is ordered probit (Nkegbe et al., 2017). The ordered probit model is therefore used in this study.

Assume that the latent random variable y_i* is dependent, and use y_i as a stand-in for it as well as an observed variable with "j" response categories. The probit model is defined as follows:

$$y_i^{*}= x^{*}\beta \;+\; \varepsilon_i, \text{ i}= 1,\ 2,\ 3,\ \ldots,\ N \tag{1}$$

y_i^* is the hypothesized predicators of HDD, βs is a vector of parameters to be estimated and ε_i is an error term that is assumed to be normally distributed. Then, the values for the observed variable y_i are assumed to be related to the latent variable y_i^* in the following manner:

$$\text{y}= j,\ \text{if}\mu_{j-1} \;<\; y_i^* \le j = 1{,}2{,}3{,}\ldots.,N \tag{2}$$

where μ refers to the unknown threshold parameters, u - 1 = -∞, uo = 0, uj = ∞ and the estimated cut-off points, μ follows the order μ - 1 < μ0 < μ1 …….. < μj. The probabilities that a given household will fall within a response category of j follows:

$$t_{ij} = t(y_i = j) = t\left(u_{j-1} < y_i^* \le u_j\right) = R\left(u_j - x_i'\beta\right) - R\left(u_{j-1} - x_i'\right) \tag{3}$$

where R′ (·) is the standard normal cumulative distribution function and j is the response categories, in this case 1, 2 and 3 since there are three categories for HDD.

Marginal effects are used to calculate the impact of explanatory variable changes on cell probability. In the ordered probit model with j choices, there will be j sets of marginal effects. Therefore, an increase in regressor x has the following marginal effect on the likelihood that a household will fall into the j response category:

$$\frac{\partial_{tij}}{\partial_{xri}}= \{\text{R}'(\text{uj} - 1 - \text{x}'\text{i}\beta) - \text{R}'(\text{uj} - \text{x}'\text{i}\beta)\} = \{\text{R}'(\text{uj} - 1 - \text{x}'\text{i}) - \text{R}'(\text{uj} - \text{x}'\text{i})\}\beta \tag{4}$$

Where R′ (·) is the standard normal density function. Then, the final estimated model is specified as:

$$HDD_{ij} = \alpha + \beta P_i + \delta X_i + \gamma Y_i + \theta Z_i + \varepsilon_i \quad (5)$$

where DD stands for HDD, subscript i signifies a household, and subscript j (j = 1, 2, 3) denotes the alternative dependent dummy variables categorizing dietary diversity. (i) whether a household is in the low dietary diversity category, (ii) whether a household is in the medium dietary diversity category, and (iii) whether a household is in the higher dietary diversity category; P, X, Y and Z are, respectively, and α, β, δ, γ, θ are parameters to be estimated and ε ≈ NID (0, 1).

Table 2. Definition and measurement of variables used in the analysis

Variables	Definition and Measurement
Dependent Variable:	
Dietary Diversity	**1= Low DD; 2= Medium DD; 3= High DD**
Independent Variables:	
SEX	1= if the household (HH) head is male and 0 otherwise
AGE	Age of the HH head in years
EDUCATION	1= if the HH head is literate and 0 otherwise
HH_SIZE	HH size in adult equivalent (ADE)
FARM_SIZE	Farm size in hectare
HOME_GARDE	1= if the HH has home-garden and 0 otherwise
LIVESTOCK	Livestock ownership in Tropical Livestock Unit (TLU)
OFF_FARM	1= if HH engaged in off-farm activities and 0 otherwise
IMP_TECHNO	1= if HH used improved technologies and 0 otherwise
CREDIT	1= if the HH access credit and 0 otherwise
ACEES_RADIO	1= if the HH access radio and 0 otherwise
COOPERATIVES	1= if the HH member of cooperative and 0 otherwise
CONTACTS	Frequency of DA contacts with farmers in number
TRAINING	1= if the HH has access to training and 0 otherwise
DIS_EXT	Distance to the nearest extension office in kilometers
DIS_MARKET	Distance to the nearest market in kilometers

3. RESULTS AND DISCUSSION

Statistical Summary of Sample Respondents

The average household size of sample respondents who were categorized under low DD was 5.2 ADE while medium DD was 4.8 ADE and high DD households were 4.3 ADE (Table 3). One-way ANOVA shows that there was a statistically significant difference between the groups at ($p<0.01$). Similarly, the mean livestock ownership of households that had high DD (6.3 TLU) was relatively larger than households that had low DD (5.7 TLU) and medium DD (5.4 TLU). The mean difference was statistically significant at ($p<0.01$). The average distance to the market for households that had high DD (6.3 km) was shorter than that of medium DD households (8.2 km) and low DD households (10.7 km). Their mean difference in the average distance between the groups was statistically significant at ($P<0.05$).

Table 3. Descriptive statistics of the variables: Dietary Diversity Score

Explanatory Variables	Dietary Diversity Score Category								F-test
	Low DD		Medium DD		High DD		Overall		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
AGE	47.4	12.1	44.4	13.1	46.2	11.6	45.5	12.5	1.069
HH _SIZE	5.2	1.9	4.8	2.0	4.3	1.7	4.7	1.9	2.580***
FM_SIZE	2.6	1.6	2.7	1.9	2.8	1.9	2.8	1.9	0.264
LIVESTOCK	5.7	3.5	5.4	3.7	6.3	5.1	5.8	4.2	1.002***
CONTACT	2.0	2.6	3.5	7.2	3.8	7.4	3.3	6.7	0.912
DIS_EXT	3.8	2.6	4.0	3.5	4.5	4.2	4.1	3.6	0.698
DIS_MARKET	10.7	4.5	8.2	7.2	6.3	7.4	8.4	6.9	1.535**
% of Respondents to Given Choices for Dummy Variables									
SEX (male)	14.6		47.9		27.5		90.0		0.165
EDUCATION (literate)	9.6		25.8		16.3		51.7		7.785
HOME_GARDEN (yes)	15.4		51.3		30.2		96.9		5.185*
COOPERATIVE (yes)	9.2		37.1		24.2		70.4		3.787***
ACCESS_RADIO (yes)	15.8		52.5		30.0		98.3		3.350
OFF_FARM (yes)	2.1		7.9		6.3		16.3		1.775*
IMP_TECHNO (yes)	12.5		48.7		29.2		90.4		13.942***
CREDIT (yes)	6.7		32.1		17.5		56.3		2.692**
TRAINING (yes)	8.3		38.3		23.3		70.0		4.908***

*Note: *, **, and *** denotes significance level at 10%, 5%, and 1%.*

Among 70.4% of respondents who are a member of agricultural cooperatives, about 9% of households belong to low DD, 37% to medium DD, and about 24% belong to high DD. Their mean difference was a statistically significant difference between the groups at ($p<0.01$). Out of 16.3% of households who engaged in off-farm activities, about 2%, 8%, and 6% belong to low, medium, and high DD, correspondingly showing that there was a significant difference between the groups at ($p<0.1$). Out of 56.3% of households who access credit services, about 7%, 32%, and 17% of households belong to low, medium, and high DD. Their mean difference was statistically significant between the groups at ($p<0.05$). About 70% of households in the study areas accessed capacity-building training. Out of this, about 8%, 38%, and 23% of households belong to low, medium, and high DD showing that there was a significant difference between the groups ($p<0.01$).

Assessment of Household Dietary Diversity

The survey results indicated that in Minjar Shenkora woreda, 22%, 56%, and 23% of farm households were categorized under low, medium, and high DD, correspondingly (Figure 2). Likewise, 12%, 50% and 38% of households in Ada'a *woreda* are categorized as low, medium, and high DD, correspondingly. Results further revealed that among the total sample households about 17% were categorized under low dietary diversity, 53% in medium dietary diversity, and 30% of households were categorized under high dietary diversity. According to FAO (2013) categorization, households found are with low and medium DD are categorized as "inadequate dietary diversity" whereas households found with high DD are categorized as "adequate dietary diversity". Based on these categorizations, about 70% of households were found in inadequate DD and only about 30% of the sample households were found with adequate DD.

Moreover, results show that the mean of food groups consumed by all sample households was 5.3. This implies that among the twelve food groups, the large majority of households consumed about 5 food types and were categorized in medium dietary diversity. The minimum and the maximum number of food groups consumed by farm households were 2 and 10, respectively; it indicates that there are great disparities among households in diversifying their food consumption pattern. Focus group discussants and key informants affirmed most households were unable to diversify their diet due to lack of access to transport to the nearby market, shortage of adequate money to buy diverse food items, lack of information, ignorance, and negligence about the health benefits of diversifying their diets. Households cannot produce all types of food groups on their farm;

hence purchase or exchange is vital to eat varieties of food groups. But lack of transport and nearby market makes food purchase difficult, especially for pregnant women, elders, and mothers with kids.

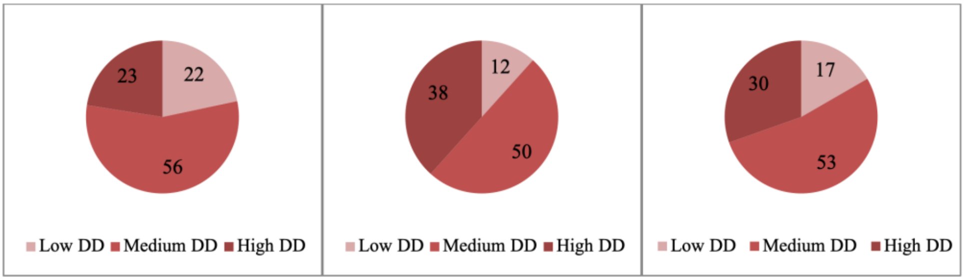

Figure 2. Minjar Shenkora DDS (%) (left), Ada'a DDS (%) (center), and the Total DDS (%) (right) (Source: Computed based on household survey data)

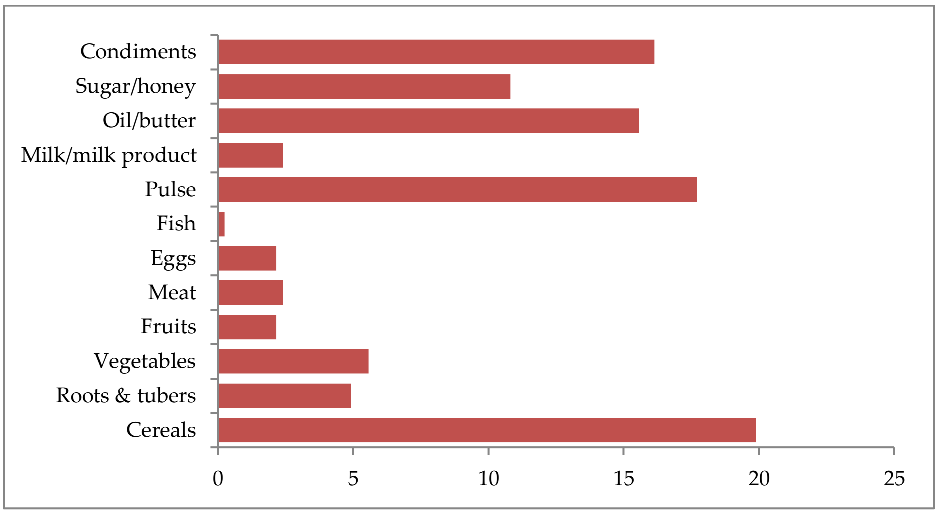

Figure 3. Percentage distributions of dietary food groups consumed by farming households

The result in Figure 3 indicates that cereals are the most frequently consumed diet per day (19.9%) followed by pulses (17.7%), condiments/beverages (16.1%), oils/butter (15.6%), and sugar/honey (10.8%). Vegetables (5.6%), roots, and tubers (4.9%) contributed moderately to the daily meal consumption by the households, however, the consumption of meat (2.4%), egg (2.2%), milk (2.4%), and fish (0.3%) was observed to be very minimal in the total daily meal. Nutritionally, meat, eggs, fish, and milk, each consisting of a weight of 4 are the most nutritious diet groups but consumed least frequently. In contrast, condiments with 0 nutritional weight were the most frequently consumed item (16.1%). Moreover, vegetables (5.6%) with a weight of 1 were also consumed at a reasonable frequency.

Table 4 shows that households on average consumed cereals (7 days), followed by oil and condiments/beverages (6.1 days), pulses (5.7 days), sugar (3.6 days), roots and tubers (1.1 days), milk (1.1 days) and vegetables (1.0 days). The consumption of animal products, vegetables, and fruits were very minimal and close to null in that group. Among the borderline consumption group, consumption of different food groups was increased, with cereals (7 days), pulses (6.3 days), oil (6.3 days), sugar (4.9 days), and milk and milk products (1.3 days). Similarly, consumption of animal products, fish, and fruits remains infrequent, at an average of less than a day per week.

Table 4. Average number of days of food consumption by food consumption groups

Food Groups	Food consumption groups		
	Poor	Borderline	Acceptable
Cereals	7.0	7.0	7.0
Roots & Tubers	1.1	1.9	1.6
Vegetable	1.0	1.7	2.1
Fruits	0.1	0.7	1.1
Meat & meat products	0.3	0.6	1.3
Egg	0.7	0.9	0.6
Fish	0	0.2	0.3
Pulse	5.7	6.0	6.3
Milk	1.1	0.7	0.8
Oil	6.1	6.4	6.3
Sugar/honey	3.6	4.2	4.9
Condiments/beverages	6.1	5.6	5.4

Determinants of Households' Dietary Diversity

Results in Table 5 show that the number of family members in the household significantly influences the dietary diversity of the household, *ceteris paribus*. Each new family member increases the likelihood of getting into the low

DD category by around 3.3% while decreasing the likelihood of categorizing into the high DD category by roughly 30%. This conclusion might be explained by the shortage of manpower in families with a lot of young children and elderly people, which leads to an over-reliance on the meager food resources of the family. This finding is consistent with Huluka and Wondimagegnhu's (2019) earlier research; however, it contradicts Jones et al (2014)'s finding that an increase in household members leads to an increase in HDDS.

The result also shows that household education positively and significantly contributes to increasing household dietary diversity. A household's likelihood of being in the high DD group will rise by 11% with each additional educated person, while its likelihood of being in the low DD group will decline by 1.3%. This suggests that education promotes awareness of dietary nutrition and is one of the most significant drivers of consumption of dietary diversity. Household heads with higher levels of education might be more aware of the health advantages of eating nutrient-dense foods and hence spend more of their food budget on a varied diet. These results are consistent with the majority of earlier studies, as more educated households are more likely to have a more varied diet (Huluka and Wondimagegnhu, 2019; Jebessa et al., 2019; Koppmair et al., 2017; Jones et al., 2014; Taruvinga et al., 2013).

Livestock ownership had a significant and positive impact on household dietary diversification. Increases in livestock ownership resulted in an 11% increase in categorized medium dietary diversity and a 1.5% increase in categorized high dietary diversity. This means that households with many livestock are more likely to diversify their diet than those with fewer animals. This finding supports previous research that found a link between food diversity and livestock ownership (Jebessa et al., 2019; Workicho et al., 2016; Megersa et al., 2014). According to Taruvinga et al. (2013), households with livestock ownership are also more likely to go from a medium to a high dietary variety status (2013).

Home gardening has influenced household dietary diversity positively and significantly. When all other factors are held constant, households with access to a home garden have an increased likelihood of falling into the medium and high DD categories by between 67% and 12%, respectively. This implies that a household with home gardening is more likely to diversify their diets than households without home gardening. Home gardening gives people a way to grow their fruits, vegetables, and other crops, giving them access to a variety of items that might not be sold in stores. The finding of this study is congruent with previous studies (Bundala, 2017; Ajah et al. 2013; Galhena et al., 2013) as they described the cultivation of home gardening as an evident factor in having a diverse diet for the household.

Off-farm activities are important activities through which rural households get additional income to purchase additional foods which help to diversify their diet. Households who engaged in off-farm activities are less risk-averse than farmers without sources of off-farm income. Therefore, off-farm activities are expected to have a positive influence on household dietary diversity. The findings indicate that households with a high level of food diversity are more likely to derive their income from off-farm sources. An increase in off-farm participation is expected to enhance the likelihood that a household will have a high diversity of nutritional intake by roughly 4.4% among high DD while 6% increase in diversity of dietary intake among households in low DD. The inference is that households that supplement their farm income with off farm income are more likely to buy nutrient-dense foods that add variety to their meals. The findings of Jebessa et al. (2019), Huluka and Wondimagegnhu (2019), Linderhof et al. (2016), Harris-Fry et al. (2015), and Jones et al. (2014) are likewise consistent with these findings.

Training in the household had a significant impact on household dietary diversity. The findings indicate that households with access to training are more likely to have a varied diet. The household's dietary diversity and consumption of nutrient-dense foods are improved with training. More specifically, the outcome suggests that training will reduce the likelihood of slipping into the lower dietary diversity category by roughly 10%. This outcome is consistent with the conclusions reached by other authors, including Jones (2017) and Jones et al (2014).

Distance to the markets is an important factor that influences household dietary diversity by reducing transportation costs. The research found that the household dietary diversity was significantly and negatively impacted by distance to market ($P < 0.001$). The likelihood of falling into the lower, medium, or higher dietary diversity categories reduced by roughly 67%, 10%, and 2%, respectively, with every unit increase in market distance. This outcome is consistent with Stifel and Minten's (2017) and Sibhatu et al. (2015) findings.

Table 5. Results of ordered probit model and the marginal effects

Variables	Pooled ordered probit model		Marginal effects					
			Y= 1		Y= 2		Y= 3	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
SEX	-0.03358	0.26113	-0.01015	0.0735	-0.02010	0.1148	0.0114	0.1058
AGE	0.0073	0.00614	-0.0016	0.0017	0.00235	0.0026	-0.0012	0.0039
EDUCATION	0.2406**	0.05186	-0.01271**	0.0089	0.01219	0.0140	0.1098***	0.0122
HH_SIZE	-0.16223***	0.04147	0.0327***	0.0109	-0.05371	0.1439	-0.3032***	0.0876
LIVESTOCK	0.03882*	0.02172	0.00386	0.0063	0.1057**	0.1675	0.0151**	0.0412
HOME_GARDEN	1.10407**	0.48143	0.0181	0.0175	0.6749***	0.2254	0.1205***	0.0484
FARM_SIZE	0.0604	0.04760	0.01214	0.0139	0.00499	0.0208	-0.02076	0.0580
COOPERATIVE	0.25909	0.18591	0.2561	0.0811	0.2231	0.0643	0.1083	0.0375
CREDIT	0.42185	0.64604	0.22694	0.2774	-0.18038	0.2883	0.0762	0.3272
IMP_TECHNO	0.62431**	0.30826	0.16214	0.1140	0.03976	0.1346	0.17595	0.6421
OFF_FARM	0.05578**	0.16888	0.06025*	0.0500	-0.10755	0.0736	0.04357***	0.01314
EXT_CONTACTS	0.44299	0.21308	0.08149	0.0418	0.04017	0.0924	-0.15209	0.3251
ACCESS_RADIO	0.00405	0.01152	0.00334	0.0047	-0.00187	0.0050	0.01464	0.0041
TRAINING	0.30038*	0.17538	-0.09823*	0.0565	0.03746	0.0768	-0.0719	0.2131
DIS_EXT	0.02807	0.0244	0.0037	0.0080	0.01119	0.0106	-0.0134	0.0369
DIS_MARKET	-0.0648***	0.01215	-0.6749***	0.2254	–0.1016***	0.0353	-0.0195***	0.0069
/cut1	1.19794	0.86760						
/cut2	2.8892	0.87950						

*Note: SE is robust standard errors *, **, and *** denotes significance level at 10%, 5%, and 1%*

4. CONCLUSION AND RECOMMENDATIONS

Household dietary diversity remains an issue in Ethiopia, particularly in rural households. It is a key nutrition outcome that measures a household's economic ability to access a variety of foods over 24 hours. Our research found that a significant number of households' diets were lacking in variety, and that consumption of animal-based items (meat, poultry, fish, and seafood) was low. Due to a variety of reasons, households were unable to diversify their food including the education level of the household head, household size, livestock ownership, home gardening, and the use of improved technologies, off-farm activities, training, and distance to the market.

A brake on HDD is being put on it by large household sizes and limited asset bases for a living. On the other side, household head education level, livestock ownership, home gardening, and off-farm income have been demonstrated to be a driver for improving dietary diversity. Furthermore, improved agricultural technologies and training are the major determinant factors of household dietary diversity. The use of improved agricultural technologies was significantly and positively associated with the diversity of household diets. Because households who adopted higher-yielding agricultural technologies could get more yield than households who did not adopt technologies could lead to additional crop sales. These can help households to diversity their food and dietary intake.

Therefore, regional and federal governments should make information accessible to rural households so they may better grasp the health and nutritional benefits of a varied diet. They should also support the employment of home gardening techniques to help rural households diversify their diets. To enhance access to inputs and knowledge through rural institutions, it is also important to encourage farmers to adopt a variety of agricultural technologies, alter their perspective of the financial benefits of doing so, and consider asset development. Market infrastructure should be improved to make it easier for households to access markets, which will help to increase dietary diversity.

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