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Feed the Future – Research Award

DIETARY DIVERSITY AND ASSOCIATED FACTORS AMONG RURAL HOUSEHOLDS IN SOUTH GONDAR ZONE, NORTHWEST ETHIOPIA

November 2015

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Agricultural Knowledge, Learning, Documentation and Policy Project (AKLDP-Ethiopia)

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DIETARY DIVERSITY AND ASSOCIATED FACTORS AMONG RURAL HOUSEHOLDS IN SOUTH GONDAR ZONE, NORTHWEST ETHIOPIA

November 2015

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Acknowledgement:
This research report is one of a series of reports on policy-relevant research on agriculture, food security, nutrition and related topics, and relevant to Feed The Future in Ethiopia. The research was made possible using grants provided by the USAID Agriculture Knowledge, Learning, Documentation and Policy (AKLDP) project to support higher education and research institutions in Ethiopia.

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ACKNOWLEDGMENTS

We first of all would like to express our appreciation to AKLDP/Tufts University for their funding. We are very grateful to Dr. Berhanu Admassu for his guidance, unlimited support, and constructive comments throughout the whole course of the research.

We thank the data collection facilitators for their genuine dedication and effort shown during the data collection process. We also express our heartfelt gratitude to the respondents for giving of their precious time during interviews.

We would like to express our heartfelt gratitude to our friends, especially Ermias Demlew, for their technical support and encouragement.

ACRONYMS

AOR	Adjusted Odds Ratio
CI	Confidence Interval
COR	Crude Odds Ratio
DD	Dietary Diversity
EDHS	Ethiopian Demographic Health Survey
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
HDDS	Household Dietary Diversity Score
Km	Kilometer
SNNP	South Nation, Nationalities, and Peoples' Region
SPSS	Statistical Package for the Social Sciences
ZHD	Zonal Health Department

EXECUTIVE SUMMARY

Background: Dietary diversity refers to increasing the consumption of a variety of foods across and within the food groups. A lack of dietary diversity is a severe problem among poor populations in the developing world. There is substantial evidence that dietary diversity is extremely low among Ethiopian rural households, especially for children. However, there is little empirical evidence on factors contributing to low dietary diversity among rural households.

Objective: The aim of this study is therefore to assess dietary diversity and determinant factors among rural households.

Methods: A community-based cross-sectional study was conducted. Eight hundred sixteen rural households were randomly selected to be involved in the study. The study questionnaire was pre-tested using 5% of the selected household heads, all of whom were responsible for family food preparation. Data were entered and cleaned in Epi Info software, then transferred and analyzed using SPSS version 20 software. Descriptive statistics, frequency, proportions, and charts were used to explore the data. Logistic regression was used at 95% CI, and odds ratios were presented to identify associated factors and to assess the strength of the association. For all statistical significance tests, the cut-off value was $p \leq 0.05$.

Results: Of the total study participants, only 16.2% had high dietary diversity, which meant seven or more food groups in their diets during the preceding 24 hours. About 83.8% of participants had inadequate household dietary diversity. Participation in food exchange at the market was found to be positively associated with dietary diversity. Respondents who exchanged foods were 2.2 times more likely (95% CI: 1.074, 3.84, 4.561) to have good dietary diversity than those who did not. There was also significant association between variables such as having a radio, mobile phone, bank account, and small animals such as hens.

Conclusions: Household dietary diversity was low in the study area. Having a mobile phone, radio, bank account/saving, small animals, and participating in exchange of foods at market were found to be major determinants of household dietary diversity.

Recommendations: Nutrition education through local media, promotion of bank accounts for savings, participation in food exchange, and rearing of small animals should be encouraged as major interventions that can improve household dietary diversity.

1 INTRODUCTION

Dietary diversity refers to an increase in the variety of foods across and within food groups capable of ensuring adequate intake of essential nutrients that can promote good health, and physical and mental development (Arimond and Ruel, 2002).

Since no single food can contain all nutrients, the more food groups included in the daily diet, the greater the likelihood of meeting nutrient requirements (Labadarios et al., 2011). Therefore, a diet that is sufficiently diverse may reflect nutrient adequacy (Kennedy et al., 2009).

Lack of diversity is a particularly severe problem among poor populations in the developing world. The vulnerability is critical in children and pregnant and lactating mothers because they require additional energy and nutritious foods for their physiological and mental development (Arimond and Ruel, 2002; Nti, 2011).

Dietary diversity is usually measured either by adding the number of foods or, more often, by counting the number of food groups consumed over a reference period (Ruel, 2002; Vakili et al., 2013). Vakili et al. (2013) suggested that dietary diversity can be used as a proxy measure of food access at household level, while at individual level it is a reflection of dietary quality.

1.1 Statement of the Problem

In the past, increasing calorie availability by boosting cereal crops production—particularly rice, wheat, and maize—has been the primary focus of agriculture. Recently, the shift from diversified cropping systems to simplified, cereal–based systems has contributed to micronutrient deficiency in many developing countries (Demment et al., 2003). Of the over 80,000 plant species available to humans, only three (maize, wheat, rice) supply the bulk of our protein and energy needs (Frison, 2010), and nutritionists now increasingly insist on the need for more diverse agroecosystems, in order to ensure a more diversified nutrient output of the farming systems (Burchi et al., 2011).

According to EDHS, dietary diversity is low in Ethiopia. For instance, less than 4% of the children in rural Ethiopia were fed with four or fewer food groups out of seven food groups (EDHS, 2011). According to an International Food Policy Research Institute study conducted in five regions of Ethiopia (Amhara, Oromia, South Nations Nationalities people (SNNP), Somali, and Tigray) Regions, it was found that the average child eats 1.46 food groups per day (IFPRI, 2015).

The current consensus is that higher incomes do improve nutrition outcomes, but they tend to do so at unacceptably slow rates (FAO, 2012; Ruel et al., 2013). Furthermore, data from many countries have shown persistent, high under-nutrition rates in regions and households where staple crop production is high and food availability is good. For instance, despite higher agricultural production in West Gojam (highest productivity in the region), about 51% of the children who were fed only cereal gruel and 47.6% of children who received injera (an Ethiopian staple food made from teff, wheat, maize, barley, etc.) were found to be stunted. Children given cow's milk and mashed potato tended to be less stunted (Teshome et al., 2009).

Investments in food and nutrition security is an important avenue that has been used to increase nutrition and dietary diversity (Martin-Prevel et al., 2012). Therefore, the aim of this study is to determine household dietary diversity and associated factors among rural households in South Gondar Zone, northwest Ethiopia.

2 OBJECTIVES AND RESEARCH QUESTION

2.1 General Objective

To assess dietary diversity and associated factors among rural households in South Gondar Zone, Northwest Ethiopia.

2.2 Specific Objectives

- To determine dietary diversity in the study area
- To identify associated factors for dietary diversity.

2.3 Research Questions

- What was the dietary diversity status among rural households in South Gondar?
- What were factors associated with household dietary diversity among rural households in South Gondar?
- What was the contribution of home gardening for dietary diversity?
- What was the contribution of small–scale farming for dietary diversity?

3. JUSTIFICATION AND SIGNIFICANCE OF THE STUDY

South Gondar Zone is one of the ten zones in Amhara Region. It comprises ten *woredas*, of which about half are food insecure. Recently, food insecurity has received increased attention everywhere because of worsening global economic conditions; it is one of the most crucial problems threatening millions of people in Ethiopia. South Gondar Zone is no exception in this regard. A study conducted in Farta district in the current study area indicated that there is a high proportion (67.6%) of household heads worried about the availability of enough food for their families. Similar proportions of the household heads (68.3%) reported the absence of preferred food, and 66.7% of respondents reported that they consumed a limited variety of foods. The overall prevalence of food insecurity was 70.7% (Endale et al., 2014).

As dietary diversity is a proxy indicator of food security (Ruel, 2002), and food–insecure households consumed a diet with less variety than food–secure households (Faber et al., 2009), it is crucial to determine dietary diversity and associated factors overall in the zone. Furthermore, there are no studies on this topic at zone level. Results of such a study would be relevant to, and could be used by, concerned stakeholders, policy makers, and program planners working on livelihood, agriculture, health, and nutrition.

4 LITERATURE REVIEW

4.1 Definition and Measurement of Dietary Diversity

Dietary diversity is defined as the number of individual food items or food groups consumed over a given period of time (Ruel, 2003). It can be measured at the household or individual level through use of a questionnaire. Most often it is measured by counting the number of food groups rather than the food items consumed. The type and number of food groups included in the questionnaire and subsequent analysis may vary, depending on the intended purpose and level of measurement. At the household level, dietary diversity is usually considered a measure of access to food (e.g., of households' capacity to access costly food groups), while at the individual level it reflects dietary quality, mainly the micronutrient adequacy of the diet. The reference period can vary, but is most often the previous day or week (FAO, 2011).

Dietary diversity scores are created by summing either the number of individual foods or the food groups consumed over a reference period (FAO, 2008). The dietary diversity scores described in the FAO guidelines consist of a simple count of food groups that a household or an individual has consumed over the past 24 hours. Since individual food items can be classified into more than one food group, the sixteen food groups were categorized into twelve food groups in order to measure household dietary diversity based on FAO's aggregation of food groups. For example, vitamin A-rich vegetables and tubers, dark-green leafy vegetables, and other vegetables were merged into a vegetables group; vitamin A–rich fruits and other fruits were merged into a fruit group; and the meat group is a combination of organ meat and flesh meat (FAO, 2011).

Assessing household dietary diversity is vital because household dietary diversity scores (HDDS) are meant to reflect, in a snapshot form, the economic ability of a household to access a variety of foods (FAO, 2011). Studies have shown that an increase in dietary diversity is associated with socioeconomic status and household food security (household energy availability), whereas individual dietary diversity scores aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in the individual dietary diversity score is related to increased nutrient adequacy of the diet (Hoddinott and Yohannes, 2002).

According to FAO's guidelines for assessing individual dietary diversity, the population of interest (for example, women of reproductive age) should be chosen prior to the start of the data collection. The respondent is asked about all the foods he/she consumed the previous day, inside and outside the home, to determine the individual-level dietary diversity. However, in order to assess household-level dietary diversity, the respondent should be the person who was responsible for meal preparation for the household on the previous day. The respondent is asked about all foods eaten inside the home during the previous day and night, by any member of the household. A dietary diversity questionnaire can be used to collect information at either household or individual level. The decision about which level to collect information about depends in part on the purpose and objectives of the survey. Both individual dietary diversity and household dietary diversity have pros and cons, depending on the ultimate goal of the study. If the purpose and objective of the survey are to determine household food security, assessing household dietary diversity is the best approach. The con to this approach is that it does not determine the nutrition adequacy of individuals in the household. If the purpose and objectives are to determine nutrient adequacy for individuals, individual dietary diversity is the best approach, although it neglects other people in the household. Since the recommendations from this study will be more applicable to the household level, it was deemed better to study household dietary diversity first and, if necessary, study individual dietary diversity to determine the effect of household food distribution, and to determine the knowledge of household heads on the dietary diversity of themselves as well as their young children (FAO, 2011).

4.2 Factors Associated with Dietary Diversity

4.2.1. Sociodemographic factors

Clausen et al. (2005) found that older adults in Botswana consume a low variety of food, with inadequate dairy products, fruits, and vegetables (35.2%, 59.3%, and 22.4% respectively). Another cross-sectional study among elderly respondents in Sharpeville, South Africa comparing a low mean dietary diversity score (3.41 +/- 1.34) and food variety score (4.77 +/- 2.2) with poverty parameters confirmed household food insecurity (Oldewage-Theron and Kruger, 2008). However, an earlier study found that respondents in the older age group had a higher mean intake for all nutrients compared to their younger counterparts (Holcombe, 1995).

Married people tend to consume a greater variety of food, perhaps because responsibility for other family members leads to a wider variety of dietary items in the household (Liu et al., 2014).

Education was positively correlated to high dietary diversity. That is, the more educated households are, the more likely they are to attain a high dietary diversity (Taruvinga et al., 2013). A cross-sectional study in a semi-rural setting in Louisiana found that intake of cereals/breads, dairy products, fruits/100% fruit juices, and vegetables was higher in subjects with more than 12 years of education (Deshmukh-Taskar et al., 2007).

4.2.2. Household socioeconomic status

Dietary diversity was shown to be strongly associated with household socioeconomic status (Hulshof et al., 2003). Families with greater incomes and resources tend to have more diverse diets, but they are also likely to have better access to health care and better environmental conditions. Evidence from a multi-country analysis suggests that household-level dietary diversity (DD) is strongly associated with household per capita income and energy availability, suggesting that DD could be a useful indicator of food security.

Households, especially those in rural areas, own farms where they can grow vegetables and raise livestock to replace or supplement purchased food (Liu et al., 2014). Dietary diversity is slightly but significantly higher among farm households than among non-farm households at the sample mean, although non-farm household are significantly richer and could therefore afford a more diversified diet (Ecker et al., 2012). It suggests that the direct access to food through farming can indeed contribute to an improved diet.

Ferguson and colleagues also made reference to differences in dietary diversity between households from different socioeconomic status groups among preschool Ghanaian and Malawian children (Ferguson et al., 1993).

4.2.3 Market access

There are no significant differences in the dietary diversity between market-oriented and subsistence farm households on average, although market-oriented farm households have substantially higher income levels (Ecker et al., 2012).

Food prices and income levels have a strongly determinative effect on dietary quality as agricultural products reach consumers through food supply chains, and each link affects the availability, affordability, and nutritional quality of foods. This is because, as incomes increase, individuals buy non-staple plant foods (lentils, fruits, vegetables) and animal products, which are denser in bio-available vitamins and minerals than staple foods (Ruel, 2003).

4.2.4 Access to animal-source foods

The importance of animal-source foods for macro- and micronutrient intakes in developing countries is addressed by Murphy and Allen (Murphy and Allen, 2003), and the functional importance of micronutrients for human growth and cognitive function is discussed by Rivera (Rivera et al., 2003) and Black (Black, 2003), respectively. The importance of animal-source foods as one component of dietary diversity is highlighted in studies in Mexico and Peru (Allen et al., 1991; Marquis et al., 1997).

In a study conducted in Peru, animal-source foods were not significantly associated with length of the child at 15 months as a main effect, but significantly interacted with overall dietary diversity in multivariate models (Marquis et al., 1997).

The specific contribution of animal-source foods to dietary diversity depends to a large extent on the definition of dietary diversity. For example, in a study conducted in Mali, the dietary diversity score was composed of eight food groups, half of which were animal product groups such as eggs, meat, milk, and fish, which were all treated as separate categories (Hatløy et al., 1998). In Vietnam, however, animal products contributed only three of the twelve food groups (fish/seafood, meat, and eggs) and thus, could account for no more than 25% of the total food group diversity score (Ruel, 2006).

4.2.5 Home gardening

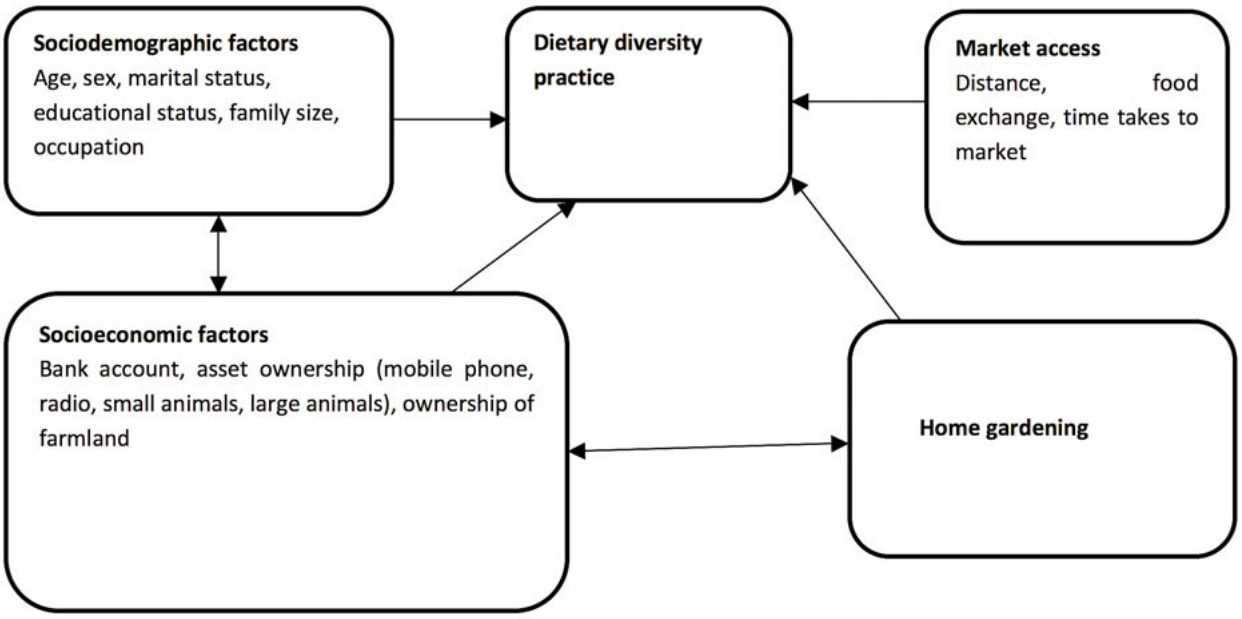
A home garden is a place where one should be able to find a large variety of foods (fruits, vegetables, herbs, condiments, etc.). Diversity of plants in the garden leads to diversity of family diet (Ajah et al., 2013). Home gardening provides a means to access a variety of foods that may not be available in the market through cultivation of fruits, vegetables, and other crops. Home gardens provide easy access to fresh plants and animal–source foods in both rural and urban areas (Galhena et al., 2013). A study done in Nepal concluded that home gardens contain high levels of species diversity. The value of home gardens for household dietary diversity and health is well recognized (Gautam et al., 2006).

There was a clear association between having a home garden and a more varied diet, and dietary diversity scores were significantly higher among children living in households with gardens (Cabalda et al., 2011).

Access to a home garden was positively correlated to high dietary diversity and negatively related to low dietary diversity (Taruvinga et al., 2013). The study by Taruvinga et al. indicated that rural households with access to home gardens are more likely to move from a medium dietary diversity status into a high dietary diversity status. A possible explanation is that home gardens normally provide a variety of micronutrient-rich horticultural crops like vegetables, fruits, and tubers.

4.3 Conceptual Framework

Figure 1. Conceptual framework: Dietary diversity and associated factors.



5 METHODS AND MATERIALS

5.1 Study Area

The study was conducted in South Gondar Zone, Northwest Ethiopia. Debre Tabor is the capital town of the zone. It is 666 km from Addis Ababa and 99 km from the capital city of Amhara Region, Bahir Dar. There are a total of 10 *woredas*. The zone has an estimated population of 2,278,555. Like the rest of the zones in the northern part of the country, the livelihood of the community largely depends on subsistence agriculture (EDHS, 2011).

5.2 Study Design and Period

A cross-sectional survey was conducted from January to September 2015 in the selected *woredas*.

5.3 Source Population

The source population was all household heads in the two *woredas*, who prepare the food for the family.

5.4 Study Population

The study population was made up of household heads who prepare food for the family and were randomly selected.

5.5 Sample Size

The sample size was determined by using a single population proportion formula as follows.

$$n = \frac{(Z\alpha/2)^2 p(1-p)}{d^2}$$

Where:

Z = Standard normal variable at 95% confidence level (1.96)

d = Margin of error (0.05)

p = Proportion of household diet diversity score (42.3%) (Goshu et al., 2013).

$$n = \frac{(1.96)2\,(0.423)(1-0.423)}{(0.05)\,2} = 375$$

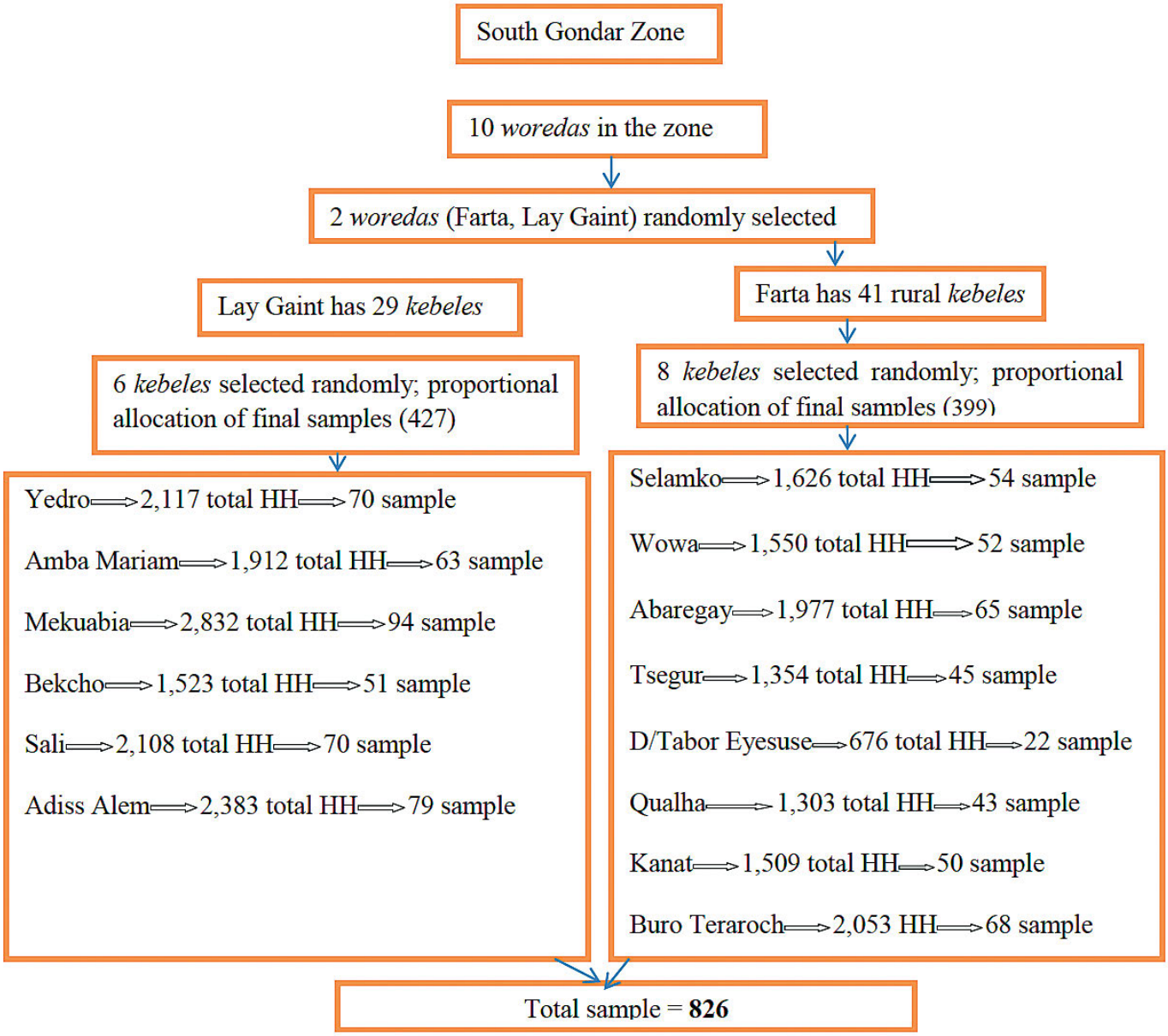
Including a non-response rate of 10%, the total study population was 413 household heads.

Multistage sampling was used to select *woredas* and *kebeles*, which has design effect; final sample size was 2 x 413 = 826.

5.6 Sampling Procedure

A multistage simple random sampling technique was employed to select *woredas* and *kebeles* in the study area. From ten *woredas*, two *woredas* were selected randomly. From these *woredas*, 20% of the *kebeles* were selected through a simple random sampling technique. Then all households were recorded as a sampling frame in the selected *kebeles*. Finally, the sample size was proportionally allocated to selected *woredas* and *kebeles*, and respondents were chosen with a random sampling technique.

Figure 2. Schematic presentation of sampling procedure.



5.7 Inclusion and Exclusion Criteria

5.7.1 Inclusion criteria

All household heads who prepare food for the family in the selected households were included.

5.7.2 Exclusion criteria

Household heads who were seriously ill or could not respond due to physical disabilities (e.g., deaf and dumb) were excluded.

5.8 Variables

5.8.1 Dependent variable

- Household dietary diversity.

5.8.2 Independent variables

- Sociodemographic factors
- Socioeconomic factors
- Market access
- Home gardening.

5.9 Operational Definitions

- **Dietary diversity:** Number of individual food groups consumed over a 24-hour period.
- **Household dietary diversity:** Defined as the number of food groups consumed by household members over a 24-hour period.

- **Low dietary diversity:** When households consume less than or equal to three food groups.
- **Medium dietary diversity:** When households consume four to six food groups.
- **High dietary diversity:** When households consume seven or more food groups.
- **Adequate dietary diversity:** When households have high dietary diversity.
- **Inadequate dietary diversity:** When households have low and medium dietary diversity (FAO, 2011).

5.10 Data Collection Methods and Instruments

Quantitative data was collected using a structured questionnaire. The questionnaire was translated and contextualized to the local situation. Data on sociodemographic factors were collected by interviewing household heads who prepare food for the family. A structured questionnaire was used to collect data on the dietary diversity of households. Through targeting the respondents' dietary history, a 24-hour dietary recall was conducted to obtain food group information for the households' food intake. The respondents were asked to recall all foods eaten and beverages taken in the previous twenty-four hours prior to the interview date. Dietary diversity scores for the households were estimated using information collected from the 24-hour dietary recall. Twelve food groups were assessed (FAO, 2012). Qualitative data were collected through focus group discussions (FGDs) to complement the quantitative data so as to identify factors affecting household dietary diversity. The focus group discussion guide explains how to conduct FGDs, the responsibilities of facilitators, and all the procedures of FGDs. FGD participants were selected purposely among women development army members in each selected *kebele*. Seven guiding questions were asked for each session. Training was given to the facilitator to lead the group discussion. There were 10 women development army members in each group; a total of 160 participants in 16 groups. After 10 sessions, it was assumed that a saturation point had been reached, and the conclusions were taken as the consensus view.

5.11 Data Processing and Analyzing

All responses to the survey questionnaires were coded against the original English version, checked for missing values and outliers, entered into the Epi Info 2002 data entry program, and analyzed using SPSS (SPSS Inc. version 20.0). For all statistical significance tests, the cut-off value was set at $P<0.05$. Descriptive data were presented using tables and graphs, and logistic regression analysis was used for data analysis of explanatory variables.

6 ETHICAL CONSIDERATIONS

Ethical clearance was obtained from Bahir Dar University. Permission was obtained from the concerned bodies of Amhara Regional Health Bureau, from ZHDs, and from all selected *woreda* health offices, and from *woreda* and *kebele* administrations through a formal letter. The necessary explanation about the purpose of study and its procedure was given, and oral consent was obtained from the respondents. Study participants were informed that they had full right not to participate in the study if they were not willing. To insure confidentiality, anonymity was explained clearly to participants.

7 RESULTS

7.1 Sociodemographic Characteristics of the Study Subjects

Out of 826 planned participants, 816 participated in the study; a response rate of 98.7%. Participants responsible for household food preparation were included in the analysis, among which 769 (94.2%) were females and 256 (31.4%) were 18–34 years old, 524 (64.2%) were 35–64 years old, and the rest were above 65 years old. The mean age of participants was 39.8 (±11.4 years).

More than half of the study participants (58.7%) live in the Weina Dega climatic region, 36.8% in the Dega region, and the rest (4.5%) in the Kolla region. The majority of participants (86.3%) are married, 5.3% are divorced, 4.4% are widowed, and the rest (4%) are single. Almost all of the participants (99.6%) are Orthodox in religion and Amhara in ethnicity (99.5%). More than half of the households (57.2%) have a family size larger than the national average (>4.5).

The study revealed that the majority of the participants (61.6%) cannot read and write, 16.4% can read and write, 8.3% have an education level between grades 1–4, 8.8% have a level of grade 5–8, and only 4.8 % participants have a level of grade 9 and above. Most of the participants (84.6%) are farmers; 11.4% of the female participants are housewives (see Table 1).

Table 1. Sociodemographic characteristics of participants

Variables	Frequency	(n = 816)	Percent (%)
Age	18–34	256	31.4
	35–64	524	64.2
Sex	Male	47	5.8
	Female	769	94.2
Climate	Dega	300	36.8
	Weina Dega	479	58.7
	Kolla	37	4.5
Marital status	Single	33	4
	Married	704	86.3
	Divorced	36	4.4
	Widowed	43	5.3
Educational status	Cannot read and write	503	61.6
	Can read and write	134	16.4
	Grade 1–4	68	8.3
	Grade 5–8	72	8.8
	Grade 9 and above	39	4.8
Occupation	Farmer	690	84.6
	Housewife	93	11.4
	Other	33	4
Home gardening	No	608	74.5
	Yes	208	25.5
Religion	Orthodox	813	99.6
	Muslim	4	0.4
Ethnicity	Amhara	813	99.5
	Tigrie	3	0.5
Family size	National average (<4.5)	349	42.8
	(>4.5)	467	57.2

7.2 Socioeconomic Characteristics of Participants

Less than one-third of participants (28.8%) had a bank account, and only 15% participants use electric power at home. Less than one-quarter of participants (23.8%) had a radio, and 3.3% of participants had a television. Half of the study participants (51.3%) use mobile phones, and only 0.6% of participants had a refrigerator. For almost all of the participants (99.3%), the floor of their home is made of soil and sand. For the majority of the participants (81.7%), the roof of their home is corrugated sheet metal.

One-quarter of the participants (25.5%) use home gardening, and the majority (90.9%) had large animals like cattle and horses. Greater than half of the participants (55.3%) had small animals like hens (see Table 2 and Annex Table A1).

Table 2. Socioeconomic characteristics of participants

Variables	Frequency	(n = 816)	Percent (%)
Bank account	Yes	235	28.8
	No	580	71.1
Electric power	Yes	122	15
	No	691	84.7
Radio	Yes	194	23.8
	No	622	78.2
Mobile phone	Yes	419	51.3
	No	397	48.7
Farming land	Yes	705	86.4
	No	111	13.6
Home gardening	Yes	208	25.5
	No	608	74.5
Cattles/horse	Yes	742	90.9
	No	74	9.1
Small animals	Yes	451	55.3
	No	365	44.7

Sample home gardening in the study area

7.3 Measures of Market Access

Five hundred sixty-six participants (69.4 %) live more than three km from the local market, and for 46.9% of participants, it takes more than a half-hour to reach the local market. About three-fourths of the participants (74.9%) go to market on foot, 15.1% use horses and carts, and the rest use vehicles. The majority of participants (84.6%) practice food exchange at the market. Less than one-quarter of participants (18.1%) had access to off-farm employment opportunities.

7.4 Measures of Dietary Diversity and Its Indicators

One hundred seventy-two (21.1%) participants consumed up to three food groups (low dietary diversity), 62.7% consumed four to six food groups (medium dietary diversity), and 16.2% participants consumed seven or more food groups (high dietary diversity) in their diet during the preceding 24 hours. The proportion of study participants with adequate dietary diversity in this study was 16.2% (see Figures 3A and 3B).

7.5 Factors Affecting Household Dietary Diversity

Twenty-one independent variables were analyzed in the logistic regression with the dependent variable of household dietary diversity to analyze their association. Twelve were significantly associated with HDD in the binary logistic regression. Seventeen variables ($p \leq 0.2$) were entered into the multiple logistic regression analysis. There was significant association between the following variables: radio, mobile phone, bank account, food exchange, and

Table 3. Measures of market access of participants

Variables	Frequency	(n = 816)	Percent (%)
Distance to market	Less than or equal to 3 km	250	30.6
	Greater than 3 km	566	69.4
Time to market	Half an hour	433	53.1
	Greater than half an hour	383	46.9
Off-farm employment	Yes	148	18.1
	No	668	81.9
Food exchange and sale	Yes	690	84.6
	No	126	15.4
Transport	On foot	611	74.9
	Horse & cart	123	15.1
	Vehicles	82	10

Figure 3A. Measures of HDD.

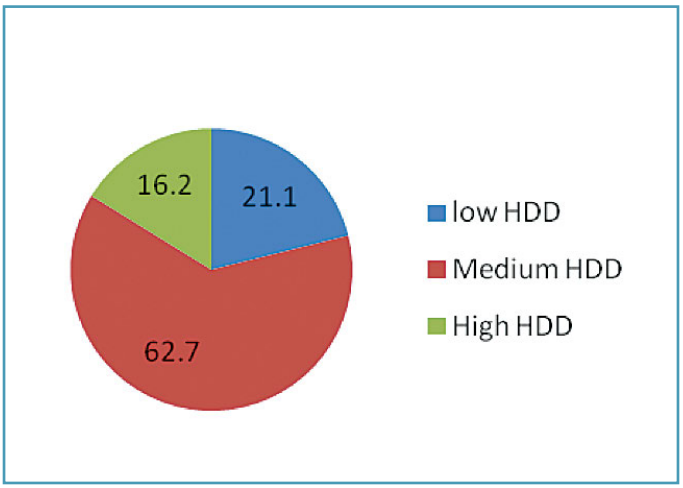
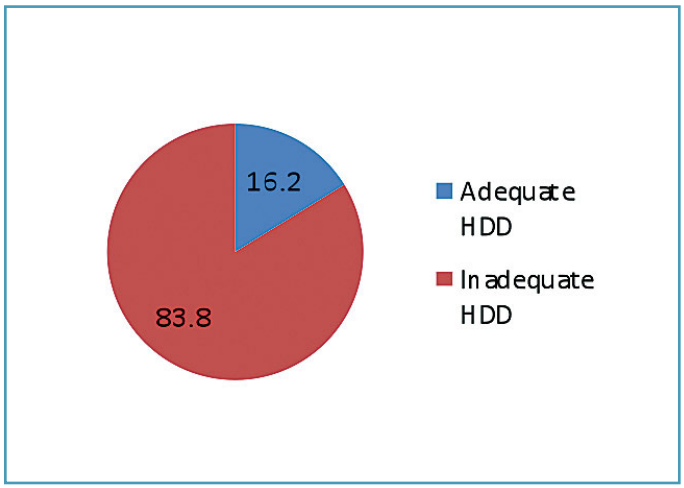


Figure 3B. Indicators of HDD.



ownership of small animals. Respondents who have a radio were twice as likely (95% CI: 1.215, 3.025) to have a diversified diet compared to those who do not have one. Participants who have a mobile phone were 1.6 times more likely (95% CI: 1.015, 2.649) to have a diversified diet compared to their counterparts who do not. A bank account is also significantly associated with household dietary diversity. Participants having a bank account were three times more likely (95% CI: 1.963, 4.868) to have a diversified diet than those who do not. Respondents who exchange food were 2.2 times more likely (95% CI: 1.074, 4.561) to diversify their diet compared to those who do not. Participants having a practice of rearing small animals were 1.7 times more likely (95% CI: 1.089, 2.707) to diversify their diet compared to their counterparts who do not (see Table 4 and Annex Table A2).

Table 4. Household dietary diversity and associated factors of participants

Variables		Optimal DDS N (%)		p-value	COR (95% CI)	AOR (95% CI)
		No	Yes			
Home gardening	Yes	160 (76.9)	48 (23.1)	0.002	1	1
	No	524 (86.2)	84 (13.8)		0.534 (0.359, 0.794)	0.704 (0.443, 1.117)
Bank account	Yes	159 (67.7)	76 (32.3)	<0.001	4.473 (3.034, 6.594)	3.091 (1.963, 4.868)
	No	524 (90.3)	56 (9.7)		1	1
Radio	Yes	136 (71.1)	58 (29.9)	<0.001	3.158 (2.135, 4.672)	1.917 (1.215, 3.025)
	No	548 (88.1)	74 (11.9)		1	1
Mobile phone	Yes	324 (77.3)	95 (22.7)	<0.001	2.853 (1.896, 4.292)	1.640 (1.015, 2.649)
	No	360 (90.7)	37 (9.3)		1	1
Farmland	Yes	591 (83.8)	114 (16.2)	0.990	1	1
	No	93 (83.8)	18 (16.2)		1.003 (0.583,1.727)	0.876 (0.430, 1.783)
Small animals	Yes	658 (79.4)	93 (20.6)	<0.001	2.171 (1.451, 3.249)	1.717 (1.089, 2.707)
	No	326 (89.3)	39 (10.7)		1	
Time to market	Less than half hr.	348 (80.4)	85 (19.6)	0.005	1	1
	Greater than half hr.)	336 (87.7)	47 (12.3)		1.746 (1.186,2.570)	0.738 (0.449, 1.215
Off-farm employment	Yes	108 (73)	40 (27)	<0.001	1	1
	No	576 (86.2)	92 (13.8)		0.431 (0.282,0.659)	0.864 (0.507, 1.472)
Food exchange	Yes	569 (82.5)	121 (17.5)	0.016	2.223 (1.162, 4.254)	2.213 (1.074, 4.561)
	No	115 (91.3)	11 (8.7)		1	1
Type of transport	On foot	530 (86.7)	81 (13.3)	<0.001	1	1
	Horse & cart	98 (79.7)	25 (20.3)		1.669 (1.015,2.745)	1.188 (0.632, 2.233)
	Vehicles	56 (68.3)	26 (31.7)		3.038 (1.805,5.113)	1.446 (0.738, 2.834)

Sample rearing of small animals in the study area

8 DISCUSSION

The aim of this study was to assess household dietary diversity and its associated factors. Use of a community-based study gives a clear picture of dietary diversity and the factors affecting it.

In this study, 172 (21.1%) participants consumed up to three food groups (low dietary diversity), 62.7% consumed four to six food groups (medium dietary diversity) and 16.2% of participants consumed seven or more food groups (high dietary diversity) in their diet during the preceding 24 hours. The proportion of study participants with adequate dietary diversity in this study was therefore 16.2%. A similar study of rural households in Amatole and Nyandeni districts, South Africa, showed that 29.3 % of the households reported a low-level dietary diversity, 35.9% of the households reported a medium-level dietary diversity, and 34.8% households reported high-level dietary diversity (Taruvinga et al., 2013). The difference might be due to variations like geographical location, seasonal variability, and other sociodemographic factors.

In Germany, Thiele and Weiss (2003) noted that household size, age, sex composition, employment status, and level of education were the major determinants of household dietary diversity. However, in this study, variables such as household size, age, sex composition, employment status, and level of education did not show any association with household dietary diversity.

The study by Taruvinga and his colleagues indicated that households that were female headed, educated, and had access to a home garden were positively correlated to high dietary diversity, which is also in contrast with this study. This may be attributed to many factors such as differences in study area, study period, and other factors (Taruvinga et al., 2013).

The independent variables of radio, mobile phone, bank account, food exchange, and ownership of small animals showed strong association in the multiple logistic regression analysis, which is in agreement with the study by Taruvinga et al. (2013).

Respondents who have a radio were two times more likely (95% CI: 1.215, 3.025) to have a diversified diet compared to those who did not have one. This might be attributed to access to information through local broadcasting media, which broadcasts nutrition and health messages as a means of advocating.

Participants who have mobile phones were 1.6 times more likely (95% CI: 1.015, 2.649) to have adequate dietary diversity than their counterparts who do not. This might be related to their economic status. Participant household heads who have a mobile phone might have a higher monthly income than those who do not have one. Furthermore, there is a significant positive relationship as expected between food security level and household assets and in turn dietary diversity (Ahmed and Naphtali, 2014). This implies that food security status and dietary diversity increase as assets level increases.

> ***The women development army reached consensus with the idea, "As far as money is there, it is possible to buy everything and diversify our diet even though the market is so far."*** **(FGD)**

Having a bank account/savings is also significantly associated with household dietary diversity. Participants who have a bank/saving account were three times more likely (95% CI: 1.963, 4.868) to have a diversified diet than who do not. This is consistent with a study conducted in Limpopo Province, South Africa where households with low dietary diversity were also the most impoverished, and fewer households had money in a savings account (Faber et al., 2009), and scores of dietary diversity have been shown to be linked to socioeconomic characteristics (Savy et al., 2007).

> ***The women developmental army reached consensus with the idea, "Saving, off-farm income sources, and availability of transport opportunities would help us to complement foods not produced on-farm to variety foods."*** **(FGD)**

Respondents who exchange foods were 2.2 times more likely (95% CI: 1.074, 4.561) to diversify their diet compared to those who do not. Those who exchange foods may have the experience of trading surplus foods from their farms for foods that are scarce or totally unavailable at home. This may help to diversify their diet.

> ***The women development army reached consensus with the idea, "Since we usually produce crops on our farm and we can't produce all types of foods, food exchange is very important to eat varieties of foods. But distance of market makes food exchange very difficult, especially for elders, pregnant women, and mothers with children."*** **(FGD)**

Participants who rear small animals are 1.717 times more likely (95% CI: 1.089, 2.707) to diversify their diet compared to their counterparts, which is in agreement with a study conducted in Amatole and Nyandeni districts, South Africa. That study showed correlation between ownership of small livestock and dietary diversity. The study indicated a positive significant association, suggesting that households that own small livestock are more likely to move from medium dietary diversity to high dietary diversity. Small livestock are easy to keep, easy to trade, and contain several food groups (eggs, meat, and goat milk) that may provide micro- and macronutrients (Taruvinga et al., 2013).

9 CONCLUSIONS

This study estimated levels and determinants of rural household dietary diversity using household cross-sectional survey data from 816 respondents. With reference to the dietary diversity status of rural households from the study area, the study suggests a low dietary diversity, mainly defined by inclusion of less than seven food groups. Regarding determinant factors, ownership of a radio, possession of a mobile phone, having a bank/saving account, rearing small animals, and participating in food exchange showed significant association with household dietary diversity.

Moreover, focus group discussion also showed that respondents were unable to diversify their diet due to factors such as remoteness of market, lack of transport, and lack of money to purchase different food items. The discussion also revealed that the participants would improve their dietary diversity if they had off-farm income sources and had easy market access for exchanging foods.

10 RECOMMENDATIONS

Ownership of a radio, having a bank/saving account, rearing small animals, and participating in food exchange showed significant association with household dietary diversity. Therefore, the following recommendations were put forward to concerned bodies.

- The local media should broadcast nutrition messages for improved household dietary diversity, since households with a radio had a more diversified diet than those who did not.

- Local microfinance and saving institutes should promote and strengthen saving habits and establish small-scale enterprises to create off-farm income opportunities for rural households. Such enterprises would improve their purchasing power and lead to good dietary diversity.

- Since rearing of small animals and livestock showed association with dietary diversity, the *woreda* agriculture offices should assist the rural households through existing programs such as the Household Asset Building Program (HABP).

- Local trade and market enterprises should support the creation of market linkage, in collaboration with the rural roads authority. Such efforts would enable communities to exchange their food commodities, which may help to improve their dietary diversity status.

- A further study with a different design (e.g., a cohort design) is recommended to address seasonal variability and other variables that were not addressed in the current study.

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ANNEXES

Annex 1 Consent Form

My name is _____ I am working as data collector in the survey conducted by Bahir Dar University, Department of Applied Human nutrition data investigators. These questionnaires are prepared to ***Assess Dietary diversity and associated factors among rural households*, south Gondar Zone- Northern Ethiopia**.

This study is designed to generate information for program expansion and designing strategies to **Dietary diversity and associated factors at household level**. To attain this purpose, your honest and genuine participation by responding to the questions prepared is very important.

If you have been interviewed, you will not be interviewed again and will send you off with thanks. If not, I request you to respond to my questions genuinely.

Confidentiality and consent

We would like to inform you that some personal issues, your answers and ideas are completely confidential and secured. Your name will not be written on this form. You can refuse to answer a single question and even to the extent to stop the interview at any time you want if you are not comfortable. We appreciate your kindness to be part of the study. The interview will take about 20-30 minutes.

Are you willing to participate?

If the answer, yes ☐ ⟶ Continue

No ☐ ⟶ stop

Thank you very much

Annex 2 Questionnaires

Section 0: Questionnaire identification

001-date_____/_____/_____

002- Questioner identification_____

003 Kebele _____

004- Gott _____

005-Interviewer Name_____ Sign_____date_____

006-Supervisor Name_____ Sign_____date_____

Section I background characteristics (socio demography & economy data)

Notice: first write or circle the appropriate answer on the coding categories & also put on the coding column.

NB.

1. No need of forcing the respondents to be included in the study
2. Please register the sex& age of study subject who refuse to participate in the study.

Annex 2.1 English Version Questionnaires
Part I. Demographic data of household heads

S.No	Questions	Option of answers	Skip
101	How old are you?	_____Age in years	
102	Agro ecological characteristics of respondent	_____	
103	Sex of the respondent	1. Male 2. Female	
104	Respondent's residence	1. Rural 2. Urban	
105	What is your religion?	1.Orthodox 2. Muslim 3. Adventist 4. Protestant 5. other	
106	What is your ethnicity?	1. Amhara 2. Tigrie 3. Oromo 4. other	

107	What is your current marital status?	1. single 2. married 3. Divorced 4. Widowed	
108	What is your house hold size	_____	
109	What is your educational level?	1. Can not read and write 2. Can read and write 3. Grade 1-4 4. Grade 5-8 5. Grade9- 12 6. Tertiary education	
110	What is your current occupation?	1. Farmer 2. Government employer 3. Merchant 4. House wife 5. Daily laborer 6. student 7. other specify	
111	Does any member of the house hold has bank account	1. Yes 2. No	
112	Does your household have: Electricity? A watch/clock. A radio? A television? A mobile telephone? A non-mobile telephone? A refrigerator? A table? A chair? A bed with cotton/sponge/spring mattress?	 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No 1. Yes 2. No	
113	Main material of the floor. record observation	Natural floor earth/sand, dung. ❑ Rudimentary, floorwood planks ❑ palm/bamboo ❑ Finished Floor parquet ❑ or polishedwood ❑ vinyl ❑ or asphalt strips ❑ Ceramic tiles ❑ Cement ❑ Carpet ❑ other ❑ 96 (specify)	
114	Main material of the roof. record observation	Natural roofing ❑ no roof ❑ thatch/leaf/mud ❑ rudimentary roofing rustic mat/ plastic sheets ❑ Reed/bamboo	

		Wood planks Cardboard finished roofing ❑ corrugated iron /metal ❑ Wood ❑ Asbestos/cement fiber ❑ Cement/concrete ❑ roofing shingles ❑ other ❑ 96 (specify)	
115	Access to a home gardening	1. yes 2. No	
116	Access to farmland	1. Yes 2. No	
117	Access to a home garden	1. yes 2. No	
118	Ownership of Large-Livestock (Cattle, horses, donkey)	1. yes 2. No	
119	Ownership of small-Livestock (hen, cock,)	1. yes 2. No	

Part II. Diet diversity measured using 12 food groups

S.No	Questions	Option of answers
A	Any [INSERT ANY LOCAL FOODS, bread, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice, wheat], or [INSERT ANY OTHER LOCALLY VAILABLE GRAIN]?	A ..... |___|
B	Any potatoes, yams, manioc, cassava or any other foods made from roots or tubers?	B ..... |___|
C	Any vegetables?	C ..... |___|
D	Any fruits?	D ..... |___|
E	Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?	E ..... |___|
F	Any eggs?	F ..... |___|
G	Any fresh or dried fish or shellfish?	G ..... |___|
H	Any foods made from beans, peas, lentils, or nuts?	H ..... |___|
I	Any cheese, yogurt, milk or other milk products?	I ..... |___|
J	Any foods made with oil, fat, or butter?	J ..... |___|
K	Any sugar or honey?	K ..... |___|
L	Any other foods, such as condiments, coffee, tea?	L ..... |___|

Part III: Market access and house hold dietary diversity

S.No	Questions	Option of answers	Skip
301	How far is market from your home in km	_____Km	
302	How long take the market from your home	_____hrs	
303	Do you have off farm income source	1.Yes 2. No	
304	Do you exchange food from the market	1. Yes 2. No	
305	What type of transport the house hold use to go to market	1. Bar foot 2. Animal transport 3. Cart 4. Bus 5. Other	

Thank you very much for your co-operation

ANNEX 2.2. Information Sheet and Consent Form

Title of the Research: Dietary diversity and associated factors among rural households, south Gondar Zone, Northwest Ethiopia

Name of Principal Investigator: Girma Nega & Research team

Name of the Organization: Institution of Technology, Faulty of Chemical and Food Engineering, Applied Human Nutrition Program, Bahir DarUniversity.

Name of the Sponsor: Tufts University/ USAID.

Information Sheet and consent form prepared for Assessment of Dietary diversity and associated factors among households, south Gondar Zone, Northwest Ethiopia

This information sheet and consent form is prepared with the aim of explaining the research project that you are asked to join by the group of research investigators. The main aim of the research project is to assess Dietary diversity and associated factors among households.

Purpose of the Research Project
The main aim of this study is to assess Dietary diversity and associated factors among householdswhich contribute positively or negatively in the study areas. The results of this study will be used as base, especially in the study area, to design appropriate intervention programs to address the problem. In the past, recent study on Dietary diversity and associated factors has not been conducted in the study area. So, this study focuses in assessing Dietary diversity and associated factors among households, south Gondar Zone, Northwest Ethiopia

Procedure
The study involves currently house headed family. For the assessment, you are selected to be one of the study participants. If you are willing to practice in our project we are so happy for you to participate in this study and we need you to clearly understand the aim of this study and to willing by oral consent. Then; you are kindly requested to give your response to the data collectors.

For this questionnaire based study, study subjects are currently head of the house selected by sampling technique. All the response given by participants and the result obtained will be kept confidentiality by using coding system whereby no one will have access to your response.

Risk and /or Discomfort
By participating in this research project you may feel that it has some discomfort especially on wasting your time (a maximum of 30 minutes) but this may not be too much as you are one of the member of the community, so your response will help as an important input to show the gap and means to improve dietary diversity practice. There is no risk in participating in this research project.

Benefits
If you are participating in this research project, there may not be direct benefit to you but your dietary diversity and associated factors may help in resource allocation and decision making.

Incentives/Payments for Participating
You will not be provided any incentives or payment to take part in this project.

Confidentiality
The information collected for this research project will kept confidential and information about you that will be collected by this study will be stored in a file, without your name, but a code number assigned to it. And it will not be revealed to anyone except the principal investigator and assistants will be kept locked with key.

Right to Refusal
You have the full right to refuse from participating in this research. (You can choose not to response some or all the questions) and this will not affect you from getting any kind of service. You have also the full right to leave from this study at any time you wish, without losing any of your right.

Person to contact
This research project will be reviewed and approved by the ethical board of Bahir Dar University. If you want to know more information you can contact through the address below. If you have any question you can contact any of the following individuals and you may ask at any time you want.

1. Mr. Girma Nega

Mobile:+251918713952/e-mail: girma_nega@yahoo.com

Annex 3 Result Tables

Table A1. Socioeconomic characteristics of participants

Variables	Frequency	(n = 816)	Percent (%)
Bank account	Yes	235	28.8
	No	580	71.1
Electric power	Yes	122	15
	No	691	84.7
Watch	Yes	10	1.2
	No	806	98.8
Radio	Yes	194	23.8
	No	622	78.2
Television	Yes	27	3.3
	No	789	96.7
Mobile phone	Yes	419	51.3
	No	397	48.7
Refrigerator	Yes	5	0.6
	No	811	99.4
Tables/chairs	Yes	301	36.9
	No	515	63.1
Bed/mattress	Yes	105	12.9
	No	711	87.1
Floor type	Soil or sand	810	99.3
	Stone	2	0.2
	Cement	4	0.5
Roof	Plastic	1	0.1
	Grass	148	18.1
	Corrugated	667	81.7
Farming land	Yes	705	86.4
	No	111	13.6
Home gardening	Yes	208	25.5
	No	608	74.5
Cattles/horse	Yes	742	90.9
	No	74	9.1
Small animals	Yes	451	55.3
	No	365	44.7

Table A2. Household dietary diversity and associated factors of participants

Variables		Optimal DDS N (%)		p-value	COR (95% CI)	AOR (95% CI)
		No	Yes			
Age	18–34	211(82.4)	45 (17.6)	0.146	1	1
	35–64	438 (83.6)	86 (16.4)		0.921 (0.619, 1.368)	0.941 (0.563, 1.573)
	≥65	35 (97.2)	1 (2.8)		0.134 (0.018, 1.004)	0.167 (0.021, 1.320)
Climate	Dega	264 (88)	36 (12)	0.043	1	1
	Weina Dega	391 (81.6)	88 (18.4)		1.65 (1.087, 2.507)	1.542 (.930, 2.556)
	Kolla	29 (79.4)	8 (21.6)		2.023 (0.859, 4.765)	3.925 (1.475, 10.446)
Marital status	Single	23 (69.7)	10 (30.3)	0.104	1	1
	Married	591 (83.9)	113 (16.1)		0.44 (0.204, 0.949)	0.551 (0.222, 1.371)
	Divorced	31 (86.1)	5 (13.9)		0.371 (0.112, 1.233)	0.577 (0.140, 2.371)
	Widowed	39 (90.7)	4 (9.3)		0.236 (0.066, 0.839)	0.491 (0.118, 2.049)
Educational status	Not read and write	436 (86.7)	67 (13.3)	0.006	1	1
	Read and write	109 (81.3)	25 (18.7)		1.493 (0.901, 2.473)	1.342 (0.753, 2.393)
	Grade 1–4	58 (85.3)	10 (14.7)		1.122 (0.547, 2.302)	0.889 (0.398, 1.984)
	Grade 5–8	55 (76.4)	17 (23.6)		2.011 (1.102, 3.671)	1.029 (0.503, 2.107)
	Grade 9 and above	26 (66.7)	13 (33.3)		3.254 (1.594, 6.643)	1.605 (0.664, 3.881)
Occupation	Farmer	579 (83.9)	111 (16.1)	0.053	1	
	Housewife	82 (88.2)	11 (11.8)		0.700 (0.361, 1.356)	0.745 (0.345, 1.609)
	Other	23 (69.7)	10 (30.3)		2.268 (1.050, 4.897)	1.426 (0.529, 3.843)
Home gardening	Yes	160 (76.9)	48 (23.1)	0.002	1	1
	No	524 (86.2)	84 (13.8)		0.534 (0.359, 0.794)	0.704 (0.443, 1.117)
Bank Account	Yes	159 (67.7)	76 (32.3)	<0.001	4.473 (3.034, 6.594)	3.091 (1.963, 4.868)
	No	524 (90.3)	56 (9.7	0.003)	1	1
Electric power	Yes	91 (74.6)	31 (25.4)		1	1
	No	590 (85.4)	101 (14.6)		0.503 (0.318, 0.795)	1.016 (0.562, 1.839)
Radio	Yes	136 (71.1)	58 (29.9)	<0.001	3.158 (2.135, 4.672)	1.917 (1.215, 3.025)
	No	548 (88.1)	74 (11.9)		1	1
Television	Yes	17 (63)	10 (37)	0.04	1	1
	No	667 (84.5)	122 (15.5)		0.311 (0.139, 0.695)	0.482 (0.181, 1.283)
Mobile phone	Yes	324 (77.3)	95 (22.7)	<0.001	2.853 (1.896, 4.292)	1.640 (1.015, 2.649)
	No	360 (90.7)	37 (9.3)		1	1
Farmland	Yes	591 (83.8)	114 (16.2)	0.990	1	1
	No	93 (83.8)	18 (16.2)		1.003 (0.583, 1.727)	0.876 (0.430, 1.783)
Small animals	Yes	658 (79.4)	93 (20.6)	<0.001	2.171 (1.451, 3.249)	1.717 (1.089, 2.707)
	No	326 (89.3)	39 (10.7)		1	

Time to market	Less than half hr	348 (80.4)	85 (19.6)	0.005	1	1
	Greater than half hr	336 (87.7)	47 (12.3)		1.746 (1.186, 2.570)	0.738 (0.449, 1.215)
Off-farm employment	Yes	108 (73)	40 (27)	<0.001	1	1
	No	576 (86.2)	92 (13.8)		0.431 (0.282, 0.659)	0.864 (0.507, 1.472)
Food exchange	Yes	569 (82.5)	121 (17.5)	0.016	2.223 (1.162, 4.254)	2.213 (1.074, 4.561)
	No	115 (91.3)	11 (8.7)		1	1
Type of transport	On foot	530 (86.7)	81 (13.3)	<0.001	1	1
	Horse &cart	98 (79.7)	25 (20.3)		1.669 (1.015, 2.745)	1.188 (0.632, 2.233)
	Vehicles	56 (68.3)	26 (31.7)		3.038 (1.805, 5.113)	1.446 (0.738, 2.834)