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MEASURING RURAL HOUSEHOLDS' FOOD CONSUMPTION PATTERN USING HDDS. A CASE OF MOPANI DISTRICT MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

Rudzani Nengovhela[1]✉, Abenet Belete[1], Jan J. Hlongwane[1], Isaac B. Oluwatayo[2]

[1]University of Limpopo, South Africa
[2]University of Venda, South Africa

Abstract. Inadequate consumption of nutritious food is still a challenge in most rural areas in the African continent, as the majority of households are in between jobs. This leads to rural households not having stable jobs, which affects their income, and results in their inability to acquire nutritious food because the level of income influences households' dietary diversity and quality. This study aimed to measure household food consumption patterns using the Household Dietary Diversity Score (HDDS), with food groups over a recall period of seven days in the rural households of Mopani District Municipality. The study estimated the determinants of rural households' dietary diversity. The sample size of the study was 173 rural households, where the sample size was determined using a multi-stage sampling procedure and proportional random sampling to select rural households in Mopani District Municipality. Descriptive statistics results indicated that a majority of rural households have a high dietary diversity status, with the average HDDS of food consumption being 80.26%. Regarding the regression results, household income, gender, level of education and the use of a home garden suggested a positive influence of rural households in attaining high dietary diversity.

Keywords: rural households, dietary diversity score, food consumption patterns, income

INTRODUCTION

Govender et al. (2017) note that the deficiency of access to a nutritious and balanced diet remains a major obstacle to the health and well-being of people living in rural areas. Cordero-Ahiman et al. (2021) concur that insufficient food and nutrition affect people's well-being, particularly among underprivileged subpopulations living in rural areas. Insufficient diet quality is a critical determinant of malnutrition, specifically, micronutrient deficiencies (Mayén et al., 2014). Malnutrition leads to serious health problems, including eye problems, diabetes and heart disease, to name but a few. Micronutrient malnutrition is regarded as a global threat, particularly in underdeveloped and developing countries (Drammeh et al., 2020). Therefore, access to sufficient and nutritious food is an important factor in terms of reducing food insecurity (Chegere and Stage, 2020). Singh et al. (2019) aver that the efforts to ensure food security are correlated to socioeconomic factors and the information available on a healthy and balanced diet. Singh et al. (2019) further note that demographic factors are related to the amount of consumption of foods such as fruits, vegetables and proteins. The consumption of these foods is associated with the prevention of adverse health conditions. Furthermore, Ochieng et al. (2017) accentuate that food consumption patterns outside the household can affect the dietary diversity of families.

Ruel (2003) defines dietary diversity (DD) as the number of different foods or food groups consumed over a given period of time. Gina et al. (2010) proffers that dietary diversity can be measured at a household level

✉Rudzani Nengovhela, Department of Agricultural Economics and Animal Production, University of Limpopo, South Africa, e-mail: nengovhelarudzani90@gmail.com; https://orcid.org/0000-0001-5337-4143

or individual level using a food intake questionnaire. Dietary diversity is measured by counting the number of food groups rather than food items consumed. However, DD does not consider foods or food groups consumed outside the household (De Cock et al., 2013). The household dietary diversity score (HDDS) consists of twelve food groups, which determine an adequate dietary diversity score. These food groups are known to provide nutrients essential for life and are also known as 'everyday foods' (Drammeh et al., 2020). Each of these food groups provides a range of nutrients and play a role in helping the body to function. However, in developing countries, dietary diversity is still a challenge, especially in rural communities where diets are based on starchy staples with insufficient animal products, fruits and vegetables (Mekuria et al., 2017). Therefore, there is a need to measure rural households' food consumption patterns using HDDS in areas such as Mopani District Municipality. The HDDS was used in this study because it measures the economic capacity of a household to access a variety of foods in a given period (Huluka et al., 2019). Through the use of HDDS, one is able to explore a more diversified diet, which is an important outcome because it is highly correlated with factors such as household income. For example, in very poor households, an increase in household expenditure from additional income is associated with increased quantity and quality of the diet. The questions asked relative to HDDS are quite straightforward and take less than a few minutes per respondent. In essence, the objectives of this study were to profile the socio-economic characteristics, assess food consumption pattern of rural households; identify rural households' dietary diversity status and to also estimate the factors that influence HDDS.

METHODOLOGY

Study area

The study was conducted in Mopani District Municipality (MDM). The district consists of five local municipalities, namely; Ba Phalaborwa, Greater Giyani, Greater Letaba, Greater Tzaneen and Maruleng. The district has a population of 1.093 million and 338 427 households (Statistics South Africa, 2016). MDM is located within the north-eastern quadrant of the province, and is approximately 70km from Polokwane City, which is the capital city of the Limpopo Province. Figure 1 below shows a map of all the local municipalities found in MDM.

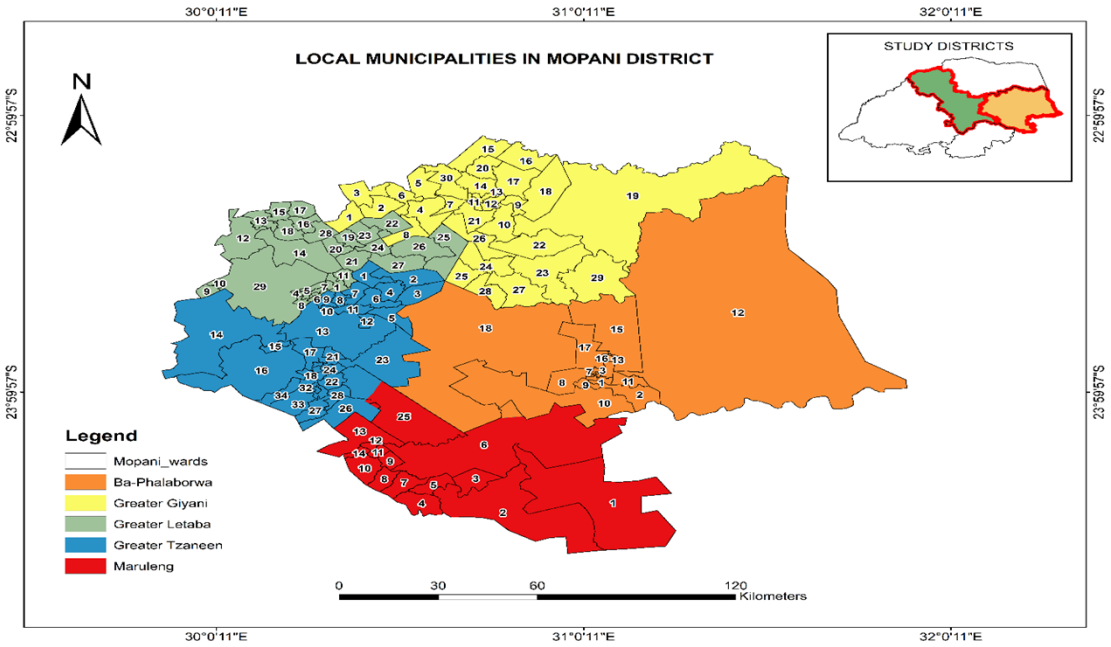

Fig. 1. Map showing local municipalities at Mopani district
Source: ARC-GIS 10.6.

Data collection

The study used a cross sectional survey to assess the dietary diversity of rural households at MDM and both qualitative and quantitative study designs were used. Open-ended questions were used to collect qualitative data from the respondents, while the closed-ended statements elicited quantitative data.

A questionnaire was used to collect data from the respondents seven days prior to the interview as a reference period. The respondents were asked to recall all foods eaten and beverages taken in over seven days preceding the interview. The study followed Cordero-Ahiman et al. (2021), who recently used a 7-days recall to analyse the factors that determine the HDDS in the rural area of the Paute River Basin in Azuay Province, Ecuador. The questionnaire was based on a set of food group questions, which was used to find the HDDS by categorising different food types based on the nutrients they comprise. The HDDS was used to measure the dietary diversity of the rural households at MDM. Put succinctly, HDDS represents the number of different foods or food groups consumed over a given reference period and is calculated by adding the number of food and food groups consumed. Furthermore, information regarding demographics and socio-economics characteristics of the rural households was collected. Below is a table showing different food groups.

Table 1. The categories of food groups

Food groups	Points
1. Any bread, rice, or any other foods made from millet, sorghum, maize, wheat or any other locally available grain	1/0
2. Any potatoes, yams, cassava or any other foods made from roots or tubers	1/0
3. Any vegetables	1/0
4. Any fruits	1/0
5. Any beef, pork, lamb, rabbit, chicken, duck, other birds and organ meats	1/0
6. Any eggs	1/0
7. Any fresh or dried fish or shellfish	1/0
8. Any food made from beans, peas and lentils	1/0
9. Any yoghurt, milk, or milk products	1/0
10. Any food made with oil, fat or butter	1/0
11. Any sugar	1/0
12. Any food such as coffee or tea	1/0
Total	12/0

Source: adopted from various sources.

A single point was awarded to each of the food groups consumed over the reference period giving a maximum total dietary diversity score of 12 points for each individual in the event that his/her responses were positive to all food groups (Taruvinga et al., 2013). A value of zero would therefore mean a low dietary diversity score and the closer the score was to 12, the higher the dietary diversity of the respondent.

The study adopted the HDDS index following Mayekiso et al. (2017), who used a similar method to measure HDDS/food security among rural households.

Sampling procedure

All local municipalities under MDM were considered for the purpose of the study. Mopani has five local municipalities; therefore, the study used a multi-stage sampling and proportional random sampling procedures to select the rural households in the municipality. The household heads were treated as units of analysis. Multistage sampling was used to divide the large population of the Limpopo Province into its district and local municipalities as well as dividing these local municipalities into their wards' numbers. This was done to distinguish rural wards from urban wards in order to select rural households for participation in the study. The implicit goal of using a proportional random sampling procedure was that the village with the highest number of households should have a larger sample size, just like a village with the lowest number of households should have a smaller sample size.

Sample size

The sample size was determined using the following formula:

$$N = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 \cdot (N-1) + z^2 \cdot p \cdot q} \quad (1)$$

According to Kothari (2004), where; n = desired sample size, z = value of standard deviation at 95% confidence level (in this case 1.96), e = desired level of precision (±5%), p = sample proportion in target population, q = 1-p and N = size of population. The formula gave

Table 2. The distribution of the sample size with respect to each local municipality

Mopani DM	Ba Phalaborwa	Giyani	Letaba	Tzaneen	Maruleng	Total
Sample size	11	41	40	65	16	173
Percentage	6	24	23	38	9	100

Source: own compilation.

the total sample size of 173 households for the study. Proportional random sampling was employed to select households to participate in the study under each local municipality. Table 2 above shows the distribution of the sample size with respect to each local municipality.

Description of data

Descriptive analysis from the Statistical Package for the Social Sciences (SPSS) 27 was used to analyse the first, second and third objectives. The first objective was to profile the socio-economic characteristics of rural households in MDM, the second objective was to assess the food consumption pattern of rural households whilst the third objective sought to identify the HDDS. The HDDS was used as an instrument to measure the rural households' dietary diversity and rural households' consumption pattern. Thereafter, descriptive statistics was used to identify rural households' dietary diversity. Furthermore, Multinomial Logistic Regression Model (MLRM) was employed to estimate the factors influencing households' dietary diversity score. This model was used to handle the case of dependent variables with more than two classes. According to Bayaga (2010), the advantage of MLRM is its computational ease, and is relatively robust, as measured by goodness of fit or prediction accuracy. The model was chosen because it allows the analysis of data where respondents are faced with more than two choices. For instance, in this study, the outcome of the HDDS was categorised into three: 0 = low dietary diversity; 1 = medium dietary diversity and 2 = high dietary diversity. For data analysis purposes, high dietary diversity (category 2) was used as a base term and was compared to low dietary diversity and medium dietary diversity when presenting the results. Following an approach by Gujarati (2002), the typical multinomial regression model was formulated as follows:

$$\text{Logit}\,(P_i) = ln\,(P_i / 1 - P_i) = \\ = \alpha + \beta_1 X_1 + \ldots + \beta_n X_n + U_t \quad (2)$$

where:

$ln\,(P_i / 1 - P_i)$ – logit for dietary diversity categories

P_i – High Dietary Diversity (HDD)

$1 - P_i$ – Low or Medium Dietary Diversity (LDD or MDD)

B – coefficient

X – covariates

U_t – error term

The probability that a household is classified in one dietary diversity category compared to the other is restricted to lie between zero and one ($0 \leq P_i \leq 1$). Pi represents the probability of a household being classified in the HDD category and $(1 - P_i)$ represents the probability of a household being classified either in the LDD category or MDD category. Thus, the model was used to assess the odds of LDD versus HDD and MDD versus HDD. By fitting the variables into the model, the model was presented as follows:

$ln\,(P_i / 1 - P_i) = \beta_0 + \beta_1$ Household size $+ \beta_2$ Age $+ \beta_3$ Gender $+ \beta_4$ Marital Status $+ \beta_5$ Level of education $+ \beta_6$ Employment status $+ \beta_7$ Household Income $+ \beta_8$ Source of Income $+ \beta_9$ Access to arable land $+ \beta_{10}$ Ownership of livestock $+ \beta_{11}$ Use of a home garden $+ \beta_{12}$ Access to credit for borrowing money

RESULTS AND DISCUSSION

This section presents the empirical results based on descriptive findings and the MLRM used to estimate the factors of HDDS. Table 3 presents a summary of the basic sample statistics of the respondents.

Table 4 below presents the socio-economic characteristics of the study sample. A total of 173 respondents were considered. There were more female respondents

Table 3. Variables specified in the MLRM and their expected signs

Variables	Description	Unit of measurements	Expected signs	
			LDD	MDD
HHS	Household size	Number of members	+	–
Age	Age of household head	Years	+/–	+/–
Gender	Gender of household head	0 = male; 1 = female	–	+
MS	Marital status	0 = single; 1 = married; 2 = widow; 3 = widower; 4 = divorced	+/–	+/–
Edu	Level of education	0 = never went to school; 1 = primary; 2 = secondary; 3 = tertiary; 4 = Abet	+	–
ES	Employment status	0 = unemployed; 1 = employed	–	+
Income	Household monthly income	Amount in rand	–	+
SI	Source of income	0 = wages; 1 = salary; 2 = old age pension; 3 = child support grant; 4 = other grants from government	–	+
ATAL	Access to arable land	0 = no; 1 = yes	–	+
OLS	Ownership of livestock	0 = no; 1 = yes	–	+
UHG	Use of a home garden	0 = no; 1 = yes	–	+
ATC	Access to credit for borrowing money	0 = no; 1 = yes	–	+

Source: authors own computation from various sources.

(61.8%) than their male counterparts (38.2%). Most of the respondents were married (43.4%). The results of the study also show that some respondents depended more on salary (35.8%) whereas those who depended on child support grant were (26.6%). The largest income group of the respondents comprised those whose income ranged from R2000 to R2999 per month. Table 4 further reveals that a significantly large number of respondents (43.4%) had tertiary education. None of the respondents received assistance from extension officers. About 42.8% of the respondents participated in informal markets. The majority of the respondents (84.4%) had access to arable land. Household size was observed to range between a minimum of 1 and a maximum of 16 family members, with an average household size of 9 members. The youngest and oldest respondents were 29 and 89 years old, respectively, with the sample's average age being 59 years.

Table 5 shows that the majority of the respondents (80.26%) consumed all the food groups shown in the previous table. These findings suggest that rural household heads at MDM had a diverse diet and that they consume different nutritious food, as noted in the table. The results also depict the average consumption of food groups. However, the consumption frequency of the food groups also reveals that on average, food groups are mostly consumed on a daily and weekly basis (46.60%; 33.66%, respectively). Furthermore, the findings of the study indicate that the food group that consists of bread, rice, wheat and maize has the highest percentage. This is due to the fact that maize products are the staple food in the Limpopo Province. The figure below shows the categorisation of respondents with respect to dietary diversity.

Figure 2 below presents the dietary diversity of rural households in MDM. The results show that 49% of the rural households had a higher HDD score, while 36% had a medium HDD score and 15% had a low HDD score. These results indicate that the majority of the rural households' diets are diverse. As highlighted in the methodology section, a value of zero means a low dietary diversity score (HDDS) and the closer the score is to 12, the higher the dietary diversity of the respondent.

Table 4. Basic statistics of the respondents

Variables		Frequencies	Percentages %
Gender	Male	66	38.2
	Female	107	61.8
Marital status	Single	71	41.0
	Married	75	43.4
	Widowed	20	11.6
	Divorced	7	4.0
Level of education	Never went to school	6	3.5
	Primary school	17	9.8
	Secondary school	72	41.6
	Tertiary school	75	43.4
	Abet school	3	1.7
Ownership of livestock	No	65	37.6
	Yes	108	62.4
Household income	Over R1000	17	9.8
	R1099–R1999	45	26.0
	R2000–R2999	52	30.1
	R3000–R3999	20	11.6
	R4000–R4999	17	9.8
	Over R5000	22	12.7
Source of income	Wages	5	2.9
	Salary	62	35.8
	Old age pension	31	17.9
	Child grant	46	26.6
	Other grants from government	29	16.8
Employment status	No	106	61
	Yes	67	39
Remittance	No	107	61.8
	Yes	66	38.2
Access to credit for borrowing money	No	112	64.7
	Yes	61	35.3
Access to arable land	No	27	15.6
	Yes	146	84.4
Use of a home garden	No	113	65.3
	Yes	60	34.7
Assistance from extension officers	No	173	100
Do you participate in	None	51	29.5
	Formal markets	0	0
	Informal markets	74	42.8
	Use the produce for home consumption	48	27.7
	Minimum	Maximum	Mean
Age	29	89	59
Household size	1	16	9

Source: own elaboration.

Table 5. Food consumption patterns of rural households of MDM

Food groups or types	Consumption status (%)		Consumption frequency (%)	
	Yes	No	Daily	Weekly
1. Any bread, rice, or any other foods made from millet, sorghum, maize, wheat or any other locally available grain	98.3	1.7	33.2	65.1
2. Any potatoes, yams, cassava or any other foods made from roots or tubers	59.0	41	27.8	31.2
3. Any vegetables	89.6	10.4	39.9	49.7
4. Any fruits	89.0	11	60.7	28.3
5. Any beef, pork, lamb, rabbit, chicken, duck, other birds and organ meats	93.1	6.9	45.1	48
6. Any eggs	93.6	6.4	64.2	29.4
7. Any fresh or dried fish or shellfish	37.8	62.2	5.2	32.6
8. Any food made from beans, peas and lentils	56.7	43.3	11.6	45.1
9. Any yoghurt, milk, or milk products	80.9	19.1	55.5	25.4
10. Any food made with oil, fat or butter	91.9	8.1	78	13.9
11. Any sugar	98.3	1.7	92.5	5.8
12. Any food such as coffee or tea	75.0	25.5	45.5	29.5
Average	80.26	19.77	46.60	33.66

Source: research survey.

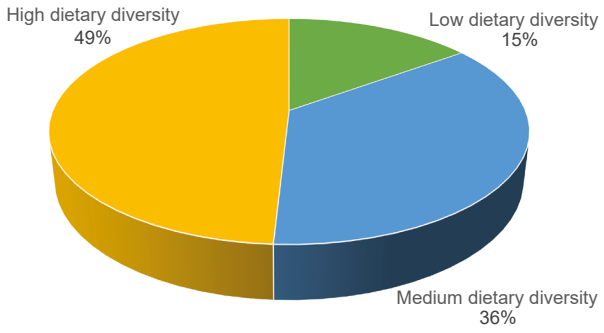

Fig. 2. Categorisation of respondents with respect to dietary diversity. Key: 0–3 (Low Dietary Diversity), 4–6 (Medium Dietary Diversity), 7–12 (High Dietary Diversity)
Source: research survey.

With the given results, a majority of the rural households are categorised by households which are less food insecure. These results further indicate that rural households of MDM consumed several different food groups as HDDS reflects the number of different food groups consumed over a given period of time.

The HDDS is vital because a more diversified diet is an important outcome in and of itself as it is highly correlated with factors such as household income (even in very poor household, an increase in household expenditure from additional income is associated with an increased quantity and quality of the diet). For the analysis, high dietary diversity was treated as a reference term since the interest of the study was households who have low to high dietary diversity and the details of these results are presented in Table 6 below.

Table 6 below shows the results of the econometric estimation. The factors that influence the HDDS of rural households were estimated using the MLRM, where high dietary diversity was used as a base/reference term. The detail of the results is presented below.

Low to high dietary diversity

Level of education

Level of education was negatively correlated to a low dietary diversity. These results suggest that the less educated the respondent is, the greater the chance that such a respondent may not shift from a low to a high

Table 6. Results of MLRM analysis showing the factors that determine HDDS

Independent variables	B	Std error	Significance
Dependent variable: Low dietary diversity vs High dietary diversity			
Intercept	4.356	2.611	0.999
Household size	0.075	0.104	0.469
Age of household head	–1.071	1.319	0.417
Gender of household head	–1.306	1.279	0.307
Marital status	–0.211	0.611	0.730
Level of education	–1.370	1.326	0.000***
Employment status	0.708	0.697	0.310
Household income	1.942	1.379	0.000***
Source of income	–0.621	1.009	0.538
Access to arable land	–0.684	0.897	0.446
Ownership of livestock	–0.018	1.204	0.988
Use of a home garden	1.818	1.019	0.075*
Access to credit for borrowing money	–0.878	0.886	0.322
Dependent variable: Medium dietary diversity vs High dietary diversity			
Intercept	3.137	1.622	0.999
Household size	–0.090	0.106	0.396
Age of household head	0.038	0.033	0.250
Gender of household head	1.125	0.546	0.039**
Marital status	–1.039	2.521	0.995
Level of education	1.942	0.635	0.000***
Employment status	–0.392	1.718	1.000
Household income	0.347	0.568	0.088**
Source of income	0.476	1.001	0.996
Access to arable land	1.803	2.789	0.995
Ownership of livestock	–1.771	0.750	0.018**
Do you plant your home garden	1.300	1.403	0.000***
Access to credit for borrowing money	–2.054	1.914	0.283
Base term category		High dietary diversity	
No. of observation		173	
Chi-square		155.021	
Pseudo R-square		0.619	

***, ** and * indicates significance at 1%, 5% and 10% probability level, respectively.
Source: research survey.

dietary diversity. This may be because such individuals are likely to struggle finding a job, since such individuals lack skills and are probably not even competitive in the labour market. This has an effect on the household income as it affects their dietary diversity status. Similar findings were also shared by Cordero-Ahiman et al. (2021) who noted that a high level of education of the household head is associated with an increased probability of a higher HDDS.

Income

Income was positively correlated to low dietary diversity. The positive relationship could mean that as income increases, there is a greater chance of a household shifting from a low dietary diversity to a high dietary diversity status.

Use of a home garden

With reference to the use of a home garden, results indicate a positive significant correlation between the use of a home garden and low dietary diversity status. These results therefore suggest that the more households use their home gardens, the more likely they are to shift from a low dietary diversity to a high dietary diversity status. Hirvonen and Headey (2018) state that home gardening may increase the availability of nutritious foods in the household.

Medium to high dietary diversity

Gender

Gender was positively correlated with medium dietary diversity status. These results indicate that female headed households are more likely to shift from a medium dietary diversity to a high dietary diversity status.

Level of education

There was a positive correlation between education and medium dietary diversity. These results suggest that the more households are educated, the higher the probability of shifting from a medium dietary diversity to a high dietary diversity score. Similar findings were also reported by Cordero-Ahiman et al. (2021) indicating that a higher level of education of the household head contributes to the improvements of HDDS.

Income

The results of the model indicate a positive association between income and medium dietary diversity. These findings suggest that the higher the level of income, the higher the probability that households could shift from a medium dietary diversity to a high dietary diversity. Similar findings were also discovered by Jebessa et al. (2019) who stated that socioeconomic factors such as income have a significant influence on dietary diversity.

Use of a home garden

Use of a home garden was positively correlated to medium dietary diversity. These findings suggest that a rural household that uses home gardens is more likely to move from a medium dietary diversity status to a high dietary diversity status.

Ownership of livestock

The results also indicate a negative correlation between ownership of livestock and medium dietary diversity. These findings suggest that households that own livestock are less likely to move from a medium dietary diversity status to a high dietary diversity status. For instance, if the household has a smaller number of livestock, there is a high probability of not using the livestock for subsistence purposes to increase their dietary diversity. Furthermore, such households may not consider selling their livestock to diversify their income and yet income significantly contributes to a diverse diet.

CONCLUSIONS

The dietary diversity of rural households at MDM was measured using the HDDS, with food groups over a recall of seven days. The determinants of rural household dietary diversity were estimated using the Multinomial Regression Model, with high dietary diversity as a base/reference term. The results of the study indicated that the average HDDS of food consumption was 80.26%. However, these food groups were consumed on a weekly and daily basis. Based on the empirical results, it was concluded that the determinants that can positively influence rural households to attain a high dietary diversity status are household income, use of a home garden, gender and level of education. In view of this, the study recommends the following: Rural households of MDM have diverse diets as established by the study's results. Rural households under study seemed to consume more maize, wheat and sorghum compared to any other food group. This, therefore, calls for relevant stakeholders, such as Nutritionists or any health practitioners, to

educate individuals through workshops or information sessions about healthy eating habits. The information may assist households to be informed that eating healthy and having a variety of nutritious food types may improve dietary quality among households and communities at large. The study further recommends that policy makers or government officials should promote the use of home gardens and empower households to increase the production of diverse fruits, vegetables and livestock farming and also create jobs for rural households in order to improve their purchasing power. This will diversify households' diets and will lead to a healthy life.

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