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Keywords: *determinants, food security, household dietary diversity.*

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Determinants of Household Dietary Diversity in Bangladesh

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Abstract- Dietary diversity is considered crucial for household welfare and also for carrying out other development activities. The emerging interest in household dietary diversity against dietary quantity presents an opportunity to estimate household food security. Based on secondary data, probit regression model was used to estimate the determinants of household dietary diversity in Bangladesh. The result suggests that household size, literacy of household head, total amount of land, married household head, total amount of remittance received and income of household head were major determinants in attainment of high dietary diversity. Government policies and intervention programs targeting the above variables may improve household dietary diversity which in turn may improve household food security.

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I. Introduction

Dietary diversity refers to an increase in the variety of foods across and within different food groups (WHO/FAO,1996) capable of ensuring sufficient intake of essential nutrients that can promote good health Ruel,(2002).Dietary diversity is essential for household welfare as well as for other development activities. Households often face different challenges related to food insecurity including poor health and a decline in productivity due to insufficient access to food. As we know that different foods contain different nutrients either macro-nutrients or micro-nutrients. No single food can contain all nutrients, Labadarios *et al.,* (2011) noted that the more food groups included in daily diet the greater the likelihood of meeting nutrient requirements. Kennedy *et al.*, (2009) argued that, a diet which is sufficiently diverse may represent nutrient adequacy. Thus, dietary diversity can be viewed as a proxy measure of food security Hoddinott, (2002).

Understanding household dietary diversity can be used as an alternative easy pathway to estimate household food security Thorne-Lyman et al., (2009); Vakili et al., (2013). Lack of dietary diversity is a great challenge for rural communities in developing countries. Their diets are by default defined on starchy staples with inadequate animal products, fresh fruits and vegetables. In countries where resources are very inadequate, lack of access to adequate and diversified diet has been recognized as one of the most severe problems among poor populations and it gives rise to various forms of nutritional problems. A non-diversified diet can have negative consequences on individuals' health, well-being and development, mainly by reducing physical capacities.

Bangladesh is a developing country of South Asia. Bangladesh has made a steady progress in the expansion of food production but due to the rising population pressure, there has been an extensive utilization of land to meet the growing demand for food. Despite the increasing amount of food production and its availability, there have been reports that food availability still remains very low and food insecurity still exist mainly because of the lack of purchasing power and thus of access to food especially for the ultra -poor community. Bangladesh has the lowest availability of calories per capita in South Asia. A nationwide representative survey (State of Food Security and Nutrition in Bangladesh, 2011) estimates that approximately 45 percent of households in Bangladesh suffer from some form of food insecurity. This survey also highlights that the prevalence of inadequate maternal dietary diversity is nearly 62 percent whereas that of chronic malnutrition among children is 45 percent.

This study may provide much needed baseline information on the household dietary diversity and may contribute to the existing literature in helping to implement proper policies to improve household food security. As household food security is subject to change, it is important to explore its determinants to predict future shocks and also to understand how the household responds to food insecurity.

It is important to distinguish between dietary diversity and dietary quality. Dietary diversity reflects the number of food items or food groups consumed Ruel, (2003). Dietary quality is commonly perceived as a reflection of nutrient adequacy, proportionality and moderation of food intake (Food and Agriculture Organization of the United Nations/World Health Organization, 1998). Dietary diversity can be considered a component of dietary quality. As rightly suggested by Rashid *et al.,* (2006) a large number of studies seem to be focusing on determinants of dietary quantity at the expense of dietary quality and diversity. Therefore, it naturally arises the necessity to focus also on

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determinants of dietary diversity given the fact that a diverse diet normally rare in rural communities from developing countries is critically important for infants and young children in terms of supply of micronutrients and energy for physical and mental growth Torlesse *et al.,*(2003); Pan-American Health Organization and WHO, 2003; *Ruel et al., (2004*).On the basis of the above background, the objectives of this study is to identify the major factors which may influence household dietary diversity at the household level

II. Existing Literature

Dietary diversity is defined as the number of different foods or food groups consumed over a given reference period Hatloy, Torheim, & Oshaug, (1998). Based on the assumption that no single food can contain all nutrients, dietary diversity has been conjectured to have a greater practical potential of meeting nutrient requirements Labadarios *et al.,* (2011). Dietary diversity has been positively associated with four pillars of food security Hillbruner & Egan, (2008); Kennedy, & Labadarios, (2006). This is because it is linked with increased energy and nutrient intake, thus various improved health results including nutrient adequacy and anthropometric indices Bukania *et al.,*(2014). Therefore, obtaining information about the household dietary diversity in populations can serve as a useful indicator of assessing household food security Vakili*et al.*, (2013).

In developed countries the resources and time are often available to measure nutrient adequacy, dietary diversity, proportionality and moderation. However, in developing countries, there is a reverse situation. Simple food counts of different food groups eaten by the household over a specific period of time has been used to measure dietary diversity. The deficiency of dietary diversity is a severe problem among poor people in the developing countries suggesting that they feed mostly on starchy staples without or with use of minimal use of animal products, fresh fruits and vegetables Popkin, (1994). Hoddinott and Yohannes (2002) studied the association between household dietary diversity scores and dietary energy availability in ten countries. The study showed that, across the ten countries, the association between dietary diversity and household per capita caloric availability increases with the mean level of household per capita caloric availability. Also, poor people in some developing country face different seasonal problem which effect on nutritional status and household food security. Hillbruner and Rebecca (2008) studied effect of seasonality on food security in Bangladesh and they identified dietary diversity and lost work due to the weather as specific pathways through which season affected household food security. The most significant difference between urban and rural parts of a country concerning food access is that rural people are usually able to produce their own food, whereas urban people are entirely dependent on food purchased from the market. Hatloy *et al.*, (2000) studied dietary diversity of rural and urban people of Mali. He found a large difference in diversity between urban and rural households. Rural households had much lower dietary diversity than even the urban households with the lowest socioeconomic status. His findings further emphasize the lack of access of the rural dwellers to most of the food that is available within a developing country. This relationship has also been demonstrated in post research in Kaduna State, Nigeria showing that the low-income households were food secured on cereals, legumes and vegetables, but were not able to sufficiently access meat and meat products Odunze *et al.,* (2005). Hatloy (2000) recommended that, in order to enhance the dietary diversity in this community, it is important to improve both the general food availability as well as the capacity of people to acquire the foods.

There are two ways to measure dietary diversity one is food variety score (FVS) and another one is dietary diversity score (DDS). Hatloy *et al., (*1998) first used DDS tools, represented as a simple count of food items and food groups, can actually predict the nutritional adequacy of the diet in developing countries. Ahiman (2017) developed methodological tools to allow the identification of dietary diversity in the households and individually, such as the household dietary diversity score (DDS).An FVS is measured as the mean number of different food items consumed from a possible of 75 food items as adapted from a previous study Drewnowski, Renderson, Driscoll, & Rolls, (1997). DDS is the mean number of food groups out of nine possible groups that was consumed over the last 24 hours Kant, Block, Schatzkin, Ziegler, & Nestle, (1991). DDS provides more accurate result than FVS and DDS fits more successively than FVS in regression. A more recent study by Torey *et al.* (2004) also illustrates that dietary diversity is positively associated with nutrient adequacy in rural Mali. Rashid *et al*., (2011) has also approved the use of FVS and DDS for predicting dietary quality in Bangladesh. These studies imply the efficacy of using these simple and inexpensive counts to measure dietary diversity and therefore nutrient adequacy in specific populations in developing countries. Harris-Fry (2015) conducted a study on socio-economic determinants of household food security and women dietary diversity condition in Bangladesh using dietary diversity score.

Given the importance of dietary diversity and its possible link to food security this section summaries some of the major determinants of dietary diversity as highlighted in literature. Several studies have been carried out on the determinants of household dietary diversity as a proxy measure of food security in many different contexts (urban/rural) and levels (regional, national, local) using different variables and

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methodologies. Kidane (2004) conducted a research with primary data techniques to analyze determinants of household dietary diversity as a proxy measure of food security in Ethiopia. The study found out that educational accomplishment of even primary level can significantly affect household's food security status. Rose *et al.,* (1998) explored determinants of household food security in United States of America (USA). According to results of the analysis, there is an inverse relationship exists between schooling and food insecurity.

Size of the household, age, sex and employment status are the other major variables that can affect food security status of the family. Amaza (2006) analyzed some of these factors affecting food security at household level in Nigeria. Logistic regression results showed that chances of household's food insecurity status increase as the number of dependent family member's increases overtime. Feleke, (2005) also found a similar result while conducting a research in Southern Ethiopia. Land ownership, relative wealth, women's literacy, access to media and women's freedom to access the market all significantly reduced the risk of food insecurity Harris-Fry, (2015). This study also showed that households with vegetable gardens, rich households and literate women were significantly more likely to have better dietary diversity scores. Age of household head, income of household head and the level of education of households' head were found to significantly influence household food security in Bangladesh Ali, (2015).

Remittances had continuously been remained one of the vital sources of income and external finances for many poor people across developing countries and a promising source of economic growth Jebran et al., (2016). Remittances received from abroad were found more likely to increase household dietary diversity Abdullah *et al*., (2017).Social safety nets can also affect food security status of a family. Putnam (1995) studied that casual safety nets can take various forms such as staple sharing, credits, group membership, the receipt of remittances, house sharing, and lending of farms and animals. Income plays a key role in a household's accessibility to food. It enables households to modernize their production by giving them an opportunity to buy the necessary inputs and reduce the risk of food shortage during periods of unexpected crop failures through purchases. It was expected the total annual income of the household and food security would be positively related Muluken, (2005), Ruel, (2002); Rashid *et al.,* (2006).

Literatures suggests that there is a growing interest in understanding households and individual dietary diversity mainly because of its relevance in meeting nutrient requirements Labadarios *et al*., (2011) and nutrient adequacy Kennedy *et al.,*(2009). Moreover, positive association of dietary diversity with four pillars of food security and its simplicity in measurement is another reason for its rapid growing interest.

III. Data and Methodology

a) Data Source

The study is based on secondary data from Bangladesh Integrated Household Survey (BIHS), 2011-2012 conducted by International Food Policy Research Institute (IFPRI) under the program of Bangladesh Policy Research and Strategy Support Program (PRSSP).

b) Variable Description

In order to assess the relationship between household dietary diversity and related factors at the household level in Bangladesh, in this paper household dietary diversity scoreis used as a dependent variable and is calculated by summing the number of food groups consumed in a household in the last 7 days. In a regression model, the DDS can contribute to a significantly better fit with the measure of dietary diversity than FVS.

There are many factors that can influence house hold dietary diversity. Among these, gender of the household head (male=1), age of the household head measured in years, total income of the household, farming (=1), rural area of residence (=1), literacy of household head (=1), married head, access to safety nets, access to remittance, affected by shocks, total area of plot size in Decimals.

IV. Econometric Analysis

Models for explaining a binary dependent variable include the linear probability model (LPM), probit and logit models, Maddala, (1992); Greene, (2003), Gujarati, (2004) and Woolridge, (2015). However, since the dependent variable is dichotomous, the use of LPM is not appropriate because the predicted value can fall outside the relevant probability range of 0 and 1. Besides, it is also reported to have non-normal and non-constant error terms and posing constant effect of the explanatory variable. To overcome these problems, logit or probit models have been recommended. These models have been argued to have similar estimates, Maddala, (1992); Greene, (2003); Gujarati, (2004); Hill *et al.* (2008), Woolridge, (2015).

The concept of Dietary Diversity Score (DDS) in diet quality assessment has been tried in a number of places among some population groups, Mathews, Yudkin & Neil, (1999). At the household level, DDS is often used as a proxy for determining food access while at the individual level as a reflection of dietary quality, Vakili *et al.,* (2013). In examining the socioeconomic determinants of dietary diversity, a probit regression model is used in this study. The median DDS among the twelve food groups was calculated and used as a standard for the samples. Households whose DDS were

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below the median score were classified as "low dietary diversity" and those with DDS above and equal to the median as "high dietary diversity." HDD and LDD are shown in table 1.

Therefore, the dependent Variable (Dietary Diversity) is a binary variable represented by 1 if high dietary diversity or 0 if otherwise.

V. Results and Discussion

For this study, the twelve food groups, recommended by Food and Agriculture Organization of the United Nations (FAO, 2008), were used to assess household dietary diversity scores (DDS).

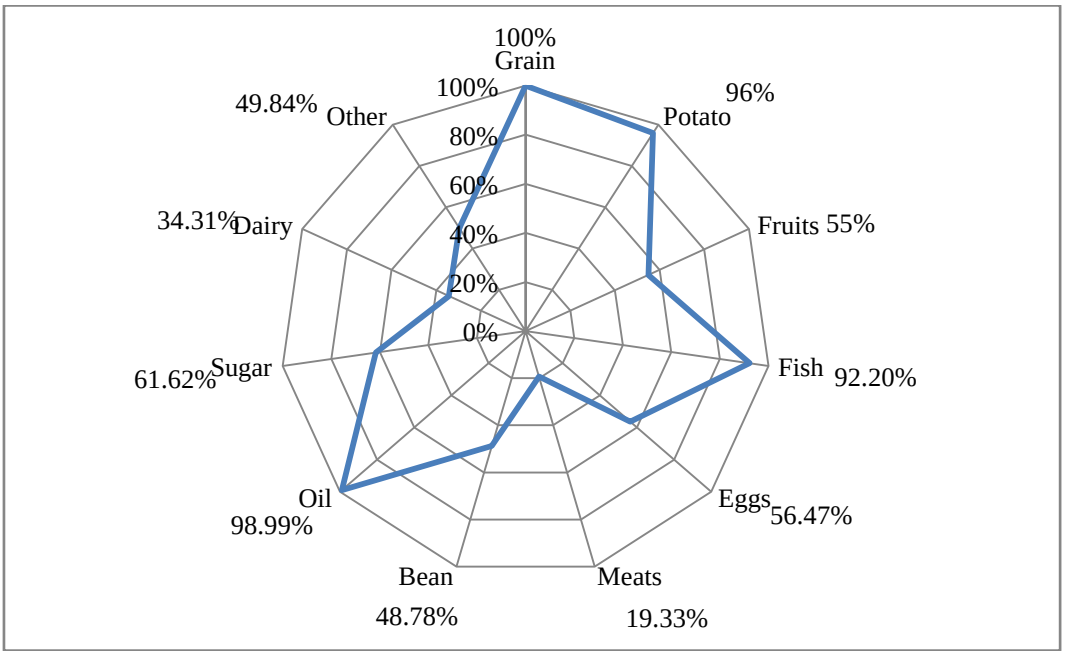

Figure 1: Categories of food groups

Figure 1 represents a summary of consumption pattern of twelve food groups. The distribution indicates that the following food groups were mostly consumed: grain (100%), potatoes (96%), oils (98.99%), and fish (92. 2%). The following food groups were also consumed but not mostly: meats (19.33%), dairy (34.31%) and beans (48.78%). The observed distribution suggests that on average households' diets are mainly dominated by food groups grains, potatoes, oil and fish at the expense of meats, dairy products, and beans.

a) Household Dietary Diversity Scores

For this study, "Yes" and "No" categories were used in the secondary dataset to measure DDS. Yes, was given a score of one (1) to each food group if the household consumed at least one food item from a particular food group for the past 7-days prior to the survey. No, was given a zero (0) score for a particular food group if the household did not consume any food item from that food group. Finally, the scores were counted from each food group and summed up and DDS were calculated based on the FAO guidelines for measuring household and individual dietary diversity. Summary of results are presented in table 1. As shown in the table, only 0.22% households had eaten only one food group whereas, 1.92% households had eaten all twelve food groups within the given period.

Table 1: Dietary Diversity Scores

Dietary Diversity Scores	Percent
1	0.22
2	0.05
3	0.09
4	1.18
5	5.66
6	11.64
7	17.68
8	20.85
9	19.02
10	14.39

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11	7.29
12	1.92
Total	100

Source: IFPRI Bangladesh Integrated Household Survey, 2011–12.

The average DDS was found to be 8(+/-1.78) different food groups eaten with 21% of households. The median dietary diversity score 8 was considered as the standard base. Therefore, table 2 shows the percentage of the households who attained high dietary diversity that means their DDS is greater than the median DDS of the households, and vice versa.

Table 2: High and Low Dietary Diversity Scores

DDS	Percent
0= LDD	36.52
1= HDD	63.48
Total	100.00

Note: LDD= Low Dietary Diversity
HDD= High Dietary Diversity

b) Determinants of Household Dietary Diversity

Based on theory and literature of empirical studies, variables ranging from socioeconomic, demographic and some other factors were examined to assess their effect on household dietary diversity score. Summary statistics of all the variables used are presented in table 3 and 4. Table 3 represents the summary statistics for all continuous variables and table 4 shows the frequency and percentage of all categorical variables.

Table 3: Description of Continuous Variables

Variables	Mean	Std. Dev.
HH Size	4.20	1.63
Age	44.17	13.98
Plot Size (decimal)	91.31	145.42
Monthly Total Income	6230	9559
Monthly Remittance Received	1473	5570
Number of observation	6,503	

Source: IFPRI Bangladesh Integrated Household Survey, 2011–12.

Table 4: Description of Categorical Variables

Variables	Percent
Male head of HH	82
Literacy of HH Head	47
Rural area of residence	80
Access to safety net	46
HH affected by shocks	46
Married Head	91
Farming occupation	42
Received remittance	15

Source: IFPRI Bangladesh Integrated Household Survey, 2011–12

Probit regression results are used to estimate the determinants of household dietary diversity. Estimated results are presented in Table 5.

Table 5: Determinants of dietary diversity from probit regression

Independent variables	Marginal Effect at Mean
Male HH Head	0.011 (0.023)
HH Size	0.040*** (0.004)
Age of HH	0.001

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	(0.001)
Literacy of HHH (1=can read and write)	0.159*** (0.013)
Rural Area of Residence (=1)	-0.086*** (0.019)
Total Amount of Land (in decimals)	0.0001*** (0.000)
Access to safety net	-0.060*** (0.013)
HH affected by shocks	0.015 (0.012)
Married Head	0.059* (0.025)
Occupation farming	0.018 (0.016)
Total Household Income (BDT)	0.017*** (0.003)
Receive Remittance (=1)	0.119*** (0.019)
Number of observations (n)	6,503
Wald chi2(12)	491.59
Pseudo R2	0.068

Source: Estimated by authors using data from the IFPRI Bangladesh Integrated Household Survey, 2011–12.

*Note: Robust standard errors are shown in parenthesi. * p<0.1, ** p<0.05, *** p<0.01*

The marginal effect of probit model suggests that larger households are more likely to attain high dietary diversity than smaller households. Since a household member may have access to food from a variety of sources (home production, purchased outside the house, received in exchange for labor, etc.), a larger household size may simply be a replication of the greater variety in food consumption patterns as a result of having more people living in the household. The area of residence implies less likelihood of high dietary diversity if the household resides in rural area. This is not surprising because rural households have limited access to diverse food items as compared to urban households especially in a developing country like Bangladesh. However, an increase in total amount of land measured in plot size is more likely to ensure high quality and diversified diet. That implies, land ownership is likely to be positively associated with high household dietary diversity both through an income or wealth effect, as well as by making available a larger stock of productive assets, Sraboni *et al*., (2014).

Consistent with the existing literature on household food security and dietary diversity, the literacy of the household head has the likelihood of a positive and significant relationship with high dietary diversity. However, the category farm occupation is likely to be insignificant with high dietary diversity. Household receives remittance are more likely to purchase a variety of foods and enjoy diversified diet than those who doesn't receive.

Households having access to safety net programs are less likely to achieve high dietary diversity probably because the poorer households are more likely to be a part of safety net program. However, affected by shocks is likely to be an insignificant indicator of the same which is followed by male head and their age. It was predictable that married heads operate functional homes and family might be more likely to have access to diversified food and therefore there are more probability to have high dietary diversity than those who are unmarried. Higher income households are more likely to have access to a variety of diets which proves that in Bangladesh, like elsewhere, income is a key determinant of dietary diversity.

VI. Conclusion and Policy Recommendation

The paper estimated the determinants of household dietary diversity in Bangladesh. The study found household size, literacy of the household head, total income of household, access to safety net programs, total amount of land owned by a household, rural residents, household received remittance, married heads are some of the influencing factors of high dietary diversity. With reference to dietary diversity status of households in Bangladesh, the paper suggests a low-quality diet mainly defined by starchy staples (grains, potatoes and fish) at the expense of protein sources (meats and dairy products). The econometric results indicate that 36.52% of households are likely to be food insecure in terms of dietary diversity score.

Results highlight positive likelihood of literacy with respect to high dietary diversity. So programs to increase literacy should be promoted. Community based health and nutrition education should also be strengthened. Access to safety net programs are less likely to have diversified and high-quality diet. So,

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targeted safety net programs for the poor should be continued and made more effective. The rural households, as estimated by the model, are less likely to access diverse food items due to low income, inadequate market infrastructure etc. and more likely to have diverse types of food having more financial supports such as remittances. Supports should be expanded for income generating activities for the rural poor as well as for adequate market infra-structure, strategic policy targeting, research and investment which might play a significant role towards improving household dietary diversity and household food security in Bangladesh. The increasing use of household dietary diversity as a proxy measure of household food security calls for further in depth-analysis and qualitative assessment which is beyond the scope of this study. However, this paper has prepared a ground on which further analysis can be done in the context of Bangladesh.

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