

Determinants of Food Security Status of Rural Households in Benishangul Gumuz Region: The Case of Pawe Woreda

Chirotaw Tsegaw, Adem Endris, Getaneh Assefa

Collage of Agriculture and Natural Resource, Assosa University, Assosa, Ethiopia

Email address:

chirotawasu2010@gmail.com (C. Tsegaw)

To cite this article:

Chirotaw Tsegaw, Adem Endris, Getaneh Assefa, Determinants of Food Security Status of Rural Households in Benishangul Gumuz Region: The Case of Pawe Woreda. *International Journal of Natural Resource Ecology and Management*. Vol. 3, No. 3, 2022, pp. 88-97.
doi: 10.11648/j.scidev.20220303.12

Received: May 19, 2022; **Accepted:** June 8, 2022; **Published:** July 5, 2022

Abstract: Rural household's food security mediations can be viably actualized through in-depth Analysis of food security status and its determinants. Food insecurity frailty is basically more broad and serious in rural areas than in urban ones. This study was conducted to analyze the determinants of household food security in Pawe woreda. This study followed two-stage sampling procedure to draw samples representing rural households. The total of 330 households were randomly selected from four rural Kebeles. The study employed survey questionnaire, Focus group Discussion (FGD) and Key Informant Interview (KII) data collection methods. Descriptive statistics were used. Accordingly, the percentages of food security status of all respondents in the study area were found to be 26.36%, 32.12% and 41.52% were low, medium and high dietary diversity score, respectively. In econometric analysis we employed ordered probit model. Accordingly, education level of household head and farm experience, utilization of credit, tropical livestock, market information and access to training showed a significant and positive effect on food security. Whereas distance from the nearest market have a negative and significant effect on food security. The results suggest that the concerned bodies give emphasis, strengthening education and skill training centers to farming households and agricultural marketing and infrastructures that enhance off farm activities in sustainable manner need to be designed to increase food security in the study area.

Keywords: Food Security, Ordered Probit Model, Rural Households

1. Introduction

Food insecurity is one of the major challenges the world has been facing for a long period [24]. The prevalence of food insecurity is even more complex in regions with increasing population growth leading to more people under malnutrition [7, 38]. Recent data showed that 0.8 billion people in the world are undernourished, out of which 28% of them are living in sub-Saharan Africa and more than half are living in East Africa [40]. Likewise, in Ethiopia, poverty and food insecurity remain to be the major development challenges. Food insecurity is a prolonged problem in Ethiopia. Specifically, 23.5 percent of the population is living under poverty [34]. The country is ranked at 104th out of 119 countries labeled as "serious hunger" based on the Global Hunger Index [34]. To this end, the government has set a clear agricultural development policy to reduce the challenge and help millions of smallholder farmers' to escape out of the

food insecurity trap. Among others, the support by agricultural research and extension endeavors particularly on improving the production and productivity smallholder farmers is one [24].

The agricultural shock impacts on food security have been identified as a major area of concern owing to climatic variations in many parts of the world. The predominance of rain-fed agriculture in much of the developing world especially in sub-Saharan African (SSA) has resulted in food systems that are highly reliant and sensitive to rainfall variability. Agricultural shocks, driven by climate changes, affect agricultural production and hence food security in a multitude of ways.

Food insecurity status is increasing from time to time. According to recent estimates of FAO [13], over 870 million people are chronically malnourished and food insecure around the world. Even though considerable efforts were made to reduce food insecurity, the number of people

suffering from malnutrition and hunger remains unacceptably high. In the developing countries, the vast majority, over 850 million people, are estimated to be undernourished. Similarly, some authors, have pointed out that the number of food-insecure people in SSA is showing unabated signs, increasing from 170 million in 1990 to over 200 million in 2004 and hence food security in a multitude of ways [49].

The current food security levels on an aggregate basis do not necessarily provide a good indicator of gauging future food security. More importantly policies and food security interventions based on static food security analyses do not capture the imminent needs of a potentially large share of the population that is likely to change its food security status in the near future. These include currently food secure households that may become food insecure in the near future and, on the other hand, households that are likely to overcome a currently food insecure situation without external assistance [25].

To identify the determinants of food security, properly designed and rigorous study was required. Beside this, rural household food security interventions can be effectively implemented through in-depth analysis of food security status and its determinants. We acknowledge that there are empirical studies on determinants of food security in different countries [37, 25, 23]. However, to the best of our knowledge these studies did not address the factors that affect households' food security. Hence, this study investigated the demographic and socio-economic characteristics of farmers that influence farm household food security. More importantly, the current study has used one from the measures of food security – i.e. Household dietary diversity score (HDDS).

The present study area, Pawe woreda, is one of drought prone Woredas of Metekel Zone and per capita growth of production of major food items have not been sufficient to satisfy the demand of an increasing population. Rate of population growth is increasing due to lack of knowledge on family planning services on the part of the household head, limited or no health related service providers and socio-cultural influence. For example, a household who has larger family size (children) is considered to be rich in the society. Although the extent of food shortage varied from year to year, many farm households face seasonal food shortage almost every year. Food insecure and food secure farm households reside as neighbors and could share common climate and weather situation and mainly similar socio-economic, cultural and land topography. Yet, one faces seasonal food crisis and become dependent on food aid, while other remains food secure, requiring no food aid [54, 44, 45].

In the study district, agriculture is the main source of income or livelihood of the people, is dependent on rain, and the pattern of rainfall is erratic and insufficient. In the absence of rainfall farmers constantly faced with food shortages and crises. Even in a good season, the onetime harvest is too little to meet the yearly household needs. Various efforts have been made to overcome problems of declining agricultural product and productivity which have direct effect on food security but problems still a serious and critical issue of the people in the study area. A number of

studies undertaken in different parts of Ethiopia identify the determinants of household food security [3, 22, 46, 32, 1]. However, to the knowledge of writers of this article, factors determining the household food security status in the Pawe district have never been investigated. Therefore, this study planned to fill this gap to investigating the level of household food security status based on households' dietary diversity food score and its determinants in the study area.

2. Research Methodology

2.1. The Study Area

The study was conducted in Pawe district of Benishangul Gumuz Regional State, Ethiopia. Pawe is one of the seven districts of Metekel Zone. The district is located about 575 kms away from Addis Ababa and 378km from the regional capital city, Assosa. The district has an estimated total population of 49,758 of whom 24,438 are women. The area has hot and humid temperature and it is characterized by a unimodal rainfall pattern with high and torrential rainfall that extends from May to October. The area receives a mean annual rainfall of 1586.32 mm [33, 41].

The total area of the district is 63,400 hectares of land out of which 50.4% of the land is suitable for the cultivation of different crops. The farming system in the area is dominated by mixed crop-livestock production, which accounts for 96% of the population and 3.8% involved only in livestock production. Types of crops grown in the area include cereals (maize, sorghum and finger millet), oil crops (sesame and groundnuts), vegetables, fruits (mainly mango and papaya), pulses (mainly haricot bean and soybeans) [18, 41, 43].

2.2. Source and Method of Data Collection

The study used both primary and secondary data. A structured questionnaire was employed to obtain the primary data. The questionnaire was coded and programmed on Kobo toolbox, and the data was collected by trained enumerators. The household level data was collected through house to house survey. Interviews with key informants including development agents (DAs) based in each *kebele* and *woreda* agricultural experts were also conducted face to face. Check list was prepared to collect qualitative data from experienced farmers through focus group discussion (FGD). The study also consulted secondary data from the zonal and district agricultural offices' annual report and Pawe agricultural research center.

2.3. Sample Size Determination

There are several approaches to determine the sample size. These include using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas to calculate a sample size. According to Pawe district Office of Agriculture (2020), the total rural households of Pawe district is 49,758 and the total rural households from sample Kebeles are 1900. The composition of sample households drawn in the study areas and sample size of sample households were indicated in (table 1).

In this study, the sample size was determined by using Yamane formula [52]. This formula expressed as:

$$n = \frac{N}{1 + N(e)^2} \Leftrightarrow n = \frac{1900}{1 + 1900(0.05)^2} = 330$$

Where: n = denotes statistically acceptable sample size N = denotes total size of target households (1,900) in the study area and e = denotes level of precision/margin error (5%).

Table 1. Sample size sampled Kebeles.

Name of Kebeles	Households	Sample
Kebele 9/10	320	56
Kebele 28/29	475	82
Kebele 30	556	97
Kebele 23/45	549	95
Total	1900	330

Source: Own design (2020).

2.4. Sampling Techniques

The study followed two-stage sampling procedure to draw samples representing rural households in the study area. In the first stage 4 Kebeles were selected randomly from 21 rural administrative Kebeles of Pawe. In the second stage, a total of 330 sample household heads were randomly selected from the total of four Kebeles based on probability proportional to size of the households in the selected Kebeles. The target population of this study is rural households in Pawe woreda, which are about 49,758 households (PWAO, unpublished). Those households have similar characteristics in many respects like in livelihood strategies, ethnicity and other socioeconomic characteristics. The numbers of sample respondents from each Kebeles were calculated using the proportion of total households living in the Kebeles by taking the total households from the four Kebeles as a basis (Table 1).

2.5. Estimation Strategy

In order to address the objective of this study, the ordered probit model was used to express and estimate the relationship between explanatory variables and the ordered outcome variable. Hence, the model needs to consider more than two possible responses. A similar approach has been followed by [37, 1, 4]. Whenever food categories have a natural order, the ordered probit is the appropriate model to be employed in the estimation of relevant probabilities [19]. Though ordered probit and logit model can be used interchangeably, these models have minor differences. Their difference lies in the distribution of error terms. In the logit model, errors are assumed to follow the standard logistic distribution; while, the probit model assumed to follow the standard normal distribution [20, 50, 51].

The ordered probit model differs from a binary probit one in that the dependent variable is no longer a dummy variable, but an ordered variable taking values 1, 2, 3 according to the level of food security the household is encountered with. As in a binary probit model, the model is built around a latent regression variable. An ordered probit model allows for

multiple ordered values for the dependent variable and analyzes the effect of each independent variable on the dependent variable; i.e. in the probit model 'F' is the standard normal cumulative distribution function (CDF), which is expressed as an integral:

$$F(z) = \Phi(z) \equiv \int_{-\infty}^z \phi(z) dv$$

Where $\Phi(z)$ represents standard normal probability density function and $F(z)$ cumulative distribution function which is strictly monotonic functions between zero and one. It increases most quickly at $z=0$, $F(z) \rightarrow 0$ as $z \rightarrow -\infty$ and $F(z) \rightarrow 1$ as $z \rightarrow \infty$. Probit model can also be derived from underlying the latent variable model. Assume the level of poverty of the sample household i (Y_i^*) is the unobserved or latent variable model and Y_i^* is expressed in the following equation:

$$y_i^* = \beta_0 + \sum_{j=1}^k \beta_j x_{ji} + u_i$$

Where x_{ji} are the above mentioned explanatory variables; u_i are the residuals or error term and β_0 and β_j are the parameters to be estimated [19]. We assume that u_i is normally distributed across observations. As mentioned previously, Y_i^* is unobserved and we can only observe whether the household under consideration falls in category "1," "2," and "3." So, what was observed is the following actual placement in the discrete category:

$$Y_i = 1 \text{ if } Y_i^* < \mu_1 \text{ (low)}$$

$$Y_i = 2 \text{ if } \mu_1 \leq Y_i^* < \mu_2 \text{ (medium)}$$

$$Y_i = 3 \text{ if } \mu_2 \leq Y_i^* < \mu_3 \text{ (High)}$$

In this model, Y (the dependent variable) represents the intensity of household diversity score experienced by a household. Here intensity of food security is defined according to the following three categories:

1 = implies low; HDDS of ≤ 3

2 = medium; HDDS of 4-5

3 = high dietary diversity; The HDDS of ≥ 6

Gujarati, D. N. (2004) [20] Coefficients of the ordered probit model (β) give an indication of the positive or negative impact of an independent variable on the probability of being poor, but do not transmit information concerning the magnitude of the effect. Using a transformation function, the model creates a linear index of the probabilities with a cumulative standard normal distribution. Given the classification, we can derive the probabilities of being poor of different degrees as follows:

$$\Pr(Y_i = 1) = \Pr(Y_i^* < \mu_1) = \Phi(\mu_1 - \beta'X_i)$$

$$\Pr(Y_i = 2) = \Pr(\mu_1 \leq Y_i^* < \mu_2) = \Phi(\mu_2 - \beta'X_i) - \Phi(\mu_1 - \beta'X_i)$$

$$\Pr(Y_i = 3) = \Pr(\mu_2 \leq Y_i^* < \mu_3) = \Phi(\mu_3 - \beta'X_i) - \Phi(\mu_2 - \beta'X_i)$$

Where μ_i represent the threshold or cut-off parameters for placement of Y_i^* in the discrete food security categories, and Φ

() is the standard normal cumulative distribution function such that the sum total of above probabilities is equal to one. We maximize the log-likelihood function to obtain the estimates of μ 's and β 's employing STATA 14 statistical software.

Marginal effects are calculated using the linear probability index. They tell us the effect on the probability of being poor in a particular category for changes in the independent variables ($\partial \Pr(Y=1, 2, \text{ and } 3) / \partial X_i$). The marginal effect is the percentage change on the probability related to a unit change in the independent variable. The marginal effect for each variable is calculated at the mean values of the independent variables. In this context, it is possible to assess the probability of being poor for given factors, and comparisons can then be made across characteristics.

2.6. Variable Definition and Hypothesis

The full range of food insecurity and hunger cannot be captured by any single indicator [6]. Hence, in this study we adopt from measures of food security is HDDS to account for different dimensions of food security.

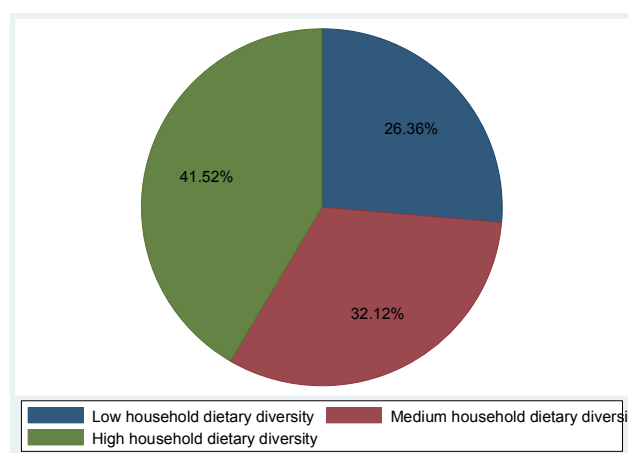
Outcome variable: According to [13], the HDDS measures

a household's economic access to food and can be calculated by summing a number of food groups consumed by the household over the last seven days recalling period. The number of different food groups consumed over a given reference period - is an attractive proxy indicator for the following reasons. A more diversified diet is an important outcome in and of itself. A more diversified diet is associated with a number of improved outcomes in areas such as birth weight, child anthropometric status, and improved hemoglobin concentrations (Appendix). For this, respondents were asked whether they consumed the 12 food groups and their "yes" responses were coded as 1 and the negative response were labeled as "no" and coded as 0. The next step is summing the dietary diversity variable values of all food groups to get a potential score that ranges from 0 to 12. The higher score indicated that households consumed more diversified food groups. The households with HDDS values of ≤ 3 , 4-5 and ≥ 6 are categorized as low, medium and high dietary diversity respectively [14, 48].

Independent variables: Selection of the variables used in this study is mainly based on a literature review.

Table 2. Measurement and definition of explanatory variables.

Variable name	Variable definition and measurement	Hypothesis
Dependent variable		
HDDS		
IB=ND		
SexHH	= 1 if sex of the household head is male and 0 otherwise	+
AgeHH	Age of the household head (years)	+
Education	Education level of the household head measured in completed years	+
FamSize	Total number of people living in the house for more than 6 months	+
FarmSize	Total area of cultivated land the household owned (hectares)	+
Livestock	Livestock holding of the household in tropical livestock unit (TLU)	+
FarmExp	Farming experience of the household head (years)	+
DISMkt	Distance from the residence to nearest market (minutes of walk)	-
Credit	= 1 if the household has access to credit and 0 otherwise	+
Extension	Household's frequency of contact with the extension agent in the last one year	+
Training	= 1 if the household has attended formal training on agricultural technology and 0 otherwise	+
MktInfo	= 1 if the household has market information and 0 otherwise	+
HHIncome	Total income of the household measured in Ethiopian birr	+



Source: Own survey result (2020)

Figure 1. Classification of rural households' food security status based on HDDS.

3. Results and Discussions

3.1. Classification of Rural Households' Food Security Status

The food security statuses of the rural household were grouped in to three ordinal categories of food security status. In this article households dietary diversity score was used to measure household food security by physical consumption of food groups in the study area. The rural household whose consumption is less than or equal to 3 food groups was categorized as low households dietary diversity score, and households' food consumption between 4-5 food groups was household categorized as medium households dietary diversity score, whereas; households' food consumption greater than or equal to 6 food groups was household categorized as high households dietary diversity score. Accordingly, in this article the percentages of food

security status of all respondents in the study area were found to be 26.36%, 32.12% and 41.52% were low, medium and high households dietary diversity score, respectively (see Figure 1).

3.2. Demographic and Socio-economic Characteristics of Sample Households

This section presented in both dummy and continuous variables and their association with food security status of rural households based on HDDS in the study area. From the

total sample households, 82.73% are male respondent households while 17.27% are female respondents. From low HDDS, 20.00% of households are male and 6.36% of households are female respondents. About 25.15% of medium HDDS are male households and 6.97% medium HDDS are female households. Similarly, about 37.57% of high HDDS households are male and 3.94% of high HDDS households are female households. The chi-square test indicates that sex of household associated with food security status is significant at 1% probability level (table 3).

Table 3. Descriptive statistics of households' food security status with respect to independent variables.

Household Food Security Status Based on HDDS										
Dummy variable	Category	Low HDDS (87)		Medium HDDS (106)		High HDDS (137)		Total Household (330)		X ² -Value
		Freq.	%	Freq	%	Freq.	%	Freq	%	
Sex of household head	Male	66	20.00	83	25.15	124	37.57	273	82.73	10.13***
	Female	21	6.36	23	6.97	13	3.94	57	17.27	
Credit Utilization	Utilize	7	2.12	30	9.09	79	23.94	116	35.15	60.68***
	Not utilize	80	24.24	76	23.03	58	27.58	214	64.85	
Extension Service	Yes	18	5.45	70	21.21	126	38.18	214	64.85	118.70***
	No	69	20.91	36	10.91	11	3.33	116	35.15	
Access of Training	Yes	8	2.42	52	15.76	125	37.88	185	66.06	148.52***
	No	79	23.94	54	16.36	12	3.64	145	43.94	
Access of market information	Low	57	17.27	36	10.91	29	8.79	122	36.97	57.11***
	Medium	22	6.67	54	16.36	59	17.89	135	40.91	
	High	8	2.42	16	4.85	49	14.85	73	22.12	

Continuous independent variable										
	Mean	St.Dv	Mean	St.Dv	Mean	St. Dv	Mean.	St.Dev	F-Value	
Age of households	46.32	8.54	48.63	9.44	48.78	9.35	48.08	9.21	1.14	
Family size	4.02	1.81	4.57	1.72	4.83	1.84	4.52	1.82	1.89*	
Education	0.16	1.50	1.87	4.28	5.08	5.59	2.75	4.87	6.91***	
Land size	1.62	1.24	2.21	2.22	2.61	1.01	2.22	1.21	3.05***	
Farm experience	18.41	8.51	23.52	8.44	25.24	9.31	22.89	9.22	1.97***	
Distance to market	149.17	105.6	95.82	69.53	86.25	62.85	105.9	85.35	1.57***	
Tropical livestock unit	3.27	1.79	4.03	1.78	5.20	1.92	4.31	2.00	1.12	
Ln of income	9.12	0.66	9.10	0.66	9.25	0.70	9.17	0.68	0.83	

Note: ***and * Significant at $p < 0.01$ and $p < 0.1$ probability level respectively

Source: Own survey result, 2020.

The mean of sample households did utilize formal credit and didn't utilize formal credit were 35.15% and 64.85%, respectively. From low HDDS, 2.12% of households did utilized formal credit and 24.24% of households didn't utilized formal credit. About 9.09% of medium HDDS households did utilized formal loan and 23.05% households didn't utilized formal loan from medium HDDS households. Similarly, about 23.94% of high HDDS households did utilized formal credit and 27.58% households didn't utilized formal loan from high HDDS households. A survey result revealed that there is statistically significant association between food security statuses of sample households in terms of utilization of formal credit at 1% significance level (table 3).

From the total sample households, 66.06% of respondent households get training while 43.94% of respondent households did not get training. About, 2.42% of households get training and 23.94% of households did not get training from low HDDS households. About 15.76% of medium HDDS households did get training and 16.36% households didn't get training from medium HDDS households. Similarly, about 37.88% of high HDDS households did get training and

3.64% households didn't get training from high HDDS households. A survey result revealed that there is statistically significant association between food security statuses of sample households in terms access of training at 1% significance level (table 3). Similarly, we can interpret other significant dummy independent variables in this way.

The mean of family size in adult equivalent of all sample households were 4.52 in adult equivalent with of standard deviation of 1.82. The mean of family size in adult equivalent for low, medium and high HDDS were 4.02, 4.47 and 4.83 respectively. The F- test indicated that average family size was significant mean difference between food security statuses of HDDS at 10% significant level (table 3). Then, the average of education in grade of all sample households was 2.75 grades with of standard deviation of 4.87. The mean of education in grade for low, medium and high HDDS were 0.16, 1.87 and 5.08 grades with standard deviation of 1.50, 4.28 and 5.59 respectively. The F- test indicated that average education in grade was significant mean difference between food security statuses of HDDS at 1% significant level (table 3).

The mean of cultivated land size in hectare of all sample households was 2.22 with of standard deviation of 1.21. The mean of cultivated land size in hectare for low, medium and high HDDS were 1.62, 2.21 and 2.61 hectares with standard deviation of 1.24, 2.61 and 1.01 respectively. The F- test indicated that average cultivated land size in hectare was significant mean difference between food security statuses of HDDS at 1% significant level (table 3). In addition, the mean of farm experience in year of all sample households were 22.89 with standard deviation 9.22. From the low HDDS households the mean of farm experience in year is 18.41 with standard deviation of 8.51. Moreover, the mean of farm experience in year were 23.52 and 25.24 years with standard deviation of 8.44 and 9.31 on the medium and high HDDS of households, respectively. The F- test indicated that average farm experience in year was significant mean difference between food security statuses of HDDS at 1% significant level (table 3).

Finally, the mean of distance to the nearest market in minute of all sample households was 105.91 minutes with standard deviation of 85.35. The mean of distance to the nearest market in minute for low, medium and high HDDS were 149.17, 95.82 and 86.25 minutes with standard deviation of 105.6, 69.53 and 62.85, respectively. The F- test indicated that distance to the nearest market in minute was significant mean difference between food security statuses of HDDS at 1% significant level (table 3).

3.3. Determinants of Households' Food Security Status Based on Dietary Diversity Score Method

The result of model showed that around eight variables were found to have a significant influence on the probability of food security status from thirteen variables included in the model. These are education level of household head, farm experience, utilization of formal credit, frequency of extension service, tropical livestock unit, level of market information and access to training were found to have positive and significant influence in food security status; while distance to nearest market in minute was found to have negative and significant influence on the probability of food security status. The remaining variables are not significant influences on the probability of food security status (Table 4).

As the model result revealed that the variable education had a positive and significant influence on households' food security status at less than 1% significant level. It indicated that the higher education level of household head had more likely to consume dietary diversity of food score. Therefore, adding one year education level can increased by one grade would decrease households' low and medium dietary diversity of food score by 1.89% and 1.68%, respectively; whereas high level households' dietary diversity food score increased by 3.58%, *ceteris paribus* (Table 4). This result is in line with the findings of [27, 12].

The survey result revealed that the variable farm experience in year had a positive and significant influence on households' food security status at less than 1% significant level. Therefore, adding of farm experience can increased by one year would decrease households' low and medium

dietary diversity of food score by 0.98% and 0.86%, respectively; whereas high level households' dietary diversity food score increased by 1.05%, *ceteris paribus* (Table 4). Suggesting that households with higher farming experience may have better experience in diversified food crop production and consume more diversified food groups. This result is in similar with the findings of [21, 5, 8]. Whereas; the survey result revealed that the variable distance to the nearest market in minute had a negative and significant influence on households' food security status at less than 1% significant level, being the other factor remains constant. Therefore, distance to the nearest market in minute can increased by one minute would increase households' low dietary diversity of food score by 0.05% and also medium and high level households' dietary diversity food score decreased by 1.02% and 0.09%, respectively (Table 4). This result is in similar with the findings of [9-11].

In addition, the survey result revealed that the variable utilization of formal credit had a positive and significant influence on households' food security status at less than 1% significant level. Therefore, utilization of formal credit can increased by one unit would decrease households' low dietary diversity of food score by 7.8%; whereas medium and high level households' dietary diversity food score increased by 0.04% and 16.28%, respectively, *ceteris paribus* (Table 4). This result is in similar with the findings of [39, 26, 47].

As the model result revealed that the variable extension service had a positive and significant influence on households' food security status at less than 5% significant level. It indicated that the higher frequency of extension contact had more probable to consume dietary diversity of food score. Therefore, frequency of extension contact can increased by one time would decrease households' low and medium dietary diversity of food score by 10.45% and 8.48%, respectively; whereas high level households' dietary diversity food score increased by 17.07%, *ceteris paribus* (Table 4). This result is in line with the findings of [53].

As the model result revealed that the variable livestock in tropical livestock unit had a positive and significant influence on households' food security status at less than 1% significant level. It indicated that the adding livestock in tropical livestock unit had more probable to consume dietary diversity of food score. Therefore, livestock in tropical livestock unit can increased by one in tropical livestock unit would decrease households' low and medium dietary diversity of food score by 3.31% and 6.62%, respectively; whereas high level households' dietary diversity food score increased by 4.36%, *ceteris paribus* (Table 4). This result is in line with the findings of [35].

As the model result revealed that the variable the level of market information had a positive and significant influence on households' food security status at less than 1% significant level. It indicated that more level of market information had more probable to consume dietary diversity of food score. Therefore, level of market information can increased from low to high level that would decrease households' low and medium dietary diversity of food score

by 6.53% and 2.04%, respectively; whereas high level households' dietary diversity food score increased by 12.28%, *ceteris paribus* (Table 4).

Finally, the survey result show that the variable access to training had a positive and significant influence on households' food security status at less than 1% significant level. It indicated that the households' can get access to

training had more probable to consume dietary diversity of food score. Therefore, access to training increased in one unit that would decrease households' low and medium dietary diversity of food score by 23.74% and 13.85%, respectively; whereas high level households' dietary diversity food score increased by 37.85%, *ceteris paribus* (Table 4). This result is in line with the findings of [36, 2].

Table 4. Result of ordered probit regression model: Food security status is outcome variable.

Predictor variable	Coef.	Std. Err.	mfx (1)	mfx (2)	mfx (3)	p> z
Age of household head	-0.0141	0.0124	0.0026	0.0023	-0.0049	0.256
Sex of household head	-0.3096	0.2271	0.0510	0.0627	-0.0038	0.173
Family size in AE	-0.0175	0.4623	0.0033	0.0029	-0.0061	0.705
Education in grade	0.1015***	0.0193	-0.0189	-0.0168	0.0358	0.000
Cultivated land size	0.0421	0.0715	-0.0079	-0.0069	0.0148	0.556
Farm experience	0.0523***	0.0129	-0.0098	-0.0086	0.0105	0.000
Distance to nearest market	-0.0027***	0.0010	0.0005	-0.0102	-0.0009	0.009
Utilization of credit	0.4511***	0.1717	-0.0780	0.0004	0.1628	0.009
Extension service	0.5082**	0.1977	-0.1045	-0.0848	0.1707	0.011
Tropical livestock unit	0.1238***	0.0438	-0.0231	-0.0662	0.0436	0.005
Market information	0.3485***	0.1205	-0.0653	-0.0204	0.1228	0.004
Access to training	1.1485***	0.1918	-0.2374	-0.1385	0.3785	0.000
Household income in ETB	-0.0270	0.1205	0.0051	0.0045	0.0095	0.822
/cut1//	0.7561	1.2344				
/cut2//	2.4845	1.2398				
Number of observation		330	LR chi square (13)		297.05	
Log likelihood		-208.2792	Prob>chi ²		0.0000	
Pseudo R ²		0.4163				

Note: *** and ** Significant at p<0.01 and P<0.05 probability level respectively

Source: Own survey result 2020.

4. Conclusion and Recommendations

4.1. Conclusion

This study was conducted in Pawe Woreda of Benishangul Gumuz Regional state of Ethiopia with the objective of identifying the determinants of food security in the rural households of the study area. Households' demographic, socioeconomic and institutional data which were deemed to be relevant were collected, organized, analyzed and interpreted to come up with the results.

The sampled households were classified into low, medium and high HDDS groups based on number of food groups consumed by the household over the last 24-hour recall period. Accordingly, the percentages of food security status of all respondents in the study area were found to be 26.36%, 32.12% and 41.52% were low, medium and high households dietary diversity score, respectively.

Ordered probit model was employed to study the relations between the probabilities of households low, medium and high and household's socio-economic characteristic. The result revealed eight significant variables out of the hypothesized variables. Among these significant variables educational status of household head, farm experience, extension service, TLU, market information, access to training and credit utilization of household were positively related with food security status. While distance from market

center were negatively related with food security status of the households in the study area.

4.2. Recommendations

The study result indicated that, variables such as education has statistically significant and positive influence on household's dietary diversity, therefore, urgent actions aimed at reducing/eliminating the incidence of food insecurity of the households in the study area. Hence, the following recommendations are forwarded households to improve their food security status.

This finding revealed that credit utilization is one of the significant factor in determining the household's food security status. Thus, credit is a room to overcome farmers' financial constraints and it empowers their economic decision power to contribute the use of new technologies that is enhances to consume different food groups then increase their dietary diversity score, Therefore, any governmental or non-governmental organization need to consider the need to promote farmers credit utilization up to the affordable rate.

Education has a significant and positive influence on HDDS. Hence, strengthening adequate and effective basic educational opportunities to the rural farming households in general and to the study area in particular is required. In this regard, the regional and local governments need to strengthen the existing provision of education through facilitating all necessary materials.

Appendix

Table A1. Conversion factors used to calculate Tropical Livestock Units (TLU).

Animals	TLU-equivalent
Calf	0.25
Heifer and Bull	0.75
Cows and Oxen	1.00
Donkey young	0.35
Donkey adult	0.70
Sheep and Goat	0.13
Mule	1.00

Source: Storck *et al.* (1991).

Table A2. Food groups and food items.

+	Food Group	Food Item	1= yes, 0= No
1	Cereals	Any foods made from wheat, teff, sorghum, and maize, Barely, e.g. Beso, Kolo, porridge, injera or other locally available grains.	
2	Vegetables	Any vegetables? (Pumpkin, carrot, squash, onion, tomato, cabbage, head cabbage, lettuce, + other locally available vitamin A rich vegetables).	
3	Fruits	Any fruits? (Mango, papaya, Avocado, Apple, wild fruits and 100% fruit juice made from these + other locally available vitamin A rich fruits.	
4	Meat	Any beef, lamb, goat, wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?	
5	Egg	Any eggs? (eggs from chicken, duck, guinea fowl or any other egg)	
6	Fish and other sea food	Any fresh or dried fish or shellfish?	
7	Legumes, nuts and seeds	Any foods made from Beans, peas, lentil, cowpeas, pigeon peas nuts, Haricot bean, chickpea, soybean, and vetch?	
8	Milk and milk products	Any cheese, yogurt, milk, or other milk products?	
9	Oils and Fats	Any food made with oil, fat, or butter	
10	Sweets	Any sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes?	
11	White root	Any other foods made from roots or tubers?	
12	Spices, condiments and beverages	Any other foods, such as condiments, salt, spice, coffee, tea, ginger, carmine, and other alcoholic beverage?	

FAO, 2010.

References

- [1] Alemayehu, G., De Jong, Niek, Kimenyi Mwangi, S., and Mwabu, Germano (2005). Determinants of Poverty in Kenya: A Household Level Analysis. *Economics Working Papers*. Paper 200544.
- [2] Alemnesh, D., Rahmeto, N., Agidew A. (2018). "Determinants of Household Food Security and Coping Strategy: (Evidence from Amaro Woreda of Southern Ethiopia)." *Int. J. Res. Granth*. 6 (5): 128-137.
- [3] Arega, B. (2012). Determining food security indicators at household level in drought prone areas of the Amhara region of Ethiopia: The case of Lay Gaint district. *Ethiopian Journal of Environmental Studies and Management*. 5 (4), 422-434.
- [4] Ayalneh, B., and Korf, B. (2009). Analysis of poverty and its covariates among smallholder farmers in eastern Hararghe highlands of Ethiopia. Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009.
- [5] Bekabil UT. 2015. Empirical Review of Production, Productivity and Marketability of Soya Bean in Ethiopia. *Int J u- e-Service, Sci Technol* 2015; 8: 61–6. <https://doi.org/10.14257/ijunesst.8.1.06>.
- [6] Bickel G, Nord M, Price C, Hamilton W, Cook J. 2000. Guide to Measuring Household Food Security.
- [7] Brown GW, Craig TKJ, Harris TO. 2008. Parental maltreatment and proximal risk factors using the Childhood Experience of Care & Abuse (CECA) instrument: A life-course study of adult chronic depression - 5. *J Affect Disord*; 110: 222–33.
- [8] Bruns HA. 2016. Macro-Nutrient Concentration and Content of Irrigated Soybean Grown in the Early Production System of the Midsouth. <Http://DxDoiOrg/101080/0010362420161225079> 2016.
- [9] Di Falco SADIF, Eronesi MA V, Esuf MAY. Does Adaptation to Climate Change Provide Food Security? A micro-Perspective From Ethiopia. *Agric Appl Econ* 2011; 93: 829–46. <https://doi.org/10.1093/ajae/aar006>.
- [10] Diro S. and Demissie W. M. 2015. Determinants of adoption of soybean and its impact on the livelihood of smallholder farmers in Jimma zone. (January).
- [11] Ebrahim M. 2019. Adoption of Improved Potato Varieties And Its Impact on Household Nutrition: Evidence From Emba Alaje Woreda, Northern Ethiopia. Bahir Dar University.
- [12] Faltermeier L, Abdulai A. 2009. The impact of water conservation and intensification technologies: empirical evidence for rice farmers in Ghana. *Agric Econ*; 40: 365–79. <https://doi.org/10.1111/j.1574-0862.2009.00383.x>.

- [13] FAO (food and Agriculture Organization). 2010. Guidelines for Measuring Household and Individual Dietary Diversity. Rome, Italy.
- [14] FAO. 2011. Guidelines for measuring household and individual dietary diversity. Rome, Italy.
- [15] Faturoti BO, Emah GN, Isife BI, Tenkouano A, Lemchi J. 2006. Prospects and determinants of adoption of IITA plantain and banana based technologies in three Niger Delta States of Nigeria; 5: 1319–23.
- [16] Foster AD, Rosenzweig MR. 2010. Barriers to Farm Profitability in India: Mechanization, Scale and Credit Markets Andrew D. Foster and Mark R. Rosenzweig September.
- [17] Gecho Y, Ayele G, Lemma T, Alemu D. 2014. Rural Household Livelihood Strategies: Options and Determinants in the Case of Wolaita Zone. South Ethiop Soc Sci 2014; 3: 92–104. <https://doi.org/10.11648/j.ss.0303.15>.
- [18] Getahun A, Atnaf M, Abady S, Degu T, Dilnesaw Z. 2016. Participatory Variety Selection of Soybean (*Glycine max* (L.) Merrill) Varieties Under Rain Fed Condition of; 3: 40–3.
- [19] Greene, W. H. (2002). Econometric Analysis. 5th edition. Engelwood Cliffs, NJ: Prentice Hall.
- [20] Gujarati, D. N. (2004). Basic Econometrics 4th edition. The McGraw-Hill Companies, New York.
- [21] Hofferth SI. 2004. Persistence and change in food security of families with children, 1997–1999. Economic Research Institute, USDA, Monograph (EFAN04001). Economic Research Institute, USDA, Monograph (EFAN04001).
- [22] Hussein, W., Janekarnki P. 2013. “Determinants of rural household food security in Jigjiga district of Ethiopia”. Kasetart.
- [23] Iticha MD, Taresa B. 2020. Factors Affecting Adoption of Soybean Production Technologies in Ethiopia. Food Sci Qual Manag; 96.
- [24] Jaleta M, Kassie M, Marennya P, Yirga C, Ernstein O. 2015. Impact of Improved Maize Variety Adoption on Household Food Security in Ethiopia: An Endogenous Switching Regression Approach. Int Conf Agric Econ: 1–26.
- [25] Ketema M, Kebede D, Dechassa N, Hundessa F. 2016. Determinants of Adoption of Potato Production Technology Package By Smallholder Farmers: Evidences From Eastern Ethiopia. Rev Agric Appl Econ 2016; 19: 61–8. <https://doi.org/10.15414/raae.19.02.61-68>.
- [26] Khonje M, Manda J, Alene AD, Kassie M. 2014. Analysis of Adoption and Impacts of Improved Maize Varieties in Eastern Zambia. World Dev 2015; 66: 695–706. <https://doi.org/10.1016/j.worlddev.09.008>.
- [27] Koffio-Tessio EM, YH Tossou, KA Homevor 2005. Impact of education on agricultural productivity in sub-Saharan Africa. Paper presented at a “Global Conference on Education Research in Developing Countries”, Prague, Czech Republic, 31 March–2 April.
- [28] Lokshin M, World T, Washington B, Sajaia Z. 2011. Impact of interventions on discrete outcomes: Maximum likelihood estimation of the binary choice models with binary endogenous regressors. Stata J; 11: 368–85.
- [29] McDonald JF, Moffitt RA. 1980. The Uses of Tobit Analysis. Rev Econ Stat; 62: 318. <https://doi.org/10.2307/1924766>.
- [30] McGuire S. FAO, IFAD, and WFP. 2015. The State of Food Insecurity in the World 2015: Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress. Rome.
- [31] Meron, A. (2003). Female-Headed Households and Poverty in Urban Ethiopia. An MSc Thesis Presented to the School of Graduate Studies of Addis Ababa University, Addis Ababa, 113 pp.
- [32] Meskerem, A., Degefa, T. (2015). Household Food Security Status and Its Determinants in Girar Jarso Woreda, North Shewa Zone of Oromia Region, Ethiopia. Journal of Sustainable Development in Africa (Volume 17, No. 7) ISSN: 1520-5509.
- [33] Miruts F. 2016. Analysis of the Factors Affecting Adoption of Soybean Production Technology in Pawe District, Metekele Zone of Benshangul Gumuz Regional; 53: 122–37.
- [34] MoFED. Growth and Transformation Plan (GTP) 2010/11-2014/15. Addis Ababa, Ethiopia: 2014.
- [35] Mugisha J., Mwadime R., Sebatta C., Gensi R. and Obaa B. 2017. Factors enhancing household nutrition outcomes in potato value chain in South-Western Uganda.
- [36] Musba Kedir. 2019. Impact of Improved Soybean (Belessa-95) Variety on Income among Smallholder Farmers in Bambasi Woreda, Benshangul Gumuz Regional State. Greener Journal of Agricultural Sciences.
- [37] Nelson KM. 2013. Analysis of Farmer Preferences for Wheat Variety Traits in Ethiopia: a Gender-Responsive Study. Cornell University.
- [38] Pachapur PK, Pachapur VL, Brar SK, Galvez R, Le Bihan Y, Surampalli RY. 2020. Food Security and Sustainability. Sustainability, Wiley; p. 357–74. Meron, A. (2003). Female-Headed Households and Poverty in Urban Ethiopia. An MSc Thesis Presented to the School of Graduate Studies of Addis Ababa University, Addis Ababa, 113 pp.
- [39] Pappoe P (2011) Effect of Biofuel production on household food security in the central region of Ghana. M.Sc. Thesis, University of Ghana, Ghana.
- [40] PRICE V, TEWKSBURY D, POWERS E. 1997. Switching Trains of Thought. Commun Res; 24: 481–506. <https://doi.org/10.1177/009365097024005002>.
- [41] Sales P, V. G., Pelúzio JM, Afféri FS, Sales ACR da C, Sales VH. 2016. Effect of pods’ position on the protein content in soybean grains at low latitude. J Bioenergy Food Sci; 3: 216–21.
- [42] Samuel D and Wondaferahu M. 2015. Determinants of adoption of soybean and its impact on the livelihood of smallholder farmers in Jimma zone. ZENITH Int J Multidiscip Res; 5: 119–38.
- [43] Shiferaw B, Kassie M, Jaleta M, Yirga C. 2014. Adoption of improved wheat varieties and impacts on household food security in Ethiopia. Food Policy <https://doi.org/10.1016/j.foodpol.2013.09.012>.
- [44] Stubbs B, Koyanagi A, Hallgren M, Firth J, Richards J, Schuch F. 2016. Physical activity and anxiety_ A perspective from the World Health Survey. J Affect Disord 2017; 208: 545–52. <https://doi.org/10.1016/j.jad.10.028>.

- [45] Teferi A, Philip D, Jaleta M. 2015. Factors that affect the adoption of improved maize varieties by smallholder farmers in Central Oromia, Ethiopia. *Dev Ctry Stud*; 5: 50–9.
- [46] Tewodros, T., Fikadu T. (2014). Determinants of Households Food Security and Coping Strategies for Food Shortfall in Mareko District, Guraghe Zone Southern Ethiopia. *J. Food. Secu.* 2 (3): 92-99.
- [47] Tibebe, A., Sisay G. (2017). Level and Determinants of Food Security in North Wollo Zone (Amhara Region – Ethiopia). *J. Food Security*, vol. 5, no. 6; 232-247.
- [48] Tiruneh ES, Wassie SB. 2020. Adoption and ex-post impact of alternative teff production technologies: micro-level evidence from Ethiopia. *Agrekon*: 1–16. <https://doi.org/10.1080/03031853.2020.1782761>.
- [49] Tobin J. 1968. “Estimation of relationships for limited dependent variables.” *Econometrical*.
- [50] Wabwile VK. 2016. Effect Of Improved Sweet Potato Varieties on Household Food Security In Bungoma County, Kenya. <https://doi.org/10.22004/AG.ECON.243474>.
- [51] WFP. 2008. Vulnerability analysis and mapping: Calculation and use of the food consumption score in food security analysis.
- [52] Yamane, T. (1967). *Statistics, an Introductory Analysis*, 2nd ed., New York: Harper and Row.
- [53] Yishak Gecho and Punjabi N. 2011. Determinants of Adoption of Improved Maize Technology in Damot Gale, Wolaita, Ethiopia.
- [54] Mohammed, A.; Wassie, S. B.; Teferi, E. T. Determinants of Smallholders’ Food Security Status in Kalu District, Northern Ethiopia. *Challenges* 2021, 12, 17. <https://doi.org/10.3390/challe12020017>