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DETERMINANTS OF FOOD SECURITY AND LIVELIHOOD RESOURCES IN KILTE AWELALO

Majority of world's poor in most developing countries live in rural areas majorly depending on undersized farms as main source for income and food. Improving agricultural productivity of these smallholding farmers is one means of enhancing households' and national food security. Food security is a growing concern for majority developing nations in the globe and similarly food insecurity and undernourishment are present crucial policy challenges in Ethiopia.

Various factors can be put in plain words towards the increasing food insecurity condition in Ethiopia. The interaction between high population growth pressures, lessening of land holding sizes, environmental degradations and etc. have led to a very significant decline on household's productivity. Combining these aforementioned challenges with recurring droughts over years, they have substantially eroded the productive assets of households where by affecting community assets such as forests and pasture land leading to an escalating environmental degradation and high pressure on farm. In similar lines, smallholding farmers are unable to cope up with seasonal shortfalls because of less accumulation of savings and assets like food and livestock holdings, even in good days. Moreover, inadequate access to non/off-farm income generating opportunities among rural smallholding farmers and limited access to food has made households vulnerability shoddier (Girmay, T., 2006).

One of the objectives of the study is to assess the determining factors of food security and livelihood strategies basing on the data collected from 370 sample smallholding farmers in selected

areas of Kilte Awelalo *Woreda*. In order to achieve this objective, initially determining factors of livelihood resources and strategies is incorporated so as to get a better picture of the challenges faced by the smallholding farmers. Moreover, to assess the determining factors of food security, the data was analyzed through various independent variables in three major categories; Adequacy in supply by Months of Adequate Household Food Provisioning (MAHFP), consumption by Food consumption Score and finally utilization determinants by using BMI (Body mass index).

7.1 Determinants of Livelihood Strategies

Ethiopia is one of the least developing nations in the globe and has been plagued with issues of food insecurity for decades. Food insecurity is majorly the result of an unsatisfactory livelihood resources and strategies, and in the long run it can cause an irreparable harm to the livelihoods of poor farmers and will diminish self-sufficiency. Nevertheless, the identification various determining factors which determine the capabilities of rural households' to involve in various livelihood strategies in Ethiopia has received a small attention despite its huge threat over the lives of the poor. Concomitantly, this study has tried to depict the determining factors of involvement in various livelihood strategies assuming the fact that solely depending on agriculture limits households options of better survival approach and leaves them vulnerable to various shocks. To achieve this objective, various independent variables were selected basing on reviews of literatures and field experiences. In concomitant to this, Probit model was selected as a regression model to test the significance and impact level of the selected independent variables on the dependent variable; engagement in off/non-farm activities.

Table 7.1 Estimates of Maximum-Likelihood Probit model of engagement probability in different livelihood strategies

Probit regression				Number of obs	= 370	
				LR chi2(12) =	168.98	
				Prob > chi2 =	0.0000	
Log likelihood = -149.44759				Pseudo R2 =	0.3612	
Part. in d.t livelihood strategies	Coef.	Std. Err.	z	P>z	df/dx	
Sex of HH	-.4998642	.3771912	-1.33	0.185	-.1624914	
Age of HH	-.0050201	.0083565	-0.60	0.548	-.0016319	
Education level of HH	.36749	.1118527	3.29	0.001*	.1194604	
Household size	.1774538	.0627928	2.83	0.005**	.0576851	
Formal credit access	-.043095	.2357076	-0.18	0.855	-.0140089	
Total livestock holding	0235552	.0224136	1.05	0.293	.0076571	
Agricultural extension visit	-.9396697	.2508066	-3.75	0.000*	-.3054595	
Use of modern fertilizer	1.290501	.3004724	4.29	0.000*	.4195048	
Farmers Association Membership	.4441705	.1945968	2.28	0.022**	.144387	
Social Association membership	.1273175	.1933815	0.66	0.510	.0413872	
Farmland size	-.605083	.1177702	-5.14	0.000*	-.196695	
Safety Net membership	.2387624	.2195211	1.09	0.277	.0076571	
_cons	-1.427872	1.169096	-1.22	0.222	-.3054595	
Marginal effects after probit: y= Pr(I) (predict) = .2611002						

Source: Survey result, 2015
Notice: *, ** and *** significant at 1%, 5% and 10% significance levels, respectively

Out of selected 12 variables which were assumed to have an impact on the involvement in various livelihood strategies of smallholding farmers in the study areas, six of them were found to have distinct levels of significant impact. The significant variables were education level of the household head, household size, agricultural extension visits, use of modern fertilizers, farm land size and farmers association membership. The coefficients of age, sex, formal credit access, total livestock holding, social associations membership and safety net participation were not statistically

significant in all 1%, 5% and 10% significance levels implying that they were less important in affecting the probability involvement in various livelihood strategies in the study areas. The effect of the significant explanatory variables on farmers' probability of involvement in various livelihood strategies is discussed below.

Education level of the household head was found to be positively and highly significant at 1% level of significance. Moreover, it is found that one level of increase in educational attainment, increases the probability of involvement in various livelihood strategies by 11.9%. This implies that the higher educational attainment, the more probability of the household to engage in various livelihood strategies for better welfare of the family. Education is very crucial asset for the smallholding farmers to gain better access to jobs which require formal schooling and usually secondary school pass and beyond. During the survey, it was noticed that, there are small leather processing industries, marble factories and etc. around the study areas. However, farmers' engagement in this industries is highly limited due to the requirements of formal primary schooling and usually secondary pass. Similar studies have also noted that, education enhances farmer's abilities to engage in higher remunerable livelihood strategies and to be one of the most crucial factors of income from nonfarm activities, especially in higher remunerative skilled and salaried occupations (Barrett, C. B., Reardon, T., Webb, P., 2001).

In contrary, Adugna E., (2008) conducted a study in Wolayita and found that education level was highly significant but negatively influencing the decision of household heads' participation in non/off farm activities. In similar words, involvement in nonfarm and off farm activities and lower level of educational attainment of the household heads were positively related, implying that the household heads with higher educational attainment realized that engaging in non/off farm activities has low returns as compared to own agricultural work and decided to work

fulltime on agriculture. The likely possible justification of the fact that the average educational attainment by the sample households is not sufficient enough to be employed in higher paying jobs as they could not find skill specific demanding livelihood options in the study areas (Adugna E., 2008).

Household size was also found to be positively significant at 5% level of significance, implying the more the household size the higher probability of the household to involve in various income diversifying livelihood strategies. The marginal effect revealed that one household member increase leads to 5.7% increased chance in the probability of engagement in various livelihood strategies. The likely possible justification behind the positive association between household size and involvement decision of household in various livelihood strategies might be due to larger family size creating more labor which cannot be accommodated in the available agricultural fieldwork. Meaning, the marginal productivity of adding labor to an existing similar limited inputs such as land and capital, is less than that of engaging in other allied activities. On the other hand, this probably corresponds to the fact that the higher number of mouths to feed in a household leads to a more involvement in various livelihood strategies than to just solely depend on agriculture in order to meet basic needs of the household. Similar studies also revealed that an increase in an additional household member decreases the odds to engage only in farming (Bezemer D. J., and Lerman Z., 2002).

Moreover, agricultural extension visits was found to be highly significant at 1% level of significance but having a negative coefficient and association with involvement in various livelihood strategies. Keeping other factors constant, the likelihood of involvement in various livelihood strategies by households' decreases by 30.5% for households who are having frequent extension visits. The negative association reveals that more frequent the agricultural extension

agents visits the less likely the smallholding farmers' involvement in various livelihood strategies. During the survey, it was observed that community development works in the study areas as part of safety net programs and trainings for farmers on agricultural productivity designed to support the highly vulnerable smallholding farmers are highly time consuming. It was also observed that for households to engage in various livelihood strategies, there is a need for a less time consuming trainings or rescheduling the timing of visits is necessary in such a way that can create an ease for enhanced communication benefits to the smallholding farmers.

In addition to this, adoption of modern agricultural inputs was found to be highly significant at less than 1% level of significance with a positive association in the involvement of farmers in various livelihood strategies. It was found that farmers who are adopting modern agricultural inputs have a 41.9% higher probable chance of being involved in various livelihood strategies as compared to non-adopters. This is mainly due to the fact that use of modern agricultural inputs increase productivity yield of households, thereby increasing their income base and opening opportunities to involve and invest in various livelihood strategies than to just solely depend on agriculture. Adugna E., (2008) also found that use of modern agricultural inputs was found to have a positive and significant impact on rural households' decision to choose agriculture coupled with off/non-farm livelihood strategies at less than 10% level of significance. Furthermore, he asserted that the probable justification behind is improvement of productivity yield through modern agricultural inputs adoption can lead the farmers go for petty trading and other similar nonfarm activities.

Furthermore, membership to peasant/farmers' association was also found to have a positive and significant impact at less than 5% level of significance on the probability of households' involvement in various livelihood strategies. It was found that households who are members of

farmers' association have a 14.4% higher probable chance of engaging themselves in various livelihood strategies than their counter parts. Similar studies also stated that membership in various association such as farmers associations and producer organizations have positive impacts on the income generation capacity of farmers through widening local economy by production and market linkages (Bezemer D. J., and Lerman Z., 2002).

Lastly, farm land size was found to have a high significance at less than 1% level of significance with negative association on the probability of farmers to pursue other livelihood strategies. It was found that the chances of involving in various livelihood strategies is less among farmers with relatively larger land size holdings and the marginal effect also revealed that one hectare increase in land size, decreases the probability of engaging in various livelihood strategies by 19.6%. On one hand, it implies that the probability of engaging in various livelihood strategies decreases when land size holding of households increases. The likely explanation for this is that farmers with larger farm land size are going to be more engaged in farming since land encourages more farming. Increased role in other livelihood activities such as petty trading, part-time laborer and wage employment is more feasible for the households with less farm land size holding and other allied crucial resources (Adugna E., 2008). This line supports the idea that involvement in other livelihood strategies contend over the limited resources that households own. Berehanu E., (2007) found that farmland holdings per capita are negatively associated with the participation in off/nonfarm activities and other occupations.

During the survey, it was observed that majority of the farmers majorly depend on crop production and they lack entrepreneurial skills and capital to engage themselves in income diversifying strategies for better livelihood options and food security. It was also observed leaving behind engagement in business and other income generating activities, farmers were not even able

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to diversify their crop production patterns. As the *Woreda* Food Security coordinator asserted, without a water pump and proper facilities of irrigation, it is impossible to diversify the crop production in semi-arid areas like of the study areas.

In line with the above, the study assessed the major hindrances which are keeping smallholding farmers in the study areas from engaging in better income diversifying strategies.

Figure 7.1 Major reasons hindering Off/Nonfarm activities participation
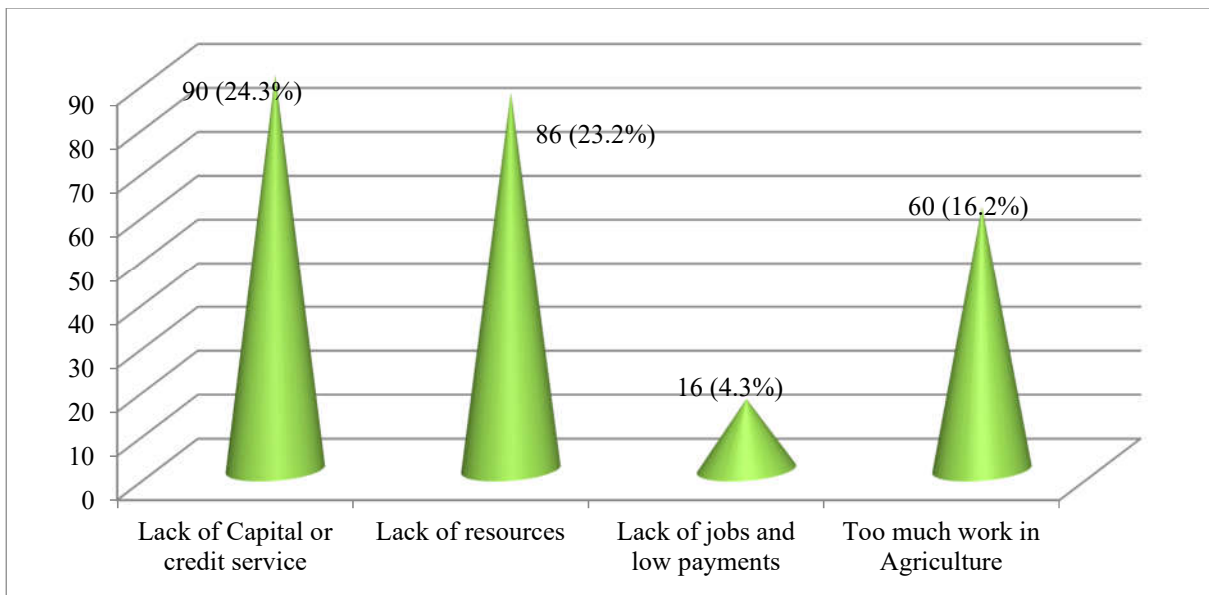
Source: Survey result, 2015

Majority of the respondents revealed that lack of capital and proper credit facilities as major limitations followed by lack of resources such as land and labor. In concomitant to this, time consuming hard work on their agricultural farmland (crop production) was also found to be a major determinant which is taking majority of their work time and leaving them in convoluted condition from participating in other income generating activities. This is also a supporting line for the above regression result were it was found that farmers with larger land size holdings were the ones with less participation in other livelihood strategies.

Moreover, it was observed that in the three selected study areas, there have been major developments in new factories like leather and marble factories and are in a dire need of laborers. Nevertheless, during the survey respondents revealed that the factories do not even pay poverty wages and give limited, if any benefits. However, keeping in mind the average educational attainment of the households, they cannot engage in better paying positions in these industries. Similar studies also revealed that farmers in most instances switch to other activities when the farm activity in not promising as such. Farmers consider other allied livelihood activities such as engagement in off/nonfarm activities as a last alternative income source in cases of crop production failure (Berehanu E., 2007).

Moreover, households were inquired regarding their perception on priority challenges and causes of food insecurity in their household. Accordingly, households revealed shortage of land for cultivation as their first priority cause for food insecurity by the majority 229 (61.9%). The sample households also revealed poor quality of the land as their second priority challenge by 144(38.9%) households. The third and last rank was given to low and inconsistent rainfall by 130 (35.1%) households as a cause for their households' poor food security conditions.

In addition to the perceptions regarding causes of food insecurity, households were also inquired about their major constraints hindering them from livestock farming. The issue of livestock faming was given an emphasis due to its direct impact on food security through consumption and its importance as source of income in times of shocks. Consequently, households revealed lack of capital 205(55.4%) as their first priority challenge hindering them from livestock farming. Moreover, 146 (39.5%) households also put lack of fodder as their second priority challenge and lastly lack of water reserves by 126 (34.1%) was asserted as a reason hindering them pursuing livestock farming.

7.2 Determinants of food security

In Ethiopia, the debate over the causes and determinants of food insecurity has stimulated a highly antagonistic viewpoints between the development thinking and the academic disciplines over the past few decades, giving a rise to proliferation of economic, demographic, cultural and political prominence across food security literatures. The root factors of the problem at household, regional and national level are quiet complex. The key causes can be grouped into three major categories; socio-economic, natural causes and policy factors (Devereux S., 2001).

A study conducted by World Food Programme in Tigray region on food security indicated that food availability was negatively affected due to food commodities poor supply, grains hoarding by traders, high transport costs and increase in exports of local grains. These factors have highly contributed for the shortage of food commodities in various markets. Regarding food accessibility, various factors such as high poverty status of households (about 70% of the total population living below a dollar a day) and poor asset holding levels for majority of the surveyed households, high food expenditure where more than 70% of the total income being spent on food commodities affected negatively the ease accessibility of food in Tigray region (WFP, 2009).

In line with this, the study has classified three components to assess the determinants of food security, namely, determining factors of food consumption, determining factors of Months of Adequate Household Food Provisioning (MAHFP) and finally determining factors of Body Mass Index (BMI) of households. Moreover, demographic, socio-economic and policy wise information like age, gender, educational attainment, household size, land size and fertility, livestock holdings, credit facilities and off-farm activities, adoption of various agricultural inputs which can enhance agricultural productivity, participation in safety net program and other similar factors were

expected to influence different components of households' food security for this particular study. Accordingly, these independent variables which are assumed to impact food security condition were regressed in the three selected models and the results are as follows.

7.1.1 Determinants of Food Consumption

The result of the econometric regression showed that selected independent variables which were hypothesized to have a significant effect on the probability of food consumption of households have revealed a significant impact. However, variables such as improved seed, safety net, education level of "9-12", medium land fertility and safety net participation turned out to be insignificant at less than 10% significance levels. From the table 7.2 below, the marginal effect output y = Pr (Food Con. SC.) (Predict)= 0.77660885 signifies that about 77.6% of households on average have the chance of having a better food consumption score. Here in the discussion part, independent variables which were found to be insignificant are not included as part of the report.

Table 7.2 Estimates of Maximum-Likelihood Probit model of Food Consumption Score

Food Con SC.	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]	dy/dx
_Iedun_2	-2.671609	1.610733	-1.66	0.097***	-5.828588	.4853691	-.7771452
_Iedun_3	.6616691	.3952457	1.67	0.094***	-.1129982	1.436336	.178649
_Iedun_4	-2.137606	5.843498	-0.37	0.715	-13.59065	9.315439	-.7040206
HH size	-.2607563	.1228461	-2.12	0.034**	-.5015303	-.0199823	-.077886
Land size	1.078707	.2149779	5.02	0.000*	.6573582	1.500056	.3222021
_Ifertilit~2	-.4858679	.3949284	-1.23	0.219	-1.259913	.2881775	-.1478293
_Ifertilit~3	2.169628	.5203194	4.17	0.000*	3.189435	1.149821	.6879182
Main Mkt. Dist.	.5744457	.1152093	4.99	0.000*	.3486396	.8002519	.1715828
Irrigation	1.829938	.3583362	5.11	0.000*	1.127612	2.532264	.5533563
Improved seed	-.9463196	1.137396	-0.83	0.405	-3.175574	1.282935	-.1945339
Safety net	-.2311191	.5110746	-0.45	0.651	-1.232807	.7705687	-.0690336

Total livestock	.2938816	.0508392	5.78	0.000*	.1942386	.3935247	.0877803
Off-farm act.	-1.473713	.6823117	-2.16	0.031**	-2.81102	-.1364071	-.4401877
_cons	-2.876809	1.603423	-1.79	0.073	-6.01946	.2658416	

Probit regression	Number of obs = 370
	LR chi2(13) = 294.31
	Prob > chi2 = 0.0000
Log likelihood = -60.703814	Pseudo R2 = 0.7080
Marginal effects after Probit	y = Pr(Food Con. SC.) (predict) = .77660885

Source: Survey result, 2015
Notice: *, ** and *** significant at 1%, 5% and 10% significance levels, respectively

Out of 10 independent variables nine variables were found to be partaking a significant variation in the probability of food consumption patterns of households. Education level of; 'Read and write' and 'Less than 8th level', household size, higher fertility of land, distance from main market to households' residences, irrigation, total number of livestock holdings and participation in off/non-farm activities were the variables which were found to have a significant impact on food consumption score of households. The coefficients of education level more than '8th level', medium fertility rate, adoption of improved seeds and participation in Productive Safety Net Programme were not statistically significant at all; at 1%, 5% and 10% significance levels implying they were less important in affecting the probability of households' food consumption pattern.

With regard to education level of household heads, illiteracy was set as a control variable and comparing with the control variable, households with education level of "Read and Write" and "Less than 8th level" were found to have a significant impact on food consumption score of households negatively and positively respectively at 10% significance level. "Read and Write" was found to have a negative relationship with that of food consumption score where household in this education level were having a 77.7% less chance of having a better food consumption score.

Whereas, it is found that households with education level with "Less than 8th level" (Primary education) have a better chance of enhancing their food consumption. Referring to the marginal effect, households with education level of primary education have a 17.8% chance of better food consumption score. Here, it can be noted that at least achieving a primary education level is very crucial determinant of food consumption pattern. However, education level more than that was found not to have a significant impact on food consumption score of households. Other studies also revealed that farmers with higher level of education are more likely to have better food security as compared to their counterparts (Tsegay G., 2009).

Household size was also found to be a very crucial factor in determining food consumption pattern of households in the study areas. As the number of members living under the same roof increases, the number of mouths to be fed also increases where by decreasing the food availability of the household. Similarly, the study found an inverse relation between household size and food consumption score of households. Household size was found to be significant at 5% significance level. The marginal effect also revealed that as the number of household size increases by 1, the probability of food accessibility of households' decreases by 7.7%. Similar studies also indicated that increase in household size undoubtedly create more mouths to be fed out of the limited resources smallholding farmers have and this in turn upsurges the burden on the available food in a household (Yishak G., et. al., 2014).

In concomitant to this, farm land size as noted by leaders of the "*Tabias*" is one of the major significant factors which stands as a mark for the wealth difference among households in the study areas. In similar lines, the study also found that farm land to be one of the highly significant variables at 1% significance level impacting the food consumption score of households positively. Households with an additional farm land size of 1 *Timad* (0.25 Ha) have a 32.2% better chance of

increasing their food consumption. Related studies also indicated that land size is larger for food secure households than the food insecure ones and it is highly significant at 1% level of significance (Adugna E., 2008).

Fertility level of the farm land is also one big factor which plays an important role in the food consumption pattern of households. The survey also found that households with a highly fertile land have better food access and the variable "highly fertile land" was found to be significant at 1% level of significance. Moreover, the survey found that comparing households with a highly fertile farm land to the households with a less fertile land, food consumption score of households with a fertile farmland is higher by 68.8%. As indicated by WFP (2009), in the region, soil infertility coupled with environmental degradation is a major challenge which has left a space for a gap in fulfilling food demands.

The estimated distance from the main market to the households' residence was also found to be highly significant at 1% level of significance. Distance to main market was expected to be negatively affecting food consumption score of households (meaning as the distance between the main market and households residence increases, food consumption score decreases). However, the marginal impact result revealed that households who are further away from the market by 1 Km, have a 57.4% better food consumption than the ones who are located nearer by 1 Km. The likely possible explanation for this positive relationship lies on the point that as the distance to market from households residence is shorter, farmers will try to deliver products which are available at their disposal even if small so as to gain cash for future investments and expenditure by limiting current consumption. On the other hand, the opportunity cost of delivering their products to market for farmers who are located far off distance from main market will be less than

consuming it due to factors like adequacy of produces, means of transportation, delivery time consumption and etc.

In addition to this, irrigation is also one of the important technology inputs for enhancing agricultural productivity especially in areas with limited and variable rainfall. The smallholding farmers in the study areas are highly dependent on rain fed agriculture as majority of them are incapable to afford modern irrigation system in their production. Correspondingly, the study also found that irrigation as one of the highly decisive and positively significant factors at 1% level of significance. The food consumption score of households who are employing irrigation is superior by 55.3% than those who do not employ. Similar studies also indicated that the yield difference between solely rain-fed and irrigated crop production is 40%, i.e. irrigation has a better potential to enhance crop production yield by 40% (CSA, 2005 as cited in Ahmed A., 2008).

As the food consumption score gives higher weights for foods which originate from animals and animals' products, the total number of livestock was also incorporated. Concomitantly, the total number of livestock holding measured in total livestock unit was found to be highly significant at 1% significance level as a decisive factor of food consumption pattern of households. Furthermore, the marginal effect of total livestock holdings reveals that as the number of total livestock holding increases by 1 livestock unit, food consumption score increases by 8.7%. A similar study conducted in Tigray region revealed that livestock ownership is a highly significant factor in the rural parts of the region as a source of income, food and means of transportation. Moreover, it was asserted that the proportion of households who are food insecure is higher by 50.4% who own livestock less than the sample mean of 3.94TLU (Total Livestock Unit) (Tegay G., 2009).

Moreover, participation of households in non/off-farm activities create an opportunity for additional source of income which in turn enhances food availability condition. Similarly, it was expected that participation in non/off-farm activities to have a positive impact in the food availability condition of smallholder farmers. However, the study found an inverse relation where households who are participating in non/off-farm activities were found to have lessened food consumption score. The likely possible explanation for this is that majority of households who are not participating in non/off-farm activities were either the landless or households with small land size and infertile ones. About 59% of the households who are not participating in non/off-farm activities were owning land, revealing majority of smallholding farmers in the study areas participate in non/off-farm activities either if they are landless or owning a small size land which may not fulfill the needs of the household. Whereas, households who own land and concurrently participating in non/off-farm activities accounted for 20% of the total sample population. With this in mind, the result from the regression reveals the food consumption score of households who are not participating in non/off-farm activities is higher by 44% than the ones who are participating. Other similar studies also indicated the importance of engaging in alternate livelihood strategies and its positive impact by revealing households mingle crop production and non/off-farm activities to fill their income and food gaps of their households (Yishak G., et. al., 2014).

A study conducted in Laelay Maichew *Woreda,* Tigray region revealed that out of 16 selected explanatory variables to analyze total calorie availability (adult equivalent/day) only 5 variables were found to be highly significant in impacting food security condition of farmers. These variables included age of household head, number of total Livestock Unit/Household, use of improved seeds, number of adult equivalent/household and the farm land size. The impacting factors of food security are highly interrelated and multidimensional. The variables with higher

marginal impact included households with large total livestock unit per household, large land size per household and higher educated households contributed positively to household food security. Moreover, proper veterinary services, suitable management and handling of farming land and finally expansion of educational coverage in the *Woreda* are the most crucial routes to solve the problem of household food insecurity. In addition to this, commitment of the government and the community in the expansion of irrigation and in enhancing rural farmer cooperatives are vital to solve the rooted causes of household food insecurity (Shishay K. and Messay M., 2014).

7.1.2 Determinants of Months of Adequate Household Food Provisioning (MAHFP)

MAHFP indicator tries to capture the changes in households' ability to deal with vulnerability in such a way to guarantee that food is available above minimum level all year round. Households below the food poverty threshold generally have less than nine months (ACF, 2010). It is an indicator which shows the annual food gap in a household by counting the number of months where households were not able to sufficiently provide food to their members. In the study areas, the average number of months of adequate household food provision was found to be 6.44 months which is less than that of the average food poverty threshold.

In this study, Poisson regression analysis is used to examine the relationship and significant impact between the dependent variable; Months of Adequate Household Food Provisioning and the explanatory variables such as Age of the household head, Sex of the household head, Education level of household head, Household size, Cultivated farm land size, Fertility level of the farm land, Total number of livestock, Number of oxen, Use of; irrigation and fertilizer, Access to credit and Agricultural extension, Participation in; Safety net program, Direct Food aid and non/Off-farm activities.

Table 7.3 Estimates of Maximum-Likelihood Poisson regression of MAHFP

MAHFP	Coef.	Std. Err.	Z	P>z	dy/dx	Std. Err.	z	P>|z|	X
Age	.0042222	.0022291	1.89	0.058*	.0272074	.01436	1.90	0.058	53.8324
Sex	-.0717305	.0934136	-0.77	0.443	-.4622246	.60184	-0.77	0.442	1.15405
_Iedun_2	-.3139684	.1171832	-2.68	0.007**	-1.760098	.56745	-3.10	0.002	.043243
_Iedun_3	.002527	.0647116	0.04	0.969	.0162902	.41732	0.04	0.969	.345946
_Iedun_4	-.1584808	.1250791	-1.27	0.205	-.9513256	.69794	-1.36	0.173	.045946
HH size	-.0089426	.0144225	-0.62	0.535	-.057625	.09292	-0.62	0.535	5.47027
Cultiv. Land size	.0537624	.0187647	2.87	0.004*	.34644	.12085	2.87	0.004	2.31486
_Ifertilit~2	-.0129717	.0634203	-0.20	0.838	-.0835043	.40788	-0.20	0.838	.421622
_Ifertilit~3	.2501783	.0844898	2.96	0.003*	1.566835	.51476	3.04	0.002	.375676
Total liv.	-.0018449	.0070142	-0.26	0.793	-.0118885	.0452	-0.26	0.793	7.20541
No of oxen	.0085295	.0428797	0.20	0.842	.054963	.27631	0.20	0.842	1.35135
Irrigation	.2974964	.0585554	5.08	0.000*	1.930315	.38186	5.06	0.000	.489189
Improved sd	-.3111859	.1013357	-3.07	0.002*	-2.214087	.79362	-2.79	0.005	.805405
Agri. Ext.	-.1546527	.0576851	-2.68	0.007*	-.9965683	.37092	-2.69	0.007	1.45405
Fertilizer	.356526	.1039423	3.43	0.001*	2.039645	.52479	3.89	0.000	.848649
For-credit	-.0192403	.0658671	-0.29	0.770	-.1239826	.42442	-0.29	0.770	1.68108
Safety net	.005062	.0542175	0.09	0.926	.0326189	.34937	0.09	0.926	1.34595
Food aid	.0931973	.0504254	1.85	0.065***	.6005549	.32476	1.85	0.064	1.62162
Off-farm act	.0108991	.0599236	0.18	0.856	.0702331	.38615	0.18	0.856	1.65946
_cons	1.648019	.2866411	5.75	0.000					
Poisson regression				Number of obs = 370					
				LR chi2(19) = 276.94					
				Prob > chi2 = 0.0000					
Log likelihood = -724.91795				Pseudo R2 = 0.1604					
Marginal effects after Poisson	y = predicted number of events (predict) = 6.4439099								

Source: Survey result, 2015

Notice: *, ** and *** significant at 1%, 5% and 10% significance levels, respectively

Explanatory variables which were hypothesized to have impact on households' MAHFP but which were found to be insignificant are not included as part of the report. From the total 16 explanatory variables, only 9 of them; Age, Education_2, Cultivated land size, higher Fertility of farmland, Irrigation, Improved seed, Fertilizer, Access to agriculture extension service and Food aid were found to be significant in impacting the MAHFP in the study areas. Regarding age of the household head, it was found to be significant at 10% level of significance, and as it was hypothesized, the coefficient of household age is positive. The marginal effect of age was found to be 0.027 month, implying a one year increment in the age of the household head, households will have a 0.027 month better MAFHP. Though, age of the household head is significant statistically, but its significance policy wise is a twaddle.

With regard to the educational attainment of the household heads, education level of "Read and Write" was found to be significant at 5% level of significance and was found to have a negative relation with MAFHP. Household heads with this educational level were found to have MAHFP of less 1.7 months in a given year. Furthermore, household heads with education level more than that were not found to have a significant relation with MAHFP. Though other educational attainments are having positive relation with MAHFP, they were found to be statistically insignificant.

Cultivated land size was also found to be highly significant at 1% significance level with a positive relation as it was hypothesized with MAFHP. Household heads with an additional of 1 "*Timad*" (0.25Ha) of cultivated land were found to have MAFHP of additional 0.34 month (10.2 days in a year). Other similar studies also revealed that farmland shortage as one of the most limiting factors for smallholding farmers in Tigray Region. Data from Bureau of Planning & Finance Tigray Region (2015), revealed that the per capita landholding size in the region has

diminished from 0.31Ha in the year 1997 to 0.19Ha in the year 2006 mainly due to population pressure and the inability of non-farm sectors to provide employment opportunities. The per capita farm land holding has become below the minimum area requirement for households to produce the average yield of cereals (Tagel G., 2008).

The extent of land fertility is also one of the determinants of MAHFP and it was significant positively at 1% level of significance. Household with a highly fertile land were found to have MAHFP of additional 1.56 months in a year. In case of the study areas, one of the major determinants mentioned by the household as a big factor is the level of fertility of the land. Accordingly, it was also mentioned by the Food Security Coordinator (FSC) of the *Woreda* that the level of land fertility is very low as compared to other areas and it is a big impediment for the betterment in the food security condition of smallholding farmers.

Moreover, irrigation was also found to be a highly determining factor of MAHFP positively at 1% level of significance. Households who employ irrigation system in their agricultural production have a better production yield than those who do not. Concomitantly, the study found that the MAHFP of households who use irrigation is higher with 1.9 months (≈2 months) in a year. Another similar study revealed that farm management system in most parts of Ethiopia generally follows a traditional method and there is a high limitation in the adoption of irrigation. Hence, agriculture has been dependent on rain fed farming for decades. It also asserted that in the study areas, there is about 8 months of semi-starvation for majority households with an acute shortage of food (Mequanent M. & Esubalew T. 2015).

In addition to this, agricultural extension service was also found to be significant at 1%level of significance negatively impacting MAHFP of smallholding farmers. This is a similar finding to

the negative impact of agricultural extension on smallholding farmers' involvement in various livelihood strategies. During the survey, it was noted that agricultural extension trainings and development programs were highly time consuming.

Furthermore, use of fertilizer in agricultural production stands as a proxy of technological advancement in agriculture in most developing countries. Similarly, the study found that the use of fertilizer to be a highly and positively significant determining factor of MAHFP at 1% level of significance. Accordingly, households who employ fertilizer were found to have a higher MAHFP of 2.03 months in a year. Yishak G., et. al. (2014) also asserted that use of modern fertilizers has a significant positive impact in enhancing the production yield of farmers thereby enhancing the food stock and availability.

Food aid is one means of filling food gap of households and as food aid is a direct contribution of food support to vulnerable households, it was expected to have a positive impact on MAHFP. Accordingly the study also found that, food aid is having a positive significant impact on MAHFP at 10% level of significance. The marginal effect also revealed that households who participate in food aid programs were found to have a better MAHFP with 0.6 month ($\approx$ 18 days) in a year comparing to those who do not.

7.1.3 Determinants of Body Mass Index (BMI) of households

The concept of food security is comprised of chief constituents; availability, accessibility and utilization of sufficient and nutritious food coupled with stability which stands for the temporal dimension of these components. Basing on this, food insecurity arises mainly due to a limited availability of nutritionally adequate and safe food or in cases like the ability to acquire socially acceptable foods is limited. Food insecurity comprises of hindrances related with quality and

quantity of food available, uncertainty with the food supply and experiences of hunger. Furthermore, the determining factors are complex and multidimensional across different groups of people, and as a result there is no universally fixed parameter or index to assess the determining factors for the various components of food security.

Even so, for this study to assess the determining factors of nutritional adequacy and the root causes for energy deficiency in the selected sample households in the three study areas, Body Mass Index (BMI) was employed. The body mass index, as the name implies it is the ratio between weight and height squared and is a good parameter to evaluate chronic energy deficiency. Information on the nutritional status of a community is crucial to have a wide-ranging idea about development process, as undernutrition is one of the major health dilemmas of most developing countries (Dipak K. et.al, 2006)

In most low income countries, a higher BMI is mostly associated with a profuse whereas in high income countries it is more often associated with a lower socioeconomic status. Correspondingly, there are various factors other than the socio-economic factors like the productivity and consumption patterns which will possibly impact BMI. Therefore, this sub section of the study tries to assess the significant and determining factors of nutritional adequacy with observable outcomes of weight and height; i.e. BMI of sample household members in the study areas.

In addition to this, there are some precautions that were taken under considerations while hypothesizing and selecting variables which may stand as determining factors of BMI for the sample households in the study areas. Initially, the variables were selected basing on respondents views and review literatures related with BMI measurement at different levels. Likewise, 15

independent variables were put in order to assess the determining factors. Accordingly the log linear regression results of the hypothesized independent variables on the dependent variable are presented as follows in Table 7.4 below.

Table 7.4 Log-Linear regression result for Determinants of BMI

Log BMI	Coefficient	Std. Err.	t	P>t
_IAge~8-14	.0542174	.0143779	3.77	0.000*
_IAge~15-25	.3365039	.0169568	19.84	0.000*
_IAge~26-45	.3838889	.0124229	30.90	0.000*
_IAge~46-64	.4125283	.0153721	26.84	0.000*
_IAge~>65	.4209486	.0165631	25.41	0.000*
_Iedun~2	.0561416	.0175714	3.20	0.001*
_Iedun~3	.0056495	.0116433	0.49	0.628
_Iedun~4	.0629409	.015314	4.11	0.000*
_Iedun~5	.0595313	.0435525	1.37	0.172
_Iedun~6	.3258541	.0392242	8.31	0.000*
Household size	.0068446	.0023007	2.97	0.003*
Farmland size	-.0105599	.0039329	-2.69	0.007*
Total livestock	.0004992	.0009332	0.53	0.593
MAHFP	.0041595	.003067	1.36	0.175
FCS	.0002788	.0010692	0.26	0.794
Main Road	.0005128	.002816	0.18	0.856
Off-farm Activity	.0108974	.0090232	1.21	0.227
Food aid	-.0765338	.0091625	-8.35	0.000*
Safety net|	.004883	.0087105	0.56	0.575
Agri. Extension	.0034506	.0092877	0.37	0.710
Improved Seed	.0431482	.0168676	2.56	0.011**
Fertilizer	-.0044926	.016286	-0.28	0.783
Irrigation		-.0352959	.0112009	-3.15	0.002*
_cons	2.599786	.0391001	66.49	0.000

Source: Survey result, 2015

Notice: *, ** and *** significant at 1%, 5% and 10% significance levels, respectively

The independent variables which were hypothesized to have impact on BMI include; age of sample members as a dummy to control the effect of age on weight balance, education level, household size, land size, total livestock holdings, Months of Adequate Household Food Provisioning (MAHFP), Food Consumption Score (FCS), distance to main road, participation in; non/off-farm activity, food aid, safety net, agricultural extension program, use of fertilizers, improved seeds and irrigation. From these, education level of; "Read and write", "9-12 level" and "College Diploma", household size, land size, food aid, use of improved seeds and irrigation were found to be significant at distinct levels of significance in determining BMI of sample households in the study areas.

Regarding educational attainment, "Read and Write" and "9-12 level" were found to be significant positively at 1% level of significance. The coefficient of "Read and Write" reveals that, as a household member education level increases to "Read and write", BMI will also increase by 5.6%. In similar lines, household members who have attained education level of "9-12th level" have a positive enhancement in BMI by 6.29%. This shows that higher attainment in education has a positive outcome in the BMI of household members.

Moreover, household size was also found to be positively significant at 1% level of significance on BMI of households in the study areas. That is, as the number of household member increase by one, BMI also increases by 0.6%. Though household size is significant statistically, but policy wise it is limited due to its very low impact on BMI of households. The likely possible explanation behind the positive relation is during the survey it was noticed that having higher number of household members creates a big source of labor which lets higher sharing of workloads. This lessens the burden of fieldwork per individual whereby affecting BMI positively.

Land size was also found to be highly significant at 1% level of significance determining the BMI of households in the study areas. The effect of land size holdings on BMI was found to be negative which is an inverse impact comparing to its impact on FCS and MAHFP. Statistically, it has been found that as land size is increases by 1 "*Timad*" (0.25Ha) BMI of household members decrease by 1.05%. As majority of the households revealed during the survey, the fieldwork requires a hard labor and in cases like the study areas' with rough and difficult weather condition, the more hardened workloads on the smallholding farmers. Concomitantly, a more land size means a higher burden on labor force to cover up, which in turn impacts the BMI of households negatively.

Another variable which was found to be highly significant at 1% level of significance is participation of households in food aid. It was found that households who are participating in food aid programs have a less BMI, where statistically it was found that food aid participants have a less BMI by 7.65% that those who do not. The likely explanation for this lies on data where majority who are participating in food aid programs are the vulnerable and these groups as observed during the survey, they were the ones with very less BMI. On the other hand, the negative relationship between BMI and food aid raises a question of whether the food aid support is nutritionally adequate or not. A similar study conducted in Amhara Region revealed that the mean per capita kilocalorie of households who receive food aid was 2259.11Kcal and was higher than the non-recipients of 2183.98 Kcal. However, the mean difference was not statistically significant between the two, which shows that food aid has no significant impact on households' kilocalorie per capita availability (Tilaye T., 2004).

Moreover, it was found that use of improved seeds to be significant at 5% level of significance and having a positive relation with BMI. The result shows also, households who

employ improved seeds in their crop production have a 4.3% positive enhancement in their BMI than those who do not. With regard to irrigation use, it was also found to be highly significant with negative impact at 1% level of significance. The marginal effect also shows that households who employ irrigation in their agricultural production have a 3.52% less chance of having a better BMI. During the survey, it was noticed that, irrigation, apart from its importance, it creates additional workload and requires more additional hard labor. Moreover, taking into consideration of the challenging weather for fieldwork and other similar possible explanations, it leads to a more energy loss and a negative impact on households BMI.

Conclusion

The Tigray regional state where the study sites were located has one of the poorest regional economies record in the country. Vast number of households in the region were only able to produce sufficient food for six months or less in a year. Taking this into consideration, the study tried to investigate the problems related to food insecurity and livelihood resources and strategies determining factors. Initially, the study tried to assess the determining factors of livelihood strategies and six significant determining factors were found. These significant variables with their relation and significance level are education level of the household head (positive at 1% level of significance), household size (positive at 5% level of significance), agricultural extension visits (negative at 1% level of significance), use of modern fertilizers (positive at 1% level of significance), farm land size (negative at 1% level of significance) and finally farmers association membership (positive at 5% level of significance). Majority of the smallholding farmers also asserted that lack of capital, proper credit services and time consuming hard work on their

agricultural farmland as major challenges limiting them from engaging in diversified livelihood strategies.

With regard to determining factors of food security, the study has tried to depict the impacting factors basing on the three indices which were employed to assess the food security status of the smallholding farmers. It was found that eight variables were having a significant impact on food consumption patterns of the farmers, namely; education level of; 'Read and write' and 'Less than 8th level', household size, higher fertility of land, distance from main market, irrigation, total number of livestock, and participation in non/off-farm activities. Regarding Months of Adequate Household Food Provisioning (MAHFP) nine variables were found to have a significant impact. These significant variables were age, education level of 'read and write', farmland size, higher fertility of land, irrigation, improved seeds, fertilizer, access to agriculture extension service and food aid. Finally, concerning to the determining factors of Body Mass Index (BMI) of household members, education level of; "Read and write" and "9-12 level", household size, farmland size, food aid, use of improved seeds and irrigation were found to be significant at distinct levels of significance.