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Food insecurity in the *green famine* belt of Ethiopia: Extent and severity in Belo-jiganfoy District, Benishangul-gumuz region

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The *green famine* belt of Ethiopia is customarily viewed as food secure area only due to relatively adequate rainfall and green vegetation cover. In contrast, this paper argues and shows that the food insecurity condition termed as "green famine" has always existed in the belt. Accordingly, the paper examined the extent and severity of food insecurity based on a cross-sectional survey of 220 households in Belo-jiganfoy district. A structured questionnaire was employed to collect data. A household food balance model was used to determine the food insecurity status and then to compute the head count ratio and food shortfalls index for determining the extent and severity of food insecurity respectively. The result showed that food insecurity was widespread and deep-rooted. The head count ratio showed that about 72% of the surveyed households were food insecure. The food shortfall index showed that on average households were 48% far below the food security threshold. The household food insecurity access prevalence showed that about 62% of the respondents were food insecure at different levels of severity: 21% mildly, 23% moderately, and 18% severely food insecure. Small-scale irrigation, wage labor, family size, land size, livestock, off-farm income and household head education were significant determinants of food insecurity. Therefore, it is safe to conclude that the extent and severity of food insecurity in the *green famine* belt is at best similar with, and at worst more than, the situation in the drought-prone and non-green famine areas of Ethiopia.

Key words: Food insecurity, extent, severity, determinants, Western Ethiopia.

INTRODUCTION

Food security is defined as "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Canali and Slaviero, 2010). In other words, food insecurity occurs when people fail to meet the above definition and famine occurs when people face extreme level of food shortages revealing extreme hunger and/or

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starvation. Households that face food shortages on a permanent basis are termed as chronically food insecure (Degefa, 2005) while those who face it when hit by disasters or shocks are termed as transitorily food insecure; and when transitory food shortages are cyclical, it is termed as cyclical or seasonal food insecurity (Brown and Amdissa, 2007). In Ethiopia, chronically poor and food insecure people are found throughout the country although these characteristics are used to define the conditions of drought-prone areas. On the other hand, food insecurity in Western Ethiopia in general and in Benishangul-gumuz region in particular is generally seasonal and/or transitory in nature (BGR 2004). However, close field observations reveal chronic nature of food insecurity for the majority of the households in the region.

It should be noted that the causes of the known famines and hunger events of Ethiopia are almost entirely attributed to natural calamities such as drought, high variability of rains, and crop pests (Degefa, 2005). Evidences show that drought has been exacerbated by high population pressure and the resulting land degradation causing deterioration of food production (Berhanu, 2001). With this premise, historical famines and the present day chronic poverty and food insecurity could be regarded as features of either the drought-prone eastern and northern parts, or high population pressure areas of central and some southern parts of the country. To this end, two wider areas where series of famine and food shortages have occurred are identified. The first covers the central and northern highlands lying from northern Shewa through Wollo to Tigray, and the second covers the areas of agro-pastoral lowlands extending from Wollo through Hararghe, Bale, Sidamo to Gamo Gofa in the South (Canali and Slaviero 2010). Consequently, research and policy interventions have generally been limited to eastern half ignoring the western half of the country. In fact, a recent work by Mulugeta (2014) tries to indicate the prevalence of famine in the southern part of Ethiopia. This is a good start as it introduces the concept of *green famine* in the green belt of Ethiopia which, like the traditional views, relates its causes to droughts and high population pressure on land resources. The customary view that attributes severe shortage of food and famine to eastern half and drought and population pressure is however contended in this paper. The paper primarily argues that *green famine* has always existed along with its unique features but not well recognized.

Ethiopia has a long history of famine and food insecurity that goes back at least to the 19thcentury*great famine* (Degefa, 2005) and the 20thcentury Wello famine (Sen, 1981). All forms of food insecurity (chronic, transitory and cyclical/seasonal) have occurred in the country although data show a declining trend in it. For example, it was approximately 52% in 1980s, and declined to 43% in 1995/96 (Devereux, 2000), to 44% in 2003 (USAID, 2004), to 38.7% in 2004/05, 35.6% in 2005/06, to 33.3% in 2006/07, and came down to 28% in 2009/10 (MoFED, 2008). Despite this, the actual number of people exposed to food shortages has remained significantly high.

In western Ethiopia (that is, part of *green famine* belt), few empirical studies showed the extent of food shortage but perhaps none showed its severity. For example, Save the Children estimated that approximately 37% of the population of Benishangul-gumuz region faces food shortage for several months each year (Save the Children, 2010 to 2015). This seems an underestimation as empirical studies in the region indicate figures that are much more than this. For example, 58.1% of the population of the region was living in poverty in 2004 (BGR, 2004). This is more than the national figure of 50% in the mid-2000s (CIDA, 2013). The empirical household level studies also show that the proportions of food insecure households in Bullen and Assosa districts were 58% (Guyu, 2014) and 85% (Dagnachew, 2004) respectively. In addition, a qualitative study entitled *villagization for transforming semi-pastoral communities in Benishangul-gumuz region* indicates the severe nature of poverty and food insecurity in the region in general and in Dibate district in particular (Guyu, 2012). According to this study, the people (mainly the indigenous ethnic group, the Gumuz) resort to wild food as coping mechanism although it is a culture of all indigenous people of the region. These figures are far more than the national figure of approximately 44% of food insecure population in 2004 (USAID, 2004) and about 33% chronically food insecure households in 2013 (CIDA, 2013). Moreover, the figures are much higher than the situation in central Ethiopia, for example, in Nonno district, Shewa, where about 21.09% of such food insecure households were found (Messay, 2013). Likewise, they are higher than the situation in the northern Ethiopia, for example, in Tigray region where about 42% of food insecure households were found (Tsegay, 2009). This shows that the food insecurity situation in the *green famine* belt in general and in *Benishangul-gumuz region* in particular is more critical than those in *non-green famine* areas of Ethiopia. Despite this fact, empirical research regarding the extent and severity of food insecurity in the district is either little or none. Research and policy focus about food insecurity in Ethiopia seems to have biased as it geared towards northern, eastern and southern parts. Thus, this study is valuable in that it contributes to the existing literature about food security/insecurity by highlighting the situation of food insecurity in the western Ethiopia, which narrows the geographical gap in food security literature. Accordingly, the study aimed at examining the extent and severity of household food insecurity employing different rigorous approaches, tools and indicators. The findings may awaken policymakers, researchers and other stakeholders to consider this part of the country, without which overall national food security challenges may not be effectively addressed.

MATERIALS AND METHODS

The study area

Green famine belt is generally located in western half of Ethiopia where Benishangul-gumuz region is a part. The region is located between 09°17' to 12°06' Northing and 34°10' to 37°04' Easting. According to the region's official report, it has an area of 50380 km^2 with altitude ranging from 580 to 2731 m above mean sea level. Agro-ecologically, it is divided into three: 75% of *kola* (lowlands below 1500 m with tropical climate), 24% of *Weina dega* (midlands between 1500 and 2500m with temperate climate) and 1% of *Dega* (highlands above 2500 m with cold climate). Average annual rainfall varies between 800 and 2000 mm. Depending on the place and season, the minimum daily temperature ranges from 12 to 20°C while the maximum ranges from 20 to 25°C in rainy season and rises to 35 to 40°C in the dry season. It has a population of 670,847, of which nearly 86% live in rural areas (CSA, 2008).

Observation shows that Belo-jiganfoy sufficiently represents the region in terms of physical, cultural, socioeconomic, and demographic characteristics as well as ethnic composition. The absolute location of the district center (Soge town) is at 11° 18'43"North and 36° 12'57"East (FDRE-ERA, 2008). The district lies between 1100 and 1450 masl, which experiences nearly the characteristics of lowland. Its rains are mono-modal type that begin in April/May and ends in October/November. The daily average temperature during rainy season ranges between 20 and 25°C while the minimum temperature ranges between 12 and 20°C depending on the season and altitude. Staying for at least eight months every year, rains of the region is sufficient for food production in terms of amount and distribution. In this regard, the case study area resembles the whole *green* belt of Ethiopia. As it is located in the western Ethiopia, Belo-jiganfoy experiences longer duration of rainy season. The district, like most parts of the region has extensive fertile arable land, natural forest, surface and ground water, and mineral resources. Accordingly, the livelihood of households in the district depends largely on land resources through mixed farming, fishing and collection and hunting of wild foods. Despite availability of large rivers such as Didessa and Anger, small irrigation is little practiced.

Population pressure is not a major problem in Belo-jiganfoy district as it has a very low density (18.5 persons/km^2) although growing from time to time. It consisted of total population of 27,381. Of this 53% were males and 47% were females while 90.84 and 9.16% were rural and urban populations respectively. The average family size was 5.1. The rural population of the district (90.84%) is much higher than the national average (85%) implying that the lives of most people in the district depend on agriculture. Moreover, about 42% of the population was under 15 years old, 56% between 15 and 64 and only 2% was above 64 (CAS, 2008:38). The major ethnic groups of the district include Gumuz, Berta, Mao, Amahara and Oromo while few others also live in it. The cultural interaction of these different ethnic groups and the resulting experiences is what is termed as *ethno-culture* (Guyu, 2014). The religious composition of an area has its own impact on local and national development efforts. In rural areas, it may affect agricultural productivity via the number of days devoted to working in farms and religious festivals. Almost all types of religious practices are found in Belo-jiganfoy district. Data show that the district consists of 46.4% followers of Orthodox Christianity, 44.6% protestant Christianity, 16% Catholic, 46% Muslim, 2.2% traditional healers and 0.8% followers of undefined beliefs (CSA, 2008).

The livelihood of almost all population of Belo-jiganfoy is founded on agriculture in the mixed fashion (arable and livestock farming). Most indigenous people of the district have been mainly shifting cultivators. Major cereal crops such as maize and sorghum, legumes such as haricot beans and soya beans, oil seeds such as sesame and, fruits such as mangoes are produced. Livestock production is also practiced in the district although the potential remains unexhausted. Cattle, goats, sheep, poultry and bees are better. Belo-jiganfoy district has only one main market center at Soge which serves twice a week. Following the regional pattern, it has weak road network that covers only 18 km (FDRE-ERA, 2008). Mobile telephone service is functional in most areas of the district. Electricity line that is not functional for much of the time is available presently only in Soge town. The rural areas of the district depend on biomass as a source of energy. Protected water for domestic use is very limited in the district. According to district office information, the health coverage of the district had reached 58% but characterized by poor quality while there were 11 primary and 1 secondary school showing 73% coverage of primary education in the district. One credit service institution is available at the district center, Soge town.

Research process

A cross-sectional survey was conducted in Belo-jiganfoy district, Benishangul-gumuz region, western Ethiopia during the last week of August in 2013. The district was purposively selected as it can generally represent the *green famine* belt in terms of physical, socioeconomic and cultural backgrounds.

Data were collected from 220 randomly selected rural households considering the indigenous and non-indigenous ethno-culture groups using structured questionnaire. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 19. The extent and severity of household food insecurity was measured and analyzed using dietary energy supply (DES) and household food insecurity access scale using its prevalence (HFIAP), a categorical indicator of severity of food insecurity. Finally, the impact of socioeconomic and demographic characteristics of the surveyed households on food insecurity was examined using binary logistic regression model.

Different methods were used to determine the food insecurity status of each household. The household food balance model is a simple balancing equation that calculates the net food or net DES as the difference between the gross food available to a household from all sources and the total food disposal for any reason (Equation 1).

$$\text{Net Food/DES} = (GF - FDSPL) = (OP + FP + FB) - (FS + SR + PHL) \quad (1)$$

Where; NF/DES = Net food/dietary energy supply; GF = gross food; FB = food borrowed; FDSPL = food disposal ; FS = food sold; OP = own produce; SR = seed reserved; FP = food purchased; PHL = post-harvest lost.

The net food obtained from this equation for each household is compared against the minimum recommended threshold amount of 2100 kcal/ADE/day. The net DES which considers the amount of calories in each food item was used to determine the net DES available to each household. The amount of calories for each household was obtained by converting respective amount of net food into kcal equivalent based on conversion factors (Hoddinott, 1999). For example, the suggested equivalence of 1kg of millet is about 3390kcal (Hoddinott, 1999). The kcal consumption of each household is compared with the nationally recommended minimum amount for a healthy adult person per day of 2100 kcal (Messay, 2013) to identify food secure and food insecure households. Then, the head count ratio was calculated based on the food security status using the following formula:

$$HCR = [(n/N) \times 100] \quad (2)$$

Where, HCR is head count ratio; n = number food insecure households; N = Total number of sample households.

This ratio shows the extent of food insecurity in terms of the percent of food insecure households in the population but tells us little about the severity/depth of food insecurity (Frehiwot, 2007). As a result, the food shortfall index (FSI) was determined to solve this problem based on the following procedure:

$$FSI_i = [(MRF - TFA_i) / MRF] \quad (3)$$

Where; FSI_i is food shortfall index of i^{th} food insecure household; MRF is the minimum recommended food and; TFA_i is Total Food Available for i^{th} food insecure household. The total FSI is then calculated as the average value of the sum of FSI_i for all surveyed households (N) and expressed as follows:

$$\text{Total FSI} = \Sigma[(FSI_i / N)] \quad (4)$$

HFIAPis also a categorical measures used as indicator of access to food security/insecurity, which involve complex analytical procedures when determining their respective scale/index (Coates et al., 2007).

Finally, determinants of household food insecurity were analyzed using logistic regression model for its advantage over other regression models. Different options of models are available for analyzing a categorical dependent variable. But, logistic regression and discriminant analysis are the two widely used statistical methods used for analyzing data with categorical outcome variables (Tsegay, 2009). Discriminant analysis is often employed if all predictors are continuous and normally distributed; logit analysis is often used if all predictors are categorical, and logistic regression is often chosen if predictors are mixed and/or if they are not nicely distributed (Karl, 2011). In other words, logistic regression makes no assumption about the distribution of explanatory variables for best prediction of binary outcomes. The dependent variable (Y_i) is defined as 1 if a household is food insecure or 0 if food secure (i range from 1 - 220) and given as follows:

$$Y_i = \beta + \beta 1X1 + \beta 2\ X2 + \beta 3\ X3 + \ldots + \beta nXn + e \quad (5)$$

Where; $Y_i$is the dependent variable; β is a constant value that represents the Y intercept; β1, β2, β3, …, βn, coefficients of X1, X2, X3, …, Xn respectively, and . X1, X2, X3, … Xn are explanatory variables, and e is error term.

Ethical issues were also maintained in order to increase the reliability and validity of the information. Ethical clearance was obtained from the post graduate committee of Addis Ababa University. It was addressed during both data collection and analysis. Permission was obtained from the capacity building office of the district prior to data collection. Moreover, informed consent was obtained from each respondent by explaining the purpose of the research, dispersion of the results, and participant rights prior to their participation in the survey.

RESULTS AND DISCUSSION

Sources of food for the surveyed households

As elsewhere in Ethiopia, rain-fed arable farming is the main source of food availability for almost all rural households in Belo-jiganfoy district. The study showed that about 99% of the total land cultivated by the surveyed households was through rain-fed system and only about 1% was cultivated through small-scale irrigation. Similarly, 1.5 and 98.5% of the total yield was produced through small-scale irrigation and rain-fed cultivation respectively. Vegetables, fruits and to some extent maize were the major crops produced through small-scale irrigation. This is almost the same as the national figures that showed rain-fed agriculture and small-scale irrigation accounted for about 98 and 1.2% of annual production respectively (CIDA, 2013). This implies that the potential of irrigation in general and small-scale irrigation had not been fully exploited, which might have probably caused the prevailing condition of food insecurity.

The result (Table 1) indicates that the annual gross available food for the surveyed population from all sources was 7198.2 quintal (qtl hereafter). This was expected to feed the total household size of 922.82 in adult equivalent (ADE hereafter) with average size of 4.20. The result also showed that almost all of the food for the surveyed households (that is, about 95%) came from own production. The next better source of food was wild food which accounted for about 4% of the total gross food available households. This was followed by food purchase that accounted for about 1% and borrowing as a food source was almost absent as it accounted for about 0.2% of the total food available to the respondents. The dominance of own produce as food source should not be miraculous as it is reflected in the overall trend of rural communities elsewhere in the world in general and in Ethiopia in particular. In principle, the food obtained from all of these sources may not be eaten. Some of it might have been sold, reserved, or lost through different ways such as attacks from rodents and infestation of grain pests. With these assumptions, data regarding grain sold, seed reserved and grain lost were collected and computed. Finally, the total amount of food (qtl) was deduced from total amount obtained from all sources. The result showed that there was about 3709 qtl net food available to the surveyed households resulting in average food amount of 4.02 qtl/ADE/year (Table 1).

The extent of food insecurity

On average the respondents produced 4.02 qtl/ADE/year of food from different sources. This was a little less than the average household size of 4.20ADE (Table 1). This roughly shows the prevalence of food shortfall in the district. Contrary to this was that the average net food (4.02 qtl) was much more than the minimum recommended grain equivalent of food (that is, 2.25 qtl) suggesting that the respondents were on average food secure. But, both are not good indicators of household food security situation as disparity exists among households in their access to food and amount produced as well as in the calorie content of each food item. The dietary energy supply (DES), proxy indicator of consumption, was used to show the extent and severity of the food security/insecurity situation and harmonize the above contrasting results. This was because DES

Table 1. Food available to the surveyed households from all sources.

Food source	Amount produced (qtl) and household size (ADE)					
	Total	%	Mean	Std	Min	Max
Cereals	5850	81.27	25.86	18.57	0.00	106.00
Legumes	274.50	3.81	1.68	6.48	0.00	48.00
Oil seeds	448.05	6.23	3.45	7.15	0.00	90.50
Vegetables and fruits	98.25	1.37	0.45	1.65	0.00	10.00
Meat (domestic)	157.96	2.19	0.37	0.29	0.00	1.28
Total own produced	**6828.76**	**94.87**	**30.01**	**22.44**	**0.06**	**131.15**
Grain purchased	81.51	1.13	0.29	0.97	0.00	5.00
Grain borrowed	12.5	0.17	0.05	0.27	0.00	2.00
WEFs (all)	275.43	3.83	13.19	2.3	0.00	20.50
Grand total	**7198.2**	**100.00**	**-**	**-**	**-**	**-**
Grain sold (GS)	2798.1	38.87	8.20	9.45	0.00	74.00
Seed-reserved (SR)	384.76	5.34	1.75	1.73	0.00	12.50
Post-harvest-lost (PHL) (5% of total yield)	307.19	4.27	0.71	0.51	0.01	3.26
Total deduced	3490.05	48.48	3.82	4.10	0.00	84.10
Net Food	**3709.09**	**51.52**	**14.21**	**10.17**	**0.15**	**65.25**
Household size (ADE)	922.81	-	4.20	1.65	1.68	13.65
Ave. Net Food/ADE/year	4.02	-	4.02	2.93	0.04	19.59

Meat of 1 antelope = on average 25 kg; 1 bird = on average 0.5 kg; 1 kg fish = 10 fish; 1 'medeb' cattle meat = on average 10 kg.

Table 2. Distribution of households by kcal supply and food security status.

Information type		Total	Mean	Std.	Min.	Max.
Household size (number)		1210.0	5.50	2.41	2.00	20.00
Household size (ADE)		922.82	4.15	1.62	1.68	13.65
Kcal/ADE/day (FS + FIS)		388643.1	1766.6	1440.1	0.01	8899.5
FS (28.2%)	Average hh size (ADE)	220.19	3.55	1.35	1.68	8.04
	kcal/ADE/day	220112.5	3550.2	1546.5	2107.9	8899.5
FIS (71.8%)	Average hh size (ADE)	693.18	4.38	1.66	1.94	13.65
	kcal/ADE/day	168530.6	1066.7	462.8	0.01	2069.1
DES (kal)	% of food insecure households = 71.8% % of food secure households= 28.2% % of both households =100%					
Total FSI	Index = -0.48					

accounts for the variation in the calorie amount in each food item.

The result of the analysis of the DES (Table 2) showed that on average the surveyed households had net kcal of 1766.56 with Std. of 1440.1 kcal. The average kcal for the food secure and food insecure households was 3550.2 kcal/ADE/day with standard deviation of 1546.5 kcal/ADE/day and 1066.7 kcal/ADE/day with STD of 462.77 kcal/ADE/day, respectively. The result showed that about 72% of the respondents were food insecure whereas only about 28% was food secure one (Table 2). This proportion of food insecure households is very high by the standards of some countries in Africa including Ethiopia. For example, in Kwara State, Nigeria 75% of surveyed households was food insecure (Omotesho et al., 2006). Similarly, it is alarmingly larger than the national level of incidence of undernourishment indicated in FAO's previous study in Ethiopia that showed 41% between 2005 and 2007 and 28% in 2009/10 fiscal year (FAO, 2010). It is almost similar with the finding in previous study conducted in Oromiya zone (Wollo) where drought is frequent. Here, about 81 and 74% of

Table 3. Distribution of households by HFIAP category.

Information	HFIAP categories				Total
	Food- secure	Mildly-food-insecure	Moderately-food-insecure	Severely-food-insecure	
Household (no.)	86	45	50	39	220
Percentage (%)	39.04	20.57	22.59	17.76	100
Cumulative (%)	39.08	59.65	82.24	100.0	-

households felt food insecure and food non-sufficient respectively (Degefa, 2005). This is also almost similar with the finding of a previous study conducted in Arsi zone (Dodota district) in central eastern Ethiopia that showed about 79% of food insecure households (Haile et al., 2005), an area characterized by low rainfall distribution. Moreover, the finding is much higher than the finding in northern Ethiopia: Amhara and Tigray regions as well as central Ethiopia (Nonno district in Oromya), where population density, land fragmentation and soil degradation are critical problems. The respective level of the above areas is about 56% (Frehiwot, 2007), 42% (Tsegay, 2009) and 21% (Messay, 2013) respectively. In Bullen district (located in the 'green famine' belt) too, it was 58% (Guyu, 2011) implying that food insecurity had been worsened over the past years. Within the *green famine* belt of Ethiopia (specifically in Benishangul-gumuz region), a previous study showed larger proportions of food insecure households than this. For example, a previous study conducted at household level in Bullen district showed about 58% of food insecure households (Guyu, 2014).

The overall implication of the above results is that the depth and severity of food insecurity in the *green famine* belt of Ethiopia is at best as severe as the one in the drought-prone and high population pressure areas and at worst higher than it.

The severity/depth of food insecurity

The extent and or coverage of food insecurity indicated in the above subsection may not give how severe the situation is. It merely shows the proportion of households affected without its depth. Thus, full understanding of the food insecurity situation should consider its level of severity. TFSI was used to measure the depth/severity of food shortage. The total FSI for the surveyed households was -0.48 (Table 2) indicating that on average, the food shortfall for each household was far down from the threshold (that is, 2100 kcal/ADE/day) by 48%. This mean distance from the threshold is much deeper than the case in Tigray region (32.5%) (Tsegay, 2009) located in one of the drier parts of Ethiopia. This clearly shows that food insecurity in the western part of the country in general and in the studied district in particular is much deeper and/or severe than the situation in the most fragile northern part. Severe food shortfall is the ultimate indicator of famine conditions and was extraordinarily deeper in the study area showing that it has already turned into the *famine* conditions and hence *green famine (*Guyu and Muluneh, 2015*).* Thus, the total FSI of 48% was significantly deep proving that the *green famine* condition is evident in the area.

Furthermore, in order to cross check and confirm the result of the total FSI, we employed the household food insecurity access scale, which is an access related indicator of household vulnerability to food insecurity. Its categorical indicator known as household food insecurity access prevalence (HFIAP) was computed in order to examine and understand the severity and/or depth of food insecurity. The HFIAP customarily categorizes households into four severity levels as food secure, mildly food insecure, moderately food insecure and severely food insecure (Coates et al., 2007). The result (Table 3) showed that 62% of the respondents were food insecure at different levels of severity. Out of this about, 21% was mildly, 23% moderately and, 18% was severely, food insecure. Only about 39% of the respondents were found to be food secure. In the routine classification of households' vulnerability status based on kilocalorie supply, about 72% of the surveyed households was food insecure and about 28% was food secure. The result of the HFIAP was almost close to the result obtained from DES. This shows that food insecurity is severe by all measures and standards in the *green famine* belt of Ethiopia.

Determinants of household food insecurity

Socioeconomic and demographic variables that influenced household food insecurity were analyzed using forward stepwise logistic regression model. The Hosmer-Lemeshow statistic was >0.05 (0.170) showing the model fits well into the data. Regression analysis was conducted on 24 original variables thought to have influenced household food insecurity. The model produced 7 determinants whose effects on dependent variable were significant (Wald statistics <0.05 level). As a rule, linear regression predicts the category with higher value in this paper, food insecure households. The model predicted the food insecure group because they were denoted by 1 as compared to food secure denoted by 0

Table 4. Parameter estimates showing the effect of each variable.

Explanatory variable	B	S.E.	Wald	df	Sig.	Exp. (B)
Family size/ hh (number)(FSZ)	0.454	0.124	13.417	1	0.000	1.574
Off-farm income (birr)/year (INCOFF) *	-0.186	0.064	8.480	1	0.004	1.000
Educ. of hh head (years) (EDUY)	-0.164	0.049	10.958	1	0.001	0.849
Livestock size (TLU)	-0.206	0.082	6.297	1	0.012	0.814
Land cultivated/hh (LCULT)	-0.243	0.081	8.885	1	0.003	0.784
Irrigation Use (dummy) (IRRG)	-1.413	0.565	6.257	1	0.012	0.243
Wage Labor (dummy) (WLBR)	0.911	0.386	5.566	1	0.018	2.487
Constant	1.018	0.652	2.435	1	0.119	2.767

*US $1 was 19.54 Eth. birr (Ethiopian currency) at the time of survey.

in the SPSS. Thus, each predictor in the model predicted the probability of being food insecure.

The new model is given as follow:

$$Y_i = 1.018 + 0.454*FSZ - 0.186*INCOFF - 0.164*EDUY - 0.206*TLU - 0.243*LCULT - 1.413*IRRG + 0.911*WLBR + e$$

Where Y_i is the probability of being food insecure by i^{th} household (i = 1 - 220).

The model fairly predicted the food insecurity occurrence (the Nagelkerke R^2 = 0.638) implying that about 64% of the variation in household food insecurity was explained by the model. Based on these variables, the model predicted the probability of being food insecure at 81.4% showing that food insecurity increased if the current conditions would remain the same.

The results (Table 4) showed that, as indicated in the B column, family size was positively associated with food insecurity (B = 0.454) implying that a unit increase in the probability of being food insecure was caused by increases in household size by 0.454. This is similar with several previous studies that showed statistically significant and positive relationship between household size and food insecurity (Haile et al., 2005; Omotesho et al., 2006; Bogale and Shimelis, 2009). The likely explanation is that many household members would be in their non-productive age and were incapable of contributing their labor about 97 dependent people per 100 economically active people existed in the region and most households depend on hoe-culture rather than on oxen-plough or other cultivation systems. In addition people in the study area are not hard workers who prefer to pass much of their working days in villages drinking alcohols (Guyu, 2016).

Off-farm income affected household food insecurity negatively (B = -0.186). This implies that a unit increase in the probability of being food insecure was caused by a decrease in off-farm income by 0.186. This is similar with previous studies that show negative relationship between off-farm income and food insecurity (Omotesho et al., 2006; Bogale and Shimelis, 2009). The likely justification of the negative relationship is that households might buy food by the income they earned through off-farm activities.

Average education of household heads was also negatively related with food insecurity implying that a decrease in the number of years a household stayed at school by 0.164 increased the probability of being food insecure by one unit. This goes in line with a previous study in Ethiopia which showed statistically significant and negative relationship between level of household head education and the probability of being food insecure (Haile et al., 2005). The likely justification is that educated households are better in the timing and prediction of seasonal food insecurity occurrence. Accordingly, they might be well prepared for tackling the problem.

The TLU was also negatively associated with household food insecurity (B = -0.206) implying that a unit increases in food insecurity was caused by a decrease in TLU by 0.206. This finding is similar with the general literature and some previous studies (Bogale and Shimelis, 2009; Messay, 2009). The possible explanation for this is that most households had no livestock that would be sold for buying food during the times of food shortage.

The average cultivated land size per household was negatively related with food insecurity. The B value = -0.243 implies that a unit increase in food insecurity was caused by a decrease in land size by 0.243 ha. This goes in line with the theory that argues that a negative relationship exists between cultivated land size and food insecurity (Degefa, 2005). The result is also similar with many studies in Ethiopia that showed cultivated land size influences household food insecurity negatively and statistically significantly (Messay, 2009; Bogale and Shimelis, 2009). The likely explanation is that as the size of cultivated land increases, the amount of yield also increases keeping other factors constant.

Practice of small scale irrigation was negatively correlated with household food insecurity showing a unit increase in food insecurity with a 1.413 unit decrease in the practice of small scale irrigation. This goes in line with the findings of many previous studies conducted in Ethiopia which showed statistically significant and negative relationships between irrigation use and household food insecurity (Degefa, 2005; Bogale and Shimelis, 2009). The possible explanation is that access to and use of small-scale irrigation enabled households to produce twice a year. This might have increased their access to both income and food from crop production.

Lastly, it was found that involvement in wage labor positively influenced the food insecurity of households (B = 0.911) although it was not significant at less than 10% level.

The odds ratio in favor of the probability of being food insecure increased by a factor of 2.478 with increased participation in labor union. The likely justification for the violation of the expected relationship between participation in labor union and food insecurity is that households were perhaps engaged in such work to cope with food shortages by earning money and buying grains.

Conclusion

The purpose of this study was to measure and understand the extent and severity of household food insecurity in the *green famine* belt (western Ethiopia) based on a case study. The study showed that food insecurity was widespread and deep-rooted. The fact that food insecurity affected about 72% of the surveyed households shows that food insecurity is widespread phenomenon and it is as prevalent as the situation in the conventional drought-prone non-green famine parts. The food shortfalls were very deep reaching 48% far below the food security threshold. Out of about 62% of food insecure households as indicated by the household food insecurity access prevalence, 21% were food insecure mildly, 23% moderately, and 18% severely food insecure. Small-scale irrigation, wage labor, family size, land size, livestock, off-farm income and household head education were significant determinants of food insecurity. Thus, any intervention measure to improve the food insecurity status of households should target at addressing these variables. Therefore, we can disprove the perception that the *green famine* belt of Ethiopia is food secure only due to a relatively adequate rainfall and green vegetation cover. Instead, it can be concluded that the extent and severity of food insecurity in the *green famine* belt is at best similar with, and at worst more than, the situation in drought-prone and non-green areas of Ethiopia.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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