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Options to reduce poverty among agro-pastoral households of Ethiopia: A case study from Aysaita district of Afar national regional state

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This paper discusses the dimension and intensity of poverty among the agro-pastoral households and development options based on survey data collected in 2011 from 180 randomly selected agro-pastoral households of Aysaita district. The study used the Foster, Greer and Thorbecke (FGT) index to examine the incidence of poverty, the poverty gap and severity of poverty. It also employed the Tobit regression model to analyse the determinants of intensity of poverty in the study area. Results show that about 52.8% of the sampled households have been living below poverty line with poverty gap and poverty severity indices of 0.16 and 0.07, respectively. The Gini coefficient is about 0.31. Some of the key determinants of intensity of poverty among agro-pastoral households are found to be diversification of livestock holding, and access to irrigated land, improved forage and market centers. The paper concludes by indicating that development interventions need to engage in diversifying herd per household, improving access to irrigation, regulating credit diversion and promoting off-farm employment to reduce poverty among the agro-pastoral households.

Key words: Agro-pastoral, poverty dimension, Gini coefficient, Tobit model, Foster, Greer and Thorbecke (FGT) index.

INTRODUCTION

Poverty in general and food insecurity in particular remains one of the challenges of developing countries in achieving their national development goals (MoARD, 2010). For instance, in Ethiopia it is estimated that about one third of the population are living in extreme poverty (DFID, 2011). About 87% of the population faces multiple deprivations while additional 6.8% of the population is at verge of falling under multiple deprivations. The intensity of deprivation of multidimensional poverty, which is the average percentage of deprivation experienced by people in multidimensional poverty, is estimated to be 64.6%. Population in severe poverty is 71.1% (UNDP, 2013). Historically, food aid and commercial food imports have been the main instruments to satisfy domestic food

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insecurity in the country (Little, 2008). Prior studies suggest that Ethiopia should address the relatively slow progress in the pastoralist and agro-pastoralist areas to meet its national development goals (Bevan and Pankhurst, 2008; PFE, 2007). For instance, about 92% of the population in Afar is food insecure in terms of calorie intake, and about 56% of the total population of the region is classified as poor (PFE, 2009). This is the region with large share of regional population living in poverty (MoFED, 2008). Specifically, the food insecurity and acute child malnutrition problems are increasing from time to time in Aysaita district, which is one of the largest districts in the region and focus of this study (FEWS NET, 2011). The number of people depending on relief assistance has increased in 2012 as compared to the late 2011 (FAO and WFP, 2012). it seems that, although various development interventions have been implemented in the area, little has been achieved.

There are ongoing policy debates among professionals and policy-makers on feasible strategies and possible intervention areas which will accelerate poverty reduction among the pastoral and agro-pastoral areas of the country. Hence, this paper assesses development options to reduce poverty among agro-pastoral households of Ethiopia. Specifically, it discusses the poverty gap and its severity among agro-pastoral households, and factors that determine the intensity of poverty in the area. The paper is organized as follows. Next, we present the research methodology such as sampling techniques, methods of data analysis, and description of the study area. Then we discuss the main results of the study. The findings show that the intensity of poverty among agro-pastoralists is determined by household assets holdings such as livestock and irrigable land; access to agricultural technologies, for instance, improved forage; and access basic institutional services such as market, extension and veterinary services. Finally, the study concludes by providing short term and long term development intervention options to reduce poverty among agro-pastoralists.

RESEARCH METHODOLOGY

Description of the study area

The study was conducted in Aysaita district of *Awsi* zone[1] in Afar National Regional State. Aysaita is one of the largest districts in the region and located in eastern part of Afar National Regional State. It has a total area of 138,800 ha and thirteen *kebeles*; of which two urban, six pastoral and five agro-pastoral *kebeles*. Naturally, it is plain in terms of topography. The mean annual temperature is between 30 and 45°C. The total population of Aysaita is estimated at 47,210 persons, of which about 66% classified as rural and 98.1% of these rural residents are Muslims (FDRE-PCC, 2008). In the district, pastoral and agro-pastoral system of livestock production is the dominant livelihood strategy. The livestock population in the district is estimated to be 71,383 cattle, 16,943 sheep, 23,086 goats, 3,277 camel and 482 donkeys (APARDB, 2009). The sedentary part of local people produces various maize, vegetable and oil crops. Cotton is also grown as a major crop by private investors along the Awash River where irrigation is possible. Due to long dry seasons and frequent recurrent drought, the quantity and quality of natural pasture is largely degraded thereby livelihood of pastoralists and agro-pastoralists are seriously affected.

[1] According to the Ethiopian Federal Democratic Republic administrative hierarchy, the regional states are divided into zones, districts and *Kebeles* (local administrative units), in that order.

Sampling and data collection methods

The study employed a multi-stage sampling procedure to collect primary data. Firstly, Aysaita district was chosen purposively because of its representativeness and high food insecurity among five *Awsi* zone districts. In the second stage, three agro-pastoral *kebeles* were selected randomly out of the five agro-pastoral *kebeles* in the district. Thirdly, 66, 60, and 54 agro-pastoral households were selected from three *kebeles* namely: Hinele, Kerbuda and Berga, respectively, applying probability proportionate to size (PPS) technique to have a total of 180 agro-pastoral households. Data was collected using pre-tested survey questionnaire. The survey questionnaire constitutes different parts which respondents were asked about their socio-demographic and economic profiles and characteristics. The survey was administered using experienced enumerators who speak the local language *Afara'f* fluently. Besides, Focus Group Discussions (FGD) were held with selected key informants (village elders, clan leaders and local administrators), and community members to supplement information we collected through survey. In addition, published and unpublished research reports from various governmental and non-governmental organizations were also reviewed.

Poverty indices estimation techniques

The primary step in poverty index computation is to determine suitable poverty line that serves as a point of reference. In this study, cost of basic need (CBN) method is used to set poverty lines. Accordingly, a seven-day recall method was used for the food items served for the household within that week. In setting a poverty line, the minimum daily energy intake requirement per adult equivalent of 2,200 kcal is used (MoFED, 2008). A reference food basket was constructed based on a typical diet for the poorest half of the sample households in the nominal consumption. The quantity of the food basket is determined in such a way that it meets the predetermined level of minimum caloric requirement. This basket is valued at local prices to arrive at a consistent food poverty line. Then, a specific allowance for a non-food component is added to the food poverty line. To account for the non-food expenditure, the food poverty line is divided by the food share of the poorest half of the sample households. Finally, this method gives a representative poverty line that provides a monetary value of a poverty line and accounts for the food and non-food components. Secondly, one has to choose the appropriate poverty measurement index. Despite various poverty measurement indices such as equally-distributed-equivalent-Foster-Greer-Thorbecke (EDE-FGT) poverty index, FGT poverty index, Watts poverty index, and Sen-Shorroks-Thon poverty index (Araar and Duclos, 2009), the three most commonly used poverty measures are the head count index (HI), the poverty gap index (PG), and severity index (Foster et al., 1984) which can be defined in terms of the well-known Foster-Greer-Thorbecke (FGT) index.

The mathematical expression of the FGT poverty index is:

$$P_{\alpha} = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{\pi - C_i}{\pi}\right)^{\alpha} \quad (1)$$

Where P_α = poverty measure; π = poverty line; C_i = household consumption expenditure per AE; n = the number of households under consideration; q = the number of poor households; i = household index; $\pi - C_i$ = poverty gap. If $C_i < \pi$ the household was counted as poor, when $C_i \geq \pi$ the household was considered as non poor; α = measure of sensitivity of the index to poverty or the weight attached to the severity of the poor.These measures are defined for $\alpha \geq 0$, the commonly used values of α are zero, one and two. When α equals to zero (all poor are given equal weight), so Equation 1 is reduced to the headcount ratio, which measures the incidence of poverty or the percentage of people falling below the poverty line:

$$\alpha = 0 \rightarrow \mathrm{P}_0 = \frac{q}{n} \quad (2)$$

When α is equal to one, we obtain P_1 or the poverty gap index which estimates the average distance separating the poor from the poverty line or the average level of deprivation among the poor:

$$\alpha = 1 \rightarrow \mathrm{P}_1 = \frac{1}{n\pi} \sum_{i=1}^{q} (\pi - C_i) \quad (3)$$

Setting α equal to two gives the severity of poverty or squared poverty gap index (Equation 4). This poverty index measures the severity of poverty. It depicts the severity of poverty by assigning each household a weight equal to its distance from the poverty line. Thus, it takes into account not only the distance separating the poor from the poverty line (the poverty gap) but also the inequality among the poor. Squared poverty gap index gives larger weight to the poorest of the poor by squaring the gap, as it is more sensitive to redistribution among the poor:

$$\alpha = 2 \rightarrow \mathrm{P}_2 = \frac{1}{n\pi^2} \sum_{i=1}^{q} (\pi - C_i)^2 \quad (4)$$

The Gini-coefficient was also estimated. The procedure involved ranking the households on the basis of some quality of interest in our case consumption expenditure and then estimating cumulative proportions. It shows the distribution of expenditure above the poverty line. The closer the distribution indicates the existence of more pronounced poverty in the study area while the more dispersed the distribution depicts the contrary. Both the FGT and Gini index were computed by employing the specialized ".ado" program DASP 2.1 (Araar and Duclos, 2009) which is compatible with the Stata statistical software.

Econometric model

In recognition of the fact that a strictly dichotomous regression model is not sufficient to examine the intensity of poverty because it assumes uniform intensity of poverty, a Tobit model is used for econometric analysis as it handles both the probability and intensity of poverty at the same time (Greene, 2003; Maddala, 1983). Thus, a Tobit regression model was used to draw inferences on the covariates of agro-pastoral household poverty intensity. The full model, which was developed by Tobin (1958) is expressed as:

$$y_i^* = \beta_i X_i + u_i$$

Where i = 1, 2, 3… n.

And

$$y_i = \begin{cases} \mathrm{y}_\mathrm{i}^* & \text{if } \mathrm{y}_\mathrm{i}^* > 0 \\ 0 & \text{if } \mathrm{y}_\mathrm{i}^* \leq 0 \end{cases} \quad (5)$$

Where y_i = The observed dependent variable; y_i^* = latent variable, which in this study is referred as the intensity of poverty; X_i = factors explaining intensity of poverty; β_i = parameters to be estimated; u_i = error terms; where, $u_i \sim \mathrm{NID}(0, \sigma^2)$.

The limited dependent variable y_i^* is defined as:

$$y_i^* = \left(\frac{\pi - C_i}{\pi} \right) \quad (6)$$

Where π = Poverty line, C_i = household consumption expenditure per adult equivalent (AE).
The expected value of the poverty intensity (poverty gap ratio) in poor households can be estimated:

$$E(y_i / y_i^* > 0) = X\beta + \sigma \frac{f(z)}{F(z)} \quad (7)$$

Where σ = The standard deviation of the error term, *z* is denoted by $\frac{\beta_i X_i}{\sigma}$ = the z-score for the area under normal curve; F(z) = the cumulative normal distribution of z, and f(z) = the value of the derivative of the normal curve at a given point.

Following McDonald and Moffitt (1980), the Tobit model can be further decomposed to determine the effect of a change in value of the k^{th} variable on change in the expected depth of the poverty. Thus, the change in the intensity of poverty with respect to a change in explanatory variables among the poor households is:

$$\frac{\partial E(y_i / y_i^* > 0)}{\partial X_k} = \beta_k \left[1 - Z \frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)} \right)^2 \right] \quad (8)$$

If parameter estimates of the entire population are required, it will be necessary to compute the derivatives of the estimated Tobit model to predict the effects of changes in the explanatory variables. Accordingly, the adjusted estimate which is the marginal effect of an explanatory variable on the expected value of the dependent variable is estimated as follows:

$$\frac{\partial \mathrm{E}(y_i)}{\partial X_i} = F(\mathrm{z})\beta_i \quad (9)$$

Based on prior studies household demographic characteristics, access to resource and attributes of the resource are identified as factors that explain the intensity of poverty at the household level (the dependent variable). Summary descriptions and expected signs of explanatory variables are presented in Table 1.

Table 1. Description and expected sign of explanatory variables.

Dependent variable	Description of the variables	Expected sign
Intensity of poverty	It refers to the poverty gap ratio such that the non-poor group was given a value 0 whereas the poor group was assessed in the continuous range	
Explanatory variable		
SEX	Dummy variable which takes a value of 1 if the household head is male; 0 otherwise.	-
EDU	Dummy variable that takes a value 1 if household head and/or spouse are literate; 0 otherwise	-
FASZ_AE	Refers to the size of agro-pastoralist household members who live together under the same roof expressed in AE.	+
DPR	Dependency ratio, it is the ratio of number of non-productive age group in family members (< 15 years and > 65 years) to the number of productive age group.	+
OXEN	Considered as dummy variable 1 if own ox/oxen; 0, otherwise.	-
IRGFARSZ_AE	Refers to the total cultivated land (in ha) under irrigation owned by household per AE.	-
TLU_AE	The total number of livestock holding measured in tropical livestock units (TLU) per AE.	-
DDSTLU_AE	Number of animals lost due to outbreak of diseases and drought in TLU per AE.	+
ASPROD	Dummy variable taking a value of 1 if the household has involved in improved forage production; 0 otherwise.	-
FARIN_AE	Refers to total annual earnings of the family from sale of agricultural produce per AE.	-
EXPEAGPA	The time (in years) since sampled household started to practice agro-pastoral mode of life rather than pastoral	-
DMOTLU	The number of dead animals during mobility in TLU	+
HERDIV	Dummy variable valued 1 for agro-pastoralists who shifted herd composition from grazers (cattle and sheep) to browsers (camels and goats) following the recent drought; 0 otherwise	-
EXTCON	The variable was considered as dummy taking 1 for households visited by extension agents; 0 if not visited	
CREDIT	Takes a value 1 if the agro-pastoral households have used the available source of credit, 0 otherwise	-
MKTDIS	This is a continuous variable used as proximity to the market center measured in kilometer.	+

RESULTS AND DISCUSSION

Dimensions of poverty among agro-pastoral households

The overall poverty indices computation using the FGT measures based on total poverty line[2] of 176.78 USD per adult per year shows that the head count index is 0.5278 while the poverty gap and poverty severity indices are

[2] The poverty line based on a typical diet for the poorest half of the sample households was ETB 2145.46 per annum (Annex Table 2A) or USD128.34 taking the rate during the survey period, 1 USD = 16.72 Birr. The total poverty line was obtained after adjusting for non-food expenditure using the average food share of the poorest 50% agro-pastoral households. The share of food expenditure of the poorest 50% households was 72.60%. Dividing the food poverty line of ETB 2145.46 by 0.726 gives the total poverty line of ETB 2955.29 per adult per year (which is around USD 176.78 per adult per year). This is approximately ETB 8 per adult per day; equivalent to half a US dollar per day.

Table 2. Poverty incidence, severity and inequality.

Kebele	Head count index (P_0)	Poverty gap index (P_1)	FGT poverty index (P_2)	Gini coefficient of consumption expenditure
Berga	0.6852	0.1481	0.0481	0.2937
Hinele	0.4697	0.1353	0.0448	0.2786
Kerbuda	0.4500	0.2040	0.1133	0.3392
Overall	0.5278	0.1621	0.0686	0.3131

Source: Own survey data (2011).

0.1621 and 0.0686, respectively (Table 2). The head count index (P_0) indicates 53% of the sampled agro-pastoral households are poor. This index indicates the percentage of the population whose consumption expenditure was less than the poverty line. The comparison of poverty incidence across the *kebeles* shows that the proportion of agro-pastoral households living in poverty is markedly the highest in Berga *kebeles*. Poverty gap index (depth of poverty) estimates the total resources needed to bring all the poor to the level of the poverty line and also captures the extent to which individual expenditure falls below poverty line. According to the household survey results, the depth of poverty is higher in Kerbuda, followed by Berga and Hinele *kebeles*, implying that more resources are required to bring the poor households out of poverty in Kerbuda than Berga and Hinele taking into account the number of people who reside in the respective *kebeles*. The overall poverty depth of 0.1621 means that if resources are mobilized equal to 16.21% of the poverty line and distributed to the poor in the amount needed so as to bring each individual up to the poverty line, then at least in theory, poverty could be eliminated. In the same way from poverty severity index, a 7% falls below the threshold line implies severe inequality. Thus, it can be inferred that there is a high degree of inequality among the poorest agro-pastoralist population. The results also show the existence of sever inequality in Kerbuda *kebele* even if there is less prevalence of poverty relatively. The indices we found differ from prior values reported in poverty profile reports, which are a head count index of 0.429, poverty gap index of 0.078, poverty severity index of 0.021 and poverty line of ETB 1075.03 in 2004/2005 in rural areas of Afar region (MoFED, 2008). Our report shows that higher percentage of the population in the area is living in poverty. This might be due to high inflation in food and non-food items prices in the year 2011.

In March 2011, the country level food inflation and non-food inflation rate was 27 and 25%, respectively as compared to the same month of the previous year (WFP, 2012). Secondly, it might consolidate the finding of Bevan and Pankhurst (2008) which stated that poverty incidence measures for Somali and Afar are generally unreliable but are likely to be high. Demeke et al. (2003) also indicated the data problems in the government reports especially in the poverty figures of rural areas. Result of the analysis in Table 2 shows that the Gini coefficient of consumption expenditure of sample respondents in Hinelee *kebele* is about 0.28 while the figure is slightly higher for samples from Berga and Kerbuda *kebeles*, which is 0.29 and 0.34, respectively. The combined Gini index for the total sample is about 0.31. Moreover, the Gini coefficent reported in this study is higher than the figure reported by the Ministry of Finance and Economic Development for the rural area of Afar National Regional State for the year 2004/2005, which is 0.28 (MoFED, 2008). This shows worsening of inequality in consumption among the population in Afar region.

The relative high Gini coefficient of expenditure distribution in Kerbuda *kebele* indicates that unequal distribution of consumption expenditure prevails among agro-pastoralists who reside in Kerbuda while the distribution is better among respondents living in Berga and Hinelee *kebeles*.

Determinants of poverty and intensity of poverty

Among a total of sixteen explanatory variables hypothesized to determine intensity of poverty, most of them turned out to be significant. The Tobit model output is presented in Table 3 shows that the family size in adult equivalent (FASZ_AE), number of livestock per adult equivalent (TLU_AE), improved practice of pasture production (PASPROD), credit utilization (CREDIT), and distance to market place (MKTDIS) have statistically significant influence on intensity poverty among agro-pastoralists at $P<0.01$ while oxen ownership (OXEN), irrigable plot size per adult equivalent (IRGFARSZ_AE), and extension contact (EXTCON) are statistically significant at $P<0.05$ and some of the remaining variables such as sex of the household head (SEX), number of dead animals due to disease outbreak and drought per adult equivalent (DDSTLU_AE) and herd diversification (HERDIV) are significant at $P<0.1$. Annex Table 1A presents summary statistics of the explanatory variables. Before fitting the Tobit model, the multicollinearity problem was tested using variance inflation factor (VIF) and contingency coefficient. We also checked for non-normality using Jarque-Bera technique, heteroscedasticity and endogeneity problems using

Table 3. Maximum likelihood estimates of Tobit model and marginal effects.

Variable	Estimated coefficient	$\frac{\partial E(y_i / y_i^* > 0)}{\partial X_k}$	$\frac{\partial E(y_i)}{\partial X_k}$
Constant	0.411 (0.374)		
SEX	-0.076* (0.039)	-0.0324 (0.018)	-0.0458 (0.025)
EDU	-0.041 (0.059)	-0.0169 (0.025)	-0.0239 (0.036)
FASZ_AE	0.040*** (0.014)	0.0156 (0.006)	0.0220 (0.008)
DPR	0.011 (0.025)	0.0044 (0.010)	0.0061 (0.014)
OXEN	-0.092** (0.036)	-0.0373 (0.015)	-0.0524 (0.021)
IRGFARSZ_AE	-0.176** (0.088)	-0.0693 (0.034)	-0.0975 (0.048)
TLU_AE	-0.032*** (0.008)	-0.0125 (0.003)	-0.0176 (0.004)
DDSTLU_AE	0.104* (0.06)	0.0410 (0.023)	0.0577 (0.033)
PASPROD	-0.168*** (0.043)	-0.0754 (0.022)	-0.1059 (0.030)
Log FARIN_AE	-0.052 (0.044)	-0.0203 (0.018)	-0.0286 (0.025)
EXPEAGPA	-0.003 (0.003)	-0.0013 (0.001)	-0.0018 (0.002)
DMOTLU	0.013 (0.009)	0.0049 (0.004)	0.0069 (0.005)
HERDIV	-0.060* (0.035)	-0.0237 (0.014)	-0.0332 (0.020)
EXTCON	-0.100** (0.046)	-0.0439 (0.022)	-0.0623 (0.031)
CREDIT	0.136*** (0.038)	0.0580 (0.018)	0.0816 (0.024)
MKTDIS	0.043*** (0.01)	0.0169 (0.004)	0.0238 (0.006)
Sigma	0.185*** (0.014)		

Source: Own survey data (2011). ***, ** and * indicate statistical significance at 1, 5 and 10% probability level, respectively. LR chi^2 (16) = 176.39***. Figures in the parentheses refer to the standard errors.

White's general heteroscedasticity and Hausman specification test, respectively. The results of the tests show that there is no serious econometric problem that could lead to biasness of the research findings. The log likelihood ratio (LR) test also depicts that the model explained significant non-zero variations in factors influencing poverty intensity and that the model displays a good fit. Similarly, the ratio of the maximum likelihood estimates of the Tobit regression to the sigma value (σ = 0.185, t = 13.11 and p = 0.000) verified that the model has a good fit to the data because it has closer figure to the corresponding probit estimators (Greene, 2003).

As stated in Johnston and DiNardo (1997), there is no direct and simple way of presenting interpretation of parameter estimates in the Tobit model. Rather a more interesting interpretation can be made using marginal effect of explanatory variable by adopting McDonald and Moffitt (1980) decomposition procedure. Therefore, the effect of changes in the explanatory variables on intensity of poverty is discussed based on the marginal effect part of the Tobit model output. The negative and significant association between the variable SEX and intensity of poverty among agro-pastoralists shows that male-headed households in the area were less vulnerable to poverty than female-headed households. Thus, having male-headed household poverty intensity of poor households reduces by 3.24%, ceteris paribus. In addition, poverty intensity of the entire sample decreases by 4.58%. The possible justification is related to resource entitlement and workload on women. Similarly, Geda et al. (2008) and Etim and Patrick (2010) reported that male headed households are associated with lesser poverty depth in Ethiopia and in Akwa Ibom State, Nigeria, respectively. There is also a positive and highly significant association between family size and intensity of poverty. On average, one unit increase in family size (in AE) among poor households increases the intensity of poverty by 1.56 %, if all other variables are held at their mean value. While the poverty intensity of the entire sample increases by 2.2%. The likely explanation is that in the study area households depend on degraded rangelands, less productive livestock, and low-input and low-output agriculture. Thus, increasing household size results in an increase in food demand. In most cases, this demand cannot be matched with the existing food supply so ultimately end up with food insecurity and poverty. Similarly, Etim and Solomon (2010) reported that households who have large family size are associated with greater poverty depth in Uyo, Nigeria.

It has been reported in various studies that livestock holding tends to reduce the intensity of poverty among pastoralists and agro-pastoralist communities (Enquobahrie, 2004; MoFED, 2008). Similarly, our findings show that a unit increase in livestock holding (in TLU per AE) tends to decrease the intensity of poverty of poor households by 1.25%, holding all other variables at their mean value. Meanwhile the poverty intensity of the entire sample decreases by 1.76%. The underlining

reason is that livestock is used as source of direct consumption, live asset (bank), source of cash income, means of purchasing power, social security and means of coping. Household with own oxen have a 3.73% intensity of poverty compared to households without oxen, keeping other things constant. At the same time, the intensity of poverty of the entire sample decreases by 5.24%. The implication is that households with oxen were able to undertake farm activities timely, properly and produce better to secure family food requirement. Similarly, keeping other variables at their mean values, a 1 ha increases in irrigable land per AE would lower intensity of poverty of poor households by 6.93%. In addition, the entire sample poverty intensity decreases by 9.75%. Nevertheless, land size is limited resource so it could not be increased as the household wishes in order to increase energy intake of the household. Thus, it only highlights the importance of irrigation schemes to intensify pastoral agriculture production and reduce poverty status of agro-pastoral households.

Bogale (2011) also reported that households who have access to irrigable land are associated with lower poverty prevalence in eastern Hararghe highlands of Ethiopia. Besides, IFPRI (2012) indicated the importance of expanding irrigation in pastoral areas to tackle poverty. The number of dead livestock due to animal diseases affects the intensity of poverty positively (Hilina, 2005; Kefelegn, 2007). An increase in death of livestock due to diseases by one TLU per AE increases poverty intensity of poor households and the entire sample by 4.1 and 5.77%, respectively, holding all other variables at their mean value. This is perhaps due to loss of live asset because of seasonal drought and diseases. Moreover, the results of the study show that as the households diversify their herd in response to recurrent drought, poverty intensity of poor households decrease by 2.37% since they can raise better disposable income from herd, throughout the year, ceteris paribus. At the same time, the poverty intensity of the entire sample decreases by 3.32%. Bhasin (2011) and Boku (2008) also found that herd diversification could be used as one of the strategies to minimize impact of climate change among agro-pastoral communities, improve resilience after recurrent drought and in turn reduce poverty. Poverty intensity of poor households reduces by 4.39% if the sample respondents have contact with development agents. In the same way, poverty intensity of the entire sample decreases by 6.23%. The implication is that more emphasis should be given to upgrade the knowledge of extension agents to improve agro-pastoralists wellbeing (Etim and Solomon, 2010). The marginal effect analysis also showed that agro-pastoral households who involve in improved pasture production were less likely to be susceptible to poverty. As the household participate in improved pasture production, the intensity of the poor households' poverty decreases by 7.54%, ceteris paribus. The poverty intensity of the entire sample decreases by 10.59%. This is because production of improved forage minimizes the livestock feeds shortage and also uses as source of cash income [in the study area, 1 kg Blue Panic (*Panicum antidotale*) seeds is sold for ETB 100].

On the other hand, quite remarkably, credit utilization showed positive relation with the intensity of poverty. This is, perhaps, because of the fact that even though the credit scheme in the area is considered pro-poor, it has not been able to list the households above the poverty line. This might be due to credit diversion problem which is common among pastoralists and agro-pastoralists in the area to use finance obtained through credit for direct consumption instead of spending on production. Although, credit is supposed to be used to purchase agricultural inputs (agricultural technologies), agro-pastoralists in the study area usually obtain agricultural inputs such as improved varieties, agricultural hand tools and implements for free from the regional government, research institutes and NGOs.

Thus, agro-pastoralists use credit to solve their immediate food shortage and social obligations rather than to purchase agricultural inputs. As a result, it is common among agro-pastoralists to sell their asset such as livestock to settle their debit which may in turn reduce their resource endowment and increase poverty. It is important also to note that the most of sampled respondents (about 48%) had accessed credit from their friends and neighbors while about 35% of the samples got credit from their relatives. Merchants are also important sources of credit for considerable sample agro-pastoral households (about 15.4%). This reveals how important the role of informal credit sources among the pastoralist and agro-pastoralist households (Annex Table 3A). Nevertheless, in most cases, credit services are in kind unless it is obtained from the formal sources such as commercial bank.

The variable distance to market place is found to be associated positively with the intensity of poverty of sample agro-pastoralist households. Specifically, with a kilometer increase in market distance from agro-pastoral household residence, the poverty intensity tends to increase by about 1.69% for the poor sample households and by 2.38% for the total samples, keeping other things constant at their mean value. It appears that agro-pastoralists living far from market place might find it difficult to escape from poverty. This is in line with the earlier research findings by Kebede et al. (2005) and Bigsten et al. (2003).

Policy implications

Findings of this study shows that the intensity of poverty among agro-pastoralists is determined, among other things, by household assets holdings such as livestock and irrigable land; access to agricultural technologies for

instance improved forage; and access basic institutional services such as market, extension and veterinary services. The study reveals that it is worth considering development interventions like developing irrigable rangelands, strengthening improved forage production to be used for both herbage and seed production in order to reduce poverty among the agro-pastoralists. Moreover, herd diversification such as development of browser animals mainly camel and goat need to be part of the livestock restocking program to develop resilience after diseases and drought induced loss of productive assets, and creating job opportunities to minimize disguised unemployment also remain important options to reduce intensity of poverty.

It appears that empowering women to improve their access to and control over resource through better institutional set up, and legal and administration system could contribute a lot in reducing the intensity of poverty among agro-pastoralists. The development programs also need to work towards improving the frequency of contact of development agents with agro-pastoralists. This can be achieved by arranging field days and continues trainings. Of course, increasing number and capacity of extension agents in the area also something that needs to be addressed.

The unexpected positive association between credit use and poverty intensity indicated that credit provisions have not been meeting their purposes of reducing poverty. Although, the underlying reasons require further empirical study, in general, credit diversion to consumption appears to be a main problem. Thus, targeted safety net program such as food transfer programs need to be tied to productive activities. Better provision of credit service (interest free credit in areas where religion bans paying and taking interest on credit) through formal institutions such as cooperatives, and pastoral and agro-pastoral research extension groups seems also an option.

In considering results of this study, what becomes clear is the importance of reducing distance of agro-pastoralist to market centers to reduce poverty. This can be achieved through development of subsidiary market places in selected sites of the rural villages and with establishment of marketing cooperatives along with other development interventions. In sum, the high poverty incidence in the study area denotes that agro-pastoralists need to receive due attention to achieve national development goals. This calls for policy measures to be geared towards promoting long-term sustainable livelihood and resilience to disaster among agro-pastoralists. In the meantime, it is necessary to implement development interventions that support immediate needs of the agro-pastoralists.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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Annex

Table 1A. Summary statistics of explanatory variables.

Variable	Dummy variables	Continuous variables			
	% of 1 responses	Mean	Standard deviation	Minimum	Maximum
SEX	77.8				
EDU	17.8				
FASZ_AE		4.94	1.63	1	10.75
DPR		1.02	0.71	0	5
EXPEAGPA		13.26	5.76	2	26
TLU_AE		5.49	4.38	0.7	29.75
IRGFARSZ_AE		0.42	0.35	0	1.59
DDSTLU_AE		0.39	0.34	0	1.59
DMOTLU		1.87	1.86	0	7.16
FARIN_AE		7.76	0.51	6.2	8.70
OXEN	56.1				
HERDIV	48.9				
EXTCON	81.7				
PASPROD	72.8				
CREDIT	34.4				
MKTDIS		7.58	1.81	3	15

Source: Own survey data (2011).

Table 2A. Diet of the poorest half of the sample households and value of food poverty line.

Food group	Gram consumption per day/AE	Mean$^{\Psi}$ kcal per kg/lt	Kcal needed to get 2200 kcal	Kcal share (%)	Mean price per kg/lt	Value of food poverty/year
Cereal	315.28	3470	1198.87	54.49	2.50	287.70
Milk	450.48	860	413.39	18.79	10.00	1644.24
Edible oil	4.33	8120	280.49	12.75	21.65	34.20
Meat	1.19	1970	61.87	2.81	32.00	13.92
Vegetables	12.86	370	15.94	0.72	1.70	7.98
Fruits	0.22	520	15.83	0.72	6.00	0.48
Spices	1.80	2970	95.09	4.32	36.00	23.66
Coffee and tea leaf	6.45	1190	43.63	1.98	35.50	83.52
Salt and sugar	11.86	1780	74.89	3.40	11.50	49.76
Total			2200	100		2145.46

Source: Own survey data (2011) and $^{\Psi}$adopted from MoFED (2002).

Table 3A. Share of agro-pastoralist major sources of credit.

Sources	Number of respondents	Percentage
Friends and neighbors	30	48
Relatives	22	35
Merchants	9	15
Commercial bank	1	2
Total	62	100.00

Source: Own survey data (2011).