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The Nexus Between Crop Productivity and Poverty in North Shewa: The Case of Lalo Midir Woreda

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Abstract

This paper used the Multidimensional Poverty Index approach to examine rural poverty (incidence and intensity) levels in Lalo Midir Woreda. OLS and Stochastic Cob-Douglass production frontier methods have been used to evaluate the drivers of crop productivity and technical efficiency level of the farmers respectively. Finally, the binary logit model has been used to examine the effect of crop productivity and other factors on poverty. In order to achieve these objectives, the study has used primary data collected from 151 rural household heads in four kebele's of Lalo Midir Woreda by deploying structured interview questions with multi-stage sampling techniques. The incidence of poverty or the percentage of people who are MPI poor was 63.4% and the average intensity of MPI poverty across the poor among the sampled households was 55.3%. The Multidimensional Poverty Index (MPI) for the sampled households was 0.351. The research also finds that multidimensional poor households not only possess fewer resources but are also much less productive (6.56 quintal per hectare) and less efficient (65%). The binary logistic regression result reveals that crop productivity, technical efficiency, farm size, family size, dependency ratio, educational level, livestock holding in TLU, number of oxen holding, and annual income are significantly influenced by rural multidimensional poverty at the farm level. Finally, the study suggests crop productivity and efficiency play a positive role in poverty reduction, policy makers should design scaling-up strategies.

Keywords: Multidimensional poverty index, crop productivity, technical efficiency, logit model

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Introduction

Cereal crops in Ethiopia are particularly important to the country's food security as they are principal nutritional staple foods for most of the population; they also comprise about two-thirds of the agricultural GDP and one-third of the national GDP and are a source of income for a majority of the people. According to CSA (2014), cereals had a share of more than 79 percent of the total crop area and 85 percent of grain crop production for the Meher season in the 2013/14 production year, ranking the country as one of the largest cereal producers in Africa. Moreover, 81 percent of agricultural farmer's practice mixed farming and are primary cereal producers(CSA, 2014).

The production of cereal crops was marked by remarkable growth in Ethiopian agricultural crop production during the last decade. Several CSA publications indicate that total cereal crop production grew consistently between 2004-05 and 2013-14, from an average of 16 million metric tons in 2004-05 to 2008-09 to 18.7 million metric tons in 2009-10 and 2013/14, averaging 17.35 million metric tons during the last decade (Bekele Hundie, 2012).

Nevertheless, the average yield of cereal food crops in Ethiopia is still low, which has contributed to the persistence of poverty in the country's rural areas. For instance, wheat yield at 2 Mt/ha is 65 % below the average of the best African region (i.e., Southern Africa) and 260 % below the average of the best world region (i.e., Western Europe) (Bekele H. and Assefa A. 2012). Menz Lalo Midir Woreda the selected area for this research purpose, the majority of household highly depends on agricultural activities for their livelihoods. Cereal crop accounts for more than 85 percent of cultivated land and 95 percent of total crop production (Woreda 2014 report).

The principal cereal crops in the area are Wheat, teff, barley, and sorghum and followed by pulses (lentils and beans). According to the Woreda's agricultural bureau, 2014 annual report the average productivity of wheat is 15 quintals per hectare, which is bellowing the country's average productivity level, i.e. 22 quintals/hectare (World Bank 2013 cereals yield report). The challenge of reducing the level of poverty has become a major phenomenon in the Ethiopian economy. According to The Global Multidimensional Poverty Index (MPI) published by Oxford University, Ethiopia ranks as the second poorest country in the world just ahead of Niger. The study is based on analysis of acute poverty in 108 developing countries around the world.

Despite making progress in reducing the percentage of destitute people, Ethiopia is still home to more than 76 million poor people, 87.3% of Ethiopians are classified as MPI poor, while 58.1% are considered destitute. In rural Ethiopia, 96.3% are poor while in the urban area, the percentage of poverty is 46.4%. Comparing the poverty rate by region, the Somali region has the highest poverty rate at 93%, followed by Oromiya (91.2%) and the Afar (90.9%). Amhara region has a 90.1% poverty rate while Tigray has 85.4%. Addis Ababa has the smallest percentage of poverty at 20%, followed by Dire Dawa at 54.9% and Harar at 57.9% (OPHI, 2014). With the Unidimensional poverty measuring approach, poverty rates in rural and urban areas were 30.4 % and 25.7 %, respectively(MoFED, 2012). Therefore, the country is poor in both poverty measurement approaches. Since the research area is found in the North Shewa Amhara regional state, it is logical and possible to conclude that people are not escaped from multidimensional poverty.

Though crop production is the main source of the farmer's income, and shares the largest size of cultivated land and employment in the research area, due to low productivity of crop output per hectare of land resulted from traditional ways of farming lead impoverished the wellbeing of the society. As a result of this, the community was vulnerable to food insecurity which pushes the farmers to sell their assets to buy food commodities. On top of that, the government was also forced to provide food aid from capital budgets for the vulnerable groups in terms of direct aid and safety net program.

Many studies conducted on micro and macro levels about the role of agricultural productivity to alleviate poverty at the national level through Uni-dimensional poverty measuring methods (income and expenditure-based measuring approach). The traditional poverty assessment that mainly uses income-based measures is now deemed incomplete as it disregards some non-income-based measures that are equally vital for improving the design and effectiveness of poverty reduction policies. Recently on the multidimensional poverty measuring approach, the Oxford Poverty and Human Development Initiative (OPHI) and Andualem Goshu conducted research in 2014 and 2015 respectively by using panel data. OPHI uses three dimensions and ten indicators for its multidimensional poverty analysis where as Andualem Goshu in his Ph.D. dissertation uses five dimensions and nineteen indicators for its multidimensional poverty analysis of Ethiopia. They focused on to know the multidimensional poverty level of the country or the end result, but not the means of multidimensional poverty of the country.

Tassew Woldehana (2014) has done an article about poverty and social exclusion both in multidimensional & expenditure poverty measuring approach. He found that the dynamics of poverty and social exclusion are found to be interrelated, with positive spillover effects that make the two processes mutually reinforcing social exclusion and poverty.

Therefore, this study attempted to answer the multidimensional poverty determinants, and the contribution of crop productivity of the household in poverty reduction and it also identifies the main crop productivity drivers in the research cover areas. The general objective of the study is to examine the nexus between Crop productivity/Productivity efficiency/ and multidimensional poverty level in Menz Lalo Midir Woreda in the Amhara regional state of North Shewa.

Literature Review

This literature tries to identify the connection between increases in agricultural productivity and poverty reduction. The evidence implies that there are several pathways through which increases in agricultural productivity can reduce poverty, together with real income changes, employment creations, rural area non-farm multiplier effects, and food price effects to society. But there are barriers to obtaining such intrinsic worth of the improvements of agricultural productivities. Such as barriers to adopt modern technology, shortage in initial asset endowments, and constraints to well-functioning market access may all slow down the ability of the poor to take part in the gains from agricultural productivity growth. Agriculture is centrally involved in prospects for economic growth, food security, income generation, and of course the reduction of poverty. Agricultural productivity is may defined in many ways, such as general output per unit of inputs used, farm yield by crop or total output per hectare of land, and overall output per worker who practices in the production process. Apart from which measure is used, empirical studies strongly support the idea that improvements in farm productivity are vital for poverty reduction (Mellor, 1999). However, productivity growth can catalyze a wide range of direct and indirect effects that mediate the pathways to poverty alleviation (Thirtle, 2003). Most studies on poverty are based on income which is used as a baseline for poverty level, which is measured at less than US$1 per day or US$1.25 per day. For example, Irz et al. (2001) in his study assess the relationship between agriculture and poverty reduction in terms of the effect of agriculture on farmers' incomes. The result of his study shows that the direct contribution of agriculture to poverty reduction is through the generation of higher incomes for farmers.

Another study by Bravo-Ortega and Lederman (2005), found that agricultural productivity per worker has a significant impact on the average income of the poorest and that this effect is less pronounced when compared to the effect of non-agricultural productivity as income increases. For example, Cervantes-Godoy and Dewbre (2010) undertake a detailed examination of the importance of agricultural growth in poverty reduction in a sample of selected 25 countries classified into three groups. The authors found that agriculture appears especially powerful in lifting the poorer groups out of poverty, though its comparative edge declines substantially when it comes to those closer to the $2 per day poverty line. They concluded that growth in agriculture plays the leading role in the reduction of extreme poverty, but non-agricultural growth is more powerful in reducing poverty among the well-off poor closer to $2 per day.

Measuring agricultural productivity is not a simple task as it deals with to establish a relationship between output and input in agricultural production. Inputs committed to agriculture have a complex phenomenon that governs farming efficiency. In general, there are two methods to measure the agricultural productivity of a certain country. Partial factor productivity and total factor productivity measures.

TFP is defined as the ratio of the value of output to the value of all inputs used (Nyoro and Jayne 1999). TFP trends over time are often used to assess net gains from technological changes (Pingali and Heisey, 1999). Though TFP measures are the most appropriate measures of productivity, they are used less often, especially in Africa. This is due to TFP measures are difficult to construct in the absence of data on prices and costs of key inputs (Nyoro and Jayne, 1999).

Partial factor productivity measure refers to the amount of output per unit of a particular input such as yield (total output per unit of land or output per animal) and labor productivity (output per economically active person or output per agricultural person-hour). Output and yield growth rates remain the most commonly used indicators of productivity growth in developing-country agriculture (Pingali and Heisey 1999). The main weakness of this index is that it doesn’t account for all the inputs used in production systems.

Stamp (1960) on the other hand, attempting to measure crop productivity per unit area put emphasis on the areal differences in crop productivity is the result partly of the natural advantages of soil, and climate and partially of farming efficiency. In other words, farming efficiency refers to the properties and qualities of various inputs, the manner in which they are combined and utilized for production, and the effective market demand for crop output. The assessment of agricultural productivity has engaged the attention of scholars working in different disciplines like economies, agricultural economics, and agricultural sciences, for a long period of time.

Thompson (1926) while measuring the relative productivity of British and Danish farming emphasized and expressed it in terms of the gross output of crops and livestock. He considered the following seven parameters: (1) The yield per acre of crops, (2) The livestock per 100 acres (3) The gross production or output per 100 acres, (4) The proportion of arable land, (6) The number of persons employed, (7) The cost of production expressed in terms of wages and labor costs, rent or interest, (8) Prices relative profitability and general economic conditions

Ganguli (1938) presented a theoretical discussion for computing productivity in agriculture. Firstly, he considered the area under any crop 'A' in a particular unit that belongs to a certain region. This area is expressed as a proportion of the total cropped area under all the selected crops. Secondly, Ganguli tried to obtain the index numbers of yield. This is found by dividing the yield per hectare for the entire region as the standard. This yield may be expressed as a percentage; the percentage may be regarded as the index number of yields. Thirdly, the proportion of the area under 'A' and the corresponding index number of yields were multiplied. There are two advantages that are apparent by using this method, i.e., (a) the relative importance of the crop 'A' in that unit of study is assessed (as indicated by the proportion of the cropped area which is under 'A' and (b) the yield of the crop 'A' in comparison to the regional standard. The product thus obtained indicates actually an index of the contribution of the crop 'A' to the productivity of the unit considered.

Hirsch (1943) has suggested the crop yield index as the basis of productivity measurement. It expresses the average yield of various crops on a farm or in a locality relative to the yield of the same crops on another farm in a second locality. Enyedi (1964) that describing, geographical types of agriculture in Hungary refers to a formula for determining agricultural productivity. This index is concerned with the ratio of production and cropped area divided by the ratio of total production and total cropped area in the region. Shafi (1972) while measuring the agricultural productivity of the Great Indian Plains attempted to modify Enyedi's formula.

In the modified formula the summation of the total yield of all the crops in the district is divided by the total area under the crop considered in the district and the position thus obtained is examined in relation to the total yield of all the crops considered at the national level divided by the total area under crops.

In estimating poverty by using monetary measures, researchers or policy makers may have a alternative between using income or consumption as the indicator of well-being. Most analysts argue that provide the information on consumption obtained from a household survey is detailed enough; consumption will be a better indicator of poverty measurement than income due to the bellow mentioned rationales:

Consumption is a better outcome indicator than income because actual consumption is more closely associated with individual’s well-being in the sense defined above, that is, having enough to meet current basic needs. On the other side, income is only one of the elements that will allow the consumption of goods; others include questions of access and availability. Consumption may be better measured than income. In poor agrarian economies like Ethiopia, incomes for rural households may fluctuate during the year, according to the harvest rotations. In urban economies with large informal sectors, income flows also may be unpredictable. This implies a potential difficulty for households in correctly remembering their revenue, in that case, the information on income derived from the survey may have low quality and lead to wrong conclusions.

In calculating agrarian income, an additional difficulty in estimating income consists in excluding the inputs purchased for agricultural production from the farmers’ revenues. Finally, large shares of income are not monetized if households consume their own production or exchange it for other goods, and it might be difficult to price these. Estimating consumption has its own difficulties, but it may be more reliable if the consumption module in the household survey is well-designed.

Consumption may better reflect a household’s actual standard of living and ability to meet basic needs. Consumption expenditures reflect not only the goods and services that a household can command based on its current income, but also whether that household can access credit markets or household savings at times when current income is low or even negative, perhaps because of seasonal variation, harvest failure, or other circumstances that cause income to fluctuate widely.

One should not be rigid, however, about using consumption data for poverty measurement. The use of income as a poverty measurement may have its own merits. For instance, estimating poverty by income allows for a distinction to be made between sources of income. When such distinctions can be made, income may be more easily compared with data from other sources, such as wages, thereby providing a check on the quality of data in the household survey. Finally, for some surveys consumption or expenditure data might not be collected. When both income and consumption are available, the analyst may want to compute poverty measures with both indicators and compare the results.

Even if poverty has been traditionally measured in monetary terms, it has many other dimensions. Poverty is linked not only with insufficient income or consumption but also with insufficient outcomes with respect to health, literacy, living standards, asset endowments, and empowerment in decision-making in different aspects of the economy. Over the years the Human Development Report has introduced new measures to evaluate progress in reducing poverty.

Research Methods

Research design provides a logical structure for research, data gathering, and analysis (Bryman, 2008). In other words, it is an action plan that guides research from question to conclusion and includes steps for collecting, analyzing, and interpreting evidences according to a pre-established proposition, units of analysis, and the logic for linking the data to the propositions, and application of a set of criteria for interpreting the findings (Yin, 2003). The study adopted a cross-sectional survey research design as its framework to guide the process of data collection. According to Bryman (2008), the cross-sectional survey research design is the collection of data mainly using questionnaires or structured interviews to capture quantitative or qualitative data at a single point in time. Therefore, this chapter explains the nexus between Crop productivity and poverty in Lalo Midir Woreda North Shewa Zone.

The appropriate technique considered for this study was surveyed research guided by a survey of the theories and empirical studies related to the subject matter. Since; the purpose of this research has been to assess the relationship between Crop productivity and Poverty. It requires the use of survey techniques such as questionnaires and interviews as well as secondary sources. The question will be raised to the head of the household, assuming that the head of the household is the main decision makers within the community.

Finally, after identifying the sampling frame which contains the complete list of all households within each selected kebele's with kebele leaders, a total of 151 sample rural households were randomly selected from the selected kebele's in proportion to their total number of households using the formula (Yamane, 1967).

This study is accomplished based on both quantitative and qualitative data types which were gathered from both primary and secondary sources. Primary data with regard to key livelihood capitals are collected from sample rural households by means of structured interviews with the help of enumerators. The questions will be related to Crop productivity, Crop productivity drivers in the research area, and concerned with MPI dimensions (household's educational levels, health status, living standards, women empowerment, asset endowment, and income) and with its indicators. Secondary data were also obtained and utilized from various sources such as reports of the district agricultural bureau, zone reports, regional reports, CSA, and the internet on issues associated with rural households and rural poverty.

Proper tools and techniques were used for the analysis of data. Descriptive, stochastic frontier C-D production function, Ordinary Least Square (OLS), and Binary logit econometric analyses were held in this study to achieve the intended research objectives.

A conventional agricultural productivity index is a measure of output divided by a measure of inputs. Total factor productivity (TFP) is defined as the ratio of the value of output over the value of all inputs used. However, TFP measures are difficult to construct since it is often difficult to value key inputs where markets are not well-functioning. For example, without well-functioning land and labor markets, rental values and wage rates for hire labor cannot be measured with accuracy and hence TFP measures become intractable. An alternative approach is partial factor productivity (PFP). PFP measure divides physical output (Q) by physical factor input, X_i:

Thus $PFP_i = Q/ X_i$

Variations in PFP may arise from differences in technology (t) or variations in other (unmeasured inputs) given a production function defined by:

$Q = f(X1, X2 \ldots Xn; t)$

The partial factor productivity index has a weakness in that it does not account for all the inputs used in production. However, carefully constructed partial measures are legitimate measures of the variations in measured output attributable to measure to variations in measured factors (Alston, Anderson, and Pardey 1994).

In the analysis of crop productivity in different kebele, the author takes Enyedi (1964) and Shafi (1972) productivity formula. Enyedi formula for assessing the productivity coefficient would be read thus:

$$\frac{Y}{\mathrm{Yn}} \quad : \quad \frac{\mathrm{T}}{\mathrm{Tn}}$$

Where,

Y = total yield of the respective crop in the unit area;

Y_n = total yield of the crop at the national level;

T = total cropped area of the unit; and

T_n = total cropped area at the national level.

Shafi (1972) while measuring agricultural productivity attempted to modify Enyedi's formula. In the modified formula the summation of the total yield of all the crops in the district is divided by the total area under the crop considered in the district and the position thus obtained is examined in relation to the total yield of all the crops considered at the national level divided by the total area under those crops.

The modified formula would be read thus:

[(yw/t) +(y/t) + (ynlt)....n]: [(Yw/T) + (Y/T) + (Y_m/T)....n)] or

$$\frac{\sum_{n=i}^{n} y}{t} + \frac{\sum_{n=i}^{n} Y}{T}$$

Where,

y_w, y_n, y_m............n = total yield of various crops in the district (individual household level)

Yw, Yn, Ym........n = total yield of various crops at the national level (sample Kebele’s)

t = total area under different crops in the district (individual household level)

T = total area under different crops at the national level (sample Kebele’s)

The author customizes the aforementioned Shafi and Enyedi formula in district and household levels for crop productivity index analysis. Using this formula, the productivity index values were calculated for four sample kebele's for the year 2015-16 and demarcated the productivity kebele's as high, medium, and low productivity areas. Enyedi's productivity index values were calculated for sample kebele's are representative to the entire Lalo Midir Woreda for the year 2015-16 and the productivity villages were demarcated by using the same method for fixing the class intervals. In general, what measure of productivity to use is certainly an open-question. Most studies have used either a production function approach or used land productivity (aggregate output divided by farm size). This measure is subject to criticism as giving too much importance to one input, land. In the Ethiopian context of extremely high land concentration and high rates of rural poverty, a focus on land is appropriate.

The method used to measure Multidimensional Poverty Index (MPI) in this paper corresponds to Alkire and Foster's (2011) family of multidimensional poverty measures, later called the AF methodology. The AF method is explained as follows:

Let n represent the number of households and $m \geq 2$ be the number of dimensions. Each dimension is represented by well-being indicators j where j is between 1 and d. Let $Y = |Y_{ij}|$ denote the $n \times d$ matrix of achievements, where the typical entry $Y_{ij} \geq 0$ is the achievement of household i=1, 2… n in wellbeing indicator j=1, 2… d. $|Zj| > 0$ is the indicator cutoff below which a person is considered to be deprived in indicator j. For any given Y, let $g = |g_{ij}|$ is a deprivation gap, which denotes the 0-1 matrix of deprivations associated with Y, whose typical element g_{ij} is defined by $g_{ij} = 1$ when $Y_{ij} < Zj$, while $g_{ij} = 0$ otherwise. Clearly, $|g_{ij}|$ is an $n \times d$ matrix whose ij^{th} entry is 1 when household i is deprived in the j^{th} indicator, and 0 when a person is not (Andualem Goshu, 2015).

After the identification of deprivations, the next step is assigning weights to each dimension. The AF method implicitly assigned equal weight to each dimension and similar weights to all indicators j within a dimension. This has been done by assuming that the available chosen dimensions are relatively equally important (Alkire and Foster, 2011).

Similar to the AF method, this paper used an equal weighting approach to each dimension and similar weights for indicators j within a dimension. Having the weighted deprivation gap ($w_j g_{ij}$) for each indicator, finding the aggregate deprivation score for each individual (C_i) is the next task. Ci is defined as the horizontal sum of weighted deprivation gaps for each individual, which is written as follows:

$$C_i = \sum_{j=1}^{d} w_j g_{ij}$$

The last step in the estimation of MPI is the identification of those who are poor and not. In a multidimensional framework, there are three types of identification rules: intersection, union, and intermediate. Under the union approach a person i is said to be multidimensional poor if there is at least one indicator in which the person is deprived. The intersection approach identifies person i as being poor only if the person is deprived in all indicators j. AF methodology uses an intermediate cutoff level for C_i that lies somewhere between the two extremes of 1 and j. Therefore, AF identification includes the union and intersection methods as special cases of extreme values (Alkire and Santos, 2011). Consider k as the poverty cutoff and q as the number of poor people, then person i is considered poor when the number of indicators in which i is deprived is at least k. On the other hand, if the aggregate deprivation score falls below the cutoff k, then the person i is non poor and his/her value will be censored to zero. From eq1, if we censored all values of C_i to zero, which are located below k, we will get a censored aggregate deprivation score (C_i *). Hence, a person is identified as poor when the aggregate score C_i is above k. The main challenging task in the intermediate method is the choice of the appropriate cutoff k among a set of k poverty cutoffs.

The choice of the appropriate k has more of a normative task which is left to the researcher similar to income poverty (Sen, 1987; Alkire, 2014). Alkire, 2014 suggested two methods of choosing the appropriate cutoff from a set of alternatives. The first method to select the appropriate cutoff is to identify the number of poor people based on the available resources. In this case, the policy maker a priori selects the number of the poor segment of the society that could be accommodated by the available resources (IBID). The second method is to use 1/3 to 1/5 of the available indicators. From a communication point of view, those people who are deprived of 1/3 to 1/5 of the available indicators are vulnerable of becoming multidimensional poor. In the MPI, a person is identified as poor if he or she has a deprivation score higher than or equal to 1/3. In other words, a person's deprivation must be no less than a third of the (weighted) considered indicators to be considered MPI poor (Alkire and Santos, 2011).

Following this, the AF family of multidimensional poverty computation has two main parts: The first one is the multidimensional headcount ratio (H) which is the proportion of incidence (depth) of people who experience multiple deprivations.

$$\mathbf{H = \frac{q}{n}}$$

The second one is the intensity or breadth of poverty (A) is the average deprivation score of those poor segments of the population:

$$\mathbf{A} = \frac{\sum_{i=1}^{n} \mathbf{Ci}}{\mathbf{q}}$$

Therefore, multidimensional poverty is the product of the above two terms.

$$\mathbf{MPI{=}H{\times}A{=}}\frac{1}{n}\sum_{i=1}^{n} c_i$$

MPI dimensions and indicators

The Millennium Development Goals (MDGs) have been the most successful global anti-poverty push in history. As part of developing country, Ethiopia has been implementing different anti-poverty policies and strategies. The MDGs were the most marvelous policy that has been implemented in the country. One of the main targets of the Millennium Development Goals was to halve the number of people living in extreme poverty by 2015. Generally, the overall objective of the MDGs is to improve the quality of life in terms of education, health, standard of living, empowerment, and asset holding of the poorest part of the society (UN, 2013). Therefore, any poverty analysis should have to incorporate and explore whether those dimensions of the MDGs are achieved or not.

This paper used five dimensions to measure multidimensional poverty: health, the standard of living, asset endowment and income, education, and empowerment. The selections of these dimensions are based on the Millennium Development Goals (MDGs), the Growth and Transformation Plan of Ethiopia (GTP), and other poverty reduction strategies. It appears that the choice of indicators for each dimension in some cases has led by experience and availability of data. The following table shows those indicators with the associated cutoffs used to identify deprived households.

Poverty decomposition by indicators

The AF methodology decomposes deprivations by indicators. This decomposition is based on the censored headcount (CH), which is the headcount for each indicator after censoring those who are poor to zero, and the raw headcount (H), which is the headcount for each indicator without censoring those who are poor to zero. Hence, the censored headcount for indicator j is defined as

$$CH_j = \sum_{j=1}^{n} g_{ij(C_{i>}k)}$$

Similarly, for raw headcount, the decomposition is defined as

$$H_j = \sum_{i=1}^{n} g_{ij}$$

Table 1

A Summary Report of Well-Being Indicators and The Associated Cutoffs

Dimensions of MPI & Weight	**Indicators in each dimension**	**Indicators cutoff (Values for not being deprived)**
Asset endowment and income(1/5)	Asset owned	Having 1/3 of important durable assets.
	Crop stored	Having a stored crop
	Land owned	Own one hectare of land
	Income	\$1.25 per person
Education(1/5)	The school completed hh head	Eight years of schooling
	The highest grade of children	At least five years of schooling
	School dropout	No one dropout school for more than 12 months
Empowerment(1/5)	School for girls or boys	Educating girls is equally important as educating boys.
	School for girls vs. marriage	Allow a girl to go to school than force for marriage
	Women right to decide	If a woman has the right to decide on the income come from the sale of crops, charcoal, or homemade products.
Health (1/5)	Child mortality	0
	Stand up after sitting	Children aged above 7 can walk for 5km or can stand up after sitting
	Walk for 5km	
	Illness days	Anyone sick or weight loose for not more than three weeks
	Weight loose days	
Standard of living (1/5)	Construction material of the house	The house is not made up of Mud/dung ('Chika/Ebet') and thatch ('Sar').
	Toilet use	Using a flush toilet or latrine
	Garbage disposal	Using at least one of the following: green manure, buried, periodically collected by a particular authority, or dumping at a specified point.
	Access to clean water	Use one of the following sources of water: piped water, borehole or pump, protected well, protected spring or rain water.

Source: Andualem Goshu Mekonnen (Ph.D. candidate at University of Milan)

This study uses an econometric approach for modeling the nexus between Crop productivity and poverty in Lalo Midir Woreda. There are econometric models popularly used in many studies where the dependent variable takes dichotomous values like the logistic regression, the probit model, and the normal log-linear regression model. The logit and probit models are the most commonly used binary response models used to establish a relationship between household demographic and livelihood capitals with a dichotomous response variable (Gujarati, 1988; Maddala, 1993).

As indicated by Gujarati (1995), the probit model can substitute the logistic regression model. Despite their quite comparable formulations, their chief difference lies in that the latter has slightly flatter tails than the cumulative normal distribution that is the probit curve approaches the axes more quickly than the logistic curve. Although logit and probit models produce similar parameter estimates, a binary logit regression model is the appropriate and preferred probability model recommended mostly from the mathematical point of view, as it is extremely flexible for interpreting binary response dependent variables (Feder et al., 1985). Hence, the binary logit model is used to analyze the relationship between multidimensional poverty status, crop productivity, and other determinants of it. The dependent variable explained in the model is dichotomous, taking a value of one when the household is poor and a value of zero otherwise. In such cases where Y is a dummy variable, binary choice models should be applied. The main idea behind that model is to find the relationship between the probability (Pi) that Y will take a 1 value and the characteristics of considered individuals. A general class of binary logit models assumes that

$$P_i = P\,(Y_i=1) = F\,(\beta_0 + \beta_1 X_{1i} + + \beta_2 X_{2i} + \ldots.. \beta_k X_{ki}) + u_i = \beta_0 + \sum_{i=1}^{k} (\beta_i x_i) + u_i$$

Where:

P_i – probability, i=1, 2...n,

F – CDF (cumulative distribution function),

β_j – parameters, j=0, 1 , 2,…,k,

X_{ji} – value of explanatory variable X_j for i^{th} household,

k –Number of explanatory variables,

n –Sample size and

u_i –disturbance term

Results and Discussion

Descriptive Analysis

The study used five dimensions and nineteen indicators for the estimation. Table 2 presents household's deprivation in different indicators. Based on MPI estimation results in this society 63.4 percent of people are MPI poor, which is extremely higher when it compared to the national average measured in head-count income poverty estimation (Uni-dimensional measure) for the year 2012, it was about 30.4 percent in rural parts of the country. Andualem Goshu (2015) who had done his research at the regional and national level based on the same dimension and poverty indicators found that the multidimensional headcount ratios for the years 2004 and 2009 are 93% and 71% respectively. Moreover, the MPI estimation results were 35% and 25% respectively for the years 2004 and 2009 which are less similar to this research finding. On the same argument, the recent Oxford Poverty and Human Development Initiative (OPHI) global MPI data report shows that, in 2011, 87 percent of the population was MPI poor, i.e. deprived of at least one-third of the weighted MPI indicators (OPHI, 2014). All in all, the research area was multidimensional poor regarding in slight differences in magnitude and supported with previous findings

In the research focus area, households are deprived at least either a) all the indicators of a single dimension or b) a combination across dimensions, such as being in a household with a malnourished person, no clean water, a dirt floor, and un-improved sanitation. The average poor person is deprived in 55.3 percent of the weighted indicators. The 63.4 percent figure is adjusted by the intensity of poverty. Because the poor are, on average deprived in 55.3 percent of the weighted indicators, therefore, this society is deprived of 35 percent of the total potential deprivations it could experience overall.

Table 2

A Summary Report of Well-Being Indicators and The Associated Cutoffs/Poverty Line

Dimensions of MPI & Weight	Indicators in each dimension	Indicators cutoff (Values for not being deprived)
Asset endowment and income	Asset owned	Having 1/3 of important durable assets.
	Crop stored	Having a stored crop
	Land owned	Own one hectare of land
	Income	$1.25 per person
Education	School completed of HH head	Eight years of schooling
	Children School enrolment	All school-aged children enrolled
	School dropout	No one dropout school for more than 12 months
Empowerment	School for girls or boys	Educating girls is equally important as educating boys.
	School for girls vs. marriage	Allow a girl to go to school than force for marriage
	Women right to decide	If a woman has the right to decide on the incomes come from the sale of crops, charcoal or homemade products.
Health	Child mortality	0
	Stand up after sitting	Children aged above 7 can walk for 5km or can stand up after sitting
	Walk for 5km	
	Illness days	Anyone sick or weight loose for not more than three weeks
	Weight loose days	
Standard of living	the construction material of the house	The house is not made up of Mud/dung Chika/Ebet and Sar.
	Toilet use	Using a flush toilet or latrine
	Garbage disposal	Using at least one of the following: green manure, buried, periodically collected by a particular authority, or dumping at a specified point.
	Access to clean water	Using one of the following sources of water: piped water, borehole or pump, protected well, protected spring or rain water.

Source: Andualem Goshu Mekonnen (2015)

Household deprivation by dimension and indicators

Table 3 showed that at the headcount ratios, the poor in the surveyed society exhibit the highest deprivation levels in Constriction materials, followed by school completed of the HH head, Garbage disposal, Toilet use, and Crop stored for the next harvest seasons. These deprivation indicators also have the highest contribution to aggregate poverty. Contributions provide a picture of relative deprivation that is much influenced by weights.

Table 3

Number of Households' Deprivation in Different Indicators

Indicators in each dimension	Censored Headcount Ratio	Deprivation Contribution by indicators	The number of deprived households.	Percentage of deprivation	Deprivation Contribution by dimensions
Health dimension					**4%**
Child mortality	0.008	0.0014	1	0.14%	
Standup after sitting	0.010	0.0010	2	0.10%	
Walk for 5km	0.010	0.0010	2	0.10%	
Illness days	0.170	0.0162	25	1.62%	
Weight loose days	0.170	0.0162	25	1.62%	4%
Education dimension					**27%**
School completed of HH head	0.835	0.1545	124	15.45%	
All school-aged child enrolled	0.290	0.0552	40	5.52%	
School dropout	0.332	0.0632	48	6.32%	27%
Living standard dimension					**45%**
Access to clean water	0.496	0.071	73	7.1%	
Garbage disposal	0.810	0.13	120	13.00%	
Toilet use	0.754	0.11	111	11.00%	
The construction material of the house	1	0.143	151	14.3%	45%
Asset endowment and Income					**16%**
Asset owned	0.088	0.0126	70	1.26%	
Crop stored	0.71	0.1016	103	10.16%	
Land owned	0.038	0.0054	30	0.54%	
Income	0.410	0.0450	135	4.50%	16%
Empowerment					**8%**
School for girls or boys	0.129	0.024	20	2.4%	
School for girls vs. marriage	0.124	0.023	19	2.3%	
Women right to decide	0.158	0.028	19	2.8%	8%

Source: Own computation

On the other hand, child mortality appeared the lowest. In terms of dimension, most of the households are deprived of living standard as well as Education and fewer Health and empowerment's indicators. This indicates that there has been a huge work made by the government on health by giving special focus on assigning health extension workers in each district and narrows down the gender gap and foster gender equality. One of the measures used to foster gender equality is by improving access to education. The study by Young Live in 2012 showed that access to primary education increases by fivefold from the year 2000.

Multidimensional poverty status based on household gender

In Ethiopia, the contribution of both women and men to the productivity of agriculture is vital. But during the previous regime opportunities are relatively skewed towards men compared to female household heads. However, the result depicts in the research area, the female who is the head of the family is less vulnerable to poverty than relatively male-headed. As shown in the table, out of the total average poor in the research area female-headed contribute 30 percent of the aggregate poverty and while the remaining 70 percent are male-headed.

Table 4

The Multidimensional Poverty Status Based on Household Gender

	Gender of Household Head		
Poverty	Female-headed household	Male headed household	Total
Average poor	28	66	94
Average non poor	28	29	57
Total	56	95	151

Source: Own computation

Multidimensional poverty distribution by agro-ecological zone

Agro-ecological zones are geographical areas exhibiting similar climatic conditions that determine their ability to support rained agriculture. Agro-ecological zones (AEZ) are influenced by a number of factors. These include: - altitude, temperature, humidity, rainfall amounts, seasonality, distribution during the growing season, and latitudes at a regional scale. These characteristics have an impact on rural poverty. As indicated in the table from the total household head sampled in kola, 94 percent is multidimensional poor followed by Dega with 56 percent of the respondents who are MPI poor.

Table 5

Multidimensional Poverty Distribution Status by Agro-Ecological Zone/Village

Agro-ecological zone/Village	Poverty distribution by Village		Total
	The average poor HHH in number	Average non-poor HHH in number	
Dega	22	17	39
Woina Dega	40	38	78
Kolla	32	2	34
Overall	94	57	151

Source: Own computation

One of the main contributions of the AF methodology is the possibility of decomposing MPI by regions. This is very important from a policy implication point of view to identify the neediest segment of society. The following tables show some results from the MPI decomposition with family sizes and districts**.**

Table 6

Decomposition by Agro-Ecological Zone

Agro-ecological Zone	H within the group	MPI within the group	H	MPI	Contribution to the aggregate
Dega	0.51	0.295	0.13	0.077	0.219
Woina Dega	0.57	0.293	0.29	0.151	0.430
Kola	0.93	0.604	0.21	0.125	0.356
Overall	-	-	63.4	35.10	100

Source: Own computation

As indicated in the above table, Woina Dega, Kolla, and Dega agro-ecological zone contributes 43, 35, and 22 percent of the aggregate poverty of the district. The highest proportional poverty was registered in Woina Dega agro-ecological zone during the survey period. But when we analyzed the headcount ratio within each agro-ecological zone, Dega and Woinadega have a relatively similar headcount ratio with its respective inhabitants, but Kolla has comprised a large amount of headcount ratio is registered during the survey period. In this society, 92.7

percent of people are MPI poor. With regard MPI intensity, on average the poor here in kola was deprived in 65 percent of the weighted indicators which by far exceeding the overall agro-ecological aggregate average deprivation (55.3 percent) level. Many reasons have been mentioned here. The first reason for the existence of a high level of headcount ratio and deprivation is the low level of land size holding and modern technology usage (chemical fertilizer, improved seeds, pesticides, extension service). The second reason is the growth of family size due to a lack of family planning and their geographical location which prevent them from accessing modern technology, infrastructure, health centers, credit, and other socio-economic factors for their economic development.

Poverty decomposition by family size

Households having a medium family size registered the highest MPI during the survey year and its contribution to the overall poverty was extremely high. Nevertheless, within the groups, household having a large family size has a high headcount ratio and MPI yet its contribution to the aggregate poverty was low due to the small number of households/inhabitants sampled, compared to small and medium-size households.

Table 7

Poverty Decomposition by Family Size

Family Size	H within each group	MPI within each group	H	MPI	Share
Small Family (1-4)	0.59	0.35	0.13	0.07	0.21
Medium Family (5-7)	0.63	0.35	0.46	0.25	0.72
Large Family (>7)	0.78	0.40	0.05	0.03	0.074

Source: Own computation

Poverty decomposition by incidence and intensity

We have already explained that the MPI is the product of two very informative measures: the headcount ratio—**poverty incidence**—and the average deprivation share across the poor—**poverty intensity**. Both are relevant and informative, and it is useful to present them both. It helps to show the composition of poverty within countries by agro-ecological group, family size, and other key household and community characteristics. This is why the MPI is sometimes described as a high-resolution lens on poverty: it can be used as an analytical tool to identify the most prevalent deprivations

Table 8

Decomposition by Incidence and Intensity Within the Agrological Zone

Agro-ecological Zone	Incidence within the group	intensity within the group	Incidence in the district level	Intensity in the district level	Share to the aggregate Intensity
Dega	0.51	0.57	0.13	0.15	0.27
Woina Dega	0.57	0.51	0.29	0.27	0.48
Kola	0.93	0.65	0.21	0.15	0.26

Source: Own computation

From the above table, we also understand that on average the poor within kola and Dega agro-ecological groups deprived in 65 and 57 percent of the weighted indicators respectably and equally contribute to the aggregate poverty. However, due to the big population size, Woina Dega contributes relatively higher for the overall poverty deprivation /Intensity.

Econometric Results and discussion

Since the measurement of technical efficiencies relies on the nature of production frontiers, there is a need to first specify the proposed functional form of the crop production function to be estimated. The two most widely used production functions, namely Cobb-Douglas and translog were applied. Akaike information Criteria (AIC[2]) was deployed to opt for the best functional forms that suites to a given context. The values of the AIC for the estimated models are 123 and 142 for C-D and translog production function respectively. This implies that the C-D is more suitable than the translog such that the CD function was used to compute the technical efficiency (Table 9).

To separate the stochastic and the pure technical efficiency effects in the model, the study first selected the distributional assumption for u_j (Bauer, 1990). This study assumed that the stochastic errors follow an exponential distribution. The exponential distribution assumption puts the mode at zero, implying that a high proportion of the farmers being examined were perfectly efficient. In the process of regression and analyzing the results, the existence of

[2] AIC=2k+nlog(RSS/n), RSS is Residual Sum Squares, k is the number of model parameters and n is the number of observations

Multicollinearity has been tested and the result didn't show strong Multicollinearity among the variables in the regression established (Table).

Table 9

MLE Estimates of Stochastic Frontier Production Function for Crop Farming

Explanatory variable	Coefficient (β)	Std. Err.	P-value
Labor inputs (person days)	-0.0906**	0.0431	0.036
Quantity of fertilizer (kg)	0.3171**	0.1507	0.035
Quantity of seeds (kg)	-0.3291***	0.1714	0.055
Farm land size in hectare	0.5431*	0.0925	0.000
Household annual income	0.3955*	0.0850	0.000
Oxen holding in numbers	0.0924	0.0673	0.170
Constant	-0.9985	0.7842	0.203
sigma2	0.152		
Log (likelihood)	-51.724		
LR-Test (1)	14.62*		
Technical efficiency	0.68		

*, ** and *** Significant at 1, 5, and 10 percent probability level respectively

The likelihood ratio test that there is no inefficiency was rejected at a 5% level of significance (Likelihood-ratio test of sigma=0: chibar2 (1) = 14.62 Prob>=chibar2 = 0.000). The estimated sigma squared for all the groups of households were large and significantly different from zero. This is an indication of a good fit of the model and the rejection of the specified distributional assumptions (all households perfectly operate on a production frontier line). The results obtained here are consistent with the findings of Seyoum et al. (1998). Moreover, it shows the existence of technical inefficiencies among the crop producers in the research areas. In other words, it justifies the need to include efficiency during the estimation of the crop productivity empirical model. Finally, after stochastic frontier production function estimation, the technical efficiency was derived (estimated). The mean technical efficiency of the household was computed as 68%. These findings indicate that farmers lose close to 32% of the potential output to technical inefficiencies. The magnitude of average technical efficiency varies from average multidimensional poor to noon poor households. On average the poor possess 65 percent efficiency and the non-poor have 71.5 percent. It suggests that the non-poor farmers are slightly more technically efficient than the poor farmers in the research area.

The result in Table 9 above reveals that use of fertilizer, improved seeds, labor inputs, household farm size, and household annual income are major determinants of the level of output and are statistically significant. In contrast, the household's number of oxen holding was not statistically significant at 1%, 5%, or 10% of the probability level, but it has a positive impact on the total crop production.

Coefficients for land, the quantity of fertilizer usage, and household income have positive signs and are all statistically significant below the 5 percent probability level. With regard to land size, similar results are obtained by Basnayake and Gunaratne (2002) among Scottish cereal producers and Sri Lanka tea smallholders respectively on an increase in the extent of land would lead to significantly increased output.

The coefficient for labor showed a negative significant value of 0.3291. This might be due to limited opportunities for income generating activities outside agriculture, especially in rural areas or due to the marginal productivity theory of labor, i.e. without any proportional changes on other agricultural input, continues labor increments may exploited fixed resources and leads to a decrease in productivity. Similarly, the improved seeds coefficient is negative, which implies that using above the required amount of seeds leads to decrease in crop production. Hence, better utilization of available human resource in rural areas by creating alternative activities (through agricultural-based industries).

Determinant of Crop productivity

The results show that there is a significant positive correlation between crop productivity and technical efficiency estimates among the respondents. The implication is that as technical efficiency estimates increases (that is increase from zero towards one, which is the production frontier), productivity increases, (and this means that the ratio of total output to land for a farm is increasing). This implies that as technical efficiency increases from zero to one average crop productivity increases, suggesting that output is being maximized from a given quantum of inputs. As I try to point out in Table 10 technical efficiency computed from the production function and the variables (inputs) in crop production has a direct contribution to crop productivity. Therefore, efficient usage of fertilizer usage, farm cultivated land, and other inputs in production can increase crop productivity per hectare of land in the research area. Moreover, with regard of household head sex, even though it is not a policy variable, the probability being a male has a positive impact on crop productivity. The implication is that male-headed have better agricultural activities management skills, resource utilization capacity, and other agricultural input intensity know how were better than female-headed in the research areas.

This finding was supported by Alemayehu S. and Fantu N. (2015), who has done research on Cereal productivity and its drivers in the case of Ethiopia by using Stochastic Frontier Analysis and data envelopment and found that improving access to information through extension service, access to education, Pesticides (chemicals), total cropping season rainfall are the major significant determinant variables of cereals crop productivity.

Walter Odhiambo & Hezron O. Nyangito (2003), Productive Sector Division of Kenya Institute for Public Policy Research and Analysis, have tried to measure and analyze agricultural productivity in Kenya, advising productive efficiency is an important determinant of productivity and should be incorporated into productivity analyses.

Table 10

OLS Regression on The Determinant of Crop Productivity

Explanatory Variables	Coefficient (β)	Robust Std. Err.	T-ratio
Technical efficiency	2.8531*	0.4785	5.96
Total annual income	0.0145**	0.0000	2.38
Distance from the plot of land	-0.0761	0.1736	-0.44
Education level	1.5783*	0.3400	4.64
Sex of household head	-0.1144	0.4621	-0.25
Credit Access	0.0032	0.0001	0.15
Rain fall level	0.8391***	0.5171	1.62
Soil fertility	0.5058	0.3924	1.29
Extension service	1.5461*	0.3732	4.14
Pesticides Usage	2.1164***	1.1396	1.86
Constant	3.7774*	0.5557	6.8

*, ** and *** denote significance at 1%, 5% and 10% significance levels, respectively

Determining factors of Poverty

The model output revealed that household crop productivity per land (CROPLND), household land size (HHLSIZ), household family size (HHFSIZADE) in adult equivalent, and the dependency ratio (DRIO), were significant at less than 1% probability level. Livestock holding

(TLIVTLU) size in tropical livestock unit (TLU) and educational status of the household head (EDNHHH) were found to be significant at less than 5 % probability level. Household annual income in adult equivalence (PCIADE) and household oxen holdings (OXN) were found statistically significant at less than 10 percent. The remaining six variables, namely access to credit (CRDTA), distance from the market (DISFMKT), age (HHHAGE) and sex (SEXHHH) of the household heads, the level of rainfall (ENVF1) and overall household land fertilities (ENVF2) of the household were not statistically significant.

The logistic regression result is shown in the table, household crop productivity, land holding size, livestock holding size in tropical livestock unit (TLU), household income in adult equivalence, household oxen holdings, and educational level of the household head were found to be a significant determinant of multidimensional rural poverty with a negative coefficient. On the other hand, household family size and dependency ratio are also key determinants of multidimensional rural poverty in the research area with a positive correlation at a one percent probability significance level to the overall poverty status.

Having estimated the multidimensional rural poverty determinants, we can now generate a simulation to predict reductions/increases in general poverty levels that result from changes in the explanatory variables included within the model. The purpose is to illustrate how changes in levels of the determinants will alter aggregate multidimensional poverty levels in the households within the research area during the 2016 harvest season. As expected, the crop productivity of a household has a negative impact on poverty with multiple pathways through which increases in crop productivity can reduce poverty, including real income changes, employment generation, rural non-farm multiplier effects, and food price effects. The average marginal effect, holding all other explanatory variables included within the model being constant, the probability of being non-poor increases on average by nearly 55% if household crop productivity per land increases by 1 unit (see Table 11). As expected, the coefficient of the total land holding was negatively correlated with household multidimensional poverty, and with a similar argument average marginal effect illustrates that increment of agricultural cultivating land holding by one hectare was found to reduce the chance of being trapped in poverty by 38 percent, being other determinant variables at ceteris paribus.

In contrast with the above explanation, household family size, and dependency ratio were found to be significant determinants in aggravating rural poverty. Where these variable increases by one unit each, the marginal effect of the household falling into the poverty trap increases by nearly 36 and 48 percent respectively. This implies that the possibility of being in poverty is very high for those families who have large size and dependent. High dependency in the rural household creates a burden for active labor forces in terms of increased food and none food consumption items.

As regards household age, sex, rainfall level, household land fertility level, and distance from the market and credit access, contrary to the expectation, the coefficients for the variables were not found to be statistically significant at either 1, 5, or 10 percent. Even though these variable coefficients were not statistically significant within the model, they have an impact on household rural poverty in different dimensions.

Though credit access is not a significant variable, its coefficient is positively correlated with household multidimensional poverty status in the research area. As indicated in the descriptive part household uses credit to household food and non-food consumption that resulted from food insecurity and lack of follow-up from the stakeholders assigned in the districts. The worst thing was the repayment period, households are forced to pay during January and February which is a time that households get more crops and the market set lower prices in the district. The household pays their debt by selling crops and livestock what they have if it is not enough for repayment they rented their land and other properties to community lenders. This issue in the district puts a negative outlook towards formal credit and leads to informal credit have been preferable to society. Therefore, though the role of credit on agricultural productivity and poverty reduction is tremendous, if it is not allocated for the intended purpose and properly managed, it negatively affects the well-being of the household and aggravating poverty rather than reducing it.

Table 11

Estimation Results of Binary Logit Model

Explanatory Variables	Coef.	Robust Std. Err.	P-value	Marginal Effect (dy/dx)	P-value
CROPLND	-2.2418*	0.5126	0.000	-0.5483	0.000
HHLSIZ	-1.5682**	0.5790	0.007	-0.3836	0.017
OXN	-1.6697***	0.9424	0.076	-0.4084	0.103
CRDTA	0.0006	0.0003	0.819	0.000	0.820
TLIVTLU	-0.2353**	0.0929	0.011	-0.0575	0.025
PCI1	-0.0001***	0.0001	0.052	-0.0025	0.084
DISFMKT	0.8748	0.5956	0.142	0.2139	0.158
HHFSIZ	1.4813*	0.4275	0.001	0.3623	0.005
HHHAGE	-0.0069	0.0676	0.918	-0.0017	0.918
SEXHHH*	0.3859	1.2349	0.755	0.0934	0.750
EDNHHH	-0.3304**	0.1408	0.019	-0.0808	0.017
DRIO	2.0041*	0.6160	0.001	0.4902	0.002
ENVF1*	-0.0155	1.5103	0.992	-0.0038	0.992
ENVF2*	-0.1524	1.2326	0.902	-0.0374	0.902
Constant	21.0895	6.8115	0.002	-	-

Logistic regression Number of obs = 151
Wald chi2(16) = 54.04
Prob > chi2 = 0.0000
Log pseudo likelihood = -18.762844 Pseudo R2 = 0.8125
Sensitivity - correctly predicted poor group 94.68%
Specificity - correctly predicted non-poor 91.23%
% correctly predicted based on 0.5 cut value 93.38%
(*) dy/dx is for discrete change of dummy variable from 0 to 1

*, **, and *** denote significance at 1%, 5%, and 5% significance levels, respectively (Source: Model Output, 2017)

Analysis of Poverty and efficiency

The model output revealed in Table 12, technical efficiency, literacy level, farm size, number of oxen and other animal stocks measured in TLU, family size, dependency, and overall level of household land fertilities is the major determinant of multidimensional poverty in the research focused area. The results show that there is a significant negative correlation between poverty and technical efficiency estimates among the respondents at 5 percent of probabilities, suggesting an inverse relationship between poverty and technical efficiency estimates among the respondents. The implication is that as technical efficiency estimates increase (that is increase from zero towards one, which is the production frontier), poverty decreases (and this means that the ratio of total output to total inputs for a farm is increasing). This implies that as average productivity increases poverty decreases, suggesting that output is being maximized from a given quantum of inputs.

Table 12

Estimation Results of Binary Logit Model (Efficiency)

POVSTT	Coef.	Robust Std. Err.	P-value	Marginal Effect (dy/dx)	P-value
Efficiency	-3.462	1.504	0.021**	-0.610	0.006
EDNHHH1*	-3.932	1.536	0.010*	-0.651	0.000
HHLSIZ	-1.482	0.723	0.040**	-0.261	0.039
OXN	-1.553	0.524	0.003*	-0.274	0.004
TLIVTLU	-0.068	0.042	0.104***	-0.012	0.079
SEXHHH*	-0.130	0.658	0.843	-0.023	0.843
ENVF1*	-0.352	1.231	0.775	-0.057	0.751
ENVF2*	-1.198	0.670	0.074***	-0.195	0.045
CRDTA	0.000	0.000	0.299	0.000	0.291
HHFSIZ	0.933	0.498	0.061***	0.165	0.045
HHHAGE	0.048	0.033	0.148	0.008	0.168
DRIO	0.902	0.443	0.042**	0.159	0.054
Constant	6.231	3.365	0.064***	-	-

Source: Estimation

Conclusion and Recommendation

This study analyzed multidimensional poverty in Lalo Midir Woreda/Administrative districts in the North Shewa Zone of Amhara regional State by using the AF methodology and the role of crop productivity to reduce household multidimensional poverty. The paper used country-specific indicators and cutoffs for household's multidimensional poverty determination in the district. Five dimensions (Asset endowment and income, Education, Health, Empowerment, and Living standards) and nineteen indicators were used for the estimation.

About 151 household heads/respondents were assessed with a field survey to get the necessary data for the analysis in 2016 from the three agro-ecological zones of the administrative districts. The study estimated result show that 63.4% of the households were multidimensionally poor in headcount ratio for the years 2015/16 which is extremely higher when it compared to the national average, measured in headcount income (uni-dimensional poverty measure) poverty estimation for the year 2012 by MoFED, it was about 30.4 percent in the rural part of the country but when it compared with Oxford Poverty and Human Development Initiative (OPHI)

MPI report on the national level in 2011 which uses three dimension and ten indicators, it was relatively lower (i.e. 87 percent of the population was MPI poor). By using similar dimensions and indicators at the national and country level in 2015, Andualem Goshu found a relatively similar MPI result with this finding.

The research finding shows that households are deprived at least either a) all the indicators of a single dimension or b) a combination across dimensions such as being in a household with a malnourished person, no clean water, a dirt floor, and un-improved sanitation. The average poor person is deprived in 55.3 percent of the weighted indicators.

In terms of dimension, most of the households were deprived in living standards (45%) and education (28%), and less deprivation was recorded in health and empowerment indicators. This indicates that there has been huge work made by the government on health by giving special focus by assigning health extension workers in each districts and narrow down the gender gap and foster gender equality in the districts.

There has been also a statistically significant difference in crop productivities between the average poor and non-poor. The average non-multi-dimensionally poor households head crop productivities per hectare of land was exceeding the average poor crop productivities by 43 percent (6.56 quintal/hectare). With a similar argument, the average modern technology (chemical fertilizer and improved seed) usage was by far lower from the average non-poor. It was strongly linked with the household annual income and household educational attainment level. Relatively the modern technology usage in Woina Dega and Dega agro-ecological zone is better than in the Kolla districts.

Measurements of technical efficiency have received increasing attention in recent years due to the important role improved efficiency plays in the growth of institutions/industries. But what is efficiency and how can we improve it? Efficiency is the ability to attain outputs with a minimum level of resources. It is therefore related to productivity which is commonly defined as the ratio of outputs to inputs. In order to manage and improve efficiency, we first need to measure it. Efficiency improvement is a continuous process. Economists usually measure the efficiency of an industry/farm based on the production function, which specifies the relationship between the observed inputs and output. To estimate technical efficiency levels, one defines a production frontier from a specified production function. A production frontier indicates the maximum output that can be produced under different input combinations; the ratio of the unit's output to the maximum possible output gives a measure of efficiency (range between 0 and 1).

This paper provides an assessment of technical efficiency among crop farmers in the Lalo Midir District. The study analyzed the factors that influence such efficiency levels by estimating a stochastic frontier production function. The empirical results predict that technical efficiency effects were significant in explaining the yield for both poor and non-poor farmers. The mean technical efficiency was estimated at 68%. The technical efficiency model indicated that all farmers were less efficient in their production and lost close to 32% of their potential output. These losses differ from one farmer to another. The non-poor farmers had slightly higher technical efficiency than the average poor farmers. The mean technical efficiency for the non-poor farmers was 0.72 compared with 0.65 for the average poor farmers in the research area.

The research finding revealed that the major crop production/productivity determinant factors are; farmland size in a hectare, resource utilization capacity (technical efficiency), annual income, educational level, extension services, modern technology usages, animal holding stocks in TLU, and the availability of sufficient rainfall during the harvest season. These variables are statistically significant at 1, 5 or 10 percent level of precision.

Poverty is one of the hottest social issues in international phenomena. In this regard, various studies have been conducted in all directions of the world to identify its determinants by using un-dimensional poverty measures. The Binary logistic model was employed so as to find out factors affecting multidimensional poverty in the research focused area. The dependent variable, the poverty situation of households, was regressed against explanatory variables. The result shows that household crop productivity per hectare of land, household land size, livestock ownership, family size and household annual income in adult equivalence, technical efficiency, household oxen holdings, educational level of the household head, and dependency ratios are significantly influencing the probability of households being in poverty. As a result, they are considered major determinants of rural poverty. On the other hand, the sex of the household head, age, overall household land fertility level, sufficient rainfall level, distance from the market, and credit access were not found to be statistically significant.

Even though identifying the various factors that affect the probability of falling into poverty does not in itself assist in its alleviation, it gives a framework upon which poverty alleviation strategies may be implemented to address poverty from different perspectives. For this reason, based on the findings of the paper, important policy implications can be drawn to highlight a direction for policy making and enlighten appropriate intervention areas.

First, the fact that crop productivity and efficiency play a positive role in poverty reduction in the district appears to be useful for policy makers to design scaling-up strategies and other interventions, particularly providing modern technological inputs, extension services, infrastructures, and creating and facilitating market opportunities. Moreover, in order to enhance productivity there is a need to emphasize the improvement of the socioeconomic characteristics of farmers. Since education significantly influenced output, the focus should be on better training for the farmers and on encouraging the use of better farm inputs. Training of farmers can be intensified by increased extension services via demonstration farms within the vicinity of most farmers. Second, the Ministry of Agriculture adopts appropriate measures that will ensure the availability of fertilizer at affordable rates and convenient locations to farmers. The study established that farmers indicated that shortages and high costs of fertilizer were major limitations to their productivity. The Ministry of Agriculture, through the National Cereals and Produce Board, should import and distribute fertilizers and improved seeds to depots within the surrounding area of the farmers.

Third, livestock and oxen holding are major determinant variables to reduce poverty. Therefore, stakeholders should intervene on access to credit as a source of finance. The agricultural finance institutions should focus on the provision of credit for the purchase of such income generating activities and agricultural equipments and farm inputs as well. This can be better done through farmers' cooperatives and other organizations at the local level with strong support and follow up from the government sides.

Fourth, Farmers are forced to sell a proportion of their agricultural products right after harvesting to repay loans obtained from ACSI. This could create a temporary excess of supply and a reduction in the selling price of agricultural products. The farmers' cooperatives should play a role in purchasing the products of the farmers at reasonable prices in the harvest season and resell them in slack seasons. By doing so, cooperatives could support farmers to get the right price during the harvest period and, at the same time, address their urgent cash needs for loan repayments.

Fifth, the extension agents and administrators’ outlooks that farmers are unwilling to accept changes and do not know what is best for them should be avoided. Farmers are reasonable to challenge changes, eager, and highly dedicated to making livelihood changes and feeding their families. Therefore, It is only we who cares about the attitude of government officials in the rural areas that should be restricted, and also extension agents should spend most of their time supporting the farmers in different intervention areas rather than focusing on political agendas.

Six, the finding shows that drought is an important factor that affects farm crop productivity, which indirectly increases the household's likelihood of falling into the poverty trap in the district. It needs policy responses targeted at agricultural adaptation, such as the adoption of drought-resistant varieties and enhancing small-scale irrigation projects that can avoid reliance on rain-fed agriculture. Finally, as finding revealed that family size aggravates multidimensional poverty in the research area. Therefore, policy makers should intervene by means of creating opportunities for income generating activities outside agricultural activities.

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