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Causes and Effects of Land Size Variation on Smallholder's Farm-Income: The Case of Kombolcha District of East Hararghe, Oromia, Ethiopia

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Abstract

For farmers, farmland is a basis of their livelihood and the basic agricultural resource and is now becoming a constraint in agricultural production. This study was carried out in Kombolcha district of Oromia National Regional State. The specific objectives of the study were to identify the factors affecting size of landholding and to analyze the effects of land size variation on farm income. To address these objectives a two-stage random sampling procedure was used to select 5 peasant associations and 110 sample respondents from a total of 19 peasant associations found in the district. Multiple linear regression and Cobb-Douglass production functions were used for analyzing the cause of land size variation and effects of land size variation on farm income respectively. Accordingly, age of the household head, agro ecology, family size and land availability in PA were found to be the significant factors in causing variation in size of land holding in the study area. The regression coefficients of the Cobb-Douglass production function indicate that the size of cultivated land, average land productivity, livestock owned and non-farm income were statistically significant factors in explaining variation in farm income among farmers. Therefore, there should be urgency of devising means and ways to improve the farm income through strengthening the production of cash crops. Besides this, productivity of land should be increased through the introduction of high yielding varieties of crops. And there should be strategy to create non-farm income sources for the smallholder farmers.

Subject Areas

Development Economics

Keywords

Land Size Variation, Farm Income, Smallholder Farmers, Multiple Linear Regression, Cobb-Douglass Production Functions Kombolcha, Oromia, Ethiopia

1. Introduction

1.1. Background

Agriculture employs about 83% of the total population and 90% of the total export earnings, 43% of Gross Domestic Product (GDP) and provides about 70% of the county's raw material requirement for large and medium scale industries [1]. Hence, the performance of the agricultural sector largely determines the performance of the entire economy of the country. In spite of its importance in the national economy, agriculture is based on subsistence farming and characterized by fragmented small farms operated by farming households [1].

Agriculture is based on subsistence farming and characterized by fragmented small farms operated by farming households. The small farm unit, the most important component of agriculture sector happens to be the lifeline for our survival and prosperity. However, the condition of agriculture sector in general is not healthy. The food produced on the small farm is not keeping pace with the increasing rate of population growth, which is estimated to be about 3 percent per annum. Thus, there is a need to improve annual food production by about 4 percent per annum [2].

The way in which property rights to land are defined is of great importance for economic growth, the effective use of this resource, governance at the local level, poverty reduction and opening up of productive opportunities for the poor. Accordingly, the size of the land that they own, the feeling of security that they have on their holdings, and the processes through which land disputes are adjudicated, all affect the households' income, their incentive to work and invest, their desire to use their land in sustainable manner and even their social and economic status in their respective communities [3].

In agrarian society where land is the primary productive asset, land tenure plays a fundamental role in economic and political power. Any land reform policy will be influenced by those with vested interest in the existing tenure systems. These facts were observed in Ethiopia under the different governments that have ruled the country for many years [4]. The prevailing difference in size of landholding and the land management practice combined with the general lack of economic growth has led to the difference in economic life among rural farm households living in the same locality. The difference in the size of landholding could be due to natural factors or human factors. In addition, the difference in size of landholding among inhabitants of the locality has created discrimination among the farmers in many respects of societal affairs such as social, political,

and cultural affairs [5].

The major problem regarding land use in Oromia is the rapid growth of population which leads to decreases in sizes of holdings and productivity, an increasing cultivation of marginal land, a small holding and low productivity, a critical shortage of grazing land, fragmentation of farm lands, etc. while the highlands are over utilized because of the concentration of population. Shortage of land for agricultural purposes, diminution of the size of landholding appeared to be one of the main constraints associated with land. The importance of land tenure institution for food production and economic development in general has been crucial in Ethiopia. As regard to the size of landholding, it is obvious fact that in the majority of the highlands and mid-highlands, small holder farmers and their families live on mini-plot of land [2].

Degradation and declining productivity of land, a static land tenure system and rapid population growth contributes negatively to the size of landholding of the rural households in Ethiopia [6]. The problem of production in peasant agriculture in Ethiopia and particularly in regions like Oromia where Kombolcha is one believed to be primarily land size. Hence, it is important to identify the different factors that influence the size of landholding in rural areas of the country and assess some of the major effects caused by the difference in landholding among rural households.

1.2. Statement of the Problem

The difference in size of landholding has different effects on the farm households. Access to rural credit services, improved agricultural technologies, and psychological relief from future unseen circumstances, aid from public, support from different development agencies and NGOs etc., are generally determined by size of farm land. Farm income, and per capita cereal food availability increases with increased access to more cultivable land. As landholding decline, per capita food production and farm income decline [7].

Besides these, the size of land a farmer uses can regulate the security of the individual or his family, hence influences social stability. It exerts considerable influence over income distribution, consumption pattern, rural employment, differential labor absorption capacity, mode of utilization of the agricultural surplus and intensity of land use [8].

The same phenomenon appears in Oromia, Kombolcha, the study area. There is observable gap in landholdings among farmers in the Kombolcha district. However, there have been no or very few studies carried out to analyze and show the effect of variation of land size on different economic and social life of the rural farmers and identify the different factors causing the variation in landholding of the farmers. To this point, the effect of land size on farm income of the people not known. This study was, therefore designed to identify and quantify, the socio-economic and environmental factors causing landholding differences and its effects on income of the farmers.

1.3. Objectives of the Study

The general objective of the study was to assess the cause and effect of the differences in size of landholding in Kombolcha district, Oromia Regional Sate.

1.4. Specific Objectives

1) To identify factors affecting size of landholding in the study district.

2) To analyze the effects of land size variation on smallholder's farm-income in the study district.

1.5. Significance of the Study

The information generated from this study has significant importance to the different government bodies in the area as it shows the effects of the difference in size of landholding on the income of farmers. The study is valuable for public and non-governmental development agencies that aim at attaining sustainable household food security through integrated holistic rural development. In addition, the study would provide micro level information for those who are interested to carry out further study on land and income related issues at different levels.

1.6. Limitations of the Study

Because of financial and time constraints, the study was undertaken only in one district of the zone. Therefore, the generalizations made based on the findings would be more applicable to the study area and the result of this study might be applicable to other areas in Oromia region or in the country where similar situations exist.

2. Research Methodology

2.1. Description of the Study Area

Kombolcha district is found in Eastern Hararghe Zone of Oromia National Regional State. It is located at 542 km east of Addis Ababa, and 17 km north of Harar city. The district is characterized by altitude range of 1200 and 2460 m.a.s.l. The district is located between latitude of 42˚07'0'East and longitude of 9˚25'60'North.

The rainfall pattern of the area is identified to be bimodal with erratic rain. The mean seasonal rain fall is 600 mm up to 900 mm during the 'belg' season. The main rainy season, 'kiremt' starts at the beginning of July and extends up to September while the short rainy season is from March up to April. The mean annual temperature ranges from 16˚C to 25˚C. The total population of Kombolcha is estimated to be 140,769 of which 71,288 are male and 69,481 are female [9]. Kombolcha has an estimated total land area of 46,461 hectares of which 12604 hectares are cultivated, 3694 is covered with forest, 300.34 hectares are pasture land, and 7900 hectares are un-classified and the remaining are not arable. More than 85% of the populations are engaged in agriculture. The type of farming in the district is mixed farming.

The diversified nature of the district's climate favours to produce both short and long rainy seasons crops. The main crops grown are maize, sorghum, groundnut, coffee, khat, haricot bean, potato, tomato and cabbage. The productivity of the main cereal crop is very low due to lack of improved seeds, fertilizer, and use of traditional farming equipment and moisture stresses. Livestock are the most important household asset and means of livelihood for most of the populations. It is source of cash income; it serves as accumulation of capital, used as transport means, food as well as the foundation of prestige and power. The types of livestock kept in the study area are cattle, sheep, goats, camel and donkeys. However, the livestock population per household is limited and productivity is hampered due to shortage of feed and poor veterinary services. Regarding Agricultural extension services and utilization of modern farm inputs, the majority of the farmers in the survey area are not using all the packages consistently. The main reasons for this are high cost of inputs and weather change. Nevertheless, some technical components of the packages, like row planting of vegetables and cereal crops, intercropping, application of cow dung in their farmland, are widely adopted by most farmers. The inputs widely used in the district are improved vegetable seeds and chemical fertilizers (DAP and Urea).

2.2. Data Sources and Methods of Data Collection

The relevant data in this study have been collected from both primary and secondary sources. Primary data were obtained from randomly selected farmers. Towards this end, a structured interview schedule was designed, pre-tested to prove its fitness and was refined. Using primary source, information vital to household's demographic and socio-economic characteristics encompassing cropping intensity, age, sex, family size, technological adoption, type of crops grown, source of land, change in size of land, labor use, soil and water conservation practices were obtained by interviewing the randomly selected farm households. The key variables that were expected to have an impact on farm income and land size were incorporated in the questionnaire. These include size of landholding, yield level, fertilizer usage, livestock production, type of crop grown and other important factors. On top of this, personal observation and informal discussions were made with some informant farmers from the selected peasant associations under study.

Secondary data such as landholding of farmers, Agricultural input usage, agro-ecology of the district, crop and livestock production and productivity, access to agricultural extension service etc., were collected from the district agricultural office, central statistical Agency, previous studies, administrative office, other published and unpublished materials and non-governmental organizations which were found to be relevant to the study. The data used in this study were collected during December 2010.

2.3. Sampling Procedure

Two stage random sampling technique was used to select the sample households

in the study area. At the first stage, 5 peasant association (PAs) out of the 19 PAs of the district were randomly selected using a random sampling technique. In the second stage, 110 sample households were selected randomly based on probability proportional to size. The number of farmers included in the sample in each PA is shown in (Table 1).

2.4. Methods of Data Analysis

2.4.1. Model Specification

After the completion of the data collection, the responses were coded and entered into SPSS version 16.0 software program for analysis. Selection of relevant dependent and independent variables is one of the important tasks in specification of an econometric model [10]. In this study, the relevant variables of interest were chosen based on the previous studies, existing reality of smallholder farmers under consideration, logical assumptions, production process of crops and based on the objective of the study. Attempt was made to choose relevant functional form in the analysis of the effects of land size variation on farmers income and in identification of relevant variable causing variation in land size.

One of the objectives of this study was to identify factors affecting the size of landholding of the smallholder farmers from a set of socio-economic variables, personal and natural factors expected to affect landholding size of farmers. For this aim, linear multiple regression analysis was employed. That means land size was regressed on the different explanatory variables expected to affect it. The relationship is expressed in linear function. This model relates the dependent variable to several independent variables as described below:

$$y_i = f\left(x_1, x_2, x_3, \cdots, x_k\right) \tag{1}$$

where, y_i is the dependent variable, $x_1, x_2, x_3, \cdots, x_k$ are the independent variables, and there were several mathematical equations that can be used in multiple regression models, and the linear function were feasible to fit the data available in explaining the functional relationship between size of landholding and factors affecting the variation, this is expressed as:

$$y_i = \alpha + b_1 x_1 + b_2 x_2 b_3 x_3 + \cdots + b_6 x_6 + u_i \tag{2}$$

where:

Table 1. Distribution of sample households by Pas.

Name of the PA	Total household heads/PA	Sample household heads/PA
Lega Hama	782	14
Egu	1978	35
Tula	870	17
Sibilu	1024	19
Bilisuma	1382	25
Total	6036	110

Source: Own Survey, 2010.

y_i = The size of landholding (the dependent variables);
x_1 = Family size (adult equivalent);
x_2 = Agro ecology;
x_3 = Age of the respondent (years);
x_4 = Slope of the land that the farmers own (dummy);
x_5 = Land availability in peasant association (cultivated land/household in PA);
x_6 = Farmers position in the peasant association (dummy);
u_1 = The error term (α = Constant term Disturbance term).

2.4.2. Cobb-Douglass Production Function

Cobb-Douglas production function is the best function to analyze production response to factor inputs and a number of researchers have applied in such studies. Therefore, Cobb-Douglas production function was fitted to calculate the elasticieties of production with respect to inputs. According to [11] the Cobb-Douglas production function is specified as:

$$y = \alpha x_1^{\beta_1} x_2^{\beta_2} x_3^{\beta_3}, \cdots, x_k^{\beta_k} e^u \tag{3}$$

where:

y = Dependent variable;
$x_1, x_2, \cdots, x_k$ = Independent variables;
α = constant;
$\beta_1, \beta_2, \cdots, \beta_{Bk}$ = Parameters to be estimated (regression coefficients) or elasticity;
k = Number of independent variables;
u = Disturbance term;
e = Base of the natural logarithm.

Cobb-Douglas production function is a power function, hence it is impossible to directly use the Ordinary Least Squares (OLS) method. Therefore, in order to change the non-linear form to a linear form the dependent and independent variables are transformed into natural logarithmic form. The general form of the regression model for k independent variables is given by:

$$\ln y_i = \ln \alpha + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \ldots + \beta_{ki} \ln x_k + u_i, i = 1, 2, \cdots, n \tag{4}$$

where:

α = an intercept;
$\beta_1, \beta_2, \cdots, \beta_k$ = The regression coefficient to be estimated;
$\ln y_i$ = dependent variable;
$\ln x_i$ = Independent variables, $i = 1, 2, \cdots, n$;
u_i = Disturbance term.

After changing it into natural logarithm, least squares technique is used to estimate the magnitude of the relationship between the dependent and independent variables.

In this study to explain the effect of land size variation on farmers' income, a Cobb-Douglas function was fitted. This production function was selected since farm income of smallholder farmers may not decrease with increasing farm size as explained by the high value of the explanatory power of the Cobb-Douglas

function. The model was specified as:

$$y_i = \alpha x_1^{\beta_1} x_2^{\beta_2} x_3^{\beta_3} x_4^{\beta_4} x_5^{\beta_5} x_6^{\beta_6} e^u \quad (5)$$

y_i = Represents the farm income in Birr (the dependent variable);

x_i = Represents the independent variables which include the following:

x_1 = Area of farm land in hectare;

x_2 = Total livestock ownership in tropical livestock unit;

x_3 = Average productivity of crops in yield per ha;

x_4 = Education of farmers;

x_5 = Nonfarm income in Birr;

x_6 = Available family labor force for farming (man-equivalent);

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = Distribution parameters (elasticity coefficients);

α = Constant term;

u_i = Error term (disturbance term).

In order to identify factors affecting land size variation as well as its effects on farm income and factors affecting it, SPSS (Statistical Package for Social Science) software was used.

2.5. Factors Affecting Variation in Land Size

Previous studies, personal judgment and the existing reality of smallholder farmers under consideration are essential in selecting explanatory variables. Therefore, to analyze the different factors causing variation in landholding of smallholder farmers in Kombolcha district six independent variables were hypothesized to affect the variation in land size. The variables hypothesized to affect size of landholding at the disposal of smallholder farmers were age of the farmer, agro ecology, slope of the land, family size, position of the farmers in the PA, and availability of land in the PA.

Prior to the estimation of the model parameters, the Variance Inflation Factor (VIF) was used to test the degree of multicollinearity among the continuous variables. Accordingly, the presence of multicollinearity was checked for the continuous variables. The computed VIF values for each of the independent variables were found to be between 1.21 and 3.94, which indicates the absence of multicollinearity among the variables. Hence, the three continuous explanatory variables retained and entered into the model and used in the linear regression analysis (Table 2).

Similarly, the contingency coefficients were used to check the degree of association among the discrete variables. The values of contingency coefficient range

Table 2. Variance Inflation Factors (VIF) of the continuous explanatory variables.

Variables	R_i^2	VIF
FAMSIZ	0.746	3.94
HHAGE	0.178	1.21
AVLANDPA	0.59	2.44

Source: Own computation, 2010.

between 0 and 1, with zero indicating no association between the variables and values close to 1 indicating a high degree of association. Accordingly, the results of the computation reveal that there was no serious problem of association among discrete explanatory variables. Hence, the three discrete explanatory variables retained and entered into the model and used in the linear regression analysis (Table 3).

Besides multicollinearity, endogenity test was carried out. Accordingly, first stage regression of the endogenous variables on the regressors was performed and the residuals from this equation were calculated and include them as additional regressors in the original estimated equation. Finally, OLS method was employed on this new equation and t-test was employed. Accordingly, the null hypothesis was not rejected which indicate the absence of endogenity problem.

Linear regression was fitted to the data and the results obtained were given in Table 4. The most commonly used measure of goodness of the regression line is coefficient of multiple determinations. It measures the proportion or percentage of the total variation in dependent variable by the regression model. The coefficient of multiple determinations for the model shows that more than 81% of the variation in land size among the sample households is explained by the factors included in the model. Hence, the selected model fits to the available data, significance level for age = 0.0154 which is statistically significant at 5 percent probability level.

Table 3. Contingency coefficients for discrete explanatory variables.

	AGRECO	SLAN	HHPOS
AGRECO	1.00		
SLAN	0.074	1.00	
HHPOS	0.14	0.05	1.00

Source: Own computation, 2010.

Table 4. Factors affecting land size variation.

Independent Variables	Coefficients	Std. Error	t-ratio	Sig
Constant	−0.20**			0.042
Age of the farmer	−0.063*	0.034	−1.85	0.154
Agro ecology	−0.12***	0.024	−4.9	0.000
Family size (AE)	0.023**	0.0095	2.4	0.035
Position of farmers in PAs (dummy)	0.035	0.041	0.85	0.182
Land availability in PAs (cul/HH)	0.20***	0.0430	4.6	0.006
Slope of the land (index)	0.10	0.167	0.6	0.365
R^2	0.814			
Adjusted R^2	0.81			
F-test	24.59			

Source: Model Output Size of cultivated land in ha is the dependent variable; ***Significant at 0.01 probability level; *Significant at 0.1 probability level; **Significant at 0.05 probability level.

The cultivated land size here represents only the farm land that is owned by the farm family. In the district, agriculture is the backbone of the economy, the size of land determines the economic status of the farm family. Moreover, the results verified that almost all of the explanatory variables, except age of the farmer, in the model had the signs that confirm with the prior expectations. Out of the six variables hypothesized to affect landholding size, four variables were found to be statistically significant in influencing land size variation.

The model results depicts that age of the farmers was statistically significant at 10 percent probability level whereas, agro ecology and land availability in the PAs were statistically significant at less than 1 percent probability level. Moreover, family size (AE) was statistically significant at 5 percent probability level. However, the coefficients of two explanatory variables, namely, position of farmer in the PAs and slope of the land were not statistically different from zero at the conventional level of significance. Next the interpretation and discussions of the model estimates in relation to each statistically significant variable will follow:

Age of household head (HHAGE): Farmers who are aged were expected to have large land as they had chance to get access to land during the early redistribution of land to the farmers. However, the model result depicts that there is negative relationship between age and land size being significant at 10 percent probability level. This means that an increase in age of the farmer by one year is accompanied with a decrease in farm land by 0.063 hectare. This is possible because aged farmers retain small farm land by dividing their farm land among the married children and hence remain with small land size.

Agro ecology (AGRECO): Farmers located in the mid high land have got access to small land size as the density per square km is high compared to low land area. In agreement with the hypothesis, this variable has a negative and significant impact on farm size at less than 1 percent level of probability. The inverse relationship indicates that farmers who live in the mid-highland areas have got access to small land size compared to lowland area. This is possible due to the fact that the low land is susceptible to various animal and human diseases and low productivity of land due to different factors. These results in high population density per square kilometer in midland area and relatively sparsely populated in low land area of the study district. In low land area, land to man ratio is relatively high compared to mid highland areas. The regression result shows that a shift from area below 1500 meter above sea level to a place above 1500 meter above sea level causes a decrease of the land size at the disposal of the farmer by 0.12 hectare. This result is supported by the findings of [12].

Family size (FAMSIZ): In agreement with the hypothesis**,** family size is positively associated with the size of landholding. According to the model output family size in the model is equal to 0.13 which is statistically significant at 5 percent probability level. This shows that one adult equivalent increase in family size results in a 0.023 ha increment of farmland. The likely explanation is that people with large family size have large farm size since this was one criterion by

which government distributes land and increased their farm size through lease arrangements. Moreover, large family posses large labour availability which enables to bring all available land under utilization. This result is supported by the findings of [13].

Land availability in PAs (AVLANDPA): In agreement with the hypothesis, the size of available land in peasant association is positively associated with the individual size of landholding. That means availability of land in peasant association strongly determines the size of landholding at the reach of the farmers. Farmers in the peasant association that have big land size have got relatively big landholding. This was shown by the location of the farmers with the respect to altitude. The regression coefficient of land availability is equal to 0.20 which is significant at 1% probability level. This result is supported by the findings of [12].

2.6. Effects of Land Size Variation on Farmers' Income

The size of farm land and other important independent variables were combined for the analyses of effects of land size variation on the income of smallholder farmers. The prevailing difference in size of landholding and the land management practice combined with the general lack of economic growth has led to the differences in economic life among rural farm households living in the same locality. The differences in the size of landholding could be due to natural factors or human factors. In addition, the difference in size of landholding among inhabitants of the locality have created discrimination among the farmers in many respect of societal affairs such as social, political, and cultural affairs [5].

In rural area land is an important asset to earn income and food. Farm income in this study includes income from different sources namely income from crop, livestock sector and non-farm income. For the purpose of the study, multiple regression (Cobb-Douglas production function) was run to know how much of the variation farmers farm income is explained by the variation in the size of farm land when combined with other explanatory variables. In this section, effects of land size variation on income of small holder farmers are analyzed. The effects of land size variation is analyzed by identifying factors influencing income of small holder farmers using the linearized CD production function. This is done based on the relationships established between farm income (dependent variable) and the independent variables. The independent variables include livestock holding, size of farm land, productivity per hectare, and education of the farmers, non-farm income, and available family labour force for farming. Before running the model to estimate the equation of farm income, the association between explanatory variables was checked using variance inflation factor (VIF), which shows how variance of estimate is inflated because of the presence of multicollinearity [14]. VIF is defined as: VIF $=\frac{1}{1-R^2}$, where R^2 is the value of coefficient of multiple determinations (**Table 5**).

Based on the above VIF result, the values of VIF for continuous variables were

found to be small (less than 10). Therefore, the data have no serious problem of multicollinearity. As a result, all the 6 explanatory variables were retained and entered into the model for further analysis (Table 6).

The regression results of CD function show that the F statistic ratio is highly significant at 1 percent probability level. This indicates that the null hypothesis formulated (all values of coefficient are equal to zero) is rejected. The value of adjusted R^2 revealed that 89.3 percent of variation in farm income of sample farmers is explained by variations in the independent variables included in the model.

The coefficients of the regression are known as the elasticity that indicates the percentage change of each independent variable on the variation of dependent variable. The model output indicates that out of six variables, four variables are statistically significant at different probability levels in explaining variation in farm income. These variables are size of cultivated land (ha), average land productivity (Qt/ha), livestock owned (TLU), non-farm income (Birr) whereas two explanatory variables were found statistically insignificant in explaining variation in farm income, namely availability of family labor force and education of the farmer.

Table 5. Variance Inflation Factors (VIF) of the continuous explanatory variables.

Variables	R_i^2	Variance Inflation Factor (VIF)
Size of cultivated land (ha)	0.55	2.22
Average land productivity (Qt/ha)	0.84	6.24
Livestock owned (TLU)	0.80	5.07
Non-farm income (ETB)	0.50	2.04
Family labour force (man-days/ha)	0.09	1.09
Education of the farmer (grade)	0.04	1.04

Source: Own Computation.

Table 6. Regression coefficients and other statistics for CD production function.

Independent Variables	Coefficients	Std. Error	t-ratio	Sig.
Constant	6.714***	0.334	20.08	0.000
Size of farm land (ha)	0.190***	0.016	11.70	0.000
Average productivity (Qt/ha)	0.320**	0.171	1.87	0.018
Total livestock (TLU)	0.530***	0.108	4.9	0.001
Non-farm income (Birr)	−0.020*	0.011	−1.82	0.102
Availability of family labour force	0.040	0.513	0.78	0.31
Education of the farmer (Grade)	0.060	0.15	0.4	0.635
R^2	0.95			
Adjusted R^2	0.893			
F-ratio	96.5			

Source: Own Computation the dependent variable is the farm income in Birr; ***Significant at 1% probability level; *Significant at 10% probability level; **Significant at 5% probability level.

The interpretation and discussions of the statistically significant variables is explained as follows:

Size of farm land (Farmlansiz): With regard to this study, the coefficient of size of farm land was hypothesized to have positive relationship with the farm income of smallholder farmers. In agreement with the hypothesis**,** its coefficient came out to be positive and significant at less than 1 percent significance level. The direct relationship is an indicator of its effects on income level of the farmer. The likely explanation is that those farmers who had access to relatively large farm size are more likely to get high income level than those households who had no or little land. According to the model output the size of landholding at the disposal of the farmer is the most important variable affecting farmers income level. The regression coefficient of size of farm land is 0.19 showing that keeping other factors constant, a 100 percent increase in farm land will increase the gross farm income by 19 percent which is statistically significant at 1 percent probability level.

Average productivity (Avprod): According to this study, the variation in average productivity of land (Qt/ha) is found to be significant at 5 percent significance level in explaining variation in gross farm income of the sample households. The result of the regression coefficient of average productivity is 0.32 which shows that a 100 percent increase in average productivity will be associated with about 32 percent increase in gross farm income of the sample households, all other factors held constant.

Total livestock owned (TLO): This refers to the total number of herd measured in tropical livestock unit (TLU). According to the model output, the other limiting factor for generation of farm income in the study area is livestock holding (TLU). Livestock holding is positively related to gross farm income and statistically significant at 1 percent significance level. The elasticity estimate of this variable shows that a 100 percent increase in TLU will be associated with about 53 percent increase in gross farm income all other factors held constant.

Non-farm income (NFI): Non-farm income is significant at less than 10% probability level, in affecting farm income of households in the study district. This is one of the powerful variables that negatively affected the farm income level of the sample households. The coefficient of non-farm income is −0.02. This elasticity estimate of the regression result shows that a 100 percent increase in non-farm income (Birr) will be associated with about 2 percent decrease in gross farm income of the sample households all other factors held constant. This means that, as non-farm income level of the sample households declines, the farm income increases. This displays that as gross farm income increases; there is tendency towards decreasing in non-farm income by the sample households.

The variation in family labor availability (man equivalent) has no significant contribution in explaining variation in gross farm income of the sample households. This shows that family labour input is not limiting factor in affecting income level of farmers of at the study area and it could be abundant resource.

3. Conclusions and Recommendations

3.1. Conclusions

This study presented important information and findings concerning factors causing size variation in landholding among farm households and effects of land size variation on farmers' income in the study district. Among the productive resources, land is very limiting and highly binding resource in the study area. The low level of production in Kombolcha district is attributed to small farm land size at the disposal of the farmers. In the study area, the size of farm land owned means everything that the farmers require and experience in their life. The results of the study indicated that there is variation among farmers in the district with respect to size of landholding and this created significant difference among farm households in livestock holding, participation in non-farm activities and generation of farm income.

The study showed that socio-economic and natural factors (age, family size, agro-ecology and land availability in the PA) caused variation in size of farm land in the study district and the coefficient of multiple determination for the model shows that 81% percent of the variation in land size among the sample households is explained by the variables included in the model. The coefficient of age of the farmer shows an increase in age of the farmer by one year decreases farm land by 0.063 hectare. Hence, it can be concluded that aged farmers retain small farm land by dividing their farm land among the married children and hence remain with them small land size. According to the model output there is positive relationship between family size and landholding size. Therefore, it can be concluded that people with large family size have large farm size. Agro ecology and size of landholding are inversely related; hence, it can be concluded that relatively large farmlands are available in midland areas than lowland due to the fact that the low land is susceptible to various animal and human diseases and low productivity of land due to different factors.

The Cobb-Douglass regression result shows that there is positive and significant relationship between size of cultivated land area and gross farm income. Therefore, it can be concluded that size of cultivated land is one of the limiting factors of crop production of the farmers in the study area. Hence, gross farm income can be increased by increasing size of cultivated land; nevertheless, this is not possible because of scarcity of farmland in the study area.

The regression result shows that there is positive and significant relationship between gross farm income and livestock owned. Therefore, it can be concluded that size of livestock owned is important for income generation of farm households. And the regression coefficient result shows that there exists positive and significant relationship between gross farm income and average land productivity. Thus, it can be concluded that gross farm income of farmers can be increased by increasing the productivity of the land.

The regression result shows that there is negative and significant relationship between gross farm income and non-farm income. Hence, it can be concluded

that as farm income increases, non-farm income of farmers decreases at current level of technology and farming conditions. Farmlands had been diminishing in size. There is no uncultivated arable land. Hence, there is no potential of accommodating additional farm households in the area.

3.2. Recommendations

1) Size of cultivated land and gross farm income are positively related, however, expanding size of land under cultivation was not be an option to earn more income in the study area because there is no arable land uncultivated. Therefore, the productivity of existing small farm land should be raised through the use of agricultural intensification which can boost farm income level of farmers from the available farm land.

2) As average productivity of farm land and gross farm income are positively related, productivity of farm land should be increased through use of improved varieties of crops, chemical inputs, sufficient and effective extension services so that farmers are able to earn more income from the small farm land available to them.

3) The model result depicts that there is a negative relationship between age and farm land size. This indicated that aged farmers retain small farm land by dividing their farm land among the married children hence, the pressure on the farm land increase over a period of time. Therefore, there should be strategy to create non-farm income sources for the farmers so that the existing farm land is at least maintained.

4) Livestock holding is positively related to gross farm income. Therefore, proper forage development programs should be introduced to increase livestock production and productivity and expanding veterinary service and disease control programs, which increase farm income from the sale of livestock.

5) The results of the research show that non-farm income of farmers and farm income are negatively related. In light of this non-governmental organizations that are working in the area and focusing only on agriculture should also channel their attention to creation of non-farm income generating activities. Besides this, the rural development strategy of the government should not only emphasis in increasing agricultural production but concomitant attention should be given in promoting non-farm activities in the rural areas which can decrease the pressure on the farmland.

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