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Gender Differential in Productivity and Income of Haricot Bean in Misrak Badawacho District of Southern Ethiopia

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Abstract

This study investigates gender differential in agricultural productivity, highlights its key determinants, and estimates the gap in income generated from the production of haricot bean. The study was conducted based on data generated from 122 male headed and 39 female headed households from Misrak Badawacho district of southern Ethiopia. Descriptive and inferential statistics as well as econometric models were employed to analyze the data. The models used were Cobb-Douglas production function, and output decomposition model. The estimates of Cobb-Douglas production function showed that fertilizer, improved seed, pesticide, labor, total land size, project participation, number of extension contact, tropical livestock unit, and distance from development agent center significantly affected productivity of haricot bean. The estimate of decomposition model found that farm income differences between male and female headed household was 311 birr. Based on the result of the study, it can be recommended that enhancing access to resource endowment and institutional support is critical in increasing the productivity and income of female headed households in the study area.

***Keywords**: Differential, Gender, productivity, Misrak Badawacho, Haricot Bean*

Introduction

The low growth rate of productivity in the African agricultural sector has been widely seen as one of the significant causes for the current high poverty rates and food insecurity. Despite the substantial progress made during the last two decades, Africa is still lagging behind in terms of production and yield levels, modern input uses, technology adoption, and access to credit or insurance markets which are often failing or incomplete (FAO, 2015).

Gender disparities in agriculture have been identified as another important hindering factor in African Agricultural transformation (Kilic *et al*, 2015). In sub–Saharan Africa, women account for almost 50% of the agricultural labor force but suffer from low access to credit and other financial markets (Croppenstedt *et al*, 2013; Aguilar *et al*, 2014).

In spite of the significant and growing role of pulse production for the economy at micro and macro levels, production of pulses in different regions of Ethiopia is severely constrained by lack of access and control over key resources and opportunities (Hailesillassie *et al*., 2007; MoARD, 2008). Recent studies suggested that women farmers have lower returns to inputs than men farmers in a way that further contributes to the existing gap in agricultural productivity, and women lag behind men in access to land, credit, and a broad range of technologies and training resources (Aguilar et al., 2015; Gete et al., 2015; Kilic *et al*., 2015; Oseni *et al*., 2015; Slavchevska, 2015).

Female-headed households and female farmers in male-headed households represent a large production resource in the agricultural sector, particularly in pulse cropping. Yet many studies consider men as key players in crop and livestock production as well as the principal beneficiaries in terms of control over the income generated from the sale of produce (ILRI, 2010; Yenealem et al, 2014; Gete et al., 2015). Tewodros (2014) in his study indicated that being female head of households reduced the likelihood of pulse market orientation by 0.331 compared to their male counterparts.

In the study area, productivity of haricot bean and income generated from the crop is poor due to natural, socioeconomic, and cultural factors of which gender differential is one and perhaps significant. The differential distribution of resources (financial, social, human, and physical capital) between men and women affect the capacity of female headed households to generate more income (District Agricultural Office, 2017). Therefore, empirical analysis on the gender productivity differentials and

their drivers is crucial to understand the ongoing changes in the area. Such analyses are important to design sound and empirically-driven intervention.

The objectives of this study are to investigate gender differentials in productivity, to identify factors contributing to gender disparity in productivity, and to analyze gender differential on income from haricot bean.

Methodology

Description of the Study Area

Location and Topography

Misrak Badawacho district is located in the East Rift Valley, 345 km south of Addis Ababa and is 121 km west of Hawassa, the capital city of the SNNPRS. The district lies between $7^0.05'$ N latitude and 37^o-$38^0.46'$ E longitude. Agro-ecologically, most of the *kebeles* (30) represent *weinadega* type (mid altitude) and some of the *kebeles* (9) represent kola type of agro ecology.The altitude of Misrak Badawacho ranges from 1580 to 2050 m.a.s.l. The mean annual temperature of the district is 20.1^oC and the annual rain fall ranges between 800 mm to 1500 mm and is bimodal. According to CSA (2013) report, the total human population of the district was about 171,524 out of which 85,210 were males and 86,314 were females. Out of the total population, about 143,267 live in rural *kebeles* and 28,257 live in town.

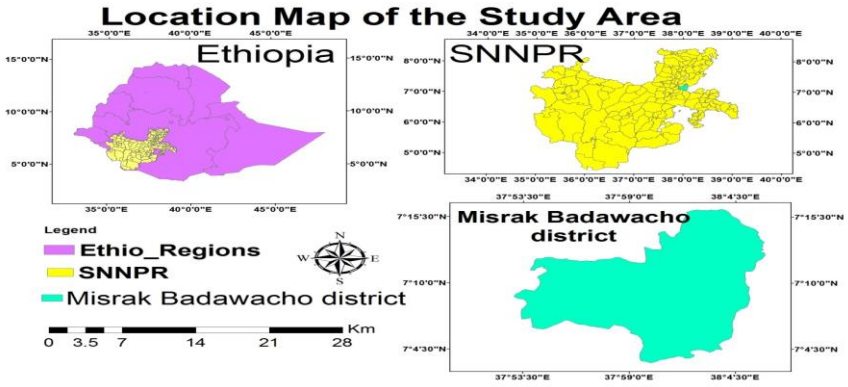

Figure 1: Location map of the study area

Research Design

Data Type, Sources, and Methods of Data Collection

Qualitative and quantitative data from primary and secondary sources were collected for analysis. Primary data were collected directly from farmers and focus group discussion through interview. The major instrument for collecting the primary data was semi-structured questionnaire. Semi-structured questionnaire was prepared and pre-tested on 15 farmers to evaluate the appropriateness of the data, clarity, and relevance of the questions. Hence, appropriate modifications and corrections were undertaken and then it was collected under supervision of the researcher. Secondary data were gathered from documented sources such as journal articles, books, thesis, dissertation, CSA, CIFISRF project. Moreover, data were also collected from Agriculture offices of selected districts.

Sample Size and Sampling Technique

A two-stage sampling procedure was employed to reach at unit of analysis. In the first stage, two kebeles producing haricot bean were selected purposively based on their potential of pulse production. In the second stage, the sample farmers were selected using simple random sampling technique, and then stratified based on the sex of household head. Finally, 161 haricot bean producers from the two kebeles were selected for the study. Of the total sample size 122 were male headed and 39 were female headed households. The number of female headed households is lower because their number in the study area is limited.

By using sampling design, the sample size was determined using sample size formula given by Yamane (1967).n = $\frac{N}{1+N(e^2)}=\frac{865}{1+865(0.07^2)} = 161$ Households

Where, n is sample size, N is total population producing haricot bean and chickpea, and e is the level of precision.

Methods of Data Analysis

Descriptive and inferential statistics as well as econometric models were employed to analyze the data. Specifically for analyzing gender disparity in pulse production and marketing, descriptive statistics such as frequency, percentage, means, and inferential statistics such as chi-square and t-test were used. Besides, econometric model was used to identify economic relationships. For this study, Cobb-

Douglas production function was employed to find out factors affecting the gross male and female headed households' productivity in value term. To clearly distinguish corresponding implication on income level of both households (male and female headed) a decomposition model was used. Both the models used in the study are described hereunder.

Cobb-Douglas Production Function

This function is one of the most widely used functions in the economic analysis of problems to empirical estimation in agriculture. This power function was used in this specific study to investigate the agricultural productivity and income difference between male and female headed households. According to Gujarati (2003), Cobb–Douglas (CD) production function, in its stochastic form, can be expressed as:Y=$AX_1^{b1}X_2^{b2}X_3^{b3}\ldots X_n^{bn}e^{ui}$

where, Y is the amount of farm output per hectare, Xi's are explanatory variables such as land size (ha), fertilizers (kg), plant protection chemicals (lit), livestock holding (TLU), male and female labor (man days), household head education level, number of extensions contact, amount of credit used, project participation, and number of oxen. While A is an intercept and represents level of technology, beta represents elasticity of output for the respective inputs and u is error term.

Cobb-Douglas production function is not linear in parameter. So, one can't use Ordinary Least Square (OLS) directly. But, as per Gujarati (2003) OLS is used extensively in regression analysis primarily because it is intuitively appealing and mathematically much simpler than the method of Maximum Likelihood (ML). Therefore, to apply OLS for estimating the parameters of Cobb Douglas, the power functions will be transformed to logarithm form, which is linear in parameter.

The production function was estimated separately for male headed households and female headed households to find out their respective yield per hectare due to heterogeneous nature and difficulty of aggregation in measuring of output which is physically hardly possible. In addition, analysis was carried out for pooled data.

$\ln Y_{mi} = \ln A + a_1 \ln X_{1m} + a_2 \ln X_{2m} + \cdots a_n \ln X_{nm} + U_i$m stands for male headed households

$\ln Y_{fi} = \ln B + b_1 \ln X_{1f} + b_2 \ln X_{2f} + \cdots + b_n \ln X_{nf} + U_i$f stands female headed households

$\ln Y_{pi} = \ln C + c_1 \ln X_{1p} + c_2 \ln X_{2p} + \cdots + c_n \ln X_{np} + U_i$p stands for pooled data set

Output Decomposition Model

Blinder-Oaxaca decomposition (Oaxaca, 1973) is widely used to study mean outcome differences between groups. They initially used the technique to analyze the wage differential between two groups. The authors divided the wage differential into a part that is "explained" by group differences in productivity characteristics such as education or work experience and a residual part that cannot be accounted for by such differences in wage determinants. The "unexplained" part is often used as a measure for discrimination, but it also includes the effects of group differences in unobserved predictors. Later researchers employed this technique to study group differences in any (continuous and unbounded) outcome variable. For example, O'Donnell et al. (2008) used it to analyze health inequalities by poverty status.

The rationale behind the OB decomposition approach is therefore to show how much of the mean income difference G = E(Y_m) - E(Y_f), with E(Y_m) and E(Y_f) denoting the expected values of income by male and female managers respectively, is accounted for by gender differences in the levels and returns of covariates X. Following Daymont and Andrisani (1984), the income difference, G can be written as:

$$G = E(Y_m) - E(Y_f) = [E(Y_m) - E(Y_f)]\beta_f + E(X_f)(\beta_m - \beta_f) + [E(X_m) - E(X_f)](\beta_m - \beta_f)$$

It follows the above equation that gender income difference can be explained by three factors:

a. Differences between male and female managers in the levels of observable covariates X. In the above equation the first component in the right-hand side gives the proportion of the estimated income gap explained by male and female differences in the levels of those covariates and is called the endowment effect.

b. Differences in the returns of the covariates X. The second term, called the structural or coefficient effect, measures the part of the income differential attributable to differences in the returns of covariates (including the estimated coefficient of the intercept).

c. Finally, the last component, the interaction effect, captures the portion of income gap coming from simultaneous differences in both the predictors and their estimated coefficients. A negative value of the first two components will imply that male managers have a structural advantage over female managers in regard to the specific covariate.

Accordingly, in this study the model was used to decompose source of difference in income of male and female headed household.

Results and Discussion

Socioeconomic and Demographic Characteristics of Respondents

There was a significant difference between male and female headed households in education, family size, landholding and land use allocation, livestock holding, access to credit, extension service, and agricultural inputs (Table 1). The finding signifies there are gender differential in access and control over resources.

Table 4 Socioeconomic and Demographic characteristics of the sample Respondents

Category	Description	Male headed households Mean	female headed households Mean	t–value
Age	Number of years	45.69	45.4	0.29
Education	Year of schooling	4.12	2.1	5.6102***
Family size	Measured in number	7.3	5.75	4.73***
Total land size	Measured in hectare	1.01	0.72	2.29**
Total cultivated land	Measured in hectare	0.81	0.52	2.36**
Grazing land	Measured in hectare	0.04	0.025	2.105**
Home garden	Measured in hectare	0.125	0.16	1.08**
TLU	Tropical livestock unit	3.15	2.14	2.44**
Credit	Amount of credit received	527	222	3.57***
Number of extension contact	Measured in number of contacts made per month	24	14	5.26***

Category	Description	Male headed households Mean	female headed households Mean	t–value
Improved seed	Measured in kilogram per hectare	66.15	43.4	2.69***
Fertilizer	Measured in kilogram per hectare	88	60	2.46***
Labor	Measured in man days per hectare	43	27	3.79***
Pesticide	Measured in litter per hectare	0.5	0.3	2.125**

Significant at *** (1%), ** (5%), and *(10%)

Yield Difference between the Male and Female Headed Households

Various studies revealed that women often achieve lower yields than men in agriculture. In Ghana, for instance, Goldstein and Udry (2008) found that women had far lower yields, resulting in far lower profits per hectare than their husbands who farmed the same crops. These studies provide stark evidence of male and female yield differentials. Even in Ethiopia, Tiruneh *et al*. (2001) found that female-headed households had 35 percent lower value of farm yield per hectare than males. Below are the averages of areas allocated for haricot bean measured in hectare, amount produced measured in quintals, amount sold in quintals, and income obtained from the sale of the haricot bean measured in birr.

Table 5 Haricot Bean Production Difference by Sex of Household Head

Haricot bean	Female headed households	Male headed households	t- value
Average area	0.19	0.28	1.29***
yield/hectare	13.99	17.84	3.3213**
Average amount sold in quintal	1.3	2.1	3.014***
HB value	1320.313	1632.042	3.7316***

Significant at *** (1%), ** (5%), and *(10%)

Results of Econometric Models

In this section, the identified explanatory variables were analyzed with the help of CD production. Before fitting the data to CD production function, multicollinearity test for explanatory variables was

done using VIF (variance inflation factor). The result of VIF test indicated that the VIF values of all continuous explanatory variables were below 10, hence the variables were included in the model for further analysis.

Cobb Douglas Analysis Result

The production elasticity of fertilizer used by male and female headed households in the study area was positive and significant at less than 1% level of probability for male headed households and at 5% level of probability for female headed households. The finding implies that increasing the amount of fertilizer used by 1% increases farm productivity by 22.3% and 9% for both male and female headed households respectively. The production elasticity of fertilizer was higher for male headed households than female headed households. The results are consistent as hypothesized and also in agreement with the findings presented by (Tchale, 2009) in Malawi where fertilizer was a key factor in production of major crops grown by smallholder farmers. Reardon *et al*. (1997) also found a positive effect of fertilizer on productivity in case studies from Burkina Faso, Senegal, Rwanda, and Zimbabwe.

Labor contributed positively and significantly to the farm productivity at less than 1% level of probability for both male headed and female headed households. The result of the survey showed that increasing labor by 1% increases productivity by 31% and 14% for male headed households and female headed households respectively. The labor elasticity was higher for male headed households implying labor was more efficiently utilized in farm production in this household. This result is consistent with the finding reported by (Shambel, 2013).

Improved seed had positive and significant effect on households' farm productivity at less than 1% probability level for both male headed and female headed households. A 1% increase in improved seed increases farm productivity level by 4% and 8.8% for male and female headed households respectively. Looking at elasticity of production with respect to improved seed measured in kilogram, it was higher for female headed households than the male headed households. Tewodros (2013) also found that increasing agricultural inputs increases productivity of haricot bean in a case study from southern Ethiopia.

Pesticide has positive and significant effect on household's farm productivity. A 1% increase in pesticide measured in litter increases output level by 12% and 23% for male and female headed

households, respectively. The elasticity is higher for female headed households. This result is consistent with the finding reported by Mukasa and Salami (2013).

Participation or being a member of projects increases household farm productivity in the study area. It has positive and significant impact. 1% increase in participation in project, increases productivity by 305% for male headed households. It is significant at less than 1% probability level. Distance from DA center decreases household productivity by3.5% and joint control of crop income in the household increases household productivity by 7.6%.

Age of household head and total land size in male headed households significantly affect household productivity. As the age of household head increases by 1%, productivity decreases by 1.03%. As the total land size of male headed households increases by 1%, productivity also decreases by 33%. This result might suggest that female managers would have an advantage over male managers since they cultivate on average smaller farms. However, since productivity differences between male and female managers still persist, other factors might be at play to explain the level of agricultural productivity. This result is consistent with the finding reported by (Mukasa and Salami, 2013).

An increase in family size is significant in affecting farm productivity for female headed households. A 1% increase in family size of female headed households decreases farm productivity by 46%. Number of extensions contact increases farm productivity for female headed households. As the number of extensions contact increases by 1% in female headed households, productivity increases by 48%.

Table 6 Cobb Douglas Analysis Result for the Respondents

	Female Headed Households		**Male headed households**		**Pooled**	
Variables	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Fertilizer	0.099**	0.03	0.223***	0.029	0.196***	0.024
Improved seed	0.088***	0.013	0.039***	0.01	0.062***	0.009
	0.00	0.088				
	0	0.00			0.000***	0.062
	0.01	0				0.000***
	0.039	0.01				
	0.000	0.039				
		0.000				
Pesticide	0.238 **	0.119	0.012**	0.003	0.009**	0.003

	Female Headed Households		**Male headed households**		**Pooled**	
Labor	0.14 ***	0.039	0.31***	0.029	0.422***	0.025
Age	-0.013	0.029	-0.04**	0.02	-0.01	0.0186
Total land size	-0.25	1.14	-0.33**	0.458	-0.91**	0.405
Family size	-0.46**	0.153	-0.013	0.109	-0.128	0.087
Education	0 .172	0.142	0.0523	0.062	0.0015	0.54
Project participation	0.643	0.806	0.588 ***	0.618	2.79***	0.537
TLU	0.23	0.002	0.025	0.134	0.029	0.115
Credit	0.594	0.642	0.447	0.445	0.0127	0.039
Extension contact	0.48***	0.115	0.0119	0.089	0.146**	0.061
Distance from DA center	-0.429	0.2914	-0.328**	0.155	-0.202*	0.017* 0.118
Joint income control			0.82**	0.465		
R^2	0.770		0.869		0.823	
Adjusted R^2	0.701		0.852		0.804	
F-value	41.42		46.21		71.6	

Significant at *** (1%), ** (5%), and *(10%)

Decomposition of output differences

Source of income difference

The key source of income in the study area is agricultural output. Farmers get their income from sale of crops, livestock, and livestock products. There is a difference in income between the two households, where the total annual gross farm income of the female headed households was lower than that of male headed households by 311ETB due to lower agricultural productivity mainly due to lower use of farm inputs (Table 4).

Table 7 Income variability between male and female headed households

1.Mean Income Differential			
Mean Income of male headed households		1632	
Mean Income of female headed households		1320	
Total Gap in Income		311.7	
2. Aggregate Decomposition	Endowment Effect	Structural Effects	Interaction Effect
Total	554.4	253.1	495.8
Share of total Gap	177.8%	81.2%	159%
3. Detailed Decomposition	Coefficient	Std. error	
Education	8.92**	0.804	
Tropical livestock unit	26.8**	0.501	
Number of extension contact	157***	0.85	
Improved seed Amount	28.9***	0.1	
Fertlizer (DAP)	100.9***	0.74	

The Oaxaca-Blinder decomposition model was used by previous studies to carryout income differential (Duomontet et.al, 2012), and it is used in other studies to compute productivity differential (Mukasa and Salami, 2013). In this study, the model result interpreted the income differential result in three portions. The first portion is the endowment effect, i.e., the proportion of the income gap due to differences in the levels of observable variables between male and female managers, accounts for negative 554.4 Birr, while the second portion explains the structural effect, i.e., the portion of the gender differential attributable to the returns of the same variables, explains -253.1 birr of the gap magnitude. This implies that the income from farm could be increased by 554.4 birr if the female headed households could adjust their inputs to the same level of male headed households through increasing agricultural productivity and production. The third portion explains the interaction of the first two portions. Based on the result, female headed households could increase income from farm if they can be able to improve technological efficiency to the level of male headed households. The main cause for the difference in farm income of male and female headed households were differences in productive inputs access and use differential. Hence, from the model computed, it was observed that the variables mentioned significantly contributed for the gap differently. Among the variables included in the model,

education, tropical livestock unit, number of extension contact, improved seed, and fertilizer use differential were decisive in explaining the difference in income obtained from production of haricot bean.

Conclusions and Recommendations

Conclusions

This study investigated gender differential in haricot bean productivity. It highlighted the key drivers of productivity and income differential from haricot bean between male and female headed households. As the estimates of Cobb Douglas production function indicates, use of pesticide, improved seed, fertilizer and labor use significantly affected the productivity of haricot bean for farmers in the study area. Therefore, increasing both male and female headed households' access to these key agricultural inputs is very important to increase farm income by increasing farm productivity and production

The study revealed that male headed households owned a greater number of livestock (especially oxen), have more average cultivated land, and use more agricultural inputs than the female headed households. They consequently generate more income from production of haricot bean than female headed households.

Recommendations

As the benefit of producing pulse crops is multiple, the producers can benefit much better by making pulses their potential crop. So, awareness creation should be done on the economic and nutritive value of pulse production, and measures should be taken in commercializing them. Comparing the two groups of households, farm inputs utilization for production was significantly lower for female headed households. Hence, development workers should give much attention to female headed households by increasing their access to these productive inputs. Increasing their access to these inputs increases their productivity and this in turn increases their income. Education, livestock holding, extension contact, and input use were contributing factors for income differential in the production of haricot bean. Thus, enhancing the resource endowments such as livestock holding, and institutional support such as extension service, input supply, and education are critical to bridge the income gap between male and female headed households.

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