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Determinants of Smallholder Farmers Coffee Production in Gombora District, Hadiya Zone, South Ethiopia

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Abstract

Coffee has greater importance in the Ethiopian economy contributing 5 percent of GDP, 41 percent of government foreign tax revenue and 10 percent of the total government revenue and 15 million households are involved in coffee production and dependent on it for their livelihoods. So, this study was carried out in the Gombora district to assess determinants of smallholder farmers' coffee production in the Gombora District, Hadiya, Zone, South Ethiopia. To achieve the objective, the target sample households were selected in a simple random sampling process. Then, the primary data collected randomly from a sample of 160 coffee producers and non-producers were analyzed using descriptive statistics and SPSS version 25. A total of 13 explanatory variables were used for the binary logit model out of which 6 variables were significant to affect the decision of producers regarding coffee production whereas none of the explanatory variables for sampled producers were found to be significant in the chi-square analysis. Hence; 76.8% of coffee producers were found food secure while only 14.4% of non-producers of coffee were found food insecure. However, the logistic regression model results that the sex of the household head, market distance, and access to credit, farm income, and farm size and extension service greatly affected coffee production. Therefore, concerned stakeholders should encourage coffee production via supporting inputs for rural farm households; accurate, reliable and timely up-to-date market information; the involvement of extension services; the development of the rural road to facilitate producers and non-producers should improve their livelihoods.

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Introduction

Agriculture is the remaining backbone of the Ethiopian economy contributing more than 50% of GDP, 90% of export earnings, and employing 85% of the population of the country. Coffee is the main cash perennial crop in the country having a large share of agricultural commodity export. In estimation, 15 million people in Ethiopia are dependent on the coffee sector (Petit, 2007). The southern, western, southwestern and eastern parts of the country are the most common for producing well-known and internationally acceptable quality coffee. However, the country is not using the full potential of the land for coffee production. While the country has 6 million ha of land suitable for coffee production, only 320,000 to 700,000 ha have been used (Mekuria, 2004).

Coffee is Ethiopia's most important export crop. Currently, Coffee in Ethiopia accounts for more than 25% of GNP, 41% of the total export earnings, 60% of agricultural export, 10% of the total government revenue and about 25% of the total population of the country dependent on production, processing, distribution, and export of coffee MARD (2008).

CSA (2010) showed that coffee in SNNPR contributes more than 73% of regional GDP and 90% of employment. The total number of coffee-producing household heads in this regional state is 1,116,601 and these farmers totally hold an area of 68,978 ha of coffee farmers. Out of 134 Districts in SNNPR 64 are coffee growers. The annual average export of clean coffee from the region is about 85,500 tones and it contributes 67% and 29% of the National washed and unwashed coffee export, respectively. With a total contribution of 96% of the coffee production of Ethiopia, Oromiya and SNNPRS, produces a total of 400,000 ha of coffee area. And from this total area, 53.3% (213,000 ha) is produced by Oromiya; and the rest 170,000 ha is produced in SNNPRS.

Since coffee is a very important crop deserving particular attention in the context of development policies concerning agricultural exports and domestic resources allocation. Coffee production and its productivity level are not satisfactory to uphold the livelihoods of the household. Although both the number of coffee producers and the area under coffee production have been increasing from time to time, the average productivity of coffee production in the known coffee-producing kebeles is below the average productivity of coffee in Hadiya Zone. Coffee farmers have also faced serious challenges including unexpected weather conditions, pests and diseases and the risk of other unforeseen events. In general, the study focus on assessing the determinants of smallholder holders farmers' coffee production in Gombora district, Hadiya Zone, South Ethiopia and specifically to describe the contribution of coffee production to the household's livelihood, to analyze factors affecting smallholder coffee production and to assess the perception of smallholder coffee producers on the major constraints of coffee production in the study area.

Material and methods

Description of the Study area

The study was conducted in Gombora district, Hadiya zone, Southern Ethiopia. Specifically, the district is found 259 km from Addis Ababa (capital city of Ethiopia) and 27km from Hosanna town. It is geographically located at the point of 7° 37′ N latitude and 37° 40′ E longitudes (Fig. 1). Moreover, the total land area coverage of the district is 48,325 ha, and four different districts such as Lemo in the east, Yem Special Woreda in the west; Misha and Gibe in the North, and Soro in the south border the study area.

The demographic characteristic of the Gombora district show, that it has 24 Kebeles (peasant association (PA)) with a total population of 92,332. Out of these, 46,225 and 46,107 are males and females respectively and the population density of the district is about 270 persons per square kilometer (DoANR, 2018). The topographic feature of the Gombora district is mostly flat and moderately gentle lands within the altitudinal range of 1600-2400 meters above sea level. However, the rainfall distribution is bimodal type, which occurs in two

main rainy seasons that is, Belg and Maher. In this regard, Belg is a short rainy season that starts from the end of March to May and Maher occurs as a long rainy season that is June to the end of September. Similarly, the mean minimum and maximum annual precipitation and temperature varies between 500-2200mm and 15-25°C respectively (DoANR, 2018).

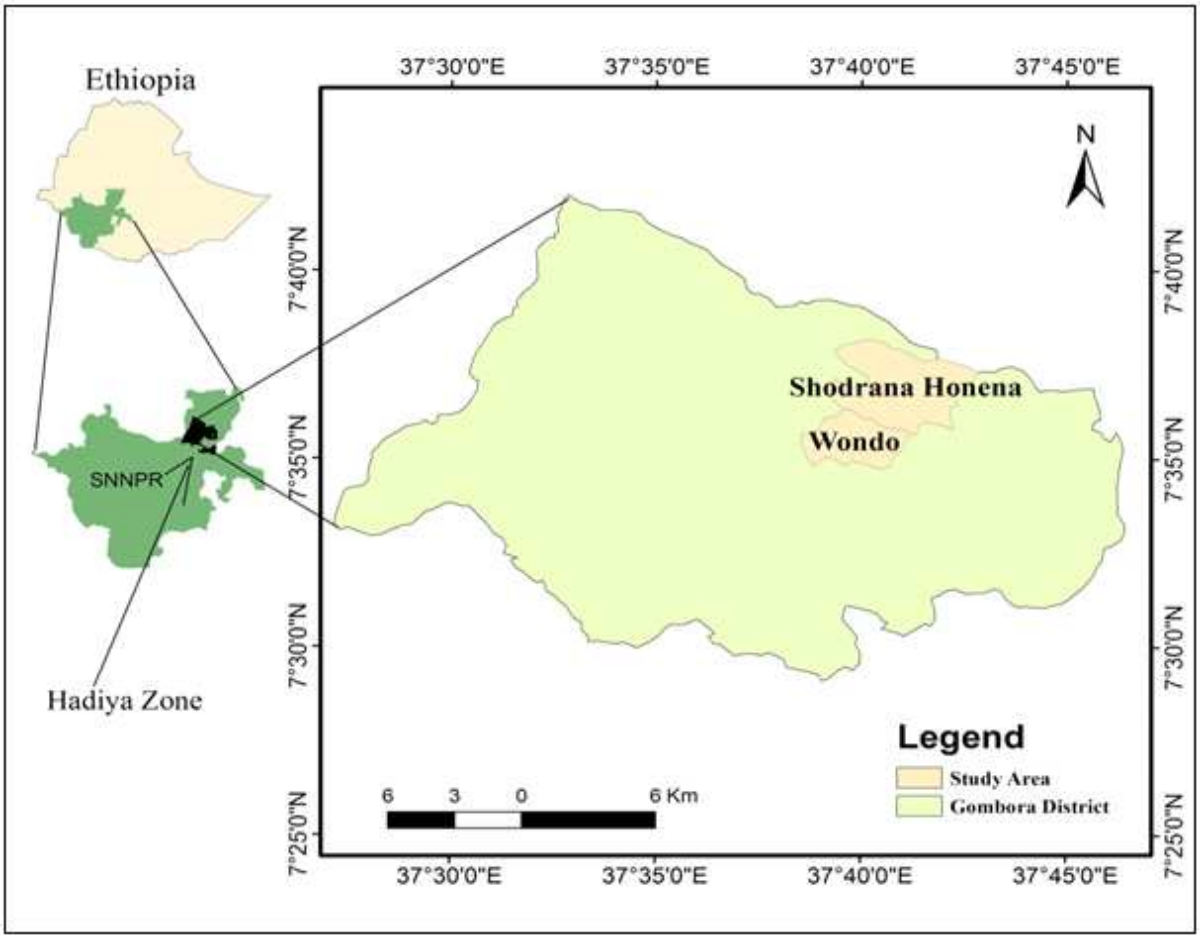

Fig. 1. Map of the Study Area.

Sampling strategy and sample size determination

The target sample households were selected from eight potential *Kebeles* for coffee production based on the location and existence of abundant coffee producers. Of the selected two *Kebeles* was selected purposively. Accordingly, 16 key informants have been selected from the total village of the selected two *Kebeles* (from every four villages 4 key informants were taken). Sample respondent selection was done randomly to select 160 respondents (120 producers and 40 non-producers from each *kebeles*) from primary producers. From each of the selected wealth categories the number of sample households for the interview was determined by using the formula developed by Cochran (1977) cited in Bartlett *et al.*, 2001).

$$n = \frac{z^2 pq}{d^2}$$

Where; n = desired sample size when the population is less than 10,000

Z= 95 % confidence limit (Z-value at 0.05 is 1.96)

P= 0.12 (proportion of the population (HHs) included in the sample i.e. 12 %)

q= 1-0.12 i.e. (0.88), N= total № of population and

d= margin of error or degree of accuracy (0.05).

Data collection

All the necessary data were gathered from the selected household and focus group discussion through the semi-structured questionnaire and field

observation.

Data analysis

The collected data were analyzed both by the descriptive and logistic regression models. Data for the study were analyzed using descriptive statistics such as tables, ratios, means, frequency distribution, and rank percentages. The logistic regression model is a non-linear regression model that has a binary response variable. According to Borooah (2002), logistic regression can be used to estimate odds ratios for each of the independent variables in the model. As such, logistic regression was most appropriate for this study due to its unique ability to account for both categorical and dichotomous dependent variables.

According to Pampel, (2000), the model equation is

Logit (E [Y]) = Logit (P) =X^T β

Where: Logit (E [Y] = is the binary response/independent variable

Logit (P) = the natural log of the odds of success

X^T = the explanatory/dependent variables

β = is the regression co-efficient.

The Logit model was employed to determine factors affecting participation decisions since it was believed to offer a better explanation of the underlying relationship between the decision to participate in coffee production and its determinants independently. The dependent variable in this case is dummy, which takes the value of one or zero. Y=1 if a given respondent participates in production or Y= 0 otherwise.

The Logit model can be mathematically described as

Pi = E(Y=1|Xi) = βo +βiXi .....(a)

Where Y=1 means a given farmer participates in the production

β = the constant and βi, i =1, 2...n are the coefficients of the independent variables to be estimated and Xi = a vector of independent variables.

Results and discussion

Socio-Economic Characteristics of the Sample Households

Age of sample household head: there was one of the demographic characteristics believed to influence participation decision in the production of coffee in the study district. In traditional societies, age serves as an important indicator of the individual's position in society. Older farmers will be in a position to experience much with their traditional farming practices, with age a farmer can become more risk averse to new technologies and are expected to be less responsive to newly introduced agricultural technologies.

Table 1. Age distribution of respondents by participation in production.

Participation in production	N	Mean age	Min	Max	Std. Deviation	t-test
Producer Non-producer	120	48.9	28	65	7.2	4.704*
	40	51.4	30	67	7.9	

Source: Survey result, 2020,

*significant at 10%.

The mean age of the sampled household head for producers and non-producers was 48.9 and 51.4 respectively (Table 1). The majority of both producers and non-producers in the study are between the ages of 40-65 years old. The survey result showed that the difference in mean age between producers and non-producers was statistically significant (t= 4.704) at less than a 10% probability level. The majority of the sampled coffee farmers were above 50 years old, representing about 67 percent; which confirms the findings of Sanusi *et al* (2004) that the average age of farmers was 54 years while the average age of coffee farms was 20 years. The Chi-square test for independence (with Pearson correlation) indicated a positive significant association between age and producer of coffee production.

Table 2. Sex of respondents by participation.

Sex of respondents	Frequency	Participation in production		Chi- square test
Male	N (%)	Producer	Non-producer	
		105 (87.5%)	36 (90%)	
Female	N (%)	15 (12.5%)	4 (10%)	3.2
Total	N	120	40	

Source: survey result, 2020.

Sex of sampled household head

determines access to information provided by extension agents in any agricultural technology, including coffee production. Table 2 below presents the distribution of both groups of households by sex. Of a total of 120 respondents, the majority (87.5%) of household coffee farmers were males, whereas, the remaining were females. Much evidence showed that female households have less access to improved technologies, credit and extension services (Ellis and Mudhara, 1995). Thus, only 12.5% of the female-headed households had access to improved coffee varieties as compared to 87.5% for the male-headed and 90% of the male respondents ever used fertilizer as compared to 10% for females in the non-producers survey made in Gombora district.

Table 3. Sampled household heads by marital status by participation in the coffee production.

Producers(120)			Non-producers(40)		Total(n=160)	
Marital status	N	%	N	%	N	%
Single	0	0	0	0	0	0
Married	113	94.2	37	92.5	150	94
Divorced	2	1.6	1	2.5	3	4.1
Widowed	5	4.2	2	5	7	9.2

Chi-square value= 3.6.

Source: Household survey data 2020.

On the other hand, male-headed households have better access to information than female households which helps for the adoption of improved agricultural coffee production technologies. According to the findings of Negussie *et al.* (2008), this result confirmed the prior expectation that male-headed households have more access to improved technology, updated information, credit and extension services than female-headed households. Therefore, the male status of the household head is positively correlated with the perception of coffee production pre and post-harvest management practices.

Table 4. Family size by participation in coffee production.

Participation in production	Mean	Min	Max	Std. Deviation	t-value
Producer	6.7	3	10	1.4	0.32
Non-producer	6.3	4	8	1.3	

Source: Computed from own survey data, 2020.

*Level of significance at 5%.

Marital status of the households

Regarding the marital status of household heads none of the respondents was single, 186.7 % were married, and 4.1% and 9.2% were divorced and widowed, respectively. Most of the farmers (about 94%) were married and about 83% had a family size of six or more people, indicating that family labour was a potential asset for coffee production in the area.

Table 5. Educational level of sampled household heads by participation.

Educational category of respondents	Participation in production								χ^2
	Producer				Non-producer				
	Count	Min	Max	Mean	Count	Min	Max	Mean	
Illiterate	25 (21%)	0	25	12.5	8 (20%)	0	8	4	2.38
Literate	95 (79%)	2	12	6	32 (80%)	1	9	5	
Total	120 (100%)				40 (100%)				

Source: Computed from own survey data, 2020.

The gender of the household head is found to negatively influence coffee production. Actually, the female would be a farm household head for three reasons: when her husband died (widowed) when her husband migrated when she is unmarried. In case of migration, we expect remittance that could facilitate and finance production possibilities and possible risks associated with coffee production. In the other two cases, it opens a good opportunity for female-headed farmers to carry out frequent follow-up and supervision of their farm; Thus, corroborating the finding of Eghe *et al* (2003).

Table 6. Wealth status of the sampled respondents in their livelihoods.

	Producers	Non producers	χ2- test
Wealth class	Frequency (n=120)	Frequency(n=40)	
Poor	37(30.8%)	9 (22.5%)	3.304*
Medium	40 (33.3%)	13 (32.5%)	
Better-off	43 (35.8%)	18 (45%)	

Sources: the survey results, 2020

* Statistically significant at 5% level.

Family size of the respondents: Table 4 shows that the average family size for producers was 6.7, while the average family size for non-producers was 6.3. Both producers and non-producers have nearly equal mean family size of 6.5. An independent t-test showed that the mean difference in the family size of participants and non-participants of production was not significantly different. Households should provide the labor that is required to participate in coffee production in the case where production is directly through family members. Large family size may be an indicator of the availability of labor provided that there are more people within the age range of the active labor force.

Table 7. Land holding size of respondents (hectare).

Participation in production	Mean	Min	Max	Std. Deviation	t-test
Producer	2.66	0.53	5.2	0.94	2.07*
Non-producer	2.4	0.5	3.75	0.8	

Source: Computed from own survey data, 2020.

Availability of labor in the household is again one of the important resources in agricultural production in general and coffee production in particular. The household who have more family size is favorable to supply more family labour. The study conducted by Kebede *et al.* (2013) in northern Ethiopia reveals that large family size hasa positive impact on farm income.

Educational status of respondents

The education level of farmers was assumed to increase the ability to obtain processes and use coffee production technology in a better way. Education is therefore expected to increase the probability of participation in coffee production activities. It is measured as a binary variable: 1, if the farmer is literate and 0, otherwise. Out of the total sample of the producers, 79.2 % are literate (either formal or informal literate) while out of the non-producers 32 literate sample households 80 % (Table 5). From this result, one can readily conclude that producers are relatively more educated than non-producers taking into account their relative proportion of the total sample household. The Chi-square test for this variable shows that participation in production significantly differs by education level. The educational background of the sample household head was believed to be an important feature that determines the readiness of the household head to accept new ideas and innovations (Mesfin, 2006) explained that the education level of farmers is assumed to increase the ability to obtain; process and use agricultural related information in a better way. The finding of several studies (Zemedu, 2004) revealed that the level of education is a strong and significant determinant of farmers' decision of improved agricultural technologies.

Table 8. Average TLU owned by Sample Respondents.

Participation in production	Mean	Min	Max	Std. Dev	t-test
Producer	11.14	3	19	11.04	
Non-producer	9.9	3	17	9.9	1.03^{NS}

Source: Computed from own survey data, 2020.

NS= not significant.

Wealth status: Table 6 explained the contribution of coffee income within each wealth class poor (30.8%), medium (33.3%) and better-off (43.8%) and poor (22.5%), medium (32.5%) and better-off (45%) of producers and non-producers respectively.

Contrarily, non-producers were not improved their wealth as much as producers so they have a difference among them looking into the chi-square test (χ2- test = 3.304) implies that statistically significant at a 5% level. According to the distribution of respondents by disaggregation based on the criteria such as the poor with household size (6-8), land area cultivated (0.375-0.5ha), perennial crops (100-500 coffee bushes, 50-100 enset stems) and having livestock (0-2 cows, 0-3 sheep ,1-7 hen); the medium: having household size (7-9), Land area cultivated (0.75-2ha), perennial crops (1000-2000 coffee bushes, 200-500 enset stems), and having livestock (1-5 cows, 2-5 sheep ,5-17 hen), and better-off farmers having family size (9-12), land holding (2-5ha), perennial crops (1400-3200 coffee bushes, 400-1200 enset stems), and having livestock (4-12 cows, 3-6 sheep ,2-5 goats, and 10-27 hen) taken from the *kebeles* database.

Table 9. Annual income of respondents from farming.

Participation in production	Mean	Min	Max	Std. Dev	N	Over all t-test
Producer Non-producer	7732.5	3125	12340	5747.37	120	
	5050	2450	7650	5782.74	40	2.82*
Total	6391.25	2787.5	9995	6393.07	160	

Source: Computed from own survey data, 2020

*statistically significant at less than 5% probability level.

Farmland size

Landholding size is also one of the indicators of participation of households in coffee production. The land is perhaps the single most important resource, as it is a base for any economic activity, especially in the rural and agricultural sectors. Farm size influences

households' decision to participate or not to participate in new technologies. It also influences the scale of technology use. Hence, the land holding was hypothesized to have a positive and significant relationship with coffee production.

The mean, minimum, and maximum total cultivated land of producers was 2.66, 0.53 & 5.2ha respectively, and that of non-producers was 2.4, 0.5 & 3.75ha, respectively (Table 7). In relation to this variable, the result of this survey showed that producers have nearly equal mean farmland sizes to non-producers. The independent t-test shows that the difference in mean land holding was also statistically significant at 1% in connection with the above findings, the coffee growers in the study area were categorized into three groups based on their farm size. Thus, farmers who own less than 0.5ha are considered small, between 0.5ha and 1ha medium and more than one ha are large. Moreover, large farmers have been allocating more area for an improved variety of plants compared to small and medium. In other words, the total flow of economic activities using modern technologies was higher for large farmers.

Table 10. Extension services provided to the sampled household heads.

	Producers (n=120)			Non-producers (n=40)			χ^2
Extension service	N (%)	Min	Max	N (%)	Min	Max	
Yes	54(45%)	0	54	14(10%)	0	14	36.35
No	66(55%)	0	66	26(90%)	0	26	
Total	120(100%)			40(100%)			

Source: Household survey data, 2020.

This find consists of the finding of Rogers (1983) who revealed that farmers, who have larger farm sizes, will get higher income from the coffee production system than farmers who have small farm sizes.

Number of livestock owned

Farm animals have an important role in the rural economy. They are the source of food and cash, animal excrement for organic fertilizer and fuel and means of transport. Like in the other parts of the country, livestock husbandry is one component of the farming system in the study areas. The majority of the sample households owned animals of different kinds. The dominant domestic animals reared in the study area include cattle, donkey, sheep, goat, mule, and chicken. The average livestock holding of producers was 19TLU and non-producers were 17TLU. The average livestock holding of producers was relatively higher (11.14) than that of non-producers (9.9) (Table 8). An independent sample t-test was conducted to compare the mean difference in TLU owned by producers and non-producers.

Table 11. Credit services provided to the sampled household heads.

	Producers(n=120)			Non-producers(n=40)			χ2
Credit service	N(%)	Min	Max	N(%)	Min	Max	
Yes	30(25%)	-	30	8(20%)	-	8	0.267^{NS}
No	90(75%)	-	90	32(80%)	-	32	

Source: survey result, 2020.

NS=not significant.

The result showed that the difference in livestock holding between the two categories was not statistically significant. Thus, the number of livestock will have a positive impact on income from the coffee farm. The finding is consistent with the finding of Muhammad (2005) who studied the socio-economic

factors affecting the income of small-scale coffee farms in hill country areas in Yemen and revealed that number of animals consistently influences farm income. Similarly, the study conducted on the contribution of coffee trees in biodiversity conservation and rural needs fulfillment by Khanal (2011) revealed that livestock is a major source of income, manure for agricultural crops and power for plugging and the number of tree species per household increased with the number of livestock units. Finally, he suggested that the existence of a large number of livestock makes a large contribution of income than farmers who have small number of livestock.

Table 12. Sampled household head access to market information.

	Participation in production				*χ^2-test*
Description	*Producer (N=120)*		*Non producer (n=40)*		*1.963**
Availability of market information	*Yes*	*No*	*Yes*	*No*	
	Count	*92(76.3%)*	*9(22.5%)*	*31(77.5%)*	
	28(23.7%)				

Source: Computed from own survey data, 2020.

Annual income from farming

The farm income refers to the total annual earnings of the family from the sale of agricultural produce after meeting family requirements. This is believed to be the main source of capital for purchasing agricultural inputs. Thus, those households with a relatively higher level of farm income are likely to purchase improved seeds or other essential agricultural inputs. In this study, the household farm cash income was estimated based on the sales of crops and livestock and livestock products. With respect to annual income from farming the result of this study also showed that there was a significant difference in annual income from farming between producers and non-producers (Table 9). Those farmers who are engaged in coffee production earn more annual income from farming than non-producers and the difference was found to be statistically significant. Out of the total income of rural farm households 61 percent was earned from farm sources while almost 39 percent came from non-farm sources. This is highly consistent with the work of (Ibekwe *et al.*, 2010). While rural farm households try to diversify their income within the agricultural sector, the highest percentage of such income comes from cropping activities 47.5 percent, followed by livestock activities 13 percent while other agricultural activities were 0.81 percent of the total income shares.

Table 13. Average distance of the respondents from the nearest market center in kilometers.

Decision category	N	Mean	DS	Min	Max	F
Producers	120	7.19	3.12	5.00	12	
Non-producers	40	6.39	2.20	4.00	8	1.39^{NS}

Source: own survey data, 2020

NS= not significant.

Income from off-farm activity

During slack periods many farmers can earn additional income by engaging in various off-farm activities. This is believed to raise their financial position to acquire new inputs. Therefore, in this study, it is hypothesized that there is a positive correlation between participation in off-farm activities and the level of the decision on new crop technologies. It is a dummy variable and takes the value of 1 if a household head participated in the activities, and 0 otherwise. Table 10 showed the average annual income obtained by producers and

non-producers from off-farm activities. Accordingly, producers obtain a larger average income from off-farm activities than non-producers. The t-test result also showed that the difference was statistically significant at less than a 5% level of significance.

Extension service in relation to coffee production

Extension service for farmers helps them to make better decisions on how they can increase production from coffee farms. In the study area, extension services are the most important in making a decision on the production of coffee. The extension is supposed to have a direct influence on the decision behavior of farmers. When there is contact with an extension agent, a greater possibility of farmers being influenced to decide on agricultural innovations. Table 11 shows that among the total sampled households, 45% had access to extension services whereas only 55% had no access to extension services whereas 10% of non-producers had access to extension services and 90% of the non-producers had no access to the extension service respectively.

Table 14. Level of involvement and practices in coffee production of respondents.

Level of involvement & Practices	Frequency (n=120)	%
Size of coffee farm(ha): <0.5	15	12.5
0.5-1	72	60.0
>1	33	27.5
Experience (years): 6-10	29	24.2
11-20	64	53.3
> 20	27	22.5
Cropping pattern: Mixed	37	30.8
Sole cropping	56	46.7
Combined	27	22.5
Land acquisition method: Inherited	113	94.2
Rented	0	0
Leased	0	0
Bought	7	5.3
Source of capital: Friend	7	4.7
Relatives	10	8.7
Personal saving	103	86.6
Source of Market: Government	33	27.5
Cooperative	0	0
Middlemen	87	72.5
Management practices: full maturity stage	92	76.4
Selective hand picking	75	62.8
Packing in jute bags	95	79.0
Daily laborers	71	59.0
Harvesting coffee: family members	49	40.8
Storage facilities : existing store	67	55.7
Lack of store	61	51

Source: own survey data, 2020.

In the study sites of this research, extension advice in relation to coffee farms much of the focus was also on the production of coffee and less on post harvesting and handling of the products. Comparing the percentage of producers and non-producers with respect to exposure to extension contact the chi-square analysis proved the existence of a statistically significant difference between the two groups, at less than a 1% level of significance ($\chi^2 = 36.35$). Extension services are also important to expand the knowledge and skills of farmers to increase income. This is in line with the study by Kebede *et al.* (2013) who revealed that an increase in extension services in the farming system is found to increase income. Similarly, the study by Goitom (2009) states that membership in an extension service program is

positively associated with total crop production value because it extends from the provision of technical advice on farming issues such as what to produce, how to produce and when to produce, to facilitate credit availability and input supplies and even to the provision of market information and capacity building training to farmers.

Access to credit

One way of improving farmers' access to new production technology. Farmers' ability to purchase inputs such as improved variety and fertilizer is particularly important. The formal sources of credit in Ethiopia are the office of agriculture, Service Cooperatives and NGOs. Farmers who have access to credit can minimize their financial constraints and buy inputs more readily. Thus, it is expected that access to credit can increase the probability of participating in an improved variety of technologies. Furthermore, farmers obtain credit from informal sources, mainly from relatives, friends and local money lenders. Out of the sampled respondents, 25% of producers and 20% of non-producers obtained credit services from different financial institutions (Table 12) respectively. The Pearson chi-square test also proved that there was no statistically significant difference between the two groups of the sample household with respect to general credit service even at less than a 10% level of significance ($\chi^2 = 0.267$).

It is believed that timely access to institutional credit would alleviate the problem of cash constraint for timely usage of seasonal inputs thereby encouraging farmers to decide on improved agricultural inputs which in turn raise agricultural productivity. The result confirms prior expectations and also findings of previous research (Legesse, 1992; Wolday, 1999; Mulugeta, 2000).

Table 15. Benefits obtained by participating in coffee production.

Benefits	Frequency	%	Monetary value (birr)
Food items	45	38	87,940
Shortage of finance (for loan payment)	18	15	59,176
Cash in bank (for saving purpose)	12	10	42,784
Livestock holding/purchasing	29	24	54,228
Material purchasing (clothes, inputs, Seed, housing, etc)	37	31	66,084
Participation in equb	23	20	37,836
For schooling purpose	32	27	47,424
Total	120	100	395,472

Source: own survey data, 2020.

Access to market information: The availability of market information in relation to coffee production was expected to vary between producers and non-producers. Table 13 indicates that among the total sampled households, 24% had access to market information service whereas only 76% had no market information service whereas 23% of non-producers had market information services and 77.5% of the non-producers had no market information service respectively. Accordingly, chi-square analysis was employed to look at whether there exist such variations or not between the two groups. The Pearson chi-square test also showed that there was a statistically significant difference between the two groups of the sample household with respect to the availability of market information even at less than a 10% level of significance ($\chi^2 = 1.963$).

Access to market distance

Farmers near the market center could get more hot and vital market information and may also participate in other income-generating activities that could ease resources used in the maintenance of matured coffee trees and thereby enhance productivity.

Table 16. Maximum likelihood estimate from logistic regression model for participation decision in coffee production.

Explanatory variables	Coefficient	Wald statistics	Standard error	Odds ratio
Sex of respondent (SEX)	1.108**	4.754	0.508	0.330
Age of respondent (AGE)	-0.013	0.789	0.014	0.987
Educational status of respondent(EDUCAT)	-0.177	0.259	0.348	0.838
Family size (FAMSIZE)	0.051	0.329	0.090	1.053
Extension contact (EXTCONTA)	1.637***	21.338	0.354	5.138
Access to formal credit (CREDIT)	-0.773**	5.411	0.332	0.462
Market distance (MARKDIST)	-1.099**	6.969	0.416	0.300
Annual income from farming (FARMINCOME)	0.000*	3.216	0.000	1.050
Farm land size (LAND)	0.166**	5.978	0.068	1.180
Number of livestock (LIVESTOCK)	0.015	0.439	0.023	1.015
Off-farm income	0.000	3.389	0.000	1.000
Availability of market information (MKTINFO)	-6.752	2.433	4.329	0.001
Percentage correctly predicted		67.4		
Omnibus test of model coefficient: Chi-square value		69.356***		
-2 Log Likelihood		133.9		
Sample size		120		

Source: model output

***, **, * represents level of significance at less than 1%, 5%, and 10%.

Regarding the distance taken to travel from home to the nearest marketplace, sample farmers reported that they had to travel an average of 6.79 km with a standard deviation of 2.83 km. For sample respondents, the minimum and the maximum distance that a farmer had to travel to access the market center were 2.5km and 10km respectively. The mean distance traveled to the nearest market centers by producers and non-producers was 7.19km and 6.39km respectively (Table 14). Markets are communication centers both for producers, consumers and traders. In this study, it is hypothesized that the distance between the respondent's residence and the nearest marketplace (measured in kilometers) is negatively correlated with the decision to decide on newly introduced crop varieties. Results of the one-way analysis of variance /ANOVA/ (F=1.39 and reveals that there is no statistically significant mean difference among decision categories. The result of this study is inconsistent with the findings of many other researchers who reported that market distance is negatively associated with adoption of crop technologies Yishak (2005), which were conducted in different parts of Ethiopia.

Farmers' Practices in Smallholder Coffee Production

The majority of the farmers (about 48 percent) were growing coffee as the sole crop; which might have implications for the mechanization of coffee farms in the area (Table 15). About 37 percent intercropped coffee along with other crops like enset, banana, chat, cereal crops among others. The results that about 29 percent of the farmers had a minimum of ten years of experience in coffee production, and about 94 percent acquired land through inheritance; suggest that most

of the coffee trees would be relatively old as they were probably inherited along with the farmland. Access of farmers to market was through the middlemen (about 73 percent), Government agents (about 28 percent). Sanusi *et al* (2004) and Eghe *et al* (2003) reported that farmers found it difficult to market their coffee beans and this could have a serious implication on their income. The method of coffee production in the study area was sole cropping and most of the farmers made a maximum harvest of coffee at the age of eight years. The size distribution patterns of holdings reveal that majority of the sample farmers (48%) were medium 31% large and 23% small. There was a significant difference between small and medium farmer groups and also between medium and large groups at a 10% level and between small and large farmer groups at a 5% level in the average coffee area per household, average production per household and average area with improved variety coffee area per household.

Table 17. Percentage Distribution and Mean Scores of Constraints on Coffee Production.

Constraints	Percentage distribution by score			Mean score	Percentage Mean score
	Very serious	Serious	Not Serious		
Disease	66.7	26.7	6.7	1.40	46.67
pest	66.7	25.3	8.0	1.41	47.1
Lack of land	17.3	6.7	6.7	1.3	43.6
Lack of capital	41.33	34.7	14.67	1.72	57.33
Weed control	19.33	40.0	41.3	1.69	56.44
Access to farm credit	40.0	37.3	13.33	1.64	54.6
Labor shortage	50.67	36.00	4.0	1.44	48.00
Reduction of farmers income	42.67	41.33	6.67	1.57	52.44
Poor processing	50.67	26.67	13.33	1.68	56.00
Low coffee price	44.00	37.33	10.67	1.57	52.44
Poor access to market information	41.33	36.00	22.67	1.87	62.22
Inefficient extension service	29.33	48.00	13.33	1.72	57.34
Drought	42.67	46.67	2.67	2.28	36.00
Average				1.84	61.18

Source: Field survey, 2020.

The majority of the surveyed farmers were exercising better harvesting and post-harvest management practices in terms of harvesting at full maturity stage (76.4%), selective hand picking (62.8%), and packing in jute bags (79.0%), which maintain the inherent coffee quality. On the contrary, 51% of the interviewed farmers lacked storage facilities and 55.7% stored their coffee for more than four months, which is considered a coffee production deteriorating factor. Obiero (1996) reported that storing dried parchment coffee for more than six months resulted in a woody flavor, which lowers quality. Wintgens (2004) further indicated that green coffees stored for a longer period described as 'aged' may suffer a loss of their acidity. Length and condition of bean storage also affect cup quality (Yigzaw, 2005). Moreover, long time storage under high relative humidity and warm conditions increases bean moisture content and consequently reduces quality in terms of raw and roasted appearance as well as liquor (Woelore, 1995.) On the other hand, in terms of labor used in coffee harvesting, the result showed that the majority, 59.2% (71) of coffee farmers harvest their coffee by hiring daily laborers while only 40.8% (49) respondent farmers harvested their coffee by themselves.

Coffee harvesting by daily laborers may contribute to the deterioration of coffee quality due to careless harvesting of ripe and unripe green berries collectively.

Socioeconomic aspects of smallholder coffee production

Coffee production is an important source of income and employment in Gombora district. Coffee produces income for a number of small farmers and their families, who are often totally dependent on the crop for their livelihood. Coffee-producing farm households are considered to be relatively better off in cash earnings than non-coffee-producing farm households in the areas. However, their earnings depend on seasons and surplus at a good harvest. Households are affected differently in response to fluctuating coffee incomes, whether occasioned by declining coffee prices or others. The coffee production systems was located as a garden or homestead coffee farms and the type of coffee variety cultivated were mainly Arabica coffee and crop types like teff, wheat, maize, sorghum, etc and with the vegetables like enset, avocado, mango, chat and so on. In the study area, 19% of the respondents keep coffee for scarcity time and as a gift for relatives beside to this 23% it is used for consumption and 58% for selling. The result shows that producers have improved their livelihood for instance, 44% of the respondents have got the ability to buy clothes, food items, and pay school and medical fees for their families. Similarly, 27% of the respondents have got the capacity to save, purchase housing materials and construct their houses respectively. The additional advantage of participating in coffee production presented in Table 16 shows about 10% of these farmers have bought additional inputs, animal feed and social acceptance due to additional money. Similarly, 14% for loan payment and 7% for the trading purpose was used. From the following table, one can analyze benefits obtained from coffee production for the producers rather than non-producers identified during the survey year.

Econometric analysis of determinants on smallholder coffee production

Logistic regression results: The estimates of the logistic regression models are significant at less than 1%, 5% and 10% probability levels. This indicates the existence of useful information in the estimated models. The chi-square test for the goodness-of-fit was also tested. The Chi-square test for goodness-of-fit compares observed and predicted values of significant exploratory variables. Out of the hypothesized explanatory variables, 6 were found to significantly determine the probability of being a participant in Coffee production. The significant variables are discussed below. The chi-square value for the omnibus test of model coefficients ($\chi 2$) of 69.356 was significant at less than a 1% level of significance and the model predicts about 67.4% of the response of interviewees from the research sites correctly. The last column represents the odds ratio which explains the effect of the independent variables on the participation decision of farmers. This odds ratio represents the amount by which the odds favoring the decision to participate in production (being producer) change for the change in that explanatory variables. Here the probability of being a participant in production due to the significant factors will be discussed.

Constraints on smallholder coffee production

The major constraints on coffee production with a percentage mean score between 50 percent and 65 percent; were poor access to market information, lack of capital, inefficient extension services, poor weed control, poor processing, poor access to farm credit, low income from coffee, and low world price; in descending order. The constraints that were indicated as being less serious, scoring less than 50 percent include diseases and pest infestation, labor shortage and lack of access to land. This result suggests that lack of access to farm credit and capital prevented the farmers from proper maintenance practices including poor weed control, thereby exposing the farm to low output. The incidence of drought also further complicates the situation as it predisposes the coffee farm to intense nutrient and water scarcity.

Moreover, inefficient extension services deprived them of the opportunity of the necessary information and skills that would have helped them improve their output level. These findings are similar to the findings of Eghe *et al* (2003).

Among agronomic and physiological factors affecting coffee production and yield, age of coffee trees, pruning, weed control, disease occurrence, and application of compost were assessed in this study. Hence, the result of the field survey showed that among 120 coffee farmers interviewed 70.6% (85) owned old coffee trees (>15 years), while 29.4 % (35) of them owned coffee trees less than 15 years old. Yigzaw (2005) reported that samples from young trees are likely to be mild and thin, but fine in flavor. Medium-aged trees, 15 to 20 years old, bear beans with good flavor as well as acidity and body. Similarly, in this survey, it was observed that even though the majority of coffee plantations in the farmer's hand were greater than 15 years old, only 27.5% of respondent coffee farmers practiced maintenance pruning. Coffee tree pruning is an extremely important pre-harvest activity for reducing incidences of diseases and modifying air movement within the plantation, which in turn reduces leaf drying time. On top of that, it was identified that the majority of coffee farmers (66.7%) and (71.2%) responded to the occurrence of disease and no application of compost in their coffee fields, respectively.

Conclusion

The model identified six variables which are positively and significantly affect income earned from coffee production practice. These variables were the sex of the respondent, farm size, and extension service, access to credit, market distance and income from farming. The economic-related constraints were lack of capital, poor market information, poor market network, low coffee price, and reduction of income; environment-related constraints were pests and disease infestation, shortage of rainfall and drought; attitudinal constraint was in terms of farmers' belief in demonic influence on poor performance of coffee farms, poor processing, weed control and labor shortage; and the institutional constraints were in terms of lack of access to farm credit and inefficient extension service. Thus, it was concluded that if the younger generation farmers were encouraged and given incentives in terms of adequate access to inputs, information and skills required for better agronomic and management practices as well as market information and linkage established, their level of involvement in coffee production and its profitability might increase. This would generate more revenue for the farmers and the government thereby contributing more to the gross domestic product and national economic development. An increase in farmers' income would contribute to improved rural livelihood, and increased coffee production would also increase the availability of coffee for domestic and export markets. The study revealed that farm income was found positive and significant influence on participation in coffee activities. Therefore, supports and subsidized inputs should be provided for rural farm households to improve coffee production. Accurate, reliable and timely information about agricultural production like coffee crop has also great importance.

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