





1. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial E(AI_i)}{\partial X_i} = F(z)\beta_i \tag{3}$$

Where,  $\frac{\beta_i X_i}{\sigma}$  is denoted by z, following Maddala, (1997)

2. The change in the probability of adopting a technology as independent variable  $X_i$  changes is:

$$\frac{\partial F(Z)}{\partial X_i} = f(z) \frac{\beta_i}{\sigma} \tag{4}$$

3. The change in the intensity of adoption with respect to a change in an explanatory variable among accessed (utilized)

is:

$$\frac{\partial E(AI_i / AI_i^* > 0)}{\partial X_i} = \beta_i \left[ 1 - Z \frac{f(z)}{F(z)} - \left( \frac{f(z)}{F(z)} \right)^2 \right] \tag{5}$$

Where,

- F (z) Is the cumulative normal distribution of Z,
- f(z) Is the value of the derivative of the normal curve at a given point (i.e., unit normal density),
- Z Is the Z score for the area under normal curve,
- $\beta$  Is a vector of Tobit maximum likelihood estimates and
- $\sigma$  Is the standard error of the error term?

Before running the Tobit model all the hypothesized explanatory variables were checked for the existence of multi-co linearity problem. Two measures often suggested testing the existence of multi-collinearity. These are: Variance Inflation Factor (VIF) for association among the continuous/discrete explanatory variables and contingency coefficients for dummy/categorical variables. In this study, variance inflation factor (VIF) was to test multi-co linearity problem for continuous/discrete and dummy/categorical variables.

According to Maddala (1992), VIF can be defined as:

$$VIF (X_i) = \frac{1}{1 - R_i^2}$$

Where  $R_i^2$  is the squared multiple-correlation coefficient between  $X_i$  and the other explanatory variables? The larger the value of VIF, the more would be the problem, as a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if  $R_i^2$  exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995). Tobit using computer software (STATA) and insignificant variable was dropped and all significant variables were included in to the Tobit model.

### 3. Results and Discussion

This chapter consists of the overall findings of the study under adoption and intensity of use of coffee technology package. In this chapter the status of adoption and intensity of use of coffee production package, current practices of coffee technology package are discussed in detail. Subsequently, the influence of different personal, demographic, socio-economic, institutional and psychological factors on the adoption and intensity of use of coffee technology package were discussed consecutively.

#### 3.1 The status of adoption and intensity of use of coffee production package

**Table 2:** Distribution of respondents by level of adoption of coffee technology package

Adopter Category	N	Index			F
		Percent	Score	Mean	
Non	20	12.5	0	0	
Low	11	6.87	0.35-0.57	0.48	
Medium	43	26.88	0.58-0.78	0.69	
High	86	53.75	0.79-1.00	0.88	
<b>Total</b>	<b>160</b>	<b>100</b>	<b>0.00-1.00</b>	<b>0.69</b>	<b>1232***</b>

Source: own survey data, 2011; \*\*\*the mean difference is significant at 1% level.

**Table 3:** Descriptive statistics among Low, Medium and High adoption categories

	Adopter Category			
	N	Mean	S.D	F
<b>Adoption of Coffee varieties</b>				
Low	11	0.35	0.15	
Medium	43	0.41	0.18	6.408***
High	86	0.52	0.22	
<b>Compost application Rate</b>				
Low	117.85	4.64	1.12	
Medium	4330.71	4.14	1.08	2.284 <sup>NS</sup>
High	8661.43	4.54	1.04	
<b>Weed Management</b>				
Low	117.86	3.00	0.45	
Medium	4330.71	3.65	0.72	54.518***
High	8661.43	5.23	1.10	

Source: own survey data, 2011; \*\*\* and NS the mean difference is significant at 1% level and no significant difference

**Table 4:** Descriptive statistics among Low, Medium and High adoption categories

	Adopter Category						Chai square (χ <sup>2</sup> )
	Low		Medium		High		
	N	%	N	%	N	%	
<b>Pruning Practices</b>							
Yes	54	55.5	27	62.8	77	89.5	109.77.9
No	65	45.5	16	37.2	9	10.5	31.22.1 19.164***
<b>Spacing Practice</b>							
Yes	6	54.5	31	72.1	80	93	117.83.6
No	5	45.5	12	27.9	6	7	23.16.4 16.472***

Source: own survey data, 2011; χ<sup>2</sup>= 19.164\*\*\*, df=2, p=.000

**3.2 Descriptive Results**

**Table 5:** Descriptive statistics among Low, Medium and High adoption categories

	Adopter Category					(χ <sup>2</sup> )
	None	Low	Medium	High	Total	
	%	%	%	%	%	
<b>Sex</b>						
Male	65	64.6	89	7	98.1	81.87
Female	35	35.4	10	3	1.9	18.12
						0.365***
<b>Access to credit</b>						
Yes	10	45.5	8	6	95.3	78.8
No	18	55.5	14	4	7	21.2
						79.304***
<b>Radio Listening Habit</b>						
Yes	9	08	1	8	95	3
No	10	18	2	4	7	5.8
						2.985 <sup>NS</sup>

Source: own survey data, 2011; \*\*\*, and NS significant at 1 and non-significant respectively

**Table 6:** Descriptive statistics among Low, Medium and High adoption categories

	Adopter category				F
	Non	Low	Medium	High	
AGE	44.70	43.09	46.02	48.91	1.927 <sup>NS</sup>
EDUCATION	2.35	4.09	4.39	6.50	21.058***
FAMILY SIZE	4.35	6.45	6.47	6.89	9.734***
LABOR	1.23	1.73	1.96	2.19	4.960*
LANDSIZE	1.40	1.39	1.53	1.61	2.303*
LIVESTOCK	1.96	0.74	1.05	1.95	4.337***
ANINCOME	7601	11455	12870	16127	11.304***
DISMARKET	2.43	2.23	1.58	0.69	26.143***
CONTEXTEN	1.10	0.91	1.05	1.22	2.422*
SOCIAPART	10.45	9.82	11.69	16.57	23.546***
COSMOP	1.70	0.64	1.58	2.71	23.204***
ACHIMMOT	12.50	14.73	15.86	16.69	28.557***
ATTITUDE	33.75	30.46	33.42	36.05	13.378***

Source: own survey data, 2011; \*\*\*, \* and NS significant at 1, 10% and non-significant respectively

**Table 7:** Determinants of adoption and intensity of use of coffee technology package

Variable	Estimated Coefficient	Standard Error	T-ratio	P-value
Constant	-.143	148	-0.96	0.337
SEXHH	.045	031	1.44	0.152
AGEHH	-.002	.001	-1.51	0.134
EDUCHH	.018	.005	4.03***	0.000
SOCIALPT	.008	.003	2.76***	0.006
RADIOHB	.012	.042	0.29	0.772
COSMOPLT	.002	.012	0.18	0.856
LIVESTOCK	.001	.008	0.08	0.939
FAMSIZE	.003	.005	0.72	0.473
LABORAVAL	.023	.010	2.26**	0.026
ANINCOME	-2.37	1.83	-0.13	0.897
FARMSIZE	.054	.023	2.39**	0.018
PARTRAIN	-.017	.033	-0.53	0.600
ACCESSCR	.072	.029	2.44**	0.016
DACONTACT	-.017	.025	-0.69	0.490
DISMARKET	-.034	.013	-2.59**	0.011
ACHIMMOT	.034	.007	5.25***	0.000
ATTITUDE	.000	.000	0.47	0.637
Sigma		.1992136		.012357
Log likelihood	= 76.507161			
ANOVA based fit measure (R <sup>2</sup> )	= 0.6387			

Source: Model output, \*\* and \*\*\* represents significance at 5% and 1% level respectively.

**Educational level of the household head**

As expected, education was positively and significantly influencing the probability of adoption and intensity of use of coffee technology package at 1% significant level. Generally education is thought to create a favorable mental attitude for the acceptance of new innovation and practices. It enhances farmers' ability to acquire, analyze, interpret and use information relevant to the adoption of agricultural innovations. The result of the analysis indicated that an increase in years of schooling increases the probability of adoption and intensity of use of coffee technology package by 1.8%. This suggests that farmers with higher educational background would have better opportunity to access information and can easily understand the benefit of improved coffee technology and apply the technologies as per the recommendation. This result supports the findings of earlier researches on technology adoption by [9, 10, 11] who reported positive and significant influence of household heads' educational level on adoption and intensity of use of improved technology package.

**Social participation (SOCIALPT)**

Social participation plays a crucial role in technology adoption. The model indicated that farmers who have participation in social activities were hypothesized to have more opportunity of getting access to information and adopting technologies better than the non-participants. The marginal effect from the model result shows that a one unit variation of social participation increases the adoption and intensity of use of coffee technology package by 0.79%. The finding of the current study is in agreement with the previous works of [12], which indicates interpersonal network as a core component in technology diffusion process since it have the

capacity to create information exchange between those individuals who have already adopted an innovation and those who are then influenced to do so. In this study also, social participation was considered to influence adoption positively. It is a social asset that creates an opportunity to share experience and exchange information on innovations in the farming community. This imply that strong social participation lead to have better access of information and technologies then lead to better technology adoption.

#### Labor availability (LABORAVAIL)

Labor availability was found statistically significant at less than 5% probability level with the expected value and positively related with adoption and intensity of use of coffee technology package. The model result confirms that households with high labor availability in man equivalent are more likely to register better adoption and intensity of use of coffee technology package than households with low labor availability in adult equivalent. The likelihood estimation indicates that the probability of adoption and intensity of use of coffee technology package increases by 2.2% as labor availability increases by one man equivalent unit. The result of this study was consistent with the finding of many other researches which were conducted in different parts of the world, as well as agrees with the ideas mentioned in the hypothesis part of this research.

#### Farm size (FARMSIZE)

The model output revealed that farm size had positive and significant influence to the probability of adoption and intensity of use of coffee technology package at less than 5% significant level. The finding in this study supports the hypothesis that farmers with large farm size are more likely to adopt coffee technology practices/packages than those farmers who have small land holding. The marginal effect from the model result shows that an increase in unit measure of the landholding increases the probability of adoption and extent of use of coffee technology package by 5.4 %. This research supports the finding of earlier researches on technology adoption.

#### Market distance (DISMARKET)

Distance from nearest market center was assumed to influence coffee technology package. The finding of this research as given in (Table 21) agrees with the hypothesis in that distance from market is negatively and significantly associated the probability of adoption and intensity of use of coffee technology package at less than 5% significance level. The negative association suggests that the likelihood of adopting coffee technology package declines as the distance from market center increases. The possible reason might be farmers nearer to market center have access to production inputs and the incentive to output market than those at far distant. This can be explained as market distance increases, farmers may incur more costs for transport, spend time and energy consumption, which increases total production cost and thereby contribute for low final return or profit of the farmer. Consequently, farmer initiation for adoption of new coffee technology package would declines. For a unit increase in market distance, the probability of adopting and use extent of improved coffee technology package will decrease by 3.4 %.

#### Access of credit (ACCESSCR)

Access of credit was also another institutional variable that was found to have significant influence on the probability of adoption and intensity of use of coffee production packages at less than at 5% level of significance. The model result shows that credit use was found to have larger contribution compared to other independent variables i.e. the variable accounted for a 7.2% of the variation in adoption and intensity of adoption of coffee production package. This has an implication that credit availability helps farmers to relax their limited resources for purchasing agricultural inputs. Service cooperatives distribute various types of agricultural inputs on credit basis that requires 50% down payment. In this case, only those farmers who possess cash at hand can benefit from formal credit. On the other hand, farmers who have no cash at hand will be devoid of the opportunity. Therefore improving performance efficiency of actors which are dealing with credit services is pertinent and looks for solutions to correct the defects associated with credit system.

#### Achievement motivation (ACHIMMOT)

Achievement motivation is something that causes a person to make an effort to become successful and be goal oriented and found to influence significantly the probability of adoption and intensity of use of coffee production packages at less than 1% level of significance. The model output result revealed that a one unit variation in the achievement motivation increases the adoption and intensity of use of coffee technology package by 3.43%. This explains that a strong need for achievement leads for better technology adoption.

**Table 8:** Effects of change in the explanatory variables on probability of change adoption and intensity of use of coffee technology package

Variable	Change in Probability of the Adoption	Change in Intensity of Adoption	Change Among whole
EDUCHH	.0004	.0181	.0181
SOCIALPA	.0002	.0079	.0079
FARMSIZE	.0012	.0541	.0541
LOBORAVA	.0005	.0226	.0227
ACCESSCR	.0034	.0719	.0721
DISMARKET	-.0008	-.0335	-.0336
ACHIMMOT	.0009	.0343	.0344

Source: Model output, 2012

The results computed in Table 8, indicate that the estimated increase in the probability of change on adoption and intensity of use of coffee technology package resulting from a unit change in schooling level is about 0.04% and 1.81% respectively. The overall change from this variable is .0181. The model result confirms that households with high participation in social activities are more likely to change on adoption and intensity of use of coffee technology package was .0079 with the probability of change on adoption and intensity of using coffee technology package increases by 0.02% and 0.79% as social participation increases by one unit respectively (Table 8).

The marginal effect of Tobit model analysis showed that the effect of farm size on adoption and intensity of use of coffee



technology package was .0541; a unit increase in the farm size of the household head increases the probability of change on adoption and intensity of use of coffee production package by 0.123% and 5.41% respectively.

Labor availability was found statistically significant at less than 5% probability level with the expected value and positively related with adoption coffee technology package. The model result confirms that households with high labor availability in man equivalent are more likely to change on adoption and intensity of use of coffee technology package was .0227 with the probability of change on adoption and intensity of using coffee technology package increases by 0.052% and 2.26% as labor availability increases by one man equivalent unit respectively.

The marginal effect of access of credit on the overall coffee production package adoption was .0721. Table 8 above showed that access of credit increased the probability of adoption and intensity of adoption of coffee technology package by 0.34% and 7.19% respectively. The effect is very immense as compared to the changes resulting from other significant variables implying that priority should be given to improving credit service provision system.

The result of this study also shows that distance from market center had negative significant effect on adoption and intensity of use of coffee technology package. As show in Table 7, the overall effect of this variable on adoption and intensity of use of coffee technology package was -.0336, and a unit increase in distance away from the market center decreases the probability of change on adoption and intensity of use of coffee technology package by -0.078% and -3.35% respectively.

The model result showed (Table 8) that the marginal effect of achievement motivation on adoption and intensity of use of coffee technology package was .0344, and if farmers have positive motivation toward coffee technology package, the probability and intensity of use of coffee technology package are increased by 0.078% and 3.43% respectively.

#### 4. Conclusion and Recommendations

In the study area Arabica coffee (Coffee Arabica L.) is an economically important cash crop, which serves as a major means of income for the livelihood of coffee producing families in the study area. Moreover, the crop plays a paramount role in the economy of Ethiopia contributing the highest of all export revenues in the country. So that, institutional supports should be given to the sector, such as credit service, research and extension were not to the expected level. These factors coupled with other household personal, demographic, socio-economic and psychological factors greatly affected the adoption and intensity of use of coffee production packages and consequently production and productivity of the sector.

As illustrated above, in this particular research the Tobit model revealed that level of education, social participation, farm size, labor availability, credit access and achievement motivation were found to have positive and significant effect

on the adoption and intensity of use of coffee technology package. Contrary to this, access to market had shown negative and significant influence on the adoption and intensity of use of coffee technology package. However, all of the variables considered in this study were found to have relatively more effect on intensity than probability of adoption.

Our result suggested that participation of farmers in different formal and informal organization like peasant association, informal associations (IDER, Ekub, Mahber and others, farmer's cooperatives and women's association has to be strengthened so as to improve farmers' access to information and adoption of technologies. Different coffee technology package with relatively less labor requirements should be designed. Attention should be given to developing infrastructure and transportation availability. Moreover, organizing and strengthening producers', co-operatives will ease procurement of inputs and sale of outputs in collective basis and will help to overcome market barrier to some extent. Barriers on the supply-side of credits (high interest rate, down payment, etc.) should be overcome if a genuine major means of income for the livelihood of coffee farming families is to be achieved in the study area. Generally, it is enhancing and promoting the overall national economy. The concerned bodies should be formulating a strategy for rewarding and recognition like green certificate, financial and material support for those farmers who are genuinely successful and be goal oriented.

In general, the result of this study indicated that adoption and intensity of use of coffee technology package was the result of many interplay of several factors, which needs much due attention by the stockholders in the provision of shade, pruning, fertilizing (such as compost, manure, etc) spacing, seed preparation, weed management and soil and water conservation need to be integrated to achieve a sustainable production system.

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**Experience:** I have been working as Senior Lecturer in Dilla University at the department of Agricultural economics from 11/09/2007 up to now. On top of this, since 2014 I have been working as a department head of Agricultural economics. Moreover, I was working as Senior Lecturer in Dilla Agricultural TVET College for the last five years. In addition to all the above, I was also worked as Farm Management Expert in Bench Maje Zone specifically in Beftue (Gurafereda) woreda in Agricultural and Rural Development Office for eight months. In addition to my teaching duties, I have also provided training on Communication, Facilitation and Networking Skill and Farm Management and Practical Extension Methods for SNNPR, Oromia and Harare regional office of agriculture.

**Training:** I have a Certificate on Computer Application from Negallgn Computer Training Center. I am trained on Ethics and Anti- Corruption Training by Haramaya University and Federal Ethics and Anti- Corruption Commission, and I do have taken training of trainers' courses in Communication, Facilitation and Networking Skills with the collaboration of Ministry of Agricultural and Rural Development and Rural Capacity Building Project.

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