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DETERMINANTS OF ADOPTION OF CERTIFIED COCOA PRODUCTION IN MEME DIVISION, SOUTH WEST REGION OF CAMEROON

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ABSTRACT

This paper examines the determinants of adoption of certified cocoa production with a view to find means increase the pace of adoption of certified cocoa production in order to improve on the livelihood of cocoa farmers, carried out in Meme division, South West region of Cameroon. The multistage purposive and random sampling technique was used to get a sample of 400 cocoa farmers or producers, from whom necessary information were elicited using questionnaires. Data was analyzed with descriptive statistics and binomial logistic model. The results revealed that 26% of respondents have adopted certified cocoa production with the performance and penetration index of 1%. Moreover the results also revealed that age of respondent, productivity, access to extension services, access to credit, off-farm income, profitability and farm size were statistically significant factors influencing adoption of certified cocoa production. Also level of education, marital status, access to input and perceived risk were positive and statistically not significant factors the influence adoption of certified cocoa production while gender and household size were not statistically significant and negatively influence adoption of certified cocoa production. It can be concluded that the main hindrance of adoption certified cocoa production is inadequate sensitization. This implied that awareness creation by the actors is inadequate. It was recommended that sensitization of farmers should reinforced and also all factors that significantly affect adoption of technologies be improved.

Keywords: Certified cocoa production, Adoption, Livelihood, Farmers, Meme division

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1. INTRODUCTION

Agricultural commodities constitute the engine of economic growth in rural areas of many emerging markets and account for about 10 percent of developing countries' gross domestic product (Wessel & Quist-Wessel, 2015). In general, basic agricultural commodities in most developing countries are produced in smallholder farms in rural areas (Ellis, 2000). These smallholder rural farmers constitute 70 percent of the world's poor (Wessel & Quist-Wessel, 2015). Worldwide, there are roughly 50 million smallholder farmers engaged in the production of key – commodities such as cocoa, coffee, tea, and cotton (Wessel & Quist-Wessel, 2015).Therefore, the sustainability of commodity trading a multi-billion dollar industry, largely relies on low-income smallholder farmers (Wessel& Quist-Wessel, 2015)

Cocoa belongs to the family *Sterculiacaea* and of the genus *Theobroma* was discovered in 18th century at the Amazon basin and later spread to the other tropical areas of South and Central America, and West Africa (Opeke, 1987). Cocoa is an important crop for consuming and producing countries and it is estimated that at least 5 million smallholder farmers work on cocoa plantations worldwide providing a living for roughly 40 to 50 million people. Cocoa is the principal ingredient in chocolate which is grown on millions of small, family- run farms worldwide. In Cameroon as a whole and in Meme division in particular, cocoa production is the most lucrative economic activity for the rural population (Minader, 2018). It has also served as a source of employment for many smallholder farmers

Since the 1980s there has been a change in the attitudes towards food production and rural development projects where the focus on sustainable development, environmental concerns, quality products, issues of fair ethical trade and corporate social responsibility (CSR) has increased (Williams *et al.*, 2009). Similarly, there is growing consciousness among consumers as the quest for quality products has become the global norm, as highlighted by (Papaoikonomou *et al.*, 2016). Papaoikonomou *et al*. (2016), there is growing belief among consumers that certified food products minimize adverse effects on humans as well as on the natural environment. For sure, through social interactions, there will be at where consumers would reject non-certified food products or food production from doubtful sources. Papaoikonomou *et al*. (2016) supported this by stipulating that through group social interactions, ethical consumers influence new learning within the ethical community. These consumers are seemingly influential and efficient at creating a social circle which might lead to the reduction or complete rejection of a particular product which is not certified or which is not from standard and sustainable sources.

Cocoa certification have evolved globally in the past decades until there are prospects of not consuming cocoa from non-certified source in the long run. Some leaders of major cocoa consuming countries declared that by 2020 the importation of cocoa beans from sustainably

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sourced wound be accepted (Rueda *et al.*, 2014). This implies that, the production of certified cocoa must rise in order to meet the increasing demand. Sustainably sourced means the production practices satisfy the principles of environmental, economic, and social sustainability (Tscharntke *et al.,* 2015; Wessel & Quist-Wessel, 2015), including ethical labor. This implied that, Cocoa certification for sure promotes respect for good agricultural practices within the cocoa farm such as: weeding techniques, sanitary harvest, pruning, shading adjustment, spraying method, fertilizer application methods, dosage of pesticides, harvesting and fermentation, respect of agricultural calendar, and namely the diversification of production. Moreover, through certification, cocoa producers are surely encouraged to introduce domestic fruit trees into their orchards. Hence diversification may to enable cocoa producers to diversify their incomes, protect biodiversity, improve shading and control certain diseases.

Cocoa farming is a lucrative activity as about 60% of farmers involved in the activity in which their major objective is profit maximization. However, profit maximization is usually affected by farming systems (certified and non-certified). Studies (Jaza *et al*., 2021) have demonstrated that the productivity of certified cocoa farmers are higher than those of non-certified or conventional cocoa farmers and also the price per kilogram of certified cocoa is higher than of conventional cocoa as they earned premium price (50 FCFA) per kilogram. This implies certified cocoa farming is more profitable than conventional cocoa farming hence certified farmers are more likely resilient to poverty than conventional farmers. Therefore certified cocoa producers might be making more profit from activity than non-certified cocoa producers.

Today, most of the cocoa orchards in Cameroon as a whole and in Meme division in particular are aging and declining in productivity and also environmental friendly practices are quickly disappearing (Jaza & Darr, 2021). This may led to decline in the quantity and quality of cocoa produced due to non-respect of improved farming practices. The reality of this non-respect of improved farming practices or techniques especially post-harvest techniques like pod breaking, fermentation, drying etc is visible from the majority of cocoa farms in Meme division. The government of Cameroon launched cocoa certification in 2012 in order to overcome the aforementioned challenges facing the sector and also to improve on the producers livelihoods. In recent times, adoption of this new technology or innovation (cocoa certification) by cocoa farmers or producers is seemingly low. This is visible as certified cocoa makes up only 3% of the national cocoa production, and as such the country faces the threat of being banned from sales in international market if all its cocoa production is not certified by the year 2025 (ICCO, 2016). However this was so severed in December 2012 where the EU rejected a shipment of 2,000 MT of Cameroonian cocoa and in December 2013, another 3,000 MT was rejected for the non-respect of international standards. Moreover, the low bean quality has pushed down prices, with

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Cameroonian beans typically trading at a discount of 400 FCFA/kg on the international market (Ecobank, 2014).

Apparently, lack of facilities, limited education and training programs, minimal access to extension services, continuous fall in the prices of cocoa, minimal access to inputs etc may have influenced the acceptance of certification practices. Even though certification requires even growing domestic fruit trees inside the cocoa orchards but the reticent farmers continue to cultivate cocoa with existing/old fruit trees, which were traditionally inherited from their parents (Jaza & Darr, 2021). Besides the cultural constraints that maybe preventing the majority of cocoa producers for removing old cocoa and fruit trees from their farms, some of these farmers also think that it is less costly, less labour demanding and easier to manage cocoa orchards under their current state rather than planting new cocoa and fruit trees which are expensive and time consuming for maintenance.

Given the dominance of the traditional practices, the quality and productivity of cocoa produced by farmers in meme division may turn to low. This low quality cocoa beans and land productivity would likely fetch low income to farmers which in return affect their livelihoods negatively. This is more witnessed on their living conditions (nature of accommodating facilities, feeding habits etc). The paradox is that cocoa certification aims in improving the quality, safety and its sustainability while maintaining environmental, economic and social sustainability which is beneficial to all the actors involve in the cocoa value chain. In this effect, this study aims to fine out awareness and adoption of certified cocoa production and also to examine adoption determinants of certified cocoa production with a view to find means increase the pace of adoption of certified cocoa production in order to improve on the livelihood of cocoa farmers in Meme division.

2. MATERIALS AND METHODS

The study makes use of a quantitative method to provide adequate answers to the problem posed. This quantitative method makes use of the Logistic regression model to analyze factors affecting adoption of certified cocoa production in the studied zone.

2.1 Study area

This study was carried out in Meme division. Meme Division is located in the South West Region of Cameroon with a total land area of 3.105 km^2 and a total population of 326, 734 (BUCREP, 2010). The division lies between latitude 40 and 60 East of the Greenwich Meridian, and between longitude 90 and 100 north of the Equator. Meme Division consists of five sub divisions namely; Mbonge, Kumba I, II & III and Konye Subdivisions. The division is bounded to the north by Kupe Muanenguba Division, to the east by the Littoral Region, to the south by

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Fako Division and to the west by Ndian Division. Temperatures within Meme division range from 26ºc in Bairto 24.4ºc Kumba, and slightly hotter in Konye due it's to inland location (Ngulle *et al.* 2007). Meme Division falls within the equatorial climatic zone which is hot and moist with two main seasons; the rainy season which lasts for about 8-9 months (from March to October) and a dry season that runs from October to March of about 3 to 4 months. The mean annual rainfall recorded for the period of 1995-1998 is presented thus: 1995=3693 mm; 1996=296.11 mm; 1997=256.23; 1998=292.23 (Nkwatoh, 2000). The major cash crops cultivated here are: cocoa, oil palms and rubber with cocoa being the dominant crop. Apart from cash crops there also food crops like; maize, tubers, and vegetable crops (okra, peppers, waterleaf, tomatoes,) etc.

Meme division plays a large role in the cacao culture in the South West as it produces over 47 700 tons of cacao on 60 410 hectares by over producers (MINADER, 2013). Moreover, South West cacao industry is based around Kumba, as it is the main base for many License Buying Agents (LBA), the National Cacao and Coffee Board (NCCB), the Institute of Agricultural Research for Development (IRAD), Barombi Kang-Kumba etc.

2.2 Sampling techniques and Sample size

This study applied multi-stage sampling technique which is purposive sampling to select the study area and random sampling to select respondents or farmers. The first stage was the purposive selection of Meme Division. The second stage was also purposive selection of three subdivisions (Mbongue, Kumba III and Konye). In Meme division, these subdivisions are the main cocoa producing subdivisions also cocoa production is the major source of income to sustain livelihood. The third stage would be purposive selection of two villages each from the four subdivisions giving a total of six villages (Baduma, Ngolo bolo, Ediki, Mabanda, Malende, Kombone mission). These villages are villages with the highest number of cocoa farmers. Finaly, random sampling technique was used to select the individual cocoa farmers in the respective villages.

Furthermore Taro Yamane formula (Yamane, 1973) was used to determine the sample size of the study. Cocoa farmers from the six villages (Baduma, Ngolo bolo, Ediki, Mabanda, Malende, Kombone mission) were considered.

Taro Yamane states that $N = \frac{n}{1+n(e^2)}$

Where; N = Sample size, n = Population (total number of cocoa farmers in the six purposive selected villages), I = constant, e = error margin/limit (e = 0.05)

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By applying this formula the total sample size was 400 cocoa farmers. However in order to determine the sample of each selected village, the Chi square formula was used: Chi square formula = Q = A x $\frac{n}{N1}$

Where; Q = Interviewees or respondent per village, A = total sample size, N = Total members (33500), I = Constant, n = Total number per village. The results from calculations are presented on the table 1.

Table 1: Distribution of respondents by localities

Division	Subdivision	Village	Average number of Cocoa farmers or producers	Sample size
Meme	Konye			
		Baduma	5,863	70
		Ngolo bolo	6281	75
	Kumba III			
		Mabanda	5444	65
		Malende	4941	59
	Mbongue			
		Idiki	5193	62
		Kombone Mission	5779	69
Total			**33500**	**400**

Source: Researcher construct

2.3 Data collection

Data was collected from primary sources through the use of structured questionnaires and interview guide. This was done with the help of six trained enumerators. This was to reduce cost, save time and to eliminate language barriers as some cocoa farmers may not be able to speak either the two official languages (English and French) or even Pidgin English. These trained enumerators were those who mastered the various communities and were living in these communities where they collected data from households heads. To ensure that appropriate data was collected and that the collection process was smooth, a hot line was established for constant communication and followup. The respondents in study were cocoa farmers who had atleast 5years experience in the cocoa operations, owned farms and 25years of age at the minimum. Data was collected specifically on socio-economic aspects of the sampled cocoa farmers, during the 2020/2021cocoa season.

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Furthermore, secondary data of this study was collected from reviewing documents which aided from the conceptualization to the completion of this study. The main reviewed documents were publish articles like: Bime *et al.,* 2015; Tscharntke *et al.,* 2015; Wessel & Quist-Wessel, 2015; Jaza *et al.,* 2021 etc. Others documents were the from the Ministry of Agriculture and Rural Development, Institute of Agricultural Research for Development, and SOWEDA (South West Development Authority)

2.4 Data analysis.

Descriptive statistics was used to analyze the socio-economic characteristic of respondent. Descriptive statistics variables used were the mean, percentage and frequency. Socio-economic variables retained for the study was; gender, age, level of education, marital status and family size. These variables were retained based on the past related studies or related literature which have proven to be general characteristics that affect the decision and the wellbeing of cocoa farmers.

The rate of adoption of certified cocoa was derived as a function of performance and penetration indices as shown in the equation below:

$$Ai = (P\alpha * Pi) * 100$$

Where, $P\alpha$ = performance index and Pi = penetration index

The performance and penetration indices were used as indicators to assess the success or acceptability levels of messages which have been communicated to farmers before the adoption decision.

Performance index $P\alpha$ shows the actual number of cocoa farmers reached against the target number of cocoa farmers that was sampled (Casley and Lury, 1982). The mathematical expression of $P\alpha$ is as shown:

$$P\alpha = (A/T) * 100$$

Where, A = Respondents aware and T= Sample size

Penetration index (Pi) shows the number of cocoa farmers producing certified cocoaout of the actual number cocoa farmers reached or sensitized (Casley & Lury, 1982). The mathematical expression of Pi is as shown:

$$Pi = (D/A) * 100$$

Where: D = Number adopting certified cocoa production technology and A = Number aware

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2.4.1 Model specification

In a study that dependent variable can only take two modalities (dichotomous variable), the ordinary least squares method can be used. But due the weaknesses of the model which are the problem of heterokedasticity of the error and the estimation of probabilities outside the interval 0 and 1 (Jaza, 2015). For this type of data, Logit and Probit models can be used and calculated through the maximum likelihood estimation method.

In this study Logit model is appropriate because in the Logit model, explanatory (independent) variables can be either continuous, qualitative or both. The data of this study contain both the continuous and qualitative explanatory variables. Hence, Logit model was used to analyze the determinants of adoption of certified cocoa production. As such, the dependent variable is a discrete dummy variable (adoption = 1; non-adoption = 0). β_n is the set of parameters to be estimated, which reflect the impact of changes in X on the probability of adopting or not and ε is the independently distributed error term assumed to be normal with zero mean and constant variance. In the logistic regression model, the regression predicts the logit, that is, the natural log of the odds of having made one decision or the other. Hence the mathematical formulation of Logit model is:

$$In(odds) = In\left(\frac{\acute{Y}}{1-\acute{Y}}\right) = \alpha + \beta X$$

Where; Ý is the predicted probability of the event for example adoption, 1-Ý is the predicted probability of the other decision for example non-adoption and X is the independent variable.

Based on the theoretical framework and on past empirical works on adoption, a number of relevant and appropriate independent variables were selected which are likely to influence decision to adopt certified cocoa production. These variables were sex, age, membership in a farmer's organization, farm size, Profitability, Risk perceive, Age of household, Gender, Marital status, Education level household, Extension services, Access to credit, Access to input

In summary, the model was specified as follows:

$$\text{Logit (Yi)} = \ln \text{(Yi / 1 – Yi)} = \beta_0 + \beta_1 Gen + \beta_2 Age + \beta_3 Msta + \beta_4 Ledu + \beta_5 Cpro + \beta_6 Ainp + \beta_7 Fsiz + \beta_8 Aext + \beta_9 Acre + \beta_{10} Mofo + \beta_{11} Ofi + \beta_{12} Prof + \beta_{13} Rper + e$$

Where:

ln (Yi / 1 – Yi) = logit for decision

Yi = Adoption

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1- Yi = Non-adoption

βi = parameters to be estimated

e = error term.

Dependent Variable

Decision (Dependent variable)	1= Adoption
	0 = Non-adoption

Explanatory Variables

Table 2: Description of the independent variables used in binomial logistic model

Variables	Definition	Expected sign
Gen = Gender of household head	1=male, 0=female	+/-
Age = Age of household	<45=1(young), >45=0 (old)	-
Msta= Marital status of household head	1=married, 0=unmarried	+
Ledu= Level of education	1=above primary, 0= primary	+
Cpro= Cocoa productivity	Quantity per ha of cocoa produced in tones	+
Ainp= Access to inputs	1=yes, 0= no	+
Fsiz= Farm size	1= >2(large),	-
	0= <2(small)	
Aext= Access to Extension services	1=regular, 0=irregular	+
Acre = Access to credit	1=yes, 0=no	+
Mofo= Member of farmers' organization	1=yes, 0=no	+

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Ofi= Off farm income of the household	1=yes, 0=no	+
Prof = Profitability	1=more, 0=less	+
Rper= Risked perceived	1=more, 0=less	-

3. RESULTS AND DISCUSSIONS

3.1 Socio-Economic characteristics of cocoa producers or farmers

This study sought to analyse socio-economic characteristics of respondents like gender, age, level of education, marital status and family size using descriptive statistics (percentage and frequency). The output of this analysis in table 3

Table 3: Socio-economic characteristics of respondents

Variables		Frequency	Percentage
Gender	Female	41	10.3
	Male	359	89.9
Age (years)			
	25-35	56	14.0
	36-45	121	30.3
	46-55	137	37.2
	>55	86	21.5
Marital status			
	Single	16	4.0
	Married	356	89.0
	Divorce	4	1.0
	Widow/widower	24	6.0
Level of education	Primary	320	80.0
	Secondary	62	15.5
	Higher	18	4.5
Experience (years)	5-10	50	12.5
	11-15	82	20.5
	16-20	117	29.2
	21-25	102	25.5
	>25	46	12.2

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Gender of respondent (table 3) revealed that a greater proportion of the respondents were males, representing 96% as opposed by 4% for females. A similar finding was reported by Tchokote *et al*. (2015) in Lekie Division of Cameroon, who found out that 86.3% of the cocoa producers were men. This predominance of males over females may likely be that cocoa cultivation or production requires hard labour which might not be afforded by women. Predominance of men in cocoa production may also be attributed to nature of land tenure system as in many societies women do not own land.

Age groups included 25-35, 36-45, 46-55 and >55 with 14%, 30.3%, 37.2% and 21.5% (table 3) respectively. This result was similar to that Hütz-adams *et al*. (2016). This implied that cocoa producers in this locality are aging or the old as majority fall within age group 46-55 years. Youths participation in cocoa production in the study area is quite low and can be attributed to the fact that many youths in the study areas are now getting more involved in non-agricultural activities such as; motorcycle riding, taxi driving, building and construction works, trade etc.

The marital status of respondents was categorised as single, married, divorced and widow/widower with 4%, 89%, 1% and 6% respectively. These results are in line with those obtained by Mahege (2014) and Yvette (2018). The greater percentage of married farmers can be attributed to the fact that the farmers want to reduce labour cost as the greater the family size, the larger the labour force hence reduction in the labour cost.

Level of education of respondents was primary, secondary and higher or tertiary with 80%, 15.5% and 4.5% (table 3) respectively. This result is in conformity with that of Manu *et al.*, (2014).Majority of respondents achieved primary education. This may be attributed to the fact that cocoa farmers reside in rural areas where availability of schools (secondary and higher institutions) is limited and school enrolment is low.

Experience of respondents in cocoa farming in years was 5-10, 11-15, 16-20, 21-25 and >25 with 12.5%, 20.5%, 29.3%, 25.5% and 12.2% (table 3) respectively. Majority of respondents have at least 16 years of experience in cocoa production. This implied that they must have gained a lot of experience in the production process which facilitate their decision making on the type of their farming system.

3.2 Rate of adoption of certified cocoa production

Rate of adoption of certified cocoa production is the percentage of interviewed farmers that are producing certified cocoa relative to the target population. Exploring the level of accepting the technology by respondents, the output of analysis are presented in table 4

Table 4: Rate of adoption of certified cocoa production

Adoption items	Frequency	Unit
Sample size (T)	400	Number
Respondents aware (A)	206	Number
Number of certified adopters (D)	104	Number
Performance index (Pα= A/T * 100)	51.5	%
Penetration index (Pi= D/A * 100)	50.5	%
Adoption rate (Ai =Pα*Pi)/100 or A=D/T	26	%

The results in table 4 revealed that among the 400 respondents interviewed, 206 acknowledged the fact that they were aware of the certified cocoa production and certification schemes or programs and only 104 of them adopted certified cocoa production. This therefore gives the adoption rate of 26.0% against 73.0 non-adoption rate.

The proportion of 26.0% of households have adopted certified cocoa production after 51.5% of the total sampled households (performance index) have actively shown interest in receiving information about cocoa certification technology in the division and 50.5% (penetration index) involved themselves in the adoption process after have been informed. The result also revealed a very close Performance and penetration that is 1% difference. This simply signifies that only 1% of the total respondents who have knowledge about the new technology (cocoa certification) have not adopted the technology. This is better described in table 9

3.3 Binomial logistic regression analysis factors affecting the adoption of certified cocoa production

Based on the logistic regression model on the decision of adoption, the dependent variables were Adopters of certified cocoa production (Y =1) and Non-adopters of certified cocoa production (Y = 0) and the independent variables were; sex, age, membership in a peasant organization, farm size, Profitability, Risk perceive, Age of household, Gender, Marital status, Education level household, Extension services, Access to credit, Access to input.

Table 9 show results of the logistic regression model analyzing the factors influencing adoption of certified cocoa production. The overall goodness-of-fit measured by the significance of the Chi-square statistic in the Omnibus tests of model coefficients is high ($\chi 2$ = 287.701***, significant at 1% level). This implied that, there is a significant relationship between the dependent variable and the selected independent variables used in the model (X^2 = 287.701, P = 0.000). Nagelkerke R Square of .752 suggests that the variables retained in our model explain

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almost 75.2% of the decisions to adopt certified cocoa production. The percentage of model's correct prediction is good (75.2%). The Hosmer and Lemeshow test shows that the model adequately fits the data. Besides, most of the explanatory variables opposed the expected signs. The estimated coefficients and Odd Ratios (OR) and/or inverse OR of each explanatory variable are presented in table 9. That is the Odds ratio [Exp(β)] and inverse odds ratio [1/Exp(β)] of coefficients (β) estimated from the logit model for certified cocoa adoption in the study area (N=400)).

Table 10: Binomial logistic regression model results for certified cocoa adoption

Explanatory variables	B	Exp(β)	1/Exp(β)
Gender of household head (male=1,female=0)	-.375	.687	1.456
Age of household head(>48=1, <48=0)	-0.53*	.949	1.054
Marital status of household head(married=1, single=0)	.366	1.443	//
Educational level of household			
Primary	.545	1.008	//
Secondary	.008	1.724	//
Tertiary	1.488	4.428	//
Household size(>7=1,<7=0)	-.107	.898	1.114
Productivity (>0.5t/ha=1,<0.5t/ha=0)	3.669***	39.228	//
Access to input(yes=1,no=0)	.603	1.828	//
Extension services (yes=1,no=0)	2.853**	17.339	//
Access to credit (yes=1,no=0)	-.820*	.440	2.273
Household head off-farm income(yes=1,no=0)	2.031***	7.625	//
Member of farmers' organization (yes=1, no=0)	1.290**	3.633	//
Profitability	.983*	2.013	//
Farm size	.336*	1.399	//
Perceived risked	.700	2.013	//

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****: Significant at 1% ; **: Significant at 5 % ; *: Significant at 10 % ; -2 Log likelihood =170.745; Nagelkerke R^2=0.752; Percentage of correct prediction=75.2%; Omnibus Test of Model Coefficients: $\chi 2$=287.701***;*

Gender of household head was not significant and negatively influences adoption of certified cocoa production. The negative sign indicates that female household heads are more likely to adopt certified cocoa production as compared with male household heads. Furthermore the model suggested the odd ratio of the gender of household head variable is 0.687 (less than one) which implies that, for an increase in the number of female household heads would increase the probability of adopting certified cocoa production by 1.456 times as compared to male headed households (Table 9). These results were in conformity with those Bime *et al*, (2015) on An analysis of the pre and post-harvest management techniques in rice production : The case of UNVDA Ndop, North West region of Cameroon and Jaza, (2016) on Factors affecting the adoption of cocoa agro-forests by farmers in the centre region of Cameroon who revealed that gender affected adoption negatively and were not statistically significant. In the other way round, the findings were contrary to those of Thomson et al., 2014 who reported that sex of the household head matters in explaining adoption of new technology or innovations with adoption favouring male-headed households. This could perhaps be explained by the fact that cocoa farming is mostly practiced by men and few women that decided to go into it are determined to maximize to profit. It could also be attributed to the fact that female farmers are more receptive towards newly introduced technologies than male farmers.

Age of household head was significant at 10% and negatively influences adoption of certified cocoa production as predicted. The negative sign indicates that household heads of below 48 years are more likely to adopt certified cocoa production as compared with household heads of above 48 years. The OR of this variable is 0.949 (lower than one) which implies that, for each additional year in the age of the farmer, the odds of adopting the certified cocoa production decrease by 1-0.949 =5.1% (Table 9). These findings are similar to those found by Jaza (2016) who said the likelihood is low to adopt the cocoa agro-forest for old farmers. Moreover, the results of this study corroborate with the findings of *Jaza et al*. (2015) according to which, young people are more favourable to the adoption of cocoa agroforests because they are more ambitious or courageous, and like adventurous situations such as the discovery of new techniques such as agroforestry. On the contrary Manu *et al*. (2014) reported that age had no significant relationship with adoption of agricultural innovation. This may be attributed to the fact that young farmers are mostly educated people who spent several years at school where they learned the advantages and benefits of cocoa certificate techniques which is contrast with old farmers who are mainly illiterate people with a little knowledge in cocoa certification. Besides, the aged people are

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physically weak whereas the young farmers are strong enough thus are more powerful to carry or manage hard tasks like proper fermentation and drying.

Level of education was not significant and positively influenced adoption of certified cocoa production as predicted. This indicates that, farmers with at least primary level of education are more likely to adopt certified cocoa production techniques as compared to farmers with below primary level of education. For this variable (level of education), the model suggest the odd ratios of 1.008, 1. 724 and 4.428 which indicates that farmers with higher level of education are 1.008, 1.724 and 4.428 times respectively more likely to adopt certified cocoa production compared with farmers with lower level of education. These results are in conformity with those of Guy *et al*. (2018) and Manu *et al*. (2014) who revealed that level of education affect the adoption of improved maize varieties and also the adoption of improved maize varieties enhances maize yields. This could be that formal literacy increases farmer's ability to obtain process and use information relevant for the adoption of certified cocoa production. Moreover, education may also lower the risk aversion behaviour as it is believed educated farmers are more likely to evaluate an innovation than uneducated farmers and thus increasing the likelihood of adopting a new technology like cocoa certification. It could also be explained that educated farmers better understand the role or multitude agronomic benefits of adopting certified cocoa production on their livelihoods.

Following the same scenario, household size was not significant but negatively influenced farmers to adopt cocoa certification which is contrary to what was predicted. This negative sign implied that the odds of larger household size are less favoured to adopt cocoa certification as compared with smaller household sizes. In order words smaller household sizes are more likely to be engaged in cocoa certification than larger household sizes. The odd ratio of household size variable is 0.898 (less than one) which implies that, for an increase in household size from small to large, the probability of not adopting cocoa certification is 1.114 (Table 9). These results corroborate with the findings of Nadeesha *et al.,* (2020) which revealed that household size influence farmers' propensity to adopt protected agricultural technologies. On the other hand, these findings are contrary to Manu *et al*, (2014) who revealed that household size had no significant relationship with adoption. This could be attributed that large household size implies high dependency ratio which then lead to low capital to invest thereby limiting adoption of certified cocoa production.

Productivity was positive as predicted and significantly influenced farmers to adopt certified cocoa production at 1% level. This implies that farmers with larger output are more likely to adopt certified cocoa production compared to farmers with smaller output. For this variable (productivity), the model suggest an odd ratio of 39.228 which indicates that, producers with larger output per ha are 39.228 (Table 9) times more likely to adopt certified cocoa production compared with producers smaller outputs per ha. These findings are in conformity with those of Kalinda *et al*, (2014) on adoption of improved maize seed varieties in Southern Zambia who revealed that productivity significantly affected the adoption of improved maize varieties. This could be explained by the fact that, population is increasing while land is fixed, this paradox reduces cultivated land. Moreover, proper fermentation of cocoa beans (one of the major cocoa certification technique) required a minimum quantity of fresh cocoa beans to be fermented. As such cocoa farmers who cannot harvest this quantity per harvest are bound not to have good fermented cocoa there by not meeting the certification requirements.

Access to input was not significant and positively influenced the adoption as the predicted. The positive sign implied that, farmers that have access to inputs are more likely to adopt cocoa certification as compared with those that do not receive inputs. For this variable, the model suggests an odd ratio of 1.282 which indicates that, farmers that receive inputs are at a 1.282 greater probability of adopting than with those farmers that do not receive inputs. Alternatively, this can be interpreted as indicating that, farmers that receive inputs increases the odds of adopting cocoa certification by a factor of 1.282 (Table 9). These findings are in accordance with that of Thonatha, 2014 who revealed that access to input influence the adoption of early maturing maize positively. This can be attributed by the fact that adoption of new technology requires acquisition or addition of new inputs therefore the availability of these inputs would fastened adoption of that particular technology.

Extension services was significant at 1% and positively influenced adoption of certified cocoa production as expected. This implies increase in the regularity of extension visits would increases the likelihood of adoption of certified cocoa production. For this variable, the model suggests an odd ratio of 17.339 which indicates that, respondents that benefit from regular extension services are 17.339 (Table 9) times more likely to adopt compared with those that benefit from irregular extension visits. This result were consistent with Jaza (2015) on The determinants for the adoption of compost from household waste for crop production by farmers living nearby Yaoundé, Cameroon who indicated that farmers who are regularly sensitized by extension agents are more likely to adopt compost as compared to those who are irregularly sensitized by extension agents receiving. This is similar as farmers who are regularly sensitized by extension agents are more likely to adopt certified cocoa production as opposed to those receiving none extension services. This can be explained by the fact that extension visits increases the awareness of farmers on new technology thereby increasing ability to adopt the new technology. Moreover Thonatha, (2014) revealed that extension services significantly affected both the adoption decision and the level of adoption. Farmers' frequent contact with the extension agents is expected to increase the farmers' ability to acquire important information on

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the new technology as well as other related agricultural information which in turn help the farmers in adopting the best technology. Furthermore, similar relationship was observed by Nadeesha *et al.*, (2020) as farmers have more access to extension services they are more likely to adopt modern agricultural production techniques.

Access to credit was significant at 10% level and positively influenced farmers' decision on adoption as predicted. Positive sign implied that respondents who have access to credit are more favorable to adopt certified cocoa production compared with those who have no access to credit. In other words farmers receiving credits would likely to adopt certified cocoa production compared to those who did not have access to credit. These results are in accordance with that of Nadeesa *et al.*, (2020) which indicated that the variable 'access to credit' has a positive and significant influence on the likelihood of adoption of PA. These findings are also consistent with that of Thonatha, 2014 who revealed that access to credit influence the adoption of agricultural innovation significantly. This could be explained by the fact that, new technology implies new and or additional capital to invest therefore availability of credit to farmers would encourage adoption of certified cocoa production.

In similar case, off farm income was significant at 1% level and positively influenced farmers' decision on adoption as predicted. This indicated that farmers who have other revenue not from the farm are more likely to adopt certified cocoa production. For this variable the model suggest an OR 7.625 indicating that the respondents with off farm income are 7.625times (Table 9) more likely to adopt certified cocoa production compared with respondents without non-farm income. This is in line with the findings of Biniam *et* al., 2019 who said that Non-farm activity had positive and significant effect on adoption of improved jalenea potato variety in Chencha Woreda, Southern Ethiopia. This could be explained by the fact that, farmers used off farm income to invest on new technology more easily than those with non-off farm income. Standard (certified farmers) fermentation takes six days and drying take four to five days meanwhile most farmers (non-certified) ferment for two days and dry for 12 to 24 hours. From this it is seen that certified cocoa production takes longer time to be processed than non-certified cocoa production. This therefore means that producers need extra income to sustain the family for the main time.

The estimated coefficient for member of farmers' organization was significant at 1% level and positively influenced adoption as predicted. This indicated that farmers who belong to farmers' organization are more likely to adopt certified cocoa production. For this variable the model suggest an OR 3.633 indicating that the respondents belonging to farmers' organisation are 3.633 times (Table 9) more likely to adopt certified cocoa production compared with respondents who do not belong to any farmer's organisation. These findings are consistence with those of Bime *et al.*, 2015 on analysis of the pre and post-harvest management techniques in rice production

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revealed that membership of association has a 10% significant effect on adoption of post-harvest technologies in UNVDA Ndop, North West Region of Cameroon. Also, these findings are in accordance with those of Manu *et al*, (2014) who revealed belonging to a farmer's organisation positively affect the probability of adopting improved maize varieties. Furthermore Jaza, (2015) reported that the probability of adopting compost of a farmer who is a member in a peasant association is over twice as great as in the case of a farmer non-member in a peasant association. This could be attributed by the fact that in a farmers' organization or association, new members/farmers would meet their old colleagues with large experience and necessary arguments to convince them to adopt certified cocoa production.

Moreover, estimated coefficient for profitability was also significant at 10% level and positively influenced adoption of certified cocoa production as predicted. This implied that farmers more with perceived profit are more likely to adopt certified cocoa production than those with less perceived profit. The model suggested an OR of 2.013 indicating that farmers with perceived profit are 2.013 times (Table 9) more likely to adopt certified cocoa production. This result is in conformity with that of Guy *et al*, (2018) on Adoption and impact of improved maize varieties on maize yields: Evidence from central Cameroon who revealed that farmers' perceptions of yields of improved maize varieties significantly affect the adoption of improved maize varieties in the central region of Cameroon. This could be attributed that every rational human being is out to maximize profit and minimize cost for this reason they would adopt farming system deemed more profitable.

Most of the studies of technology adoption are identified farm size as one of important determinant of technology adoption which can be affected positively, negatively or neutral relationship with adoption (Mwangi & Karouki, 2015). In this study, the estimated coefficient of farm size was also significant at 10% level and positively influenced adoption of certified cocoa production as predicted. This implied that farmers more with larger farm size are more likely to adopt certified cocoa production than those with smaller farm sizes. The model suggested an OR of 1.399 indicating that farmers with larger farm sizes for example farm sizes greater or equal to two hectares are 1.399 times (Table 9) more likely to adopt certified cocoa production. This could be attributed to the fact that farmers with larger cultivable lands are more market oriented commercial farmers hence they have good market linkages and access. Since they can provide continuous supply to the markets with larger quantities they may have develop good linkages with buyers and or consumers that demand their products both in quantity and quality. These results are consistence with those of Sacha *et al.*, 2021 on the meta-analysis of the empirical literature on the adoption of agricultural technology in the developing world indicated that farm size have a significant effect on the adoption of improved varieties. Also, these findings are same

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with findings of Nadeesha *et al.*, 2021and Alam, 2015 as farmers with large farm sizes are more likely to adopt new technology as compared to small farm sizes farmers.

4. CONCLUSION AND RECOMMENDATIONS

This study was set to examine the determinants influencing the adoption of certified cocoa production in Meme division, South West region of Cameroon. The study was necessary because the quality and quantity of cocoa produced seemingly has not greatly increased after introduction of certified cocoa production or improved technologies. Data was collected from a sample of 400 cocoa farmers randomly selected from different localities or villages in the study area. The results from the rate of analysis revealed that among the 400 respondents interviewed, 206 (51.5%) acknowledged the fact that they were aware of the certified cocoa production and certification schemes or programs (performance index) and only 104 (50.5%) of them adopted certified cocoa production (penetration index). This therefore gives the adoption rate of 26% against 74%non-adoptionwith the performance and penetration index of 1%. The results from the logistic regression analysis revealed that age of respondent, productivity, access to extension services, access to credit, off-farm income, profitability and farm size were statistically significant factors influencing adoption of certified cocoa production. Also level of education, marital status, access to input and perceived risk were positively and statistically not significant factors while gender and household size affected adoption negatively and were not statistically significant. It was recommended that sensitization of farmers should reinforced and also all factors that significantly affect adoption of technologies be improved.

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