Determinants of willingness to pay for hybrid cocoa seed in Cameroon

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ABSTRACT: The aim of this study is to gain a better understanding of the variables determining farmers' willingness to pay for *SNK* hybrid cocoa seeds, and the amounts farmers are willing to pay for these technologies. Faced with the volatility of bean prices in an increasingly unstable external market, and with the galloping demand from emerging processing industries, farmers are looking for varieties with high productivity and capable of withstanding climate change and diseases. Hence their preference for the hybrid *SNK* cocoa variety to improve the productive capital of cocoa farms. However, little is known about the factors that determine willingness to pay for the adoption of improved seeds. The survey was conducted among 311 cocoa farming households in the Centre Region of Cameroon, specifically in 07 divisions with high cocoa production. The data were collected using a questionnaire. Heckman's two-stage selection model was used to analyze the data. The results show that the sex of the farmer, the level of education and the number of people living in the respondent's household have a positive influence on the willingness to pay for the *SNK* cocoa variety. The amounts they are prepared to pay to acquire it varies between FCFA 50 and FCFA 500 per unit, with an average of FCFA 150 per unit of acquisition. It is therefore recommended to produce more.

KEYWORDS: *SNK* cocoa hybrid seed, willingness to pay, Cameroon Centre Region.

1   INTRODUCTION

Agriculture remains the driving force behind economic and social development in many countries around the world. Globally, it is most practised by Family Farms (FAO, 2018), which account for more than 90% of farms, and provide more than 80% of the world's food in terms of value. In Cameroon (WDI, 2015; IFAD, 2018), it accounts for more than 50% of jobs, contributes 24% of GDP, employs 75% of the working population and creates market opportunities for other sectors of activity.

Cocoa production, processing and export in Cameroon contribute around 0.905% to Cameroon's GDP. This is a significant drop compared with the estimate frequently quoted over the past ten years of a 2% contribution from this sector to national GDP (Lescuyer, al., 2019).

Cocoa, like other cash crops and exports improves the standard of living of producers, made them less migrants and allows them to occupy themselves on secondary activities (Ruf and al., 2020), is experiencing also enormous difficulties linked to the performance of producers: ageing plantations, deforestation, poor farm management, soil degradation and increased pest and disease pressure. Lescuyer, al. (2019) highlight the recurrence of climate change and market malfunctions.

The adoption of improved technologies (new agricultural practices, improved high-yielding varieties, etc.) is a response to improving the performance of producers through the transformation of agricultural systems (Mekonnen, 2017; Barry, 2016; De Janvry et al., 2015) following the example of *SNK* hybrid seeds. Innovation can boost business performance (Léopold et al., 2017; Pascal, 2017).

According to (Abadi et al., 2021; Akter et al., 2021; Mokennen, 2017; Solomon et al. 2011), it has a positive and significant impact on improving performance, but it remains conditional on producers' willingness to pay a sum to acquire it easily.

In Cameroon, some farmers have decided to innovate by adopting the hybrid seed implemented by the cocoa development company SODECAO, with a view to overcoming the productivity difficulties and diseases slowing down their performance and increasing their productive capacity.

They are aware of the changes brought about by this technology, and are willing to acquire it and use it for risky purposes. It is in this sense that this paper looks at the factors that determine the amounts agreed for its adoption.

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2 METHODOLOGY

2.1 STUDY AREA

The study took place in the Centre Region of Cameroon. Specifically in 07 of the 10 divisions where the farmers produce more cocoa. These are the divisions of Nyong and Mfoumou, Nyong and So'o, Mefou and Afamba, Mefou and Akono, Lekié, Upper Sanaga, Mbam and Kim (Figure 1).

Two main selection variables attracted the attention of the investigators: the adoption of hybrid seed, and the amount the household was willing to pay for it. A total of 311 cocoa farmers (proportion per each division in table 1) were randomly selected for the in-depth surveys. The interview guide and questionnaire were used to conduct the survey.
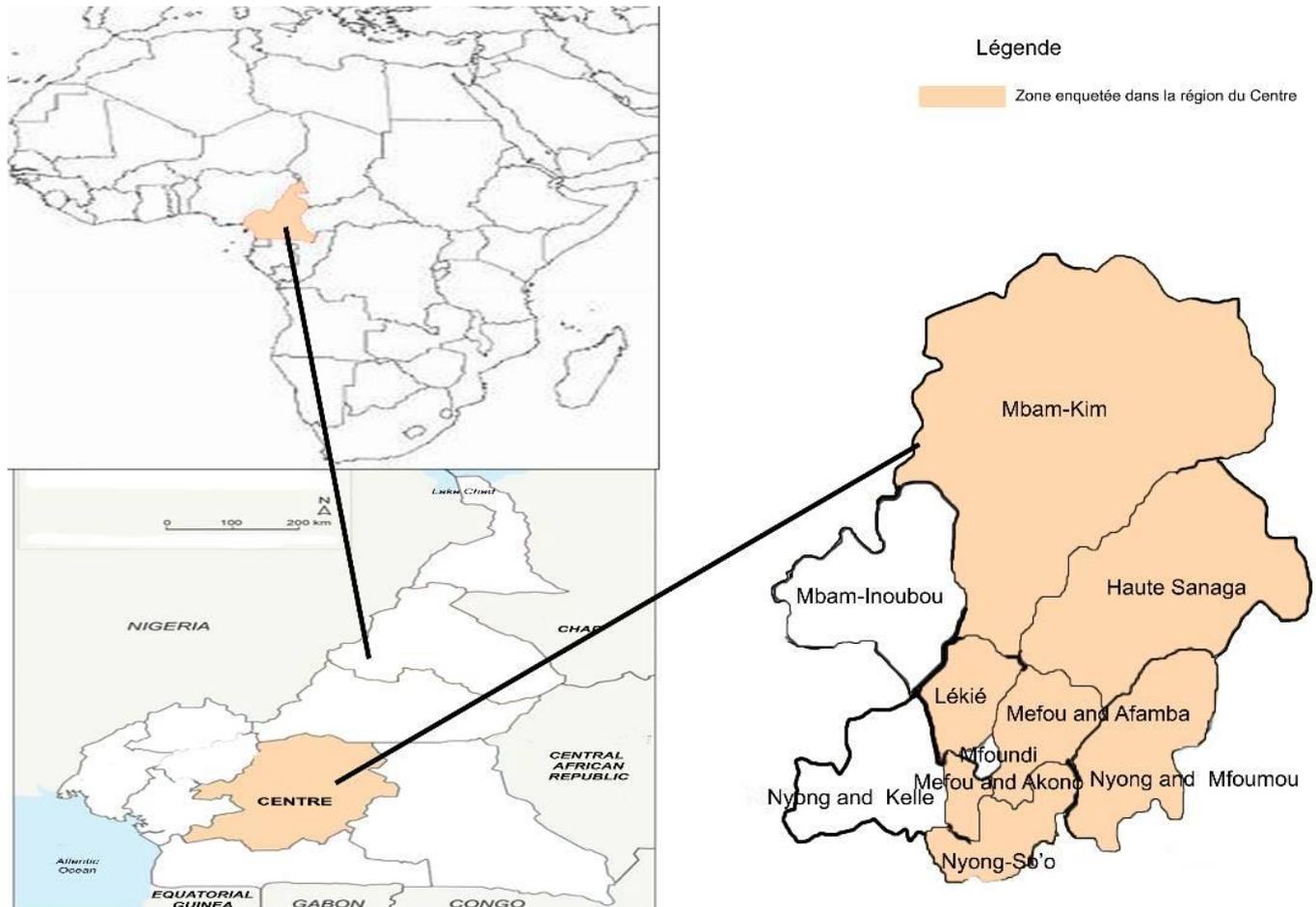
Fig. 1. *Survey area*

Source: *Author (2023) based on map of Cameroon*

2.2 SAMPLING AND DATABASE

The 311 cocoa farmers with a preference for hybrids were observed. However, the SODECAO (cocoa development company in french) hybrid was the subject of the study. More or less 5 villages according to possibilities were selected by the survey in each subdivision. Cocoa farmers, including 123 adopters of the SODECAO hybrid seed, were randomly sampled (Table 1) on the basis of primary data in 2022, using the interview guide and questionnaire.

Table 1.   Survey locations

Divisions and proportion of sampling	Subdivisions	Villages
Upper Sanaga 20 surveyed with 7 adopters	Lembe-Yezoum	Lembe 1, Lembe 2
	Mbandjock	Ndjoré, Ekombitié
	Nkoteng	Nkoteng
Lekie 65 surveyed with 23 adopters	Obala	Nkometou 1, Koudandeng, Ombolo-Bingana
	Okola	Okola, Mva'a, Ndanguen
	Evodoula	Ekol
	Elig-Mfomo	Nkolossan
	Batschenga	Ndi, Nkoayos
	Monatele	Elig-Ambassa, Etche-assi
	Ebebeda	Elig Bindick, Ebebeda, Ebomzout
	Sa'a	Elig-Zogo, Mbazoa 1, Ekoum-Ondom
Mefou and Afamba 51 surveyed with 18 adopters	Edzendouan	Edzendouan, Ndzana
	Soa	Ebang, Okoa, Nkolmbom
	Esse	Nkolafamba, Fegminbang
	Awae	Nkolngok, Nlong, Elat
	Mfou	Mekoé, Akoumbou
Mefou and Akono 35 surveyed with 12 adopters	Akono	Nkong-nen, Ekong
	Ngoumou	Ngoumou, Binguela, Nkoletoutoumou
	Bikok	Bikok, Ekalli 1
	Mbankomo	Nomayos, Okoa-Maria
Mbam and Kim 65 surveyed with 18 adopters	Ntui	Nguila, Ossombe, Ntui, Ohondo,
	Yoko	Ndjolé, Issandja
	Mbangassina	Biakoa, Talba, Tete, Voundou, Mbanga
	Ngoro	Egona 2
	Ngambe-Tikar	Mbouli
Nyong and Mfoumou 35 surveyed with 21 adopters	Mengang	Mengang
	Endom	Tombo, Endom
	Akonolinga	Eboa, Akonolinga, Meko'o
	Ayos	Adoua
Nyong and So'o 40 surveyed with 24 adopters	Mbalmayo	Ekombitié, Mbalmayo
	Nkolmetet	Obout, Nkolmetet
	Ngomedzap	Ngomedzap, Minlaba
	Mengueme	Soassi, Mengueme

Source: author (2023) based on survey data

2.3   LITERATURE REVIEW

2.3.1   THEORETICAL LITERATURE

Willingness to pay is therefore defined as the maximum price that a buyer is willing to pay for a given quantity (Sirine, 2021) of a new input. In this way, the farmer or economic producer will be able to demonstrate the behaviour of his rationality on the opportunity price. The one on which he bases himself to ensure the greatest utility.

As the willingness to pay is considered at the reserve price (Marine Le Gall-Ely, 2009; Kalish and Nelson, 1991; Kristensen and Gärling, 1997; Krishna, Wagner and Yoon, 2006), and sometimes when the analysis concerns the margin, it is taken as the "floor" reserve price (Wang, Venkatesh and Chatterjee, 2007), which corresponds to the maximum price at which and below which the consumer is 100% certain of buying the product. The farmer's choice is therefore motivated by a comparison between the gains and costs associated with acquiring a technology such as hybrid cocoa plants.

In the literature, the contingent valuation method (R. T. Carson and R. C. Mitchell, 1989) is the most widely used to estimate the willingness to pay (WTP) of a farmer who has adopted a technological innovation. It involves asking cocoa farmers how much they are prepared to pay for hybrid plants in order to maximise their production performance. Thus the determinants of willingness to pay are

based on those who have adopted SODECAO seedlings. Based on the hypothesis that this innovation has been adopted and that it has been appreciated, it is possible to analyse its effect. Heckman's (1979) theoretical model of analysis is appropriate for this purpose. The variable to be explained therefore consists of the amounts of WTP revealed by cocoa farmers who have adopted it. As the model is sequential, it is made up of *the selection equation,* which answers the question: Are you willing to pay for SNK cocoa plants for better agricultural performance? And the *substantial equation, which* answers the question of how much you are willing to spend to obtain them. Hence the formalisation of the following model:

$Z_i{}^* = w_i \Upsilon + \mu_i$ if the household has accepted or not: selection equation (1)

$y_i = x_i \beta + \varepsilon_i$ if $Z_{ii}{}^* > 0$: substantial equation (2)

With w_i and x_i socio-economic variables; μ_i error terms '(0; 1) and ε_i error terms following a normal distribution (0; σ).$_\varepsilon$

This type of model is normally estimated using the Maximum Likelihood Method (MLM). However, this estimation method has convergence problems. To overcome this limitation, Heckman (1979) proposed a two-stage estimation: estimate the determinants of willingness to pay for *SNK* cocoa plants using a probit or logit model. Then estimate the determinants of the amounts agreed by the Ordinary Least Squares (OLS) by integrating the ratio of Mils obtained from the estimation of the selection equation.

2.3.2 EMPIRICAL LITERATURE

Merle (2007) summarizes the literature on willingness to pay a higher price for a personalized product. In these studies, between 43% and 88% of respondents were prepared to pay more for personalization, with the price difference ranging from 10% to 207% more. The products considered are very diverse, and the percentage willing to pay is generally higher for low-price products (phone covers) than for high-price products (shoes).

SIGUE et al (2019) study the perception of technology adoption and less on the determinants of investment and willingness to pay. The purpose of this study is to analyze the determinants of farmers' willingness to pay (WTP) amounts for the use of microdose technology components on farms in the Kourittenga and Zondoma provinces of Burkina Faso. A survey was conducted among 360 farm households in municipalities in both provinces and the data were collected using a semi-structured questionnaire. Heckman's two-stage selection model was used for this study The results of the analysis revealed that: experience in microdose technique, social status, area, land tenure and distance from fields are factors influencing willingness to pay reported by farming households for the practice of the components 'Stony Cordons + Compost + Microdose'; the 'Zai + Compost + Microdose' and the 'Zai + Manure + Microdose'. While household size, available area, level of education, literacy and farm income influence the amounts reported by farmers.

Kertous (2012). Analyses subscribers' willingness to pay to improve the quality of the drinking water service in Algeria by using survey data to estimate the determinants of the declared amount, as well as its value. According to the results of the models, the technical variables used by the management company are the main determinants of the amount declared (e.g. restrictions). Estimating the willingness to pay of Algerian households provides a value of 10.57 DA/m3, i.e. an average WTP of DA 231 per quarter.

Kuimi T. et al (2022) surveyed 1,500 Quebecers to determine the value placed on Lac Saint-Pierre. They found that the value was assessed by the willingness to pay for agricultural practices that would improve the quality of the ecosystem in and around the LSP. The respondents were willing to pay for agricultural practices that would improve the quality of the ecosystem, and the willingness to pay for agricultural practices increased with the level of effort made by agricultural producers; the value attributed to the LSP by survey respondents, based on the amount they are willing to pay for farming practices, is estimated at $2,520,604,283. Willingness to pay varies according to respondents' economic situation.

Miwoto M. et al. (2017) analyze the factors that explain the amounts of willingness to pay (WTP) of households for the implementation of a sustainable management programme of Adjamey forest in the district of Djakotomey in South-West of Benin. The data were collected on 110 bordering households using a semi-structured questionnaire. Based on the two-step selection model of Heckman, this study revealed that the households participation to the program of sustainable management of this forest is influenced by factors such as: the origin and level of education of the surveyed households, the fact of having been victims of the damage caused by the hippopotamuses and the fact that the household wishes an improvement of the management of this forest. Moreover, the study shows that the total area held in the forest, the total income drawn from the activities related to the forest, the membership in a management committee and the fact that the hippopotamuses are considered as a threat constitute to the explanatory factors of the amounts of willingness to pay (WTP) declared by the households.

2.4 VARIABLES IN THE SUBSTANTIAL EQUATION

The variables that explain the likelihood of farmers adopting the new cocoa seeds are as follows:

Age: this is a continuous variable that measures the age of the farmer and has an impact on the probability of adopting the innovation. The older he gets, the more he loses the energy to innovate (N'guessan, 2008; Yabi and al.2016). This variable has a negative influence in most cases.

Gender: binary variable Matari and al. (2006) and Obisesan (2014) have shown that gender has both a significant and positive influence on adoption. For Mignouana and al. (2011); Sale (2014); Yabi and al. (2016), the results of the studies show that women have a space of economic autonomy. The expected sign is ambiguous.

Household size: This variable is continuous and corresponds to all the people living in the same house and who are all involved in agricultural activities relating to innovative technologies. According to Kebede and al. (1990), the size of the agricultural household is a source of labour and has a positive sign. However, Jiang et al. (2011) find that household size has a negative influence on the amount declared by households.

Level of education: continuous variable. A farmer with secondary education is more inclined to practise agricultural technological innovations than one who does not (Rogers, 1995; Kabore, 2011). A positive sign is therefore expected. Vasquez (2009) on Mexico finds that the level of education has a positive influence on WTP.

Secondary activity: continuous variable, for a farmer, the secondary activity concerns any other activity that may influence the desire to innovate in technology. The expected sign is negative.

Membership of a farmers' organisation: this variable indicates whether or not the respondent belongs to a farmers' organisation.

group. *Morest and al. (2018) believe that* a positive sign is expected as respondents have a good knowledge of the risks of innovation practice and Their willingness to pay should be higher.

Marital status: a continuous variable, marital status should have a positive influence on willingness to pay for technology when the respondent is married because he or she has several dependents. The expected sign should be mixed.

Occupation status of the respondent in the household: continuous variable, apart from the head of household who is often ready to innovate, the other occupants would be presumed to be neutral in terms of willingness to pay for a technology. The expected sign is therefore mixed

The nature of the variables, their codes, modalities and expected signs are summarised in the following table:

Table 2.   Variables and their expected sign

Variable name	Type	Code	Terms and conditions	Expected sign
Response variable				
willingness to pay from the respondent	Continuous	WTP	/	/
Controllers				
Age	Continuous	Age	/	-
Gender	Binary	Gender of respondent	1= male, 0=female	Ambiguous
Household size	Continuous	Number of people in your household	Number of people in your household	Ambiguous
Level of education	Continuous	Respondent level of education	0= no level, 1=Primary, 2=Secondary 4=University	+
Secondary *activity*	Continuous	Secondary activity	1=agriculture, 2=breeding, 3= functionary, 4=other to specify	-
Membership of a farmers' *organisation*	Binary	Are you in peasant organization?	1=yes, 2=no	+
Marital *status*	Continuous	Marital status of respondent	1=Single, 2=married 3=Widowed, 4=Common-law	Ambiguous
Status of respondent in household	Continuous	Occupational status of respondent in place of residence	1=head of household, 2=resident, 3=other to specify	Ambiguous

Note: (/) = no information.
Source: Author (2023)

3   RESULTS

In the light of the previous literature, the Heckman two-step regression allowed to have the following table of results.

Table 3.   Determinants of WTP for SNK hybrid cocoa by Heckman model

Variables	Modalities	Coef.	St.Err.	t-value	p-value	Sig
Gender of respondent	Female	0.152	20.744	1.21	.025	**
	Male	.765	.522	-1.47	.043	**
Respondent level of education	Primary	-11.392	20.36	-0.56	.576	
	Secondary	23.048	19.974	-1.15	.049	**
	University	-9.885	23.307	-0.42	.671	
Occupational status of respondent in place of residence	Household resident	-18.487	16.404	-1.13	.26	
	Other (specify)	-31.795	43.616	-0.73	.466	
	5	-49.711	37.754	-1.32	.188	
Marital status of respondent	Single	-8.914	15.619	-0.57	.568	
	Widowed	-45.948	57.434	-0.80	.424	
	Common-law	-16.079	11.109	-1.45	.148	
Number of people in your household	[3 - 5] people	-11.31	23.823	-0.47	.635	
	[6 - 8] people	-18.744	23.012	-0.81	.415	
	[9 - 10] persons	9.502	23.912	0.40	.691	
	[11 + [persons	27.903	22.437	1.24	.214	
Secondary activity	Breeding	-25.321	12.1	-2.09	.036	**
	Functional	6.559	21.202	0.31	.757	
	other to specify	-4.676	11.003	-0.42	.671	
Are you in peasant organization?	No	-8.879	10.736	-0.83	.408	
	Constant	213.359	39.787	5.36	0	***
	Lambda	.147	.56	0.26	.792	

*** p<.01, ** p<.05, * p<.1

Source: *Author (2023) based on survey data*

The table above shows the determinants of willingness to pay for hybrid seed. Socio-demographic variables were used for modelling, showing that gender has a significant influence on willingness to pay for hybrid seed; however, this influence is more pronounced for males (76.5% compared with 15.2% for females). With regard to level of education, only secondary education had an influence on willingness to pay for hybrid semen. Secondary activity also influenced willingness to pay for improved semen, and livestock activity was significantly positive.

Table 4.   Amounts paid by producers for the adoption of SNK hybrid cocoa seeds

Willingness to pay for a seedling of *SNK* hybrid cocoa	Min	Mean	Max
Region of Centre	50	150	500

Source: Author (2023) based on survey data

This table presents descriptive statistics on the amounts proposed by farmers who have adopted the improved *SNK* cocoa varieties.

Looking at the results, all the households that agreed to this variety would like to contribute an average of 150 CFA francs. This means a minimum of 50 CFA francs and a maximum of 500 CFA francs per unit.

This confirms SODECAO's policy of selling seedlings at the minimum price of 50 FCFA agreed by applicants.

4   DISCUSSION

With a view to achieving the Sustainable Development Goals (FAO, 2018), agricultural countries are facing the challenge of producing on a massive scale and satisfying food consumption as much as possible, as well as increasing income and gross domestic product through exports of cash crops such as cocoa. This plan is only possible if the adoption of innovations is promoted in this sector. The case of *SNK* hybrid seeds is a practical example. By mastering the determinants of the willingness to pay for a technology and the amounts agreed by adopters, we can prevent public policies and steer producers' efforts towards great success.

In the area surveyed, gender determines willingness to pay for *SNK* hybrid seeds. In the literature it is often ambiguous, but in this study it confirms the work of Matari and al. (2006) and Obisesan (2014) on the positive significance of willingness to pay for a technology.

The level of education also influences the willingness to pay for this seed. As the expected sign is positive, the results of our study show, like those of (Rogers, 1995; Kabore, 2011; Vasquez, 2009), that secondary level of education has a positive influence on WTP.

Livestock rearing as a secondary activity was found to be significantly positive in this study. Cocoa farmers rely more on the new high-productivity seeds to have enough time to take care of the secondary activity of livestock rearing. Although its expected sign was negative

Income does not figure in this study as a determining variable in willingness to pay. However, the farmers announced different amounts enabling them to acquire the improved seeds they wanted. These amounts vary between 50 FCFA and 500 FCFA, which justifies the satisfaction with productivity that these farmers expected when they adopted them.

5 CONCLUSION

At the end of the analysis of the variables determining willingness to pay for improved *SNK* cocoa seed in the Central Cameroon region, it should be noted that farmers are genuinely willing to adopt the new high-productivity hybrid seeds. There are not yet enough of these farmers to really feel the impact of the adoption of these technologies on a national and international scale. Willingness to pay for *SNK* hybrid varieties is determined by the farmer's gender (male and female), level of education (secondary) and secondary activity (livestock farming). The cost of these technologies is within the means of small farmers, but varies significantly from one farmer to another. This is why the public authorities, through their research and implementation institutions, should focus on increasing the availability of improved seeds by targeting populations with characteristics that determine not only acceptance but also willingness to pay for them.

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