Perceptions and socio-economic determinants of the willingness to pay for the market information system services: The case of cashew producers in Benin

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ABSTRACT

The cashew market is highly variable and prices and trends are changing rapidly, especially at the producer level. However, asymmetries of information prevail in transactions of the products within the sector. The market information system (MIS) is seen as an alternative in the management of information among agricultural stakeholders. The objective of this research is to analyze the perceptions of cashew farmers of the MIS and the socioeconomic determinants of their willingness to pay for the related services. Data were collected using questionnaires from a sample of 344 cashew farmers. Cashew farmers' perceptions were analyzed using Pearson's Chi-square homogeneity test. A binomial Logit model was used to analyze the socio-economic determinants of farmers' consent to pay for the MIS. The results showed that more than 50% of cashew farmers consider the different attributes of the market information system as important. The analysis of the socio-economic determinants showed that literacy, knowledge of the market information system, experience in cashew production, access to agricultural credit, access to agricultural inputs, and access to market information influence farmers' willingness to pay for the market system information. The research reveals that effective MIS implementation would improve stakeholders' productivity and income in the cashew sub-sector.

Introduction

From the mid-2000s onward, the agricultural export sector marked by the preponderance of cotton has been going through a crisis in Benin. Since then, agricultural diversification has become a priority for rural development actors in general, particularly for farmers seeking to improve and consolidate their livelihoods. Therefore, cash crops other than cotton, clearly appear as essential complements not only for the economic equilibrium of agricultural farms and livelihoods security but also for the nation because of their ability to attract foreign exchange (Adégbola *et al.*, 2010). In that sense, the cashew sector is of definite importance for Benin economy. In fact, the cashew sector contributes 3% of the gross national product and 7% of the gross domestic product (INSAE,

2009). Cashew is the second agricultural export product after cotton. Cashew nut exports are booming, rising from 84,512 tons of raw nuts exported in 2017 to 104,246 tons in 2019 (DSA, 2020).

The cashew sector employs more than 200,000 farmers and processors, both in artisanal and semi-industrial units (MAEP, 2017), generating income for the entire actors into the value chains: planters, traders, processors, exporters, and the State. However, the cashew sector in Benin is characterized by a lack of coordination between the various economic agents involved in, with frequent information asymmetry in transactions. For instance, traders have better access to information through their activities, while producers, often isolated and dispersed, are less informed. Information on the price and quality of cashew nuts flows easily between buyers, intermediaries and exporters, but producers often lack information on price fluctuations, product quality, norms, and standards (MAEP, 2017). This asymmetry results in unfair price formation often to the disadvantage of producers (Mikami, 2007; CTA, 2008).

The cashew market varies greatly and prices and trends change rapidly, especially at producers' level. But knowledge of the market would allow them to adopt a long-term strategy that will enable them to manage their cash flow properly through seasons. Access to knowledge and information would raise actors' capacity in grasping situations at a given moment and draw benefit from them. It is not necessarily about making the best profit but improving and securing their income by limiting unnecessary risk-taking. Among technologies that can offer new opportunities for communication and information sharing in markets of all types is the Market Information System (MIS). It is a system for collecting and disseminating information that eases access to agricultural and commercial data through modern means of communication, mainly mobile short message service (SMS), Internet, radio broadcast, or magazines (Galtier *et al.*, 2014b).

In addition to improving the dissemination of information, MIS is a means of overcoming the information asymmetry pertaining to farmer groups (Mikami, 2007; Mittal *et al.*, 2012). Indeed, the MIS offers new opportunities for communication and information sharing on all types of markets, thereby considerably reducing transaction costs (Aker, 2011; Kpenavoun *et al.*, 2013). However, this system is not sustainable because it is funded by external donors (CTA, 2008; Galtier, 2014c). To overcome the funding constraints and make the market information system sustainable, its services have to be taken into charge by the beneficiaries (CTA, 2008; Galtier *et al.*, 2012).

Most of the studies conducted on the market information system have focused on the evaluation of the effect of the system on users (Mittal et al., 2009; Kpenavoun *et al.*, 2013). Many of the studies came to the conclusion that the use of information from the MIS improves the actors' production and marketing decisions in agriculture. However, financing the system has very often been the concern of development programs and projects. Thus, the investments stop and the system ends at the closure of the program/project. Making the MIS sustainable imposes the system to be self-financed by its end-users. Consequently, it is essential to know the willingness of cashew growers to pay for the services of the Market Information System. That concern leads to the following research question: (i) How do cashew growers perceive the market information system? (ii) What are the socio-economic determinants of cashew growers' willingness to pay for the market information system services?

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Definition of the attributes of the market information system

The attributes related to the Market Information System research include the characteristics of the timing, the channel, the frequency, the language, the source of information dissemination, and the cost of the related services. These attributes and their levels are important in the selection of the market information system at the producer level. They were identified during the exploratory survey conducted through focus group discussion sessions with the different actors to get an insight into the characteristics of MIS and assess farmers' willingness to pay for related services.

For the monetary attribute that will serve to measure the willingness to pay, it was defined on the basis of the cost of an SMS between GSM networks: 20 FCFA equivalent to $0.033. From that basis, the different levels were identified during the focus group discussions with the different actors in the cashew sector. Price increments of 25%, 75%, 125%, and 150% were made on that basic rate to determine the maximum willingness to pay associated with the different alternatives. Table 1 provides an overview of the attributes and their levels.

TABLE 1

Attributes of the MIS

Attributes	Levels of attributes
Time of information delivery	Dawn Active moment of the day Evening Mid-day*
Information channel	Mobile Phone Magazine Radio Television*
Language	Local French
Source of information	Farmer organization Public sector Private sector
Frequency	Daily* Weekly Twice a month Monthly
Cost of information	20* 25 35 45 50

NB: Attributes with * represent the references

Materials and Methods

Research area

The research was carried out in the Center and the North of Benin covering four of the twelve provinces of the country: Collines, Donga, Borgou, and Alibori. The area corresponds to the most suitable for cashew production from the agro-ecological point of view (MAEP, 2003). Indeed, this area meets the requirements of the cashew tree (*Anacardium occidentale L.*) for good and profitable fruit production. It is located at latitudes 27° N and 28° S where the climate varies from hot to humid. It compounds a wide variety of tropical and subtropical soils on which the tree grows well. The tree also adapts well to semi-arid and arid regions with a dry period of 4 to 6 months and rainfall of about 500mm. The area of cashew production extends from the southern limit of the Zou province to the North of Borgou province and includes 31 districts. From 1996 to 2002, the area planted with cashew increased from 30,000 hectares to 74,000 hectares in Benin (MAEP, 2003).

Sampling

The sampling design combined purposive and random sampling. Of the 31 cashew-producing districts, 16 were targeted in 2014 by the project for the support of agricultural diversification (PADA) and the National Federation of Cashew Producers of Benin to carry out a census about cashew actors. For the availability of data and information in these 16 districts, they were purposively and systematically chosen for the research. Then, cashew-producing villages were purposively selected within these districts from the same database. The minimum sample size of cashew growers to be surveyed was determined by Yamane's formula (1967):

$$n = \frac{N}{1 + N \ (e)^{\ 2}}$$

With n = the sample size, N = the total size of the population at study, and e = the margin of error set at 5%.

With N = 2457 cashew growers in the selected districts, Yamane's formula was used to calculate the sample size. Thus, a sample of 344 cashew producers was drawn.

The spatial distribution of the sample through the provinces and districts is presented in Table 2.

TABLE 2

Spatial distribution of the sample

Provinces	Districts	Number of interviewees
Collines	Savè	20
	Ouessè	24
	Savalou	20
	Bantè	24
Borgou	Tchaorou	21
	Parakou	24
	N'Dali	24
	Nikki	23
Donga	Bassila	16
	Djougou	24
	Ouaké	23
	Copargo	22
Atacora	Natitingou	23
	Kouandé	24
	Péhunco	16
	Kérou	16
Total		344

Data were collected from the selected cashew producers. The data were related to the socio-economic and demographic characteristics of producers, the attributes of the market information system and their levels, the perceptions of the various attributes of the market information system by the producers of cashew, the determinants of the willingness of cashew growers to pay for the services related to the market information system, etc.

Analytical framework

Analysis of producers' perceptions: Perceptions in African countries are known to be heavily influenced by socio-economic characteristics (Assogbadjo *et al.*, 2008). For analytical purposes, we asked cashew producers to comment on the attributes of the market information system. A contingency table including count data has been produced for all attributes. Pearson's Chi-square homogeneity test was applied to analyze variations in perceptions according to attributes. There would be a variation between the perceptions of producers depending on the attributes of the market information system if the probability associated with the chi-square homogeneity test is less than or equal to 5%. The calculation of the values of Pearson's chi-square coefficient and its probability was made using R 3.5.0.

Analysis of socio-economic determinants

Theoretical model: To identify the socio-economic determinants of the willingness to pay for MIS, an econometric model of the binomial Logit type was used. Logit is based on logistics law. The dependent variable has two

modalities: either the producer agrees to pay for the services offered by the market information system or he does not consent. Referring to Peng *et al.* (2002), and Rakotomalala (2015), the model equation is as follows:

$$\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X \qquad (1)$$

The linearization of equation (1) gives equation (2):

$$\pi = P(Y) = \frac{e^{\alpha+\beta X_i}}{1+e^{\alpha+\beta X_i}} \qquad (2)$$

Where π is the probability that the producer agrees to pay for the services $(Y = 1)$, X_i = vector of explanatory variables, α is the constant of the equation, β represents the regression coefficients of the explanatory variables to be estimated.

The dependent variable $Y_i =$

$$= \begin{cases} 1 \text{ if the producer agrees to pay for the services} \\ 0 \text{ if not} \end{cases}$$

Taking the log of equation (2), we obtain the following Logit model with the coefficients to be estimated:

$$\ln\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + e_i \qquad (3)$$

e_i are the error terms and i = 1, 2, 3, 4, … k are the observations.

Then, we estimate equation (3) by estimating the coefficients α, β_1, β_2... β_k, and finally interpreted the results of the model.

Empirical model of analysis: The probability that a producer agrees to pay for the services of the market information system can be written as follows:

$$\ln\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = \alpha + \beta_1 AGE + \beta_2 SEX + \beta_3 ALPHE + \beta_4 EXPF + \beta_5 SINFO + \beta_6 ACRED +$$

$$\beta_7 REVNU + \beta_8 ACESINT + \beta_9 ACESNINF$$

Or

AGE: Age of the producer; SEX: Sex of the producer; ALPHE: Literacy of the producer; EXPF: Years of experience in cashew production; SINFO: Knowledge of market information systems; ACRED: Access to agricultural credits; REVNU: Farm income of the producer; ACESINT: Access to agricultural inputs; ACESNINF: Access to information on the cashew nut market.

We used STATA 15 to analyze the data. The validation of the binomial logit model

was carried out with the likelihood ratio, the probability of which must be less than the threshold of 5%. Mcfadden's p-seudo-R^2 gives the percentage of the variation of the dependent variable by the explanatory variables introduced into the binomial Logit model. The variables retained for this purpose in the model are those significant at the threshold of 1%, 5% or 10%.

Table 3 presents the definition of the explanatory variables of the model and their expected signs.

TABLE 3

Definition of the variables for the Logit model

Variables	Type	Modality	Expected sign
Age	Metric	Continuous	+
Sex	Nominal dichotomous	1: Male; 0: Otherwise	
Literacy	Nominal dichotomous	1: Literate; 0: Otherwise	+
Knowledge of MIS	Nominal dichotomous	1: yes; 0: no	+
Years of experience in cashew production	Metric	Continuous	+
Access to agricultural credits	Nominal dichotomous	1: yes; 0: no	+
Income from cashew production	Metric	Continuous	+
Access to agricultural inputs	Nominal dichotomous	1: yes; 0: no	-
Access to information on the sales market	Nominal dichotomous	1: yes; 0: no	-

Results and discussions

Socio-economic characteristics of producers
Table 4 shows the distribution of cashew producers according to their age, their experiences in agricultural and cashew production, and their income from cashew production (the upper part of the table). Cashew growers are on average 41 years old; they have on average 23 years of experience in agricultural production in general and 15 years in cashew production in particular. The average income from agricultural production is 625 927 FCFA (about $US 1,043.212). The lower part of the table deals with the qualitative variables. It shows that the majority of cashew producers are men (95.93%). About 33% are literate, 60% have access to credits, 94% have access to information on sales markets while about 63% have access to agricultural inputs.

TABLE 4

Socio-economic characteristics of cashew producers

Quantitative variables		Average	Standard deviation
Age (years)		41.13	8.57
Experience in agricultural production (years)		23.29	12.25
Experience in cashew production (years)		15.58	8.40
Income from cashew production ($US[1])		1,043.213	567.888
Qualitative variables		**Percentage (%)**	
Sex	Man	95.93	
	Woman	4.07	
Literacy	Yes	33.14	
	No	66.86	
Access to credits	Yes	60.64	
	No	39.36	

[1]Conversion from XOF CFA to $US based on the exchange rate of 1$US = XOF 600

Access to information on sales markets	Yes	94.47
	No	5.53
Access to agricultural inputs	Yes	63.53
	No	36.47

Source: Field Data, 2017

Perceptions of the relative importance of attributes of the MIS

Table 5 shows the importance of the attributes of the MIS according to cashew growers. About 71% of producers perceive the language of information delivery as the most important factor while only 7% of them consider it unimportant. The time of information, the frequency of delivery, and the cost to be paid are important to about 60% of producers. As for the channel and the source of information, they are important for about one out of two producers.

The analysis of the perceptions of the attributes of MIS showed that cashew producers are actively involved in the services. In fact, actors in the cashew sector are organized such to facilitate a good flow of information and their active participation in the development of the sector (CTA, 2008). However, other factors affect the degree of involvement of a producer, namely membership, experience in the sector, and level of education (Kpenavoun *et al.*, 2013). This suggests that these factors could be decisive in actors' perception of their involvement in the implementation of MIS. Cashew producers also perceived great efficiency in the data collection, the dissemination of information, the time of the delivery of information, and the types of information delivered within the framework of the services offered by MIS. It is because the types of information collected were defined by mutual agreement with the actors and the respondents were well targeted (Sossa *et al.,* 2014; Rabe *et al.*, 2017). The

producers considered that price information, the quality and availability of the product, and the existence of outlets were adequate.

The preferred delivery times for producers are active times of the day and evening. The time of information delivery is linked to the availability of the actors, which depends on the crop cycle and crop production practices (Vasquez *et al.*, 2009). In addition, producers felt that the types of information received were relevant and meet their needs. This attests to the involvement of the stakeholders into the process of selecting the information to be delivered. Otherwise, an MIS oriented towards production factors would be more interesting for the actors, and they would likely pay higher for that (Aker, 2011).

The attribute "information channel" was perceived as effective by cashew producers because the choice of the channel is linked to capital endowment and the habits of producers. The most preferred channels are mobile phones and radio. This result goes in line with previous studies that found the mobile phone as an efficient, useful, two-way, fast, interactive, and inexpensive tool that can improve rural actors' productivity and income through the dissemination of information (CTA, 2008; David-Benz *et al.*, 2012). In addition, it appears that the telephone is a basic communication device owned and used by many farmers (Mittal *et al.*, 2009; Maboudou Alidou, 2014). David-Benz *et al.* (2012) and Galtier *et al.* (2003) concluded that the radio is the most used and popular medium in rural areas because it has the advantage of reaching as many producers as possible and has a positive impact on product prices.

The channel must adapt to the information to be transmitted in order to facilitate the reception. Thus, Mittal *et al.* (2009) and Egg *et al*. (2014) assert that when information is disseminated through one or more channels to users, it improves the agricultural market. The services of the MIS involve the frequency at which the information is disseminated. This parameter appears to be very useful to producers since it provides information on the phone number on which the payments have to be done to receive the information (Mittal *et al.*, 2012; Galtier *et al*., 2014a).

The perceived cost efficiency of MIS services is explained by the low level of income of the actors involved. Cashew growers did not accept the high cost of the MIS. However, the low proportion of cashew producers who attached great importance to this factor could be explained by the level of competitiveness of this sector, which generates significant income. The ranking of the different attributes of MIS revealed that language ranks first, followed by the channel of delivery and time of the delivery of information. Producers found that it's very effective to receive information about the cashew market in local languages. Indeed, producers are mostly illiterate and live in rural areas. Taking into account the language factor enables a greater number of cashew growers to access the information for better management of their farm (Kpenavoun *et al.*, 2013; Galtier *et al*., 2014b).

TABLE 5
Perceptions of the importance of the attributes of MIS

MIS attributes	Degree of importance	Percentage of producers (%)	Chi-square (Pearson)
Time of	Not important	10.2	31.12***
	Important	64.3	
Diffusion	Very important	25.4	
Frequency of	Not important	16.40	24.98***
	Important	66.60	
Diffusion	Very important	16.90	
Channel of	Not important	5.10	7.77
	Important	51.70	
Diffusion	Very important	43.10	
Language of	Not important	7.10	8.45*
	Important	21.10	
Diffusion	Very important	71.80	
Source	Not important	11.20	50.52***
	Important	53.40	
of information	Very important	33.90	
	Not important	10.20	31.13***
Cost of information	Important	64.30	
	Very important	25.00	

*** Significance at 1% level, * significance at 10% level. Source: Field Data, 2017

Determinants of the willingness of cashew producers to pay for MIS services

The analysis of the determinants of the willingness of cashew producers to pay for the services of the MIS used a set of variables on which a correlation test was carried out. Table 6 shows that there are weak correlations between the dependent variable and most of the explanatory variables on the one hand and among the explanatory variables on the other hand. The willingness of cashew producers to pay for the services of the MIS reveals that 88% of producers are willing to pay for the services. Table 7 shows that the willingness to pay for MIS services is influenced by variables such as literacy, knowledge of the MIS, the years of experience in cashew production, access to agricultural credits, access to agricultural inputs, and access to information on the sale markets.

The coefficients of "literacy", "knowledge of the market information system" and "access to agricultural credits" are statistically significant at 0.10 level. Those of the variables "years of experience in cashew production" and "access to agricultural inputs" and their marginal effects are significant at 5%. The variable "access to information on the sale markets" is statistically significant at 0.01 level.

The negative sign of the coefficient of variable "Literacy" indicates that the more a cashew producer is illiterate, the more he would be willing to pay for the services of the MIS. Therefore, literate producers are not prone to pay for those services. Literacy certainly does not provide all producers with the intellectual capacity to appreciate the value of investing in the market information system (Casey *et al.*, 2006; Polyzou *et al.*, 2011; Egg *et al.*, 2014; Galtier *et al.* 2014b). The variables "Access to agricultural inputs" and "Access to information

on the sale markets" also affect negatively the willingness to pay. We conclude that cashew producers without access to agricultural inputs and without access to information on sale markets are more willing to pay for the services of MIS. They would then fill the gap and benefit from access to these two agricultural services. Table 7 also shows that cashew producers who are familiar with the MIS are more willing to pay for the services. The same applies to cashew producers who have extensive experience in cashew production and those who have easy access to agricultural credit (Galtier *et al.*, 2012; Galtier *et al.*, 2014a; Rabe *et al.*, 2017).

Experience in agricultural production positively affects cashew producers' willingness to pay for MIS services. The more experienced a producer is in cashew production, the higher his willingness to pay for the services of MIS. The marginal effect of that variable (+0.050), is significant and positive at 0.01 level, suggesting that when the experience in cashew production increases by one year, all other things being equal, the probability of the cashew producer paying for the services of the market information system increases by 5%. Indeed, cashew producers with higher experience in production have accumulated some knowledge in the sector, namely the demand, supply, and fluctuations of prices (Kpenavoun *et al.*, 2013). Sossa *et al.* (2014) in a study about pineapple found that the more experience pineapple farmers have in agricultural production, the higher their willingness to pay. Although the cashew sector has never experienced MIS, those with more experience in production better appreciate the usefulness of the MIS, which will provide them with information on the value chains in due time (Galtier *et al.*, 2003; Egg *et al.*, 2014; Galtier *et al.*, 2014a).

The results in table 7 show that the more cashew producers have access to agricultural credit, the more they consent to pay for the services related to the MIS. Indeed,

funding agricultural activities is one of the main constraints farmers face in investment decision-making (Issoufou *et al.*, 2017; Rabe *et al.*, 2017). Therefore, access to credit allows farmers to plan their activities and access inputs on time on the one hand and motivates them to pay for MIS in order to access information that can help improving the profitability of their activities on the other hand (Mbétid-Bessane, 2010; Egg *et al.*, 2014; Yabi *et al.*, 2016; Ouedrago *et al.*, 2017).

TABLE 6

Correlation tests between the variables of the logit model

	Payema	Age	Sex	Alphe	Expf	Sinfo	Acred	Revnu	Acesint	Acesinf
Payema	1.0000									
Age	-0.0082	1.0000								
Sex	-0.030*	-0.0131	1.0000							
Alphe	-0.0078	-0.191*	0.0513*	1.0000						
Expf	0.0048	0.6211*	0.0667	-0.070*	1.0000					
Sinfo	0.037*	0.0537	-0.0738*	0.0619	-0.047*	1.0000				
Acred	0.039*	-0.097*	0.0154	0.0066	-0.0073	0.0833	1.0000			
Revnu	0.024	-0.0150	0.0298	0.0050	-0.0535	*0.061	0.1801	1.0000		
Acesint	-0.123*	0.0838	0.0304	0.0842*	0.0221*	0.005	0.051*	0.0213	1.0000	
Acesinf	-0.0043	-0.0290	0.0884*	0.0590*	-0.0134	0.0217	0.145*	0.103*	0.1617	1.0000

* Significance at 10% level. Source: Field Data, 2017

TABLE 7

Results of the binomial logistic model

Variables	Coefficients	Standard error	Marginal effect (dy/dx)
Age of producer	-0.015	0.003	-0.014
Sex of producer	-0.361	0.225	-0.045
Literacy	- 0.119*	0.071	-0.017*
Knowledge of MIS	0.213*	0.137	0.022*
Years of experience in cashew production	0.156**	0.313	0.050**
Access to agricultural credits	0.142*	0.080	0.019*
Income from cashew sector	0.036	0.052	0.030
Access to agricultural inputs	-1.437**	0.130	-0,15**
Access to markets information	-0.211***	0.076	-0.033***
Constant	1.254	0.024	
Number of observations	344		
F(9, 344)	78.50		
PROB >F	0,0000***		
R²	0,6912		

*** Significance at 1%, ** significance at 5% and * significance at 10%. Source: Field Data, 2017

Conclusion

The present research analyses in Central and Northern Benin, the perceptions of cashew nut producers of the attributes of the MIS and the socioeconomic determinants of their willingness to pay for the services related to MIS. The attributes of the MIS considered in the research include the data collection, the information delivery, the language of delivery, the time of delivery, the types of information, the information channel, and the cost of delivery. The socio-economic determinants of cashew producers' willingness to pay for the services provided by MIS are, among others, literacy, knowledge of the MIS, years of experience in cashew production, access to agricultural credit, and access to information on the market, etc. It is important that policymakers in agricultural sector make effort to adapt the services of the MIS to the needs of producers in order to improve their productivity and income.

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