Willingness to Pay for Fertilizers at Unsubsidized Price in Togo

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Abstract: Over the period 2005-2014, the amount of fertilizers' subsidy to farmers grew sharply in Togo. Nevertheless, the government aims at removing this subsidy in the coming years.This work determines the farmers' willingness to pay for fertilizers at unsubsidized price and the factors likely to affect this willingness. The investigation covered a sample of 405 producers of cereals selected in three regions of Togo according to a two stage random sampling technique. Through contingent valuation, it appeared that farmers are willing to pay a premium about 13% regarding the current price of fertilizer. The estimation of Cragg model revealed that the standard Tobit model is very limitative to understand farmers' decision-making process. The results show that if the farmers' decision-making is positively influenced by young age, male gender, married status, education, experience in fertilizer use and the participation to Quick Start, the prepaid amounts, as for them, are affected mainly by the size of farm, non-farm income and distance to fertilizers sale points. The results do imply that the benefits of present subsidy are mostly being captured by the larger, richer and better located farmers who might well be willing to pay market prices, and also probably use the bulk of fertilizer. The results have twofold implication. Firstly, given the present characteristics of farms, and the depressive effect on fertilizers consumption subsequent to the total removal of price subsidy, it will be wise to envisage a gradual reduction of the current level of subsidy, first from 25% in year 1 and then 50% in year 2. Secondly, the government should experiment better methods, for example, voucher systems, to encourage poorer and more marginal farmers to use fertilizer.
Keywords: Willingness to pay, Subsidized price, Fertilizers, Cragg Model

INTRODUCTION

The debate over subsidizing agricultural inputs is divided between two schools of thought. The first of Keynesian vision which is described as "push-subsidy" is a policy that support the intensive use of inputs thanks to an incitation through subsidy policy [1]. The second, of a liberal view is in controversy to the first from 1980. It is qualified as "Price-pull" because it is based on an increase of agricultural products' prices followed by a reduction or even the removal of subsidies on inputs [1]. This liberalization would also lead to a privatization of the supply of inputs for farmers.

Thus, between 1980 and 1990, many African countries have moved from a subsidy-push policy to a price-pull policy resulting on liberalization and privatization of the supply and the distribution of agri-inputs.

However, given the Food Millennium Challenges for Africa and the need to increase fertilizers' consumption to 50 kg of nutrients per ha in 2015, the African Summit in Abuja held in 2006 on fertilizers had promoted public subsidy on fertilizers, which is now seen as an important instrument to boost the agriculture and the economy of Sub-Saharan Africa countries. In "Abuja's Declaration on Fertilizer for an African Green Revolution," the resolution no. 5 in substance said: "Improving access to fertilizers by providing subsidies to fertilizer sector especially to poor farmers». In a more general perspective of boosting the fertilizer market, resolution no. 2 says: "The Declaration of Abuja invites countries and Regional Economic Communities to take appropriate measures to reduce the purchasing cost of fertilizers at regional and national levels through the harmonization of policies and regulations to enable the free movement of fertilizer with free customs and free duties among the regions and capacity building for quality control" [2].

Before its adherence to the Declaration of Abuja, Togo had a long tradition regarding the fertilizers' subsidy. Nevertheless, following the ratification of Abuja agreement, the share of fertilizer subsidy has increased in public expenditures in Togo. Indeed, an analysis of the composition of the public expenditures reveals a significant part of input subsidies with a predominant part of fertilizer subsidies. Between 2002 and 2011, these subsidies have been multiplied by 10, increasing from 0.3 to 3 billion [3]. It is estimated that over the period 2005-2010, the sales prices of fertilizers to farmers had corresponded to an average subsidy of about 35 to 40% of the real cost of import and distribution except in 2009 when it reached 50%

due to the sharp increase in fertilizer prices on the international markets [3].

However, a fundamental reason raises doubt about the effectiveness of the subsidy policy relating the price of fertilizers: the "flight" of subsidized fertilizers out of the borders and away from the target group of small farmers at the advantage of the non-target group of the rich farmers [4].

Thus, in a dynamic of liberalization and privatization of the sub-sector of fertilizers, the Togolese government aims at removing the subsidy on fertilizers' price. This removal will increase the fertilizers bag's price from 11,000, the subsidized price, to at least FCFA17, 000, the bag's price in private shops, which nearly corresponds to the market price in the neighboring countries. Will this measure, already perceived by some actors as unpopular, not slow down the consumption which level is already low? In other words, will the farmers consent to pay a premium to purchase the fertilizer at unsubsidized price? If so, how much would they be willing to pay for? What are the socio-economic factors likely to affect farmers' willingness to pay for fertilizers?

The remainder of the article is organized as follows. Section 2 presents the theoretical framework of the study. Section 3 describes the method to assess the WTP and the data collection procedure. Section 4 presents and analyzes the results and section 5 concludes.

THEORICAL FRAMEWORK
The willingness to pay

The willingness to pay (WTP) is the maximum amount that respondents are willing to pay for the provision of a good or service. The techniques used to estimate the WTP can be divided into two categories: indirect methods and direct methods. Are called indirect methods, approaches based on ex-post behavioral observations. These approaches include: the hedonic price method, the cost of transportation method, method of avoided costs, the method of protection costs etc. [5].

The direct approach consist to interview an individual on the amount he is willing to pay for the establishment of a new good or service. This technique is called the method of contingent valuation and takes its root from welfare economics. The fundamental principle of this method is that the preferences of individuals should be the basis for the assessment of goods and services that have no market. It is then to individuals to reveal their preferences through the amount they are willing to pay to purchase the good or the service. Owing to the fact that it is based on intentions rather than on observations, some economists are still skeptical about the value of this method; arguing that declared intentions do not often correspond to the behavior of individuals. Furthermore, given its hypothetical nature, several biases may arise during the investigation [6].

A literature review on the WTP helps to identify 6 major biases:
(1) The strategic bias: occurs when the respondent thinks about the ultimate consequences of the investigation, then he adopts strategic behavior and does not reveal his true preference: It can be said that he plays "free rider".
(2) The information bias: it is induced by the lack of information on the respondent side.
(3) The procedure bias: also called the structural bias or instrumental bias, is introduced either by procedure used to discover the preference of the respondent; or by the analysis instrument used.
(4) The anchoring bias: is also known as starting point bias: it occurs when the value suggested by the investigator can serve as the respondent's benchmark. This amount can influence the answers of the respondents.
(5) The hypothetical bias: comes not only from the fact that the individual is faced with a contingent market which is an imaginary situation; but also from the fact that the individual cannot understand or perceive correctly the characteristics of the good described by the investigator (contingent good). Furthermore, in developing countries, individuals may not take seriously issues related to contingent valuation and thereby provide the first answers that cross their mind.
(6) The constant budget bias: derives its existence from the fact that some individuals who have been surveyed several times on the subject have in their mind a fixed budget they allocate to all problems of this nature.

According to Bonieux [6], specialists of the contingent approach used many methods to reveal preferences. The introduction of a new technique corresponded, generally in finding a new solution to new problems. Besides, all the methods were subjected to perpetual improvement and there is no agreement as for a revelation mechanism of preferences which would be more performant than the others in all practical situations. It is clear that the choice of a method is not neutral and induces an instrumental bias.

The methods used can be classified into five categories:
1. The first, called the auction method had been the most used method in the early applications and are close to a usual auction mechanism.
2. The second, called direct open question format procedure, consists in asking directly to the

respondent his WTP for greater consumption of the good or the service.

3. The third procedure commonly known as list template, or payment card method was introduced in the late 70s. It provides a list of values for the respondent and requires from him to provide the highest amount he wants to pay for the good or the service.

4. The fourth which is the most used and the most convivial, is the model of closed questions or referendum model or the " bidding game ". It was developed in the 1980s. Here, it is required from the respondent to declare the amount of money he wishes to pay for the good or service.

5. The Fifth method called contingent ranking method involves comparing pairs of baskets of goods. It originates from the ordinal approach of utility.

None of the five methods gave satisfactory results. For some authors, the open question format as well as the list template, are prone to errors because in reality, these kinds of markets are not frequent. The auction method has the inconvenience of introducing an anchoring bias due to the starting bid. For contingent ranking, the fundamental criticism is about the fact that it is a method that becomes tedious with the sample size of goods. Finally, the referendum method shows the inconvenient to generate lower values than the other methods. However, it has the merit of facilitating the task for the user. Also this method is similar to a market situation where the consumer accepts or rejects the exchange according to the price offered. This similarity is, however, of limited scope because unlike the buyer, the individual has limited information and did not experience the functioning of contingent market Arrow *et al* [7]. Nevertheless, the last two decades have seen an increasing use of the referendum method. This may be due to the fact that the method was popularized by Arrow and Solow, two Nobel economists prize who recommended it to NOAA in the United States as a method of contingent valuation of environmental damages. However, some adjustments can be made to improve its performance. This was what Bateman et al. [8] and Le Goffe and Gerber [9] did. They combined referendum method and open question method. The aim is to improve the value of the WTP either by framing or by boundary. The present study is inspired by the latter approach.

Determinants of willingness to pay (WTP)

Once, the WTP is evaluated, then comes the issue of the analysis of the determinants of the WTP. In the literature, econometric analysis has become an essential and complementary step of the contingent valuation method. A quick look at the literature enable to distinguish three categories of potential factors that affect the WTP. These are factors specific to producer, factors related to the contingent good and institutional factors. Among the factors specific to the producer, authors underscore the education and the experience as the human capital indicators, the age, the sex, the assets possession, the farm size, the availability of labor, the degree of risk aversion. In the category of factors relating to the contingent good, the literature mention the advantages and disadvantages relating to the good, the cost of the good, and the return on investment. Among the institutional factors, it is mentioned, the access to credit, the access to extension services, the land tenure, the availability and accessibility to information related to the good [10].

Concerning the specific case of fertilizers, Kelly [11] cites two main constraints that limit the optimal consumption of fertilizers by the farmers: the low incentive of the farmers to use fertilizers, due to the low profitability and the inability to obtain fertilizers and to use them effectively.

According to Tshibaka et al. [12], the probability of using fertilizer depends on socio-economic conditions of the household of the farmer, namely the availability of cultivable land, the land constraints, the household food security, the availability of labor, the technology of production and the market price.

Minot [13] used Heckman model to identify the determinants of fertilizer use in Benin and Malawi. Their study found that fertilizer use is closely related to crop mix and access to inputs on credit, but not to household income. In both countries, farmers growing cash crops are three times likely to fertilize their maize fields than other farmers. In Benin, 88 percent of the fertilizer purchased by farmers is bought on credit through the integrated cotton marketing system managed by the parastatal SONAPRA. However, almost one third of this fertilizer is diverted to maize and other crops.

As for Klutsè [14], low crop response to fertilizer use is depended on the weakness of the extension services. According to Honfoga [2], there are more specific determinants of fertilizer demand. These are the petty annoyances of the individual purchases, the remoteness of fertilizers' sale points, the difficult conditions of access to agricultural credit, the risk aversion of failures due to adverse agro-climatic conditions, etc.

As regards the choice of the relevant model, an important lesson from the literature on the contingent valuation method is that the specification of the econometric model depends on the method used to estimate the WTP. For example, if the method is an

open question, the econometric specification is a standard model in which the dependent variable (WTP) is continuous. In case of the referendum technique, the model used is a binary choice model [15]. N'Guessan [10], evaluating the determinants of willingness to contribute for the Universal Health Insurance (AMU) by the heads of rural households in Ivory Coast, shows through econometric analyzes that the simple censored Tobit model and the generalized Tobit produce different results. With the generalized Tobit, the household income influences household willingness to contribute while the income is not significant in the simple censored Tobit model.

It emerges from the literature overview on the WTP, the need to adapt the econometric analysis model to the data collection method.

METHODOLOGY
Data collection method

The objective of this study is to determine the farmers' willingness to pay for fertilizers and factors likely to affect the farmers' consent. For this purpose, a survey was conducted on June 2015 among cereals' producers (maize and rice) in three economic regions of Togo: the savannah region, the Kara region and the Plateau region. The target are the farmers who grow maize and rice and use fertilizers. We included in the sample farmers who buy fertilizers at subsidized price in CAGIA stores and those who once received fertilizers for free thanks to PADAT's Quick Start operation. The survey covered 150 producers in the Prefecture of Tone (Savannah region), 125 producers in the prefectures of Kozah and Bassar (Kara region) and 130 producers in the prefecture of Ogou (Plateau region). The investigation therefore covered a sample of 405 producers selected according to a two stage random sampling technique. In the first stage, 4 prefectures were selected randomly out of the 36 prefectures of Togo. In the second stage producers are selected randomly inside of the 4 prefectures.

Following the recommendations of [7] aiming at making credible results, two scenarios were presented to the farmers: 1) A reduction of the subsidy, raising the current price of the bag from FCFA11, 000 to FCFA 14,000, and 2) A removal of the subsidy on fertilizers, raising the current price of the bag from FCFA11, 000 to FCFA 17,000, the price of the fertilizers' bag in private shops.

Following each scenario, two questions were addressed to the farmer in order to separate the decision of acceptance and the prepaid amount as shown in the following extract from the questionnaire: "*We are going to ask you a number of questions. The aim is to make suggestions to the government in order to find the appropriate subsidizing policy for fertilizers. Please answer these questions freely and frankly. Anyway, if your answers are wrong, they will not change the subsidy policy.*

Scenario 1: Suppose the government decides to remove subsidy on fertilizers raising the current price from FCFA 11,000 to FCFA 17,000, the bag's price of fertilizers in private shops.

Question 1: Are you willing to pay a premium to buy fertilizer at raised price?

Question 2: If yes, how much would you consent to pay for a bag of fertilizer?"

The questionnaire is thus formulated in order to control a number of biases, mainly the strategic bias and the information bias. However, it necessarily includes an anchoring bias due to the fact that the prepaid amount by the farmer is indexed over the current price of the bag of fertilizer. It also includes a ceiling bias which is the bag's price in private shops.

Data Analysis Method

Given the two-stage approach used to discover the preference of farmers, it is important to disassociate the decision to pay a premium and the amount prepaid. A farmer who well understood the real benefits associated with the use of fertilizers may agree to pay a premium to purchase fertilizer. Yet, his income does not allow him to do so. In this case the amount declared shall not be significantly different from the current price of the bag of fertilizer. In contrast, for farmers whose income is significant, their declared WTP will be correlated to the value of their income. We can therefore consider that it is not the same variables that affect the decision to grant an additional amount and the prepaid amount. The Tobit model with the specification of Cragg provides an appropriate framework to solve the problem.

In general, the Tobit model is specified as follows:

$$Y_i^* = X_i \beta + \varepsilon_i$$
$$Y_i = Y_i^* \quad if \quad Y_i^* \succ 0$$
and 0 otherwise.

Like others binary models, the Tobit model defines a variable Y_i^*, the latent value of the WTP and Y_i, the observed value, X_i is the vector of socioeconomic variables and ε_i the error term assumed normally distributed.

The estimation of a Tobit model goes through the maximizing of the likelihood function. This method is one of the most used because compared to

ordinary least squares, it provides unbiased estimators [17].

The Tobit model is used when we face with a large number of observations for which the value of the endogenous variable can be null. This model implies that the observed value of the dependent variable is censored at zero. In the particular case, we have, beyond the observation that a farmer agrees or not to pay a premium to purchase the bag of fertilizer, there is a continuous measure of the WTP. The WTP can be zero if the farmer refuses to consent to an additional amount to purchase the fertilizer bag or positive otherwise. This variable is certainly continue but is observable only on an interval. The purpose is to know the determinants of WTP declared without removing from the sample farmers who do not consent.

We are faced with an alternative which consists of either keeping in the sample the observations for which the dependent variable is zero or eliminating them. In the first case, we talk about censored sample and the model used is a censored Tobit model. In the second case, we can decide to remove from the sample observations for which the value of dependent variable is zero. In this case, we talk of truncated sample and the model used is a truncated Tobit model. But in so doing, there arises an issue of bias selection due to the fact that one considers only a portion of the sample.

To correct this bias, we use the specification of Cragg known as Cragg model [18]. It consists in estimating, firstly, the Probit model which consider the entire sample. This enables to obtain a quality of the model adjustment in form of a log- likelihood value. Then we specify a truncated Tobit model where the observations for which the values of the dependent variable equal to zero are eliminated. Here again, we obtained, a log- likelihood value which allows us to judge the quality of the model estimation. The sum of the log- likelihood of these two models is then compared to that of a censored Tobit model. The latter

value must be inferior to that sum. To check this, we test the hypothesis that this difference is statically significant compared to a chi-square value. The difference to be tested is formulated as it follows:

$$\lambda = 2(LogL_{PROBIT} + LogL_{TOBIT\ TRONQUE} - Log_{TOBIT\ CENSURE})$$

Cragg 's model corresponds, therefore to two independent models, one taking into account the decision to use fertilizers (Probit model), and the other taking into account the positive amounts declared for purchasing a bag of fertilizer (the truncated Tobit model) . It appears that this type of analysis helps to take into account the different facets of the same phenomenon: the acceptance's decision to pay an amount and the prepaid amount.

EMPIRICAL RESULTS
Analysis of willingness to pay for fertilizers
To assess the maximal additional amount that the farmers are willing to pay in order to buy the bag of fertilizer, two scenarios are considered: 1) When we assume a reduction of 50% of the subsidy, raising the bag's price from FCFA11, 000 to 14,000; 2) when we assume a total removal of subsidy raising the current price of the bag from FCFA11, 000 to FCFA 17,000.

1) Scenario1: When we assume a reduction of subsidy, raising the bag's price from FCFA11, 000 to FCFA 14,000.

Following the scenario1, 90% over the 405 farmers are willing to pay a premium in order to buy the bag of fertilizers at unsubsidized price. Among them, 63% are willing to pay a premium varying between CFA1, 000 and 3,000, that is an average of CFA1375, corresponding to an additional amount of 12% base on the current bag's price (Table1). It should be underlined that the calculation of the average WTP does not take into account the zeros. We can remark that the price of fertilizers' bag remained constant at FCFA11, 000 because transportation costs are not included.

Table 1: The premium that the farmers are willing to pay in scenario1

Subsidized Price and WTP	Number of the respondents	Average Price (FCFA/L)	Minimum Price (FCFA/L)	Maximum Price (FCFA/L)	Standard deviation
Subsidized price	364	11.000	11.000	11.000	0
WTP	257	12.605	12.000	14.000	1030
Premium (FCFA)		1375	1000	3000	
Premium (%)		12	9	27	

Source: Survey data, 2015

2) Scenario2: When we assume a total removal of subsidy, raising the current price of the bag from 11,000 to FCFA 17,000.

When we assume a total removal of the subsidy, only 45%, over the 405 farmers, are willing to

pay a premium to buy the bag of fertilizer at unsubsidized prices. Among them, on average, 37% of the respondents declared amounts which correspond to a premium varying between FCFA 1000 – 6000. That is an average of FCFA1430 only. This corresponds to an

additional amount of 12%, regarding the current price of the subsidized fertilizer.

Table 2: The premium producers are willing to pay in scenario2

Subsidized Price and WTP	Number of the respondents	Average Price (FCFA/L)	Minimum Price (FCFA/L)	Maximum Price (FCFA/L)	Standard deviation
Subsidized price	182	11.000	11.000	11.000	0
WTP	151	12430	12000	17.000	2025
Premium (FCFA)		1430	1000	6000	
Premium (%)		13	9	54	

Source: Survey data, 2015

The results of scenario 2 relating to the assumption of complete removal are globally disappointing because they reveal a refusal of the majority of producers to purchase the bag of fertilizer at FCFA17, 000. Consequently, a total removal of the subsidy of the fertilizer will slow down the current level of fertilizer consumption, which is one of the lowest in Africa. Given the current characteristics of farms, the total subsidy removal will cause a significant depressive effect on consumption and therefore on agricultural production. It will be wise to envisage a gradual reduction of the current level of subsidy. First from 25% in year 1 and then 50% in year 2.

Analysis of the Determinants of willingness to pay for fertilizers
Descriptive Analysis

Table 3 below presents the descriptive statistics and the definitions of the variables used. It appears from the table, that 60% of farmers are men. The average age of the farmers is 40 years. 89% use fertilizers in cereal production for over three years. They are mostly married with about 7 dependents. Only 34% have received a formal primary school education. Only 22% are visited once in the year by extension agents. The farms have an average size of 1.23 ha. Food production is their main source of income, however 21% of the farmers have other sources of income such as small trade and crafts. Among the 405 producers, 23% have access to agricultural credit and 55% operate on their own plots. 48% have once participated to the Quick Start operation[1]. The farms are on average 22 Km away from the nearest fertilizers points of sale.

Econometric Analysis

Before estimating the econometric model and finding the relevant explanatory variables, it is worth checking whether the considered variables are not highly correlated. This question raises the issue of a possible multicollinearity between the explanatory variables which can involve instability of the estimated coefficients. To ensure that this problem is avoided, the Farrar and Glauber [18] test[2] allowed to accept the absence of multicollinearity between the explanatory variables. The table 4 presents the results of the estimated models: simple Probit, censored Tobit and truncated Tobit for only the scenario of complete removal of the fertilizers' subsidy.

1. Estimation results

Table 4 summarizes the results of Probit model, censored Tobit and truncated Tobit estimated independently and according to scenario 2[3]. The Log likelihood ratio statistics are significant at 1% for all models. Similarly pseudo R^2 is at acceptable level and consistent with results obtained by other studies [20]. Cragg's test rejects the null hypothesis that there no significant difference between the model of Cragg ($L_{Probit} + L_{Tobit\ truncated}$) and censored Tobit ($L_{Tobit\ censored}$). The model of Cragg is much more robust than the standard Tobit model. In addition, Table 4 shows that the specification of Cragg reveals a complementarity between the Probit and truncated Tobit models. Therefore, the analysis is done in two steps: the analysis of the determinants of the decision to accept through the results of the Probit model then the analysis of the determinants of the amount prepaid provided by the results of the truncated Tobit model.

2. Estimation results of Probit model

The estimation of Probit model has shown a total of six significant variables. They are GENDER, AGE, STATUT, EDUCATION, USEFERTILIZER, and QUICK START. The signs of the coefficients of all variables are in line with what is expected. Gender is a significant factor that affects the choice of the use of fertilizers. The results indicate that from the target

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[1] The Quick Start is a free distribution operation of inputs kits composed of 100 kg of NPK fertilizer, 50 kg of urea and 10 kg of seeds (for maize) or 50 kg of NPK fertilizer , 25 kg urea and 20 kg of seeds (for rice) to vulnerable farmers.

[2] *This test was conducted in two steps: the first step has determined the matrix of correlation coefficients between the explanatory variables. Due to the lowness of the coefficients, a lack of multicollinearity was suspected. So, the second step has confirmed the absence of multicollinearity of variables by chi-square test base on the orthogonal series as null hypothesis.*

[3] *We don't find necessary to present the results relate to scenario1 because the two scenarios yielded similar results.*

female group to the target male group, the probability of willingness to pay increases for 22%. This result reflects the fact that men have more duties than women. Heads of household, and sometimes polygamous, they are the one that has the first responsibility in the household livelihood and would ask more from agriculture than women. They should be more inclined to seeking information, to obtaining and adopting technologies that are likely to increase their income.

Age is a variable which significantly affects the WTP. The farmers who are less than 40 years old, the average age of the sample, are more inclined than the elders to buy fertilizers for their farms. This result is not counter intuitive because young people are often considered as people who are highly predisposed to adopt innovations, people who are more dynamic in the search of information and people who have less aversion for the risk. We do not know exactly what superior limit to set at this level of age. If for Polson and Spencer [20], this age can be situated between 20 and 50 years, Akinola [21] and Voh [22], for example, while recognizing that aged farmers are less inclined to try new farming practices, have not been able to specify a threshold level for this age. This can be due to the fact that in Sub-Saharan Africa, in agricultural households, children are initiated into farming very early and are let to take decisions very early in life. One of the implication of this finding is that younger and "progressive" farmers should be the first target of extension services involved in the distribution of technologies.

As regard the formal education, it positively affects the probability of willingness to pay a premium for fertilizers' purchase. In fact, education should enable the farmers to better perceive the benefits of soil fertilization. However, when we pass from the group of farmers less educated to the group of more educated farmers the probability of willingness to pay increases only for 7%.

Finally, the EXPERIENCE and QUICK START variables positively affect the WTP. The fact that the farmer has at least three years' experience in fertilizers use or the fact he has once beneficiate free fertilizer kit through Quick start program affect positively their willingness to pay.

Table 3: Definitions of potential explanatory variables of WTP and descriptive results, N=405

Variables	Description of the variables	Average	Standard deviation
GENDER	Dummy =1 if male and 0= if female.	0.60	0.38
AGE	Dummy variable = 1 if the age of the farmer is more than the mean age of the sample (40 years), 0 otherwise.	40.16	9.00
STATUT	Dummy variable =1 if married, 0= otherwise.	0.78	0.20
HOUSESIZE	Number of dependents in charge of the farmer.	6.57	4.26
FARMSIZE	Size of the farm (ha).	1.23	2.34
EDUCATION	Dummy variable =1 if the farmer attended to school more than six years, 0 otherwise.	0.34	1.10
EXTENSION	Dummy variable =1 if the farmer received at least one visit of extension agent, 0 otherwise.	0.22	0.57
NON-FARM INCOME	Dummy variable =1 if the farmer has another source of revenue a part from agriculture, 0 otherwise.	0.21	0.13
USEFERTLIZER	Dummy variable =1 if the farmer has at least three years' experience in fertilizer use, 0 otherwise	0.89	0.39
QUICK START	Dummy variable =1 if the farmer participated once at Quick Start operation (grant of fertilizer), 0 otherwise.	0.48	0.18
DISTANCE	Distance from farm to the nearest fertilizers' sale point (Km).	22	5.10
TENURE	Dummy variable =1 if the farmer is the owner of the farm land, 0 otherwise.	0.55	0.34
CREDIT	Dummy variable =1 if the farmer has access to credit, 0 otherwise.	0.23	0.10

Source: Survey data, 2015

Table 4: Estimation results of Probit, truncated Tobit, censored Tobit models and Cragg test

Variables	Probit		Truncated Tobit		Censored Tobit	
	Coefficients	T-ratio	Coefficients	T-ratio	Coefficients	T-ratio
GENDER	0.75	**4.35*****	- 44.31	- 1.08	2602.48	**3.46*****
AGE	0.03	**1.91***	0.97	0.04	65.28	**1.72***
STATUT	0.11	**1.75***	16.67	0.12	438.34	**1.73***
HOUSEHOLDSIZE	0.02	0.84	55.30	1.16	105.11	1.31
FARMSIZE	0.33	1.25	43.23	**2.25****	105.35	1.32
EDUCATION	0.05	**2.19****	10.35	0.58	81.76	0.25
EXTENSION	-0.05	- 0.11	-144.71	- 1.01	95.23	0.95
NON-FARM INCOME	0.35	1.01	84.11	**2.53****	709.83	1.05
USEFERTILIZER	0.18	**1.90***	-20.63	- 1.02	290.02	**2.01****
QUICK START	1.05	**3.02*****	12.01	0.39	334.04	1.05
DISTANCE	- 0.25	-1.06	-36.12	**-2.53****	270.56	0.43
TENURE	0.12	0.98	22.05	1.49	1013.29	0.20
CREDIT	0.65	0.30	-126.17	- 1.12	1013.91	0.95
CONSTANT	-1.05	-1.20	43.67	2.16	-51692	-1.47
LogL	**- 195.23**		**-1836.66**		**-2178.70**	
LR chi2 (.)	**35.25**		**39.48**		**34.05**	
Prob>chi2	**0.00**		**0.00**		**0.00**	
Pseudo R2	**0.36**		**0.27**		**0.47**	
Number of observations	405					
Number of observations = 0	148					
Number observations >0	257					
Cragg Test :	$\lambda 1 = 293^{***}$ (14 ddl)[4]					

Source : Survey data, 2015 ; *** Significant at 1%; ** significant at 5%; * significant at 10%

Table 5: Marginal coefficients values of significant variables

Variables	Probit	Truncated Tobit
GENDER	0.22	-
AGE	0.05	-
EDUCATION	0.07	-
STATUT	0.03	-
USEFERTILIZER	0.04	-
QUICK START	0.23	-
FARMSIZE	-	1135.05
NON-FARM INCOME	-	492.35
DISTANCE	-	103.02

Source : Survey data, 2015

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[4] $\lambda 1 = 2(-195.23 -1836.66 - (-2178.70) = 293.62$

3. Estimation results of the truncated Tobit model

The estimation results of the truncated Tobit model presented in Table 4 show three significant variables explaining the amounts declared. These variables are FARMSIZE, NON-FARM INCOME and DISTANCE.

The size of the farm has a significant positive effect on the amounts declared by farmers. All things being equal, when the farm size increases of 1ha, the willingness to pay increases on average FCFA1135 (see table 5). This is consistent with several studies that have shown generally that large farms are more likely to adopt new technologies compared to small farms because at first, the size of the farm is an economic indicator of wealth, then the size creates economic scale [23].

As for the non-farm income, its effect is also decisive in the amounts declared by the producers. While the majority of the farmers derives their income mainly from agriculture, yet 22% have other sources of income such as small trade and crafts. When going from the first group to the second, the willingness to pay increases on average for FCFA492. This result is consistent with several studies in Africa which have shown that the non-farm income is an important source of agriculture financing for small farmers.

Finally, the variable DISTANCE negatively affects the WTP of farmers. More the farmer's location is far from the fertilizer sale point, less is the premium declared to purchase the bag of fertilizer. When the distance increases for 1Km, the willingness of the farmer to pay the bag of fertilizer decreases for FCFA 103. In fact the distance is an additional cost that raises the total cost of fertilizers and makes then less attractive for cereals fertilization.

Variables such as EXTENSION, TENURE and CREDIT do not affect significantly the premium of the farmers probably due to inadequate institutional support for extension, tenure security and access to credit.

It follows from the aforementioned analysis that the truncated Tobit model improves understanding of the farmers' decision-making process. Thus, once taken, the decision to pay a premium to purchase fertilizer, it is in general, other factors that explain the prepaid amounts. These are the variables related to the size of farms, non-farm income and the distance of the farms regarding the sale points.

It thus appears that the Cragg model allows to take into account the two facets of the same phenomenon: the decision to accept to pays fertilizers and the prepaid amount. The standard Tobit model alone, therefore appears quite limitative for understanding the farmers' decision-making process.

CONCLUSION AND IMPLICATIONS FOR AGRICULTURAL POLICY

Over the period 2005-2014, the amount of fertilizers' subsidy to farmers grew sharply in Togo. Nevertheless, the government aims at removing this subsidy in the coming years. Does this decision not a risk that will slow down the consumption which level is already low? In other words, will farmers consent to pay a premium to purchase the fertilizers at unsubsidized price? If yes, how much will they be willing to pay in order to buy a bag of fertilizer? What are the socio-economic factors that are likely to affect the willingness of farmers to pay for fertilizers at unsubsidized price?

This study evaluated the willingness of farmers to pay the fertilizers at unsubsidized price and relevant factors that affect this willingness. For this purpose, a survey has covered 405 farmers growing cereals in three economic regions of Togo. According to the contingent valuation method the situation can become catastrophic if the government removes totally the subsidy on the price of fertilizers. Indeed, if 90% of farmers are willing to pay only 12% of premium in the scenario of 50% of subsidy reduction, in the scenario of a total removal of the subsidy, only 45% of farmers consent a premium of 13%.

In order to determine the factors which affect the willingness to pay for fertilizers, a resort to Cragg model had revealed that the standard Tobit model appears verily limitative to understand the decision-making process of the farmers. The results show that if the decision of the farmers is positively influenced by the young age, the male gender, the married status, the level of education, the experience in term of the use of fertilizers and the participation in Quick Start, the prepaid amounts, as for them, are positively influenced by the size of farms, the non- farm income and the distance from farms to fertilizer's sale points.

The results do imply that the benefits of present subsidy are mostly being captured by the larger, richer and better located farmers who might well be willing to pay market prices, and also probably use the bulk of fertilizer. This result implies also that there are better methods, for example, voucher systems, to encourage poorer and more marginal farmers to use fertilizer.

REFERENCES

1. Fontaine JM, Sindzingre A. Macro-micro linkages: structural adjustment and fertilizer policy in sub-

saharan Africa. Technical Papers No. 49, OECD Development Centre. 1991.

2. Honfoga B. Etude du secteur des engrais au Togo en vue de la formulation d'un mécanisme de subvention. Rapport final, MAEH, Lomé. Togo. 2013.

3. MAEH. Revue des dépenses publiques en agriculture au Togo. Rapport final, MAEH, Lomé. 2012.

4. Yovo K. Efficacité de la politique de subvention des engrais au Togo. Document de travail, Université de Lomé. 2015.

5. Luchini S. De la singularité de la méthode d'évaluation contingente. Economie et Statistiques. 2002;357-358.

6. Bonnieux F. Principes, mise en œuvre et limites de la méthode d'évaluation contingente, Études et Recherches en Économie Publique. 1998;1:54-115.

7. Arrow K, Solow R, Portney PR, Leamer EE, Radner R, Schuman H. Report of the NOAA Panel on Contingent Valuation Federal Register. 1993;58(10):4601-4614.

8. Bateman IJ, Langford IM, Turner RK, Willis KG, Garrod GD. Elicitation and truncation effects in contingent valuation studies. Ecological Economics. 1995;161-179.

9. Le Goffe P, Gerber P. Coûts environnementaux et bénéfices de l'implantation d'une sablière en zone péri-urbaine : Le cas de Pacé. Rapport non publié, INRA, Rennes. 1994.

10. N'Guessan CFJ. Le consentement des ménages ruraux à payer une prime d'assurance maladie en Côte-D'Ivoire. Revue Economie du Développement. 2008;16:101-124.

11. Kelly, V. Factors affecting demand for fertilizers in Sub-Saharan Africa. Discussion paper N°23, World Bank, Washington DC. 2006.

12. Tshibaka BT, Honfoga BG, Têvi J, Houngbo A, Dokoué J. Facteurs déterminants de la connaissance, de l'adoption, de la diffusion et des effets des techniques culturales modernes et des engrais au Sud-Est du Togo. Fertilizer Policy Research Project, IFPRI/IFDC, Lomé, 1992.

13. Minot N, Kherallah M, Berry P. Fertilizer market reforms and the determinants of fertilizer use in Benin and Malawi. MSSD Discussion Paper N°40, IFPRI, Washington DC. 2000.

14. Klutse R ; Etude de faisabilité d'un mécanisme fiable d'approvisionnement et de distribution des engrais coton et céréales dans les pays de l'UEMOA et au Tchad. Rapport du Togo, UEMOA, Ouagadougou. 2013.

15. Hanemann WM. Welfare Evaluation in Contingent Valuation Experiments with Discrete Responses. American Journal of Agricultural Economics. 1984;66:335-379.

16. Hanemann WM; Willingness to pay and willingness to accept: how much can they differ? American Economic Review. 1991;81:635-647.

17. Guerin O. Modèle Tobit: l'intérêt de la spécification de Cragg. Une application à la politique de couverture du risque de taux d'intérêt des collectivités territoriales françaises. Document de travail, C.R.E.F.F., IAE, Bordeaux. 2007.

18. Timothy C, Kenneth MCE. valuing environmental and natural Resources. The Econometric of non-market valuation. New Horizons in Environmental Economic. 2003.

19. Farrar DE, Glauber RR; Multicollinearity in regression analysis: the problem revisited. Review of Economics and Statistics. 1967;49(1):92-107.

20. Polson RA, Spencer DSC. Le processus d'adoption de technologies chez les petits agriculteurs : le cas du manioc dans le sud-ouest du Nigeria. La Recherche à l'IITA. 1992;5:12-177.

21. Akinola AA. An application of Probit analysis to adoption of tractors hiring service scheme in Nigeria. Oxford Agrarian studies. 1987;17:0-82.

22. Voh JP. A study of factors associated with the adoption of recommended farm practices in a Nigeria village. Agricultural Administration. 1982;9:17-29.

23. N'dé AHP. Les déterminants de l'adoption de nouvelles technologies rizicoles en Côte d'Ivoire: le cas des semences améliorées de riz et des intrants chimiques dans la région de Korhogo. Thèse de Doctorat de 3e Cycle non publiée, Université de Cocody, Côte d'Ivoire. 1997. 50-60.