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MAIZE FARMER PERCEPTION AND PARTICIPATION IN CROP AND RAINFALL INDEX-BASED INSURANCE PROGRAM IN BENIN

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Abstract

Faced with the risk of climatic variability, crop and rainfall insurance becomes a necessary tool for farmers in Benin. The insurance has been recently introduced to help farmers mitigate climate risk. However, farmers are reluctant to its participation and adoption. With 155 randomly selected farmers in the district of Ouesse, this study investigates on determinants of participation in the crop and rainfall insurance program. The results of Poisson model and the hurdle model show that gender, the age combined with experience, the acreage of maize, the understanding of agricultural insurance, the education, the perception on agricultural insurance and the household income are the main drivers of the number of time farmers subscribed to the insurance. Producers should be made aware of the purpose of agricultural index-based insurance. In addition, financial support in form of discount should be provided to farmers with low income to get access to the agricultural insurance.

Keywords: *Index-based insurance, Maize production, rainfall, Benin.*
JEL Codes: *Q18, O13*

1. Introduction

The African economy is highly dependent on agriculture and much of the continent's water (85%) is used for this activity (Gnanglè and al., 2012). It remains a central element of the West African economy, providing 30 to 50 percent of the GDP of most countries and the largest source of income and livelihood for 70 to 80 percent of the population, as well as food supply and export earnings from cash crops (Gueye, 2008). Benin, a small country in West Africa, shows no exception. Agriculture is of paramount importance as it strengthens its economy by contributing on average to 32.7% of GDP, 75% of export earnings and 15% of national income (MAEP, 2014). Among the crops grown in Benin, maize is a very important cereal because it

is the basis of the diet of the populations of Central Benin (Adégbola and al., 2011) and the most widely grown (Djohy and al., 2015). Corn is used in different ways. In human food, there are fresh or green products, dried seeds cooked and cooked, dry seeds ground into flour or semolina. For livestock feed, it allows to have sounds, cakes and germs. In agribusiness, maize is used to make beer, infant and adult improved flours (Houngbo, 2015). Maize is a fairly important crop in Benin, which is essential for ensuring food security.

However, the yields of this crop have been falling for a number of years. Indeed, according to Djohy and al (2015), during the years 1995 to 2012, corn yield ranged from 522,274.38 tons in 1995 to 1204,131 tons in 2006 (an increase of 681,856.6 tons maize), but this yield fell by 50,014 tons from 2006 to 2012. The area under cultivation has also increased from 493493.5 ha in 1995 to 1038464 ha in 2006, a difference of 544970.5 ha; then a decline of 99,610 ha between 2006 and 2012. Food production has experienced a general decline of 50% in all departments of Benin.

The period of decline in maize yield corresponds to the reduction of rainfall in quantity and distribution (Katé and al., 2015). According to the same author, after the peak of 1400 mm of water reached in Benin in 1994, from 1995 to 2011, the minimum of 800 mm and less, per year, was recorded 7 times, while the maximum water level 1200 mm has been achieved for only five years. The meteorological data of the Benin center between 1960 and 2008 reveal that the evolution of the average height of rain for the ecological zone of Benin decreases. In fact, the average height of rainfall drops from 1400 millimeters (mm) of rain in 1962 to 1250 mm in 2008 with a regression rate of 5.5 mm of rainfall on average per year for a linear adjustment (Gnanglè and al., 2009). These data thus show the climatic variability resulting in lower rainfall rates that producers have faced. The manifestations of climate change go beyond the drop-in rainfall rates. The temperature has also increased significantly (Gnanglè and al., 2012) and the upsurge of heavy rains has resulted in the destruction of 25,000 ha of food crops and has caused damage estimated at more than 9 billion ha (Djohy and al., 2015). These climatic variabilities have not only become constraints to the producers, but they will persist in the coming years. The GIEC (2007) projections show that by the year 2020, agricultural production and access to food will be compromised by the phenomenon of climate variability. Agriculture thus becomes an activity that presents a high risk related to climate variability. Farmers of maize are developing various strategies to adapt to this change. Corn producers adopt improved varieties of short-cycle corn; they practice late planting and reduce seedling density (Tidjani & Akponikpe, 2012). To these climate risk management strategies is added agricultural insurance which is defined as the equitable transfer of the risk of loss, from one entity to another, in exchange for payment (Duhan, 2017). Farmers perceive that insurance reduces farm risks and losses and reduces the consequences of losses and reduces vulnerability (Chikaire and al., 2016). This tool not only reduces agricultural risks but also improves farmers' incomes (Jayakumara & Pramod, 2012). Insurance mitigated the impacts of shocks in credit access, induce investments in productivity, supports social transfers, improve food security and encourage growth and poverty reduction (Jensen and al., 2018). Considering how producers are compensated, there are several types of agricultural insurance, including traditional insurance and index insurance. Traditional insurance is based on the recognition and evaluation of crop damage, while index insurance is linked to indices correlated with the extent of the phenomena (drought, lack of rain, etc.) (Leblois & Quirion, 2016). The second type of insurance that is the one present in our study since 2013, is preferred to the first because the associated premiums caused by traditional insurance are usually unaffordable for low-income small-holder farmers and the speed at which are often slow to alleviate the impacts of their livelihoods (Daron & Stainforth, 2014). According to the same authors, the management costs are lower than traditional claims-based forms of insurance and the traditional-handling process. Despite its advantages, the uptake of index insurance in pilot programs worldwide has been generally low, and no examples demonstrating clear success with a demonstrable

capacity for scalability or sustainability over the long run have appeared (Jensen and al., 2018). This product implemented by the agency called AMAB in this study area, confirms the low uptake of index insurance. The data from this structure show that few producers have regularly subscribed to this type of product. Indeed, the data collected from this AMAB show that over the four years in which the insurance was offered to producers, among the producers who subscribed at least once to agricultural index insurance (557 producers), only 56 producers (10.05%) have taken out insurance regularly (for all the four years). The majority of producers show resistance to participation in insurance. This behavior of producers is certainly due to certain factors and producers' perceptions towards insurance. This was initiated to capture the factors that contribute to the participation of farmers in the agricultural insurance program.

The general objective of this study is to generate useful information for the promotion of the program. The specific objectives are two-fold: (1) to identify farmers' perceptions of agricultural insurance program, (2) to identify the determinants that affect farmers' participation in the agricultural insurance program. The remainder of the article proceeds by providing the description of the program in Section 2, giving an overview of the theoretical and conceptual framework in the Section 3, describing the methods used in the Section 4, presenting the results and discussion in the Section 5, and presenting some conclusions and policy implications in Sections 6 and 7, respectively.

2. Description of Agricultural Index-based Insurance

Agricultural index-based insurance has started in 2013 in the district of Ouèssè in Northeastern of Benin. This insurance program is designed to compensate the insured in case of corn production losses resulting from bad weather conditions. This method does not require the insurance institution to investigate the producers' fields individually when there is urgency for compensation. It considers several insureds at a time. This avoids several problems such as: the delay in the payment of compensation after a disaster, the abandonment of the field by the producer, the choice of the insurance by the producers whose climatic risk is quite high. Indeed, the insurance program is based on climatic indexes for the compensation of the insured. The quantity of water sufficient for the growth of the maize crop is known beforehand using historical data on rainfall and environmental yields. By knowing the amount of water needed for each phase of maize growth, an emergency release threshold is defined. As soon as there is drought in an area, the insurance institution is alerted automatically and compensates the producers concerned. The amount of compensation varies depending on the water deficit. The period covered by the contract is approximately four months and starts in May or July. This period often coincides with the growing season of maize. Before covering the producer, he must pay a total insurance premium. This premium refers to the amount that the producer or insured gives to the insurer to be compensated at the appropriate time. It is 10,000 FCFA (approx. 20 USD) per hectare in the study area.

3. Theoretical and Conceptual Framework

In agriculture, there are five categories of risk: climate and health risk, price or market risk, institutional risk, financial risk, which also includes the risk of non-payment and liquidity risk, and human and professional risk (Cordier and al., 2008). According to Lafrance (2015), the risk management theory states that there are three generic basic principles of risk reduction which include: sharing, pooling and diversification. Risk sharing involves an agent who is not subject to risk in order to spread the possibility of loss or gain. Pooling consists of grouping different producers with a similar risk and probabilities and sharing the results. Diversification is represented by the old adage that says "do not put all your eggs in one basket". In addition, producers who face risks react differently. There are three categories of producers in their

response to risks: a first category of producers who do not like to take a risk, a second category of producers who prefers it and one that is indifferent (Concina, 2014). Thus, given the risk threats faced by producers, those who are risk-averse, pursue two production objectives: reducing risk and achieving the best economic results (Sall, 2015). Three methods are thus developed to achieve these objectives. The first is to reduce the level of risk, the second is to diversify it and the last is to sell it to a third party (Cordier and al., 2008). Regarding the first method, the self-insurance tool is used by producers to overcome difficulties. The second method is based on diversification. It allows the producer to reduce the risks. The third method involves a risk transfer to the insurer (risks, agricultural markets). With regard to all these risk management methods, the third method refers to agricultural insurance, which is an innovation in our study area. However, farmers' participation in insurance could be motivated by his perception on the profitability or be guided by the maximization of profit derived from his activities taking into account the cost related to paying the insurance. In addition, other factors such as age, experience, education, area planted, debts, land access, geographical position, local conditions (types of farming, soil, need or no water), non-agricultural income, expected production yield, perception of yield risk, agricultural diversification and risk preference could be a source of motivation for the participation in the program.

4. Materials and Methods

4.1 Study Area and Data Collection

The study was carried out in the commune of Ouèssè which is classified in the 5th agro-ecological zone of Benin and is located in the tropical humid zone. It stands on a fairly homogeneous region covering a pen plain modeled on dominated Precambrian material, mainly in the east, by granite hills of about 300 meters (PDC, 2005). It is a large food producing area, commonly referred to as the " granary " area of the Hills Department. It enjoys a tropical climate intermediate between the Guinean climate and the Sudanese climate, with the trend in recent years towards one growing season instead of two a year. The annual rainfall varies between 1100 and 1200 mm (Akomagni, 2006). This area is currently threatened by climate change (Gnanglè and al., 2009).

The survey was conducted among 155 randomly selected producers in levels of participation in agricultural index insurance (no participation, one-time participation producers, two times participation producers, three times participation producers, and four times participation producers). The list of producers who participated in the insurance in the municipality of ouèssè was obtained from the structure in charge of insurance. Table 1 below shows the number of producers in each stratum and the number of producers surveyed.

The data collected from them are related to their socio-demographic characteristics, the number of crop types practiced, the importance of climate risk on the farm, the understanding of index insurance information, the corn acreage, land acquisition method and household size. The data collection was done using a questionnaire administered to each producer during a structured interview.

Table 1. Number of Producers and Number of Producers Surveyed

Number of Farmers	Non-participant Producers		Producers who Participated			
Strata	zero	once	twice	three times	four times	Total
Surveyed	80	29	23	12	11	155
Total	-	218	178	105	56	557

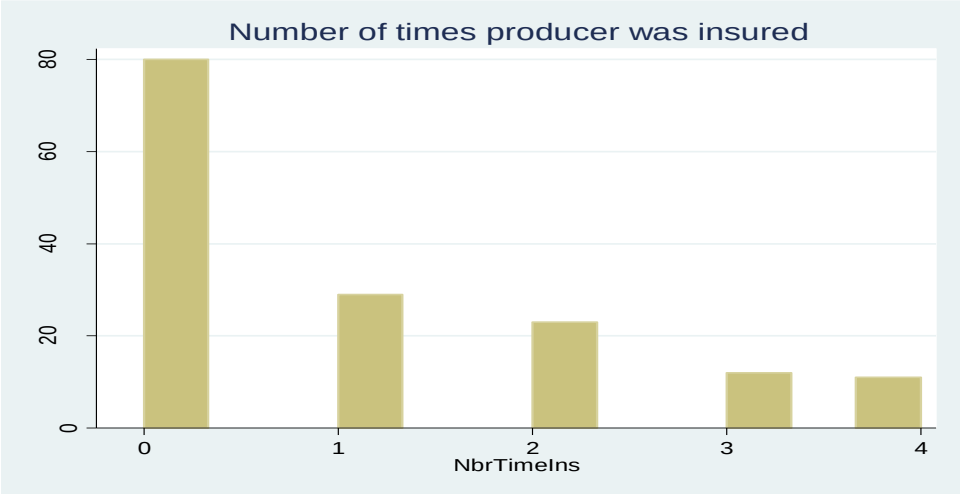

Figure 1. Distribution of Farmers 'Participation in Agricultural Insurance Program in the District of Ouesse, Benin.

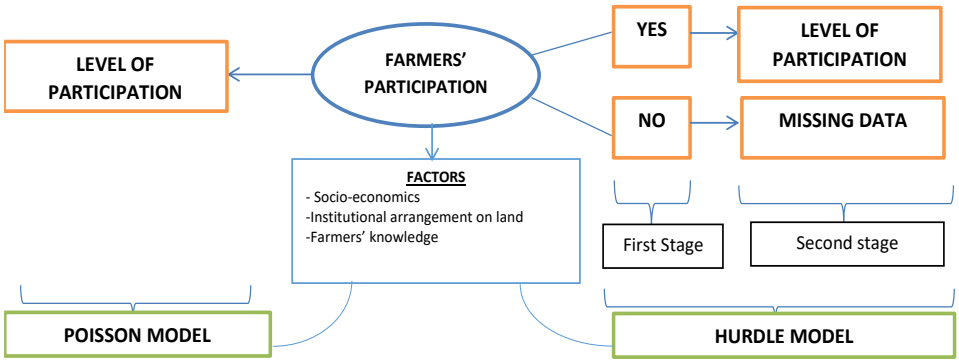

Figure 2. Farmers' Decision-Making Process in Participation in Agricultural Insurance Program in Northern Benin

4.2 Empirical Modeling

As shown in Figure 1 data collected on farmers 'participation presents a portion of farmers who did not participate in the program. Therefore, the distribution of the participation appeared to be skewed to the right and left censored around zero. To account the count nature of the participation we used count data model – Poisson regression-- instead of OLS which would generate biased and inconsistent estimates.

However, if one considers that farmer takes decision in two steps: in the first step he decides whether to participate in the program or not and in the second step he participates a

certain number of times, the Hurdle model would be more appropriate. We consider this approach by using the Hurdle model as well. Figure 2 illustrates the decision-making process that might occur in the study. In both models we hypothesize that factors such as socio-economics, institutional arrangement on land and farmers' knowledge might affect the decision-making process.

4.2.1 The Poisson Model

Given the nature the Poisson model was used to identify factors that guide farmers in their willingness to pay for insurance program. The specification of the model is based on the following equation:

$$\boldsymbol{Pr(Y_i|X_i) = exp(-\mu_i)\mu_i^{Y_i}/Y_i!} \quad (1)$$

where $\boldsymbol{\mu_i} = \mathbf{exp}(\boldsymbol{x_i}'\boldsymbol{\beta})$. The expected value of $\boldsymbol{Y_i}$ given $\boldsymbol{X_i}$ is $\boldsymbol{\mu_i}$. The variance of $\boldsymbol{Y_i}$ is also $\boldsymbol{\mu_i}$

The likelihood function of the model in equation (1) is written as follows:

$$\mathbf{L(\beta|y,X) = \prod_{i=1}^{N} Pr(y_i|\mu_i) = \prod_{i=1}^{N} \frac{exp(-\mu_i)\mu_i^{y_i}}{y!}} \quad (2)$$

The Poisson regression model uses a one-parameter model to describe the distribution of the dependent variable because it assumes that the variance is a function of the mean. Serious issues such as overdispersion may arise when using Poisson regression for modeling count. The definition of the overdispersion is that the variance of the model exceeds the valueof the mean (Hilbe and al., 2007). If overdispersion happens, its consequences for parameter estimates in the Poisson regression models are like the problem of heteroscedasticity in linear models (Gardner and al., 1995; Sturman, 1999).

4.2.2 The Hurdle Model

In the second step of our analysis, we used the Hurdle model to determine factors affecting the farmers' willingness to pay for insurance program. The Hurdle followed two steps decisions making process. In the first farmer decides whether to participate or not in the insurance program. This step is expressed in the following equation:

$$\boldsymbol{D_i^* = Z_i\delta + \mu_i} \quad (3)$$

$\boldsymbol{D_i}$is a variable representing the binary decision of paying or not for the insurance program services. $\boldsymbol{Z_i}$is the set of independent variables, $\boldsymbol{\delta}$ are the parameters to be estimated and $\boldsymbol{\mu_i}$ is the error which assumed to be a bivariate normal distribution with mean 0 variance 1. The second step occurs only in cases where $\boldsymbol{D_i}$ exceeds zero. table 2 presents the explanatory variables used both models and their expected signs used in the models.

Gender: This variable is the gender of the farmer. It is coded as 1 for males and 0 for females. Yabi and al (2016) have shown that men adopt more erosion control practice than women for the conservation of water and soil. For example, men may be more confident than women regarding insurance uptake. The expected sign is then positive.

Understanding: The variable is related to understanding the information on the purpose of farm index insurance by the producer ". It is coded as 1 for the producer who understands the object of the index insurance and 0 otherwise. According to Duhan (2017), knowledge is

an important element in the acceptance of agricultural sustainability practices. In the study, to get an idea about knowledge, we rely on the understanding of information

Table 2. Explanatory Variables Considered in the Models

Variables	**Types[a]**	**Definition**	**Expected Signs**
Age	C	Number of years from birth	±
Gender	D	0=Female; 1=Male	+
Educational Level	C	No = otherwise; Yes = formally educated	±
Income	C	Amount in FCFA	+
Understanding (Understand)	D	No = 0; Yes = 1	+
Diversification	D	No = 0; Yes = 1	-
Corn area (maizacreag)	C	Area in hectare	+
Importance of climate risk for the producer (Imprisqclim)	D	No = 0; Yes = 1	+
Household size (Householdsiz)	D	No = 0; Yes = 1	±
Experience in Agriculture	C	Number of years	+
Perception	D	Unfavorable=1 favorable=0	
Land acquisition (landacq)	D	Unsecured = 0; Secured = 1	+

Notes : [a] Types : D = Discontinuous variables ; C = Continuous variables

Importance of climate risk: the variable means " importance of climate risk for the producer ". It is coded as 1 when the producer finds that drought is the frequent event that causes damage to his crops and 0 when the producer finds that drought is not the frequent event that causes damage to his crops. Shaik and al. (2008) have shown that producers who perceive that their production risk is high, adopt agricultural insurance. The expected sign is positive.

Maize acreage: This is the variable of " acreage of maize ". Large-scale producers are more likely to adopt agricultural insurance (Adinolfi and al., 2012). The positive sign is then expected.

Land acquisition: This is the variable " land acquisition method used for maize cultivation ". It is coded 1 when the mode of access to the land is either inheritance, gift or purchase and 0 in the opposite case. According to Barry and al. (2004), producers who have a high level of land ownership have a high degree of financial stability. In this study, producers who accessed their land through inheritance, gift or purchase are landowners and would tend to adopt insurance, unlike those who landed through tenancy or sharecropping. The positive sign is expected.

Household size: Size of the household. Household size was used by Foleback and Tenikue (2011) to show its relationship with the adoption of an innovation. The expected sign is positive.

Education: Formal education: this variable is binary and takes 1 when the producer is formally educated and 0 otherwise. According to (Bharati and al., 2014), the level of education increases with the level of adoption. The positive sign is expected.

Diversification: This variable takes a value of 1 when the producer practices more than four different crops on his farm and 0 when he practices less than five crops. According to (Adinolfi and al., 2009) showed that producers who do more agricultural diversification, adopt less agricultural insurance. The negative sign is expected.

Years of experience: Year of experience in agricultural production. Experienced producers have a great ability to predict and manage climate risks. (Fagbemissi and al., 2002) have shown that it is rather young producers who are inclined to take more risks by adopting new varieties. The negative sign is expected.

Perception: Farmer's perception towards agriculture insurance is a determinant factor in his decision-making process. (Adinoldi and al., 2012; Barry and al., 2003) all showed how important farmer's perception is when it comes to make decision regarding agriculture insurance. When the farmer holds a favorable perception towards agriculture insurance, he/she will tend more to adopt it. The positive sign is expected

5. Results and Discussions

5.1 Sociodemographic Characteristics of Respondents

3 summarizes the socio-demographic characteristics of the respondents. The study surveyed 134 men and 21 of women. This sample reflects the general figure of gender participation in agricultural activities. In general, agricultural sector is dominated by men. It is noted in the study environment that most producers are illiterate (61.29% out-of-school producers versus 38.71%) even though they have experience in agricultural production (24 years in average) and are mostly adults (48 years on average).

Table 3. Farmers' Socio-economics Characteristics and Agricultural Resources

Qualitative	**Frequency**	**Percentage**
Gender		
Male	134	86.45
Female	21	13.55
Education		
Yes	60	38.71
No	95	61.29
Farmers' perception		
Favorable	127	81.94
Unfavorable	28	18.06
Land acquisition		
Secured	49	31.61
Not secured	106	68.39
Quantitative	**Mean**	**Standard Deviation**
Age	47.74	11.93
Household size	10.81	6.15
Years of experience	23.65	11.65
Acreage (in ha)	3.03	2.39

5.2 Perception Towards Index Insurance Services

Producers in the study area, have various assessments of agricultural index insurance services. Various aspects of the services were considered by the producers (summarized in Table). The results show that almost half of the respondents found that the insurance premium is high (46.66%). With regard to the payment of compensation in case of crop losses, it is noted that the majority of producers do not understand the information of the subject of the insurance. In fact, 34.66% of producers think that insurance should compensate them when their fields are destroyed by animals or fires. Other respondents (24%) find that it is in case of destruction of crops caused by animals or floods that insurance should compensate. There are 18.66% of respondents who think that insurance should come to the aid of the producer when there are floods or fires in his field. In addition, most producers' responses (58.66%) of the actual payment of benefits indicate that the payment of benefits is not effective after the destruction of the crops. These answers are explained by the fact that the majority of producers do not understand the information of the subject of index insurance. The latter therefore want to have compensation for events not taken into account by the index insurance. Only 13.33% of producers understand information about the purpose of index insurance because they find that insurance must compensate producers in case of drought. In addition, the majority of respondents (77.34%) found that all crop losses should be covered by insurance. Similarly, the majority (56%) think that insurance should take into account other crops besides corn.

Table 4. Perception of Index-based Agricultural Services

N°	Perceptions (%)				
1	The Insurance Premium				
	High		Reasonable		
	46.66		53.34		
2	Compensation payment must be made when the losses are caused by :				
	Drought	Flood and animals	Fires and animals	Floods and fires	Animals
	13.33	24	34.66	18.66	9.33
3	Actual payment of compensation in case of crop losses				
	No payment	Can’t say	Payment received		
	58.66	29.33	12		
4	All crop losses incurred must be repaid				
	Oui		Non		
	22.66		77.34		
5	Insurance must cover other crops besides maize				
	Oui		Non		
	56		44		

5.3 Factors Affecting Participation in Agricultural Index-based Insurance

Table presents the results of the Poisson and Hurdle models. It shows that the models are globally significant at the 1% threshold (Prob> chi2 = 0.0000). The results of the Poisson model revealed that gender, the age combined with experience, the acreage of maize, the understanding of agricultural insurance, the education, the perception on agricultural insurance

and the household income are the main drivers of the number of time farmers subscribed to the insurance.

The logit model reveals that the following factors significantly influenced the decision to buy index-based crop insurance: age, acreage of maize, land acquisition, understanding of insurance program, farmers' perception and income.

The Poisson model of the second stage of the hurdle model shows that education affect the number of time farmers participate in the insurance program.

Male farmers subscribed more to insurance than their female counterpart. Male farmers are dominant in maize production and their knowledge of agricultural activities is very advanced because of their contact with other farmers and the extension institution. This could be an advantage and favor their understanding of the benefits of having agricultural insurance. This might justify the results of the Poisson model. Similarly, study by (Kokoye and al., 2018) provide evidence that male is willing to pay more for soil testing services in Haiti due to the fact that they have access to more resources than their counterpart female. Gender is found to be a positive variable in farmers willingness to pay for Index Based Crop Insurance in Pakistan (Ali, 2013).

As farmers are old and experienced in agricultural production they tend to subscribe more to the insurance. This could be explained by their experience and their knowledge about the importance of having insurance to cover losses in case flooding. This result is supported by several studies. Ali (2013) also showed that older Pakistaneese farmers are willing to pay for index-based crop insurance. Fonta and al. (2018) found that farmers who have farming experience in Burkina Faso are willing to pay for weather index-based crop insurance.

As farmers' maize acreage increase, they tend to subscribe more to the agricultural insurance. This result is understandable as farmers are willing to protect their harvest. According to Matsuda and Kurosaki (2019), households with larger landholding are more vulnerable to weather risk and would demand more insurance coverage. Also, maize is the staple food and any loss of harvest could lead to deficiency and reduce food availability for the household. The logit model also identifies maize acreage to be positivity correlated with farmers decision to pay for the index-based insurance. This result is in line that of Njue and al., (2018). They found that land allocated to maize production is positively related with adoption of crop insurance. Recently, Matsuda and Kurosaki (2019) found that landholding is positively correlated with temperature and rainfall index insurance demand in India.

Land acquisition positively affect farmers decision to buy insurance program. As farmers land is secured, they are willing to invest on the land by buying the insurance. This makes sense as farmers desire to protect their investment. According to Kokoye and al. (2013) secure property right is used as an incentive in investing in agriculture. When property rights are not secure, there is a non-zero, positive probability of expropriation (Kokoye and al., 2013; Ghei, 2008).

Farmers who know well the insurance program are willing to buy. The results indicate that producers who master index insurance regularly subscribe to this product. This implies producers who do not understand index insurance, are not satisfied with the services of the product and therefore end up no longer subscribing to this service. These results appear both in the Poison and the logit model. Information and understanding are key factors in any decision-making process. As such, Skees and al. (2001) explained that the decision to use insurance is highly dependent on farmers' understanding of the insurance product.

The formal education of the producers influences significantly the subscription of the producers to agricultural index insurance. Indeed, the significant influence of the formal education variable on the subscription implies that producers who regularly buy insurance, are educated.

Table 5. Results of the Tobit Censored Regression on the Determinants of Participation in Index Insurance

Poisson model				Hurdle model					
				Logit model			Poisson model		
Variables	Coefficients	S. E.	P>z	Coefficients	S.E.	P>z	Coefficients	S. E.	P>z
Gender	-0.433	0.189	0.022**	0.959	0.685	0.162	0.208	0.465	0.654
Age	0.061	0.043	0.159	0.036	0.021	0.099*	0.0004	0.011	0.967
AgexExperience	0.001	0.0002	0.000***	-	-	-	-	-	-
Age^2	-0.001	0.0005	0.003***	-	-	-	-	-	-
Acreage of maize	0.113	0.027	0.000***	0.899	0.193	0.000***	0.010	0.045	0.818
Land acquisition	0.053	0.147	0.715	1.204	0.521	0.021**	0.021	0.261	0.936
Understanding of insurance program	1.059	0.253	0.000***	2.604	1.158	0.025**	0.425	0.433	0.326
Education	0.875	0.152	0.000***	-0.396	0.508	0.436	1.284	0.304	0.000***
Diversification	-0.085	0.168	0.613	0.111	0.536	0.835	-0.297	0.258	0.249
Perception	0.445	0.225	0.048**	3.758	1.235	0.002***	0.166	0.390	0.670
Household size	-0.030	0.026	0.252	0.092	0.056	0.103	0.019	0.040	0.630
Income	-2.21e-06	1.20e-06	0.065*	6.48e-06	1.55e-06	0.000***	-1.31e-07	6.02e-07	0.828
Understand the importance of climate risk	-	-	-	0.648	0.501	0.196	0.006	0.230	0.979
Constant	-0.888	1.135	0.434	-2.246	1.434	0.117	-0.695	0.752	0.356
Log pseudolikelihood	-15.770.483				-1.362.694				
Prob > chi2	0.0000				0.0003				
Pseudo R2	0.3065				-				
Wald chi2(12)	176.36				34.96				
Number of observations	155				155				

Notes: *, **, *** significant at 10% ($p < 0.10$), 5% ($p < 0.05$), and 1% ($p < 0.01$), respectively. S.E. means standard error.

This is because educated producers know the benefit of this product and therefore use it to minimize their climate risk. Education has revealed to be one of the most important factors in farmers decision to adoption technologies (Kokoye and al., 2018). Ali (2013) also found that education plays a major role in farmers participation in index-based insurance.

Farmers perception has a positive influence on farmers' willingness to participate in insurance program and the number of times they subscribe to the insurance. Adinolfi and al. (2012) found that the farmer's perception on agriculture insurance (agricultural premium) influences his decision to adopt it. Moreover, Barry and al. (2003) showed that farmers prefer insurance with more services. This means that when farmers have a favorable perception towards agricultural insurance, they go for it.

Farmers income has also revealed to positively affects their decision to subscribe to the insurance (logit model). However, it negatively affects the number of time farmers subscribes to the insurance. The positive correlation is consistent with several studies where authors showed that income is a determinant factor in farmers' decision to pay for agricultural services or adoption agricultural technologies (Ulimwengu and sanyal, 2011; Kokoye and al., 2018). On the contrary, the negative correlation with the number of time farmers subscribe could be explained by the fact that wealthy farmers tried insurance to see whether it could help them compensate their losses and increase their revenues in short term, but they realized that insurance does not benefit them in a short period and since they are wealthy enough to support their losses, they do not have incentive to increase number of times they subscribe.

6. Conclusions

This study analyzed maize farmers' participation in index-based insurance program in Benin. This program is in its pilot phase and producers should be made aware of the purpose of agricultural index insurance and its benefits. The results of this study showed that farmers socio-economics characteristics play a major role in their participation in the insurance program. Particularly education, experience and income are main divers of farmers' participation in insurance program. Insurance should be promoted for producers who are less educated and have less experience. In addition, financial support in form of discount should be provided to farmers with low income to get access to the agricultural insurance.

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