Determinants of Farmer's Participation in Formal Microcredit Markets in Benin: A double hurdle model

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Abstract

This study analyzes the factors that affect farmers' participation in formal credit programs in Benin. The data were collected from 400 randomly selected farmers in 20 villages representing 7 Agricultural Development Hubs (ADHs) of Benin. The estimate was made with a double hurdle model. The results indicate that gender, contact with extension services, perception of agricultural activities' risks negatively affect the probability of access to credit. Educational level, farm management experience, cash crop area and organized group membership positively affect the satisfaction rate of credit demand. Age has a negative impact on satisfaction rate of credit demand. Credit management experience, information on credit obtaining opportunities and the perception of credit access conditions influence both credit access probability and satisfaction rate of credit demand. But the influences go in opposite directions. If the influence is positive on the credit access probability, it negatively affects satisfaction rate of credit demand.

JEL classification: G G4 G41.

Keywords: Farmers, credit programs, double-hurdle model, Benin, influence,

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Déterminants de la participation des agriculteurs aux marchés formels du microcrédit au Bénin : un modèle à double obstacle

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Résumé

Cette étude a analysé les facteurs qui affectent la participation des agriculteurs aux programmes formels de crédit au Bénin. Les données ont été collectées auprès de 400 agriculteurs sélectionnés au hasard dans 20 villages représentatifs des 7 Pôles de Développement Agricole (PDA) du Bénin. L'estimation a été faite au moyen d'un modèle à double obstacle. Les résultats indiquent que le sexe, le contact avec les services de vulgarisation et la perception des risques liés aux activités agricoles affectent négativement la probabilité d'accès au crédit. Le niveau d'instruction, l'expérience en agriculture, la superficie des cultures de rente et l'appartenance à un groupe organisé affectent positivement le taux de satisfaction de la demande de crédit. L'âge a un impact négatif sur le taux de satisfaction de la demande de crédit. L'expérience en gestion du crédit, l'information sur les opportunités d'obtention de crédit et la perception des conditions d'accès au crédit influencent à la fois la probabilité d'accès au crédit et le taux de satisfaction de la demande de crédit. Mais les influences vont dans des sens contraires. Si l'influence est positive sur la probabilité d'accès au crédit, elle affecte négativement le taux de satisfaction de la demande de crédit.

JEL classification : G G4 G41

Mots-clés : Agriculteurs, programme de crédit, modèle à double obstacle, Bénin, effet.

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1. INTRODUCTION

In Benin, the agricultural sector contributes an average of 24.05 % to GDP and 89.24% to export earnings (INSAE, 2019) and provides approximately 70% of employment (World Bank, 2019). Cereals (maize, rice, sorghum, millet, and fonio) dominate food crops. Given the evolution of the production of these crops, the rate of food self-sufficiency (RFS) across Benin amounts to 91.7%, indicating that the country is generally self-sufficient in food but is still dependent on imports for some particular crops, including rice, to meet its total domestic demand. The food production growth per capita is approximately 1.6%, very much lower than the relatively high population growth, estimated at 3.5% (UNDP, 2019). This certifies that farmers' efforts to increase production and ensure food security are still insufficient and raises the issue of the effective use of technological innovations developed by research on agricultural intensification. One of the major constraints of intensification is access to funding for the acquisition of sufficient and high-quality inputs.

In recent years, major changes have taken place, further increasing the funding needs of farmers. Indeed, population growth, with the corollary of occupation of land by social infrastructure (housing, roads, public areas, etc.), the reduction of arable land, and the decline of soil fertility in Benin due to over-exploitation have made it uncertain to obtain good yields without fertilizer. Similarly, the use of improved (short cycle and/or drought-tolerant) seeds has become a requirement because of climate change. In addition, schooling for children in general, and girls in particular, has become compulsory and accentuated by rural exodus to urban centers, significantly reducing the size of agricultural labor. This imposes two requirements for agriculture. First, the use of herbicides for weed control has emerged as a necessity, because farmers fail to have sufficient labor for weeding operations. Moreover, to continue to supply food crops to cities that have become very populated, the few remaining farmers in the village need to increase production, intensifying production processes. Second, input acquisition, which became mandatory to increase food production on increasingly poor lands, requires financial resources that farmers often do not have from their own funds.

Thus, funding for agricultural activities is of paramount importance in various poverty reduction policies. Various policy measures **(**five microfinance support funds created -three national funds and two funds of partners-) initiated to facilitate farmers' access to funding have led to the multiplication of actors (micro-finance institutions, projects, programs, and non-governmental organizations NGOs) in the micro-finance sector. However, it is clear that access to credit remains far below demand, especially for agriculture in rural areas. Indeed, banks and financial institutions play a small part in agricultural financing. Furthermore, MFIs lend money to trade, with an emphasis on the sale of imported products. These institutions easily finance rural activities, such as trade, handicrafts, and food processing, which generate regular and relatively secure income, with rapid cycles of capital turnover, mitigating risks, and enabling high rates of return. As few agricultural activities have these characteristics, access to MFIs funding is difficult for farmers (Luan, 2019). Facilitating access to credit still remains a challenge for Beninese farmers and constitutes a constraint to the adoption of agricultural technologies developed through research.

To better inform policymakers on how to facilitate farmers 'access to funding, studies have mostly analyzed the determinants of credit access or participation in credit programs. In doing so, decisions regarding access and participation should be made in isolation. However, to participate in the credit program, access conditions must be fulfilled. This means that the decision to participate in a credit program is conditional on credit access. Very few studies (Sebatta et al, 2014) have analyzed the determinants of participation in the credit program, conditional on access to credit. To contribute to the scientific debate, this discussion used a double hurdle model to analyze the factors determining the participation of farmers in formal credit programs, conditional on credit access in Benin.

The remainder of this paper is organized as follows. The literature review is presented in the next section. Section 3 describe the materials and methods. The empirical results and related discussion are presented in Section 4, and the conclusions are presented in Section 5.

2. LITERATURE REVIEW

Several studies examine credit (Sekyi et al, 2014. Ene, 2006; Milanzi, 2003) often confuse access to and participation in credit programs. In a study on the determinants of Nigerian agricultural households' participation in credit programs, Milanzi (2003) stated that access to and participation in the credit program are synonymous. However, there is a difference between the two concepts, which lies in the fact that participation in a credit program involves choice among different sources of credit. Consequently, participation in credit programs is closer to the demand for credit. Access to credit involves constraints (access criteria) imposed by the credit supply structures that the credit applicant must meet beforehand. According to Doan et al. (2010), access to credit means that a household can borrow at a time, given the availability of credit, and can meet the loan criteria set by lenders, regardless of whether they borrow. Therefore, access to credit is closely linked to credit constraints. Full access to credit implies no constraints imposed by lenders. Similarly, limited access to credit implies that certain forms of credit constraints are imposed. However, participation in credit implies that households have chosen to borrow and have already borrowed. A household that participates in borrowing activities has access to special credit resources, while a household with access to credit may choose to participate in loan activities. Thus, in a study in Ethiopia, Bekele (2007) formulated two different equations for access to and participation in credit program. The explanatory variables introduced in both equations are the same, the only difference being that the credit access equation additionally includes an "eligibility" variable. However, Bekele (2007) recognized that for a household to participate in a credit program, it must meet the eligibility criteria. In other words, participation in a credit program depends on access to credit.

According to the literature, several studies conducted in developing countries, such as Benin, have attempted to identify factors that favor farmers' access to and/or participation in credit programs. Most of these studies have analyzed the determinants of access to credit (Luan, 2019; Ajah et al, 2017; Olateju et al, 2017; Sossou et al, 2017; Sulemana et al, 2017; Argaw, 2017; Anang et al, 2015; Kouty et al, 2015; Musabanganji et al., 2015; Ibrahim and Bauer, 2013; Chitungo and Munongo, 2013; Kacem and Zouari, 2013; Nguyen and Luu, 2013; Ololade and Olagunju, 2013) or participation in credit program/market (Ameh and Lee, 2022; Asante-Addo et al, 2017; Biyase and Fisher, 2017; Chandio et al., 2020; Geleta et al, 2019; Kofarmata et *al*, 2014; Mutamuliza et al, 2021; Olomola, 2014; Mwonge and Naho, 2021; Woleteyes, 2020; Shete and Garcia, 2011). Accordingly, logit, probit and tobit were used for the estimation. In doing so, the fact that access to credit and participation in the credit program are two related decisions is not considered. Indeed, fulfilling the conditions required by financial institutions for access to credit is essential for participating in credit programs. This leads to the use of truncated data and resulted in inconsistent estimates and biased coefficients (Heckman et al., 1998). Some studies have analyzed the determinants of credit program participation (credit demand) conditional on access to credit (satisfaction with access conditions). Some of these studies used Heckman or Wooldridge's (1995) selection model (Benjamin et al, 2015; Magbul, 2016; Olomola, 2014), bivariate probit models (Shete and Garcia, 2011), while others (Adebayo, 2018; Djoumessi et al., 2018; Sebatta et al., 2014 and Akpan et al., 2013) instead used the double hurdle model Cragg (1971). The two last choices imply that access and participation decisions are made in two stages. If the study that used the bivariate probit models considered participation as a binary variable, those that used the double obstacle model considered the amount of credit borrowed as a participation decision variable. Thus, although these studies provide useful information on the subject, they do not highlight credit rationing, a serious problem for farmers with access to credit. This study aimed to fill this research gap. To analyze the factors that affect farmers' participation in formal credit programs, conditional on access to credit, the study used the double-hurdle model and the satisfaction rate of credit demand (amount of credit obtained/amount of credit requested) as the farmers' credit program participation level variable.

3. DATAS AND METHODOLOGY

3.1. Data

Sampling was conducted in two stages: village selection and choice of farmers.

In total, 20 villages representing the seven Agricultural Development Hubs (ADHs) in Benin provided the framework for this study. To ensure the representativeness of the sample, two to five municipalities and villages were selected in a reasoned way in each of the seven ADHs, according to their size.

The minimum sample size of farmers to be surveyed was calculated using the following statistical formula:

$$N_e = U^2_{1-\alpha/2} \frac{p(1-p)}{m^2}$$

where:

N_e= Sample size of surveyed farmers

$U_{1-\alpha/2}$ = Statistics of the normal distribution with a value of 1.96 for a 95% confidence level.

p = Probability of access to credit set at 38% by West African Economic and Monetary Union (WAEMU) (2007)

m = error margin (usually set at 5%).

Based on this formula, the minimum sample size required was 362 producers. To reach the minimum sample size (362), 20 farmers were surveyed in each of the 20 villages, totaling to 400 farmers. These 20 farmers were randomly selected from a list obtained from the census of all farmers in the village.

After sampling, data were collected in three phases: a literature review, an exploratory survey, and a quantitative survey.

3.2. Methodology

In the credit market, a farm household may or may not have access to credit, deciding whether meeting the credit access conditions seen as attractive. When the decision to fulfill the credit access conditions is taken and the farm household has access to credit, it can decide whether or not to participate in the credit program, applying for a loan (Ramlee and Berma; Magbul, 2016).

According to Lee and Maddala (1985), both decisions can be modeled sequentially. We followed Djoumessi et al. (2018), Adebayo (2018), Sebatta et al. (2014), and Akpan et al. (2013) using the double hurdle model developed by Cragg (1971). The Cragg model is a two-stage approach, with a probit model for the first step (probability of access) and a normal truncated regression in the second stage. This model relaxes Tobit model restrictions by assuming two obstacles in the process of access and participation in formal credit programs. The double-hurdle model is expressed as follows:

$$Y^*_{i1} = \beta_0 + \beta_1 X_i + \beta_2 I_i + \beta_3 R_i + \varepsilon_i \quad \text{Decision of access (credit access Probability)} \quad (1)$$

$$Y^*_{i2} = \propto_0 + \propto_1 X_i + \propto_2 I_i + \propto_3 R_i + \varepsilon_i \quad \text{Participation Decision (credit demand satisfaction rate)} \quad (2)$$

Y^*_{i1} represents the probability of credit access and Y^*_{i2} represents the intensity of participation in formal credit programs (amount of credit obtained/amount of credit requested). The first hurdle related to the farmers' decision to have access to credit follows a probit model, while the second hurdle linked to the decision on the intensity of participation (amount of credit obtained/amount of credit requested) has a truncated normal distribution.

The double-hurdle model is considered as a dependent model if there is a relationship between the farmers' credit access decisions and their participation in the credit program decision (amount of credit obtained/amount of credit requested). This relationship can be expressed as shown in Equation (3).

$$\rho = \frac{Cov(V_i U_i)}{\sqrt{Var(V_i)} var(U_i)} \quad (3)$$

If $\rho \neq 0$ then there is dominance (zeros are only associated with no access to credit, no standard corner solutions), and the model is divided into an access probit and a common standard least squares (OLS) for $Y_i = Y_i^*$

The independent double-hurdle model assumes that the two error terms from the two hurdles are not correlated; therefore, decisions are independently taken in two stages. To test this hypothesis of the two decisions dependency, we tested the relationship between the error term in the first and second hurdles, estimating the equation (4) below:

$$Erreur_{Obstacle\,1} = \alpha_0 + \alpha_1 Erreur_{obstacle\,2} \quad (4)$$

If $\alpha_1 \neq 0$ (the value of α_1 is statistically significant), then the two error terms are linked and we conclude that the two access and participation decisions in the credit program are dependent (Aristei et al., 2007).

One of the most important econometric problems in the survey data is multicollinearity. This econometric property was tested within the included variables to ensure the consistency and unbiased quality of the probit model estimates. The variance inflation factor (VIF) was used. For VIF, the minimum possible value is 10, whereas a VIF value above 10 indicates a probable collinearity problem. VIF was estimated using the formula given in equation (5):

$$VIF_j = {}^{1}\Big/_{(1 - R_j^2)} \quad (5)$$

With R_j^2 the multiple correlation coefficient between variable j and each of the other specified variables.

Variables with a VIF greater than 10 will be excluded from the model, and only uncorrelated variables will be retained to run the double-hurdle model.

The main characteristics highlighted in the literature review determining farmers' access and participation in the agricultural credit program are: age, experience, gender, education level, household size, farm size (area owned), possession of planted area, diversity of activities, “cash crop” area, assets value, income, savings, sector of activity, membership to an organized group, distance from credit source, possession of extra-agricultural activities, perception of the risks linked to agricultural activities, information on opportunities to obtain financial services, perception of the conditions of financial services access, perception of credit access conditions, participation in an extension program, and participation in an insurance provision program. However, the direction of these factors’ influence on access and/or participation in credit market is not unanimous in the literature. Table 1 summarizes the definition, measurement, and expected signs of the variables related to farmer and farm characteristics assumed from the literature to influence the probability of access to credit and/or the intensity of participation in the credit program.

The empirical model used to estimate the first hurdle equation (access to credit) is as follows.

$$W = \beta_0 + \beta_1 AGEP + \beta_2 SEXE + \beta_3 EXPA + \beta_4 EXPCR + \beta_5 NINTR + \beta_6 TMEN + \beta_7 DIST + \beta_8 SCRE + \beta_9 INFOC + \beta_{10} RESO + \beta_{11} PMAC + \beta_{12} VULG + \beta_{13} ASSU + \beta_{14} NACTA + \beta_{15} VENT + \beta_{16} SUPE + \beta_{17} VACTIF + \beta_{18} PCAC + \beta_{19} SRENT + \beta_{20} DIVAC + \beta_{21} VREV + \beta_{22} EXTRA + \beta_{23} PRISK \quad (6)$$

The empirical model used to estimate the second hurdle equation (participation intensity: amount obtained/amount requested) is given below:

$$Y^* = \beta_0 + \beta_1 AGEP + \beta_2 SEXE + \beta_3 EXPA + \beta_4 EXPCR + \beta_5 NINTR + \beta_6 TMEN + \beta_7 DIST + \beta_8 SCRE + \beta_9 INFOC + \beta_{10} RESO + \beta_{11} PMAC + \beta_{12} VULG + \beta_{13} ASSU + \beta_{14} NACTA + \beta_{15} VENT + \beta_{16} SUPE + \beta_{17} VACTIF + \beta_{18} PCAC + \beta_{19} SRENT + \beta_{20} DIVAC + \beta_{21} VREV + \beta_{22} EXTRA + \beta_{23} PRISK \quad (7)$$

Table 1 : Definition, measures and expected signs of the different context variables

Variable	Definition	Measuring unit	Nature	expected sign	authors
AGEP	Age of respondent	years	Continious	+/-	Samba and Balamona (2015); Belisle (2012) Kouty et al. (2015)
EXP	Experience in farm management	years	Continious	+	Fall (2006); Yehuala (2008)
EXPCR	Experience in credit management	years	Continious	+	Yehuala, 2008; Sette and Gobbi, 2015
GENR	Sex of respondent	1 if the respondent is a woman and 0 otherwise	Binary	+/-	Belisle (2012); Kodjo et al. (2003)
EDUC	Number of years of education	Number of years spent in school for formal education	Continious	+/-	Avocevou (2003); Fall (2006); Etonihu et al. (2013); Ugwumba and Omojola (2013); Nonga Ngo et al. (2015) ; Nassarmadji et al. (2015)
TMEN	Household size	Number of people living in the household producer	Continious	+/-	Sossouet al.(2017); Avocevou (2003); Samba and Balamona (2015); Belisle (2012)
NACTA	Number of agricultural workers	Number	Continious	+	
SUPE	Total area sown	Hectares	Continious	+	Avocevou (2003); Fall (2006); Yehuala (2008); Ugwumba and Omojola, (2013); Nepal Rastra Bank (2014)
SUPL	Total plantation area	Number ha	Continious	+	Avocevou (2003)
SRENT	Cash crops (cotton, cashew, pineapple ...) area	Percentage	Continious	+	Fall (2006)
VREV	Value of the estimated annual income	CFA	Continious	+	Nepal Rastra Bank (2014); Sossouet al.(2017); Nassarmadji et al. (2015) ; Avocevou (2003); Ugwumba and Omojola (2013)
VACTIF	Value of assets owned	CFA	Continious	+	Ibrahim and Bauer (2013); Kodjo et al. (2003); Yehuala (2008)
WIND	Total sales	CFA	Continious	-	Ibrahim and Bauer (2013). ; Nonga Ngo et al. (2015)

NACT	Diversification or number of activities	Number	Continious	+	Kodjo et al. (2003); Chitungo and Munongo (2013); Fall (2006)
RESO	The social network	1 if the producer belongs to at least one group and 0 otherwise	Binary	+	Yehuala (2008); Sossouet al.(2017); Kodjo et al. (2003); Fall (2006)
DIST	Distance from the formal microfinance institutions (MFIs)	km	Continious	-	Etonihu et al. (2013); Kodjo et al. (2003); Nonga Ngo et al. (2015) ; (Fall (2006)
SCRE	Source of credit used	= 1 if the respondent uses an informal source of credit and 0 otherwise	Binary	+	Etonihu et al. (2013)
PMAC	The general perception of the financial services access conditions	1 if the respondent believes that the terms of access to financial services are binding and 0 otherwise	Binary	-	Eloundou Etoundi et al. (2013); (Kodjo et al. (2003)
VULG	Contact with the extension services	1 if the respondent has benefited from the services of extension during the year and 0 otherwise	Binary	+	Yehuala (2008)
ASSU	Participation in providing assurance program.	1 if respondent subscribed or has benefited an insurance service and 0 otherwise	Binary	+	Cai (2012)
PEXTRA	Possession of off-farm activities	1 = if the respondent has at least one off-farm activity and 0 otherwise	Binary	+	
Prisk	Perception of agricultural activities risk	1 = if the respondent perceives the agricultural activities as risky and 0 otherwise	Binary	-	Houedjissin et al. 2002
INFOC	Information on opportunities for obtaining financial services	1 = if the respondent has information on opportunities for obtaining credit and 0 otherwise	Binary	+	
ABCP	Perception of conditions of access to financial services	1 = if the respondent perceives terms of access to credit as painful and 0 otherwise	Binary	-	Eloundou Etoundi et al, 2013.; Kodjo et al., 2003

4. RESULTS AND DISCUSSION

4.1. Socioeconomic characteristics of farmers

The main socio-demographic characteristics of respondents are shown in Table 2.
Table 2: Demographic characteristics of the respondents

variables	Sample	Farmers with access to credit	Farmers with no access to credit	T-Test / Chi-2
Loan access status (%)		25.25	75.75	
Age(Years)	42.86	42.75	42.90	-0147
Female (%)	22	29,21	70.79	3.47 *
Male (%)	78	19.94	80.06	3.47 *
Number of years of education (years)	7.29	6.92	7.40	-0.48
Household size	7.95	8.70	7.73	0.97 **
Number of agricultural workers	3.79	4.10	3.70	0.397
Experience in agricultural production	21.08	20.44	21,26	-0.819
Experience in credit management (years)	1.53	3.55	0.96	2.58 ***
Available Area (ha)	9.29	14,05	7.95	6.10 ***
Area sown (ha)	6.68	6.99	6.59	0.39
Cash crop area (ha)	3.59	4.04	3.44	0.60
Perennial crops area (ha)	2.62	3.31	2.36	0.96 *
Part of the area affected to cash crops (cotton, cashew, pineapple ...) (%)	19.71	20.87	19.38	1.40
Annual income value (FCFA)	543 307.5	494 386.4	557 105.8	-62 719.41
Assets value (FCFA)	571 953.8	750 683.8	521 542.7	229 141 **
Total sales (FCFA)	207 103.1	254037	193 865.4	60 171.59
Number of activities carried out	1035	1	1.04	-0.04 **
Possession of off-farm activities (%)	55	25	75	-50
Social network (%)	65	25.38	74.62	49.24 **
MFIs Distance (km)	11.71	10.99	11,91	-0.93
Contact with extension services (%)	35.25	43.97	56.03	-12.06 ***
Agriculture perception as risky activity (%)	78.25	19.81	80.19	-60.38 **

* Significant at 10% level, ** significant at 5% level and *** Significant at the 1%

The Table 3 shows that the sample is composed of 88 women (22%) and 312 men (78%). In comparative terms, the number of people with access to credit is significantly lower than that without access to credit for both men and women. The difference is significant at 10% level. The proportion of women who have access to credit (29.21%) was higher than that of men (19.94%). This confirms that women have easier access to credit than men (Belisle, 2012).

The average size of respondents household is 7.95 peoples. The household size of respondents with access to credit is larger (8.70 persons) than that of respondents who do not have access to credit (7.73 persons). The difference is significant at 5%. The average number of agricultural workers in the sample is 3.79 per household, which is almost similar for both respondents with access to credit (4.10) and those who did not have access to credit (3.70).

The average experience in farm management is 21.08 years for the sample, similar for respondents with access to credit (20.44 years) and those who do not have access to credit (21.26 years). The

average experience in credit management is 21.08 years for the sample. Respondents with access to credit are more experienced in credit management (3.55 years) than those who do not have access to credit (0.96 years). The difference is significant at 1% level.

The average agricultural area available is 9.29 ha, of which 6.68 ha and 3,59 ha are respectively sown and grown in the cash crop for the sample. The respondents with access to credit had an average area available (14.05 years) larger than that of the respondents who did not have access to credit (7.95 ha). The difference is significant at 1%. The average perennial crops area is 2.62 ha for the sample. The respondents with access to credit had an average area under perennial crops (3.31 ha) larger than that of respondents who did not have access to credit (2.36 ha). The difference is significant at 10%. Perennial crops and plantations, in particular, are assets used as collateral for loans and therefore come into consideration for access to credit (Nassarmadji et al, 2015; Nepal Rastra Bank, 2014; Nonga Ngo et al, 2015; Samba and Balamona, 2015; Sossou et al, 2017). The average asset value owned is 571,953.8 CFA francs (US$ 982.94) for the sample. The respondents with access to credit have an average asset value (750,683.8 FCFA or US$ 1290.09) greater than those who did not have access to credit (521,542.7 FCFA or US$ 896.30). The difference is significant at 5% level. The number of activities was 1.035 for each sample. Respondents with access to credit had less diversified activities (1 activity) than those without access to credit (1.04 activity). The difference is significant at 5% level. The proportion of respondents with off-farm activities was 55% for the sample, of which only 25% had access to credit. The proportion of respondents who were members of at least one group was 65% for the sample of which the majority (74.62%) had no access to credit and only 25.38% had access to credit. In terms of membership in a social network, the difference between the proportion of respondents with access to credit and those who do not have access to credit is significant at 5% level. The proportion of respondents who had contact with extension services was 35.25% for the sample. The proportion of the respondents with access to credit (43.97%) was significantly lower than that of the respondents who did not have access to credit (56.03%). The difference is significant at 1% level. Finally, the proportion of respondents who perceived agriculture as a risky activity is 78.25% for the sample. The proportion of the respondents with access to credit (19.81%) was lower than that of the respondents who did not have access to credit (80.19%). The difference is significant at 5% level.

4.2. Characterization of farmers participation in the agricultural credit program

Table 3 shows the amounts requested and obtained by farmers with access to credit. The average amount claimed by farmers who have access to credit is 529,204.5 CFA francs (US$ 909.47), with a minimum of 0 FCFA corresponding to farmers who have access to credit, but have not made a request, and a maximum of 8.2 million CFA francs (US$ 14,092.18). The resulting average amount was 409,113.6 CFA francs (US$ 703.09), with a maximum of 5.3 million CFA francs (US$ 9,108.36). The average satisfaction rate of credit demand is 77.31%.

Table 3: Amounts requested and obtained by farmers who have access to credit

Variable	Average	Standard deviation	Minimum	Maximum
Amount requested (CFA)	529204.5	1225710	0	8200000
Amount (CFA)	409113.6	876508.6	0	5300000

The Figure 2 shows that the credit is primarily affected by the agricultural expenditures, which absorb 80.77% of the total credit obtained, including 42.77% for inputs, 36.04% for the labor, and 1.96% for agricultural equipment. If credit is allocated in priority to agricultural expenditures, for which it is requested, a part is directed towards other expenditure items in accordance with the fungibility principle of credit. The other items of expenditure of credit obtained are, in descending order of importance, non-agricultural activities (6.46% of the loan), livestock (5.28% of credit), children's education (2.42% of credit), household food security (2.08% of the loan), and household health (1.72% of the loan). Allocations to clothing, ceremonies, and loans to other people are rare, respectively 0.63%, 0.43%, and 0.21% of, respectively.

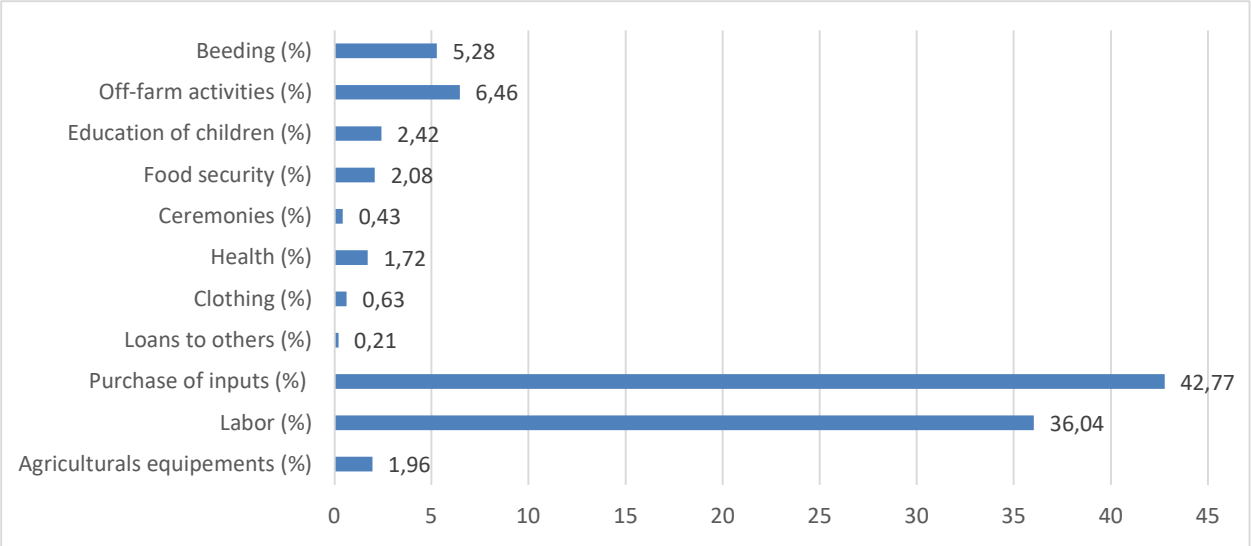

Figure 2: Allocations of the credit obtained

4.3. Results of the double hurdle model independent

To ensure the nature (dependent or independent) of the double-hurdle model or of the two decisions (access decision and participation decision) taken in two stages, the lrtest was performed t

o determine whether the two error terms of the two hurdles were correlated. The results yield LR chi2 (23) = 303.78, with Prob> chi2 = 0.000. This indicates that the error terms of the two hurdles are not correlated, reflecting the independence between the two decisions of credit access and credit program participation. Consequently, an independent double-hurdle model was estimated.

To achieve the main objective of this study, we first estimate the double-hurdle model (Table 4) given that access to credit and participation in credit program (level of participation) decisions are governed by separate processes. A farmer first takes an initial decision to have access to credit or not and a second decision regarding participation in the credit program, that is, the amount requested and obtained. This intuition is supported by our finding that different sets of variables affect credit access and participation in credit program (level of participation) decisions.

To ensure the consistency and non-similarity estimates of the probit model, a collinearity test of the explanatory variables was conducted. The results show that the variables "total available area", " share of the sown area allocated to cash crops," and "total sales" have high correlation coefficients. Therefore, these were excluded from the model. Finally, the 22 explanatory variables retained in the model are age, gender, education level, experience in farm management, income, total area sown, participation in an insurance program, contact with extension services, household size, number of agricultural workers, number of activities, distance from formal microfinance institutions, asset values, use of formal credit, use of informal credit, area under cash crops, experience in credit management, possession of off-farm activities, perception of risks linked to farm activities, information on opportunities to obtain financial services, perception of credit access conditions, and membership in a group.

Overall, the model corresponds well with 22 exogenous variables introduced, as indicated by the importance of the chi-square statistic, significant at 1% level (Table 4).

4.3.1. *Determinants of farmers' access to credit*

These results indicate that gender positively affects access to credit. The coefficient associated with gender was positive and significant at 5% level. As reported by Kouty et al. (2015) and Mwonge and Naho (2021), compared to men, the status of women increases the probability of access to credit. Women have emerged as the best customers of microfinance institutions over time. Unlike men who are ready to migrate to other places to escape the pressures of MFIs, in case of difficulties (delay or inability) of reimbursement, women, mainly because of their children, are forced to stay in the village to face these difficulties. This forces them to manage their credit to be creditworthy. This certainly contributed to the general orientation of credits towards sectors dominated by women, namely trade and processing of agricultural products in rural areas.

Contact with extension services positively affects the probability of credit access. The coefficient of this variable was significant at 1% level. Indeed, contact with extension services allows farmers to benefit from training actions by extension workers to improve their farm skills and credit management (Mwonge and Naho, 2021).

Table 4: Results of the estimation of double-hurdle model for credit access and participation in formal credit programs

variables	**First hurdle (Access to credit)**	**P> z**	**Second Hurdle (percentage amount obtained / requested amount)**	**P> z**
Age square (year)	- 0.00 (0.00)	0824	**-0.00 (0.00) *****	0.000
Sex (woman and man = 1 = 0)	**0.56 (0.22) ****	0012	0.01 (0.07)	0826
instruction level (Instructed = 1 and 0 otherwise)	-0.08 (0.19)	0670	**0.14 (0.05) *****	0006
Experience in farm management (years)	0.00 (0.01)	0753	**0.01 (0.00) *****	0001
Income (CFA)	0.00 (0.00)	0362	0.00 (0.00)	0291
total sown area (ha)	-0.01 (0.02)	0608	-0.00 (0.01)	0836
Participation in an insurance program (1 = yes, 0 = no)	1.14 (0.74)	0125	-0.05 (0.10)	0591
Contact with extension services (1 = yes, 0 = no)	**1.36 (0.19) *****	0.000	0.06 (0.05)	0252
Household size	0.01 (0.03)	0.650	0.01 (0.01)	0342
Number of agricultural workers	0.00 (0.03)	0936	-0.01 (0.01)	0146
Number of activities carried out	-0.61 (0.95)	0519	-0.44 (0.46)	0331
Distance from the formal microfinance institutions (km)	-0.01 (0.01)	0237	0.00 (0.00)	0606
Value of assets owned (CFA)	0.00 (0.00)	0588	-0.00 (0.00)	0405
Using formal source of credit (1 = yes, 0 = no)	0.14 (0.19)	0.460	-0.05 (0.06)	0407
Area in cash crop (ha)	0.04 (0.03)	0230	**0.02 (0.01) ****	0015
Experience in microcredit management (years)	**0.10 (0.02) *****	0.000	-0.01 (0.00) *	0082
Possession of non-agricultural activities (1 = yes, 0 = no)	0.26 (0.18)	0152	-0.02 (0.04)	0589
Risk perception related to agricultural activities (1 = risky activities, 0 = not risky)	**-0.46 (0.22) ****	0036	0.02 (0.06)	0752
Information on opportunities for obtaining financial services (1 = yes, 0 = no)	**0.52 (0.22) ****	0015	-0.12 (0.07) *	0083
Perception of conditions of access to financial services (1 = Painful, 0 =	**0.39 (0.22) ***	0077	**-0.14 (0.06) ****	0029

Acceptable)				
Using informal credit source (1 = yes, 0 = no)	0.36 (0.23)	0123	0.14 (0.09)	0106
Membership in a group (1 = yes, 0 = no)	-0.12 (0.20)	0535	**0.10 (0.06) ***	0082
Constant	-1.34 (1.04)	0199	**1.31 (0.44) *****	0003
Number of obs	= 368		= 65	
Prob> chi2	= 0.0000		= 0.0000	
log likelihood	= -151.89259		= 36.213962	

* Significant at 10% level, ** significant at 5% level and *** Significant at the 1%

Credit management experience positively affects the probability of access to credit. The coefficient of this variable was significant at 5%. Indeed, experience in credit use creates a sense of confidence and increases access to credit. Similarly, by getting regular credits, farmers end up creating business relationships with MFIs, reducing information asymmetry and increasing their bargaining power with the IMFs, on the one hand, facilitating access to financing (Sette & Gobbi, 2015).

Perception of risks related to agricultural activities negatively affects the probability of access to credit. The coefficient of this variable is significant at 5% level. Indeed, if the farmer thinks that rainfall will not be good, making random obtaining a good yield, on the one hand, or the prices of crops will not be paid, on the other hand, he tends not to fulfill the loan conditions for fear of being insolvent, which reduces the probability of access to credit (Eloundou Etoundi et al, 2013).

Information on opportunities to obtain financial services positively affects the probability of access to credit. The coefficient of this variable is significant at 5% level. Indeed, if the farmer is informed of credit access conditions, he/she can arrange for the filling, which would increase the probability of access to credit.

Finally, perception of the conditions of access to financial services, such as rigidity, positively affects the probability of access to credit. The coefficient of this variable is significant at 10% level. This is contrary to expectations. Indeed, when farmers consider credit access rigid, they are discouraged from meeting them, which should reduce their access to credit (Eloundou Etoundi et al., 2013).

4.3.2. Determinants of farmer's participation in the credit program

The square of age negatively affects the satisfaction rate with credit demand. The coefficient of this variable was significant at 1% level. This trend is confirmed by Shete and Garcia (2011) who noted that it is easier to young farmers to obtain credit from MFIs.

Education level positively affects the satisfaction rate of credit demand. The coefficient of this variable was significant at 1% level. Education level helps to better understand the credit system, its operation, and the rules of the procedure. It also helps to better manage risks and opportunities for profit. In doing so, MFIs are reassured of farmers' managerial capacity and facilitate access to credit (Etonihu et al, 2013; Ugwumba & Omojola, 2013; Kofarmata et al., 2014 ; Ngo Nonga et al, 2015; Chandio et al., 2020; Mutamuliza et al., 2021).

Farm experience positively affects the credit demand satisfaction rate. The coefficient of this variable was significant at 1% level. Farm experience reassures the MFI about the farmer's ability to manage the activity for which credit is claimed. This increases the chance of satisfaction with credit applications (Chandio et al., 2020).

The area under the cash crop positively affects the satisfaction rate of credit demand. The coefficient of this variable is significant at 5% level. Farmers who embark on cash crop production borrow more hope to obtain interesting benefits. Similarly, the possession of cash crops reassures the MFI of the farmer's ability to have financial resources to repay the loan, which is a motivation to grant the loan requested.

Group membership positively affects the credit demand satisfaction rate. The coefficient of this variable is significant at 10% level. Group membership increases the probability that a loan is granted and, consequently, the satisfaction rate of credit demand (Sossou et al., 2017; Mutamuliza et al., 2021). To ensure easier credit access to members on the one hand and second repayment, MFIs prefer to partner with farmers' organizations that serve simultaneously as surety (guarantee) and social pressure structures.

If loan use experience positively affects the credit access probability, it is reduced the satisfaction rate of credit demand. The coefficient of this variable is significant at 10% level. This would mean that over time, the farmers who used to apply for loans ended up fulfilling all the requirements, which increased their eligibility for credit (Woleteyes, 2020). However, if the experience does not reassure MFIs so that they have confidence in farmers, by satisfying their request, this is probably due to the stories of previous loans that would have resulted in debt, which is a reliable signal of creditworthiness of the borrower and leads to credit rationing decisions by MFIs.

Information on opportunities to obtain financial services positively affects the probability of access to credit but reduces the satisfaction rate of credit demand. The coefficient of this variable is significant at 10% level. This would mean that knowledge of credit access conditions allows farmers to fill them in order to increase their access opportunities, but it negatively influences MFI decisions on the level of satisfaction of the formulated request. The negative idea that MFIs have on farmers, actors in the high-risk activity sector, would be the reason.

Finally, the perception of credit access conditions as rigid positively affects the probability of access to credit but reduces the satisfaction rate of credit demand. The coefficient of this variable is significant at 5% level. This would mean that the lack of response (negative coefficient) expected in the access decision step was caught in the participation decision step, with a negative influence on the satisfaction rate of credit demand.

5. CONCLUSION AND RECOMMANDATIONS

5.1. Conclusion

This study analyzes the factors influencing access to credit and participation in formal credit programs in Benin. The estimation was made using a double-hurdle model. The results indicate that variables such as gender, contact with extension services, loan use experience, information on opportunities to obtain financial services and perception of credit access conditions positively influence the probability of access to credit. The perception of the risks linked to agricultural activities is the only variable that has a negative influence on the probability of access to credit. The variables that positively affected the satisfaction rate of credit demand were education level, farm experience, cash crop area, and group membership. The variables that negatively affect the satisfaction rate of credit demand are age, loan use experience, information on opportunities to obtain financial services, and perception of credit access conditions. Loan-use experience, information on opportunities for obtaining financial services, and perception of credit access conditions are three variables that influence both credit access decisions (probability of access) and the level of participation in the credit program (demand satisfaction rate). However, the senses of influence are the opposite.

In terms of political involvement, in order to facilitate farmers credit access decision, the government will, through its structures, intensify extensions actions, training and awareness both on the agricultural aspects as those relating to financial services, on the one hand, and improve the institutional environment of agricultural activities through the development of agricultural risk prevention and management structures, on the other hand. Once the decision to access credit has been made, actions such as education, capacity building in farm management, promotion of cash crops, awareness raising on the opportunities for obtaining financial services, and support for

farmers' organizations are important to reduce credit rationing and improve farmers' satisfaction rate of credit demand.

5.2. Recommandations

In terms of political implication, to facilitate farmers' access to credit decisions, government officials will have to intensify agricultural advisory, training and awareness-raising actions both on agricultural aspects and on those relating to financial services, on the one hand, and to improve the institutional environment for agricultural activities, through the development of structures for the prevention and management of agricultural risks, on the other hand. Once decisions related to credit access have been made, actions such as education, capacity building in farm management, promotion of cash crops, awareness raising of the opportunities for obtaining financial services, and support for farmers and their organizations are important to reduce credit rationing and improve the share of credit demand obtained by farmers.

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CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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