



## Research article

# Do credit constraints affect non-farm entrepreneurship entry decisions of rural agricultural households in Benin?

Cocou Jaurès Amegnaglo<sup>a,c</sup>, Armand Fréjouis Akpa<sup>b,c,\*</sup>, Gilbert Onionkiton Adjimonti<sup>d</sup>, Ahoudou Waliou Yessoufou<sup>a</sup>

<sup>a</sup> École d'Agrobusiness et de Politiques Agricoles (EAPA), Université Nationale d'Agriculture (UNA), Porto-Novo, Benin

<sup>b</sup> Institut Supérieur Agronomique et Vétérinaire de Faranah (ISAV/F), Faranah, Guinea

<sup>c</sup> Laboratoire d'Économie Publique (LEP), Faculté des Sciences Economiques et de Gestion, Université d'Abomey-Calavi (UAC), Abomey-Calavi, Benin

<sup>d</sup> Senior Agricultural Economist at African Development Bank Group, Cote d'Ivoire

## ARTICLE INFO

## JEL classification:

O16

D13

Q12

## Keywords:

Credit rationing

Off-farm activities

Entrepreneurship decision

Farmers

## ABSTRACT

This paper analyses the credit constraints' effect on non-farm entrepreneurship entry decisions in Benin. Using data from a sample of 512 farmers, we determine the factors that influence credit constraints and then assess the effect of credit constraints on non-farm entrepreneurship decisions based on an endogenous switching probit model and propensity score matching (PSM). The results of endogenous switching regression reveal that age and access to extension services are the main determinants of credit constraints while age, sex, household size, marital status, education level and farmer-based organisation (FBO) membership significantly increase farmers' decisions to engage in non-farm entrepreneurship. The PSM's results show that credit constraints have a negative effect on non-farm entrepreneurship entry decisions. The findings suggest that diversification through engagement in non-farm entrepreneurship requires the removal of credit constraints.

## 1. Introduction

Developing countries are characterised by inefficient credit markets caused by market imperfections [1–3]. Interest rate ceilings usually imposed by the government or central bank, poor development of property rights, monopoly power in credit markets often exercised by informal lenders, large transaction costs incurred by borrowers in applying for loans, and moral hazard problems are the major market imperfections. All the factors concur with low participation of the population in the credit market. However, access to credit is essential for the development of both farm and non-farm activities [4,5]. In fact, the agricultural sector is one of the most credit-dependent sectors [6–8]. Credit allows farmers to secure high-quality seeds, appropriate fertilizer and agrochemicals, modern equipment, irrigation technology and storage facilities and release labour and land constraints. If applied well, credit can increase the size of farm operations, introduce innovations in farming, encourage capital formation, improve marketing efficiency, and enhance farmers' consumption and livelihoods [9,10]. Credit will allow rural areas in general and the agricultural sector in particular to release their latent capacities and resources.

\* Corresponding author. Institut Supérieur Agronomique et Vétérinaire de Faranah (ISAV/F), Faranah, Guinea.

E-mail addresses: [cocoujaures1@yahoo.fr](mailto:cocoujaures1@yahoo.fr) (C.J. Amegnaglo), [frejuisakpa@gmail.com](mailto:frejuisakpa@gmail.com) (A.F. Akpa), [adjilbert@yahoo.fr](mailto:adjilbert@yahoo.fr) (G.O. Adjimonti), [waliou.yessoussou@gmail.com](mailto:waliou.yessoussou@gmail.com) (A.W. Yessoufou).

<https://doi.org/10.1016/j.heliyon.2024.e40900>

Received 12 June 2023; Received in revised form 19 November 2024; Accepted 2 December 2024

Available online 7 December 2024

2405-8440/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Benin is a typical case of a Sub-Saharan African country struggling to modernize and develop its economy through the removal of credit constraints. Credit constraints are generally defined as a situation where an individual is not able to obtain the desired amount of credit at a reasonable rate on time from credit markets [11]. The agricultural sector in Benin is highly credit constrained [12,13]. For example, Yegbemey [13] estimated that 84 % of farmers face difficulties in accessing credit in northern Benin while Houeninvo et al. [12] estimated that rate at 75.29 % in 49 municipalities in Benin. Furthermore, the World Bank [14] suggested that Benin's agriculture sector is marginally financed by the banks and to ease farmers' access to credit, the government put in place a facilitation credit instrument named National Funds for Agriculture Development (FNDA).

To combat farmers' credit constraints, one of the solutions proposed in the literature is the diversification of activities through the promotion of non-farm entrepreneurship as a strategy to minimise credit constraints [15–17]. Non-farm entrepreneurship implies any type of business activity in the non-farm economy that is undertaken by the rural working population [18] and typically includes many heterogeneous activities such as agribusiness, trade and sales, services, construction and transport activities [19]. Although labelled non-agricultural, many of these businesses are related to agriculture and may be located on a farm [20].

The probability of being credit constrained in non-farm entrepreneurship activities is estimated lower in the literature [21–23]. The World Bank [14] added that in Benin financial institutions prefer to finance activities like trade than agricultural ones. This is confirmed by Akrong and Kotu [24] who found that non-agripreneurs had more access to credit than the agripreneurs. Involving rural households in non-farm activities cannot only promote rural development but also indirectly reduce poverty and rural-urban migration [25,26]. Similarly, the participation of rural farm households in non-farm activities has a higher potential to reduce the rural unemployment rate as well as increase household incomes [15,27]. The improvement of non-farm employment among farmers would increase their share of farm income [27,28]. Higher off-farm income would therefore ease farmers' credit constraints by increasing their ability to repay and accumulate assets that can be used as collateral [9,29].

In developing countries, between one-third and one-half of households derive their income from non-farm activities and this share ranges from 20 to 70 % of total household income [30,31]. Nagler and Naudé [18] found in sub-Saharan Africa that almost 42 % of rural households operate in non-farm enterprises. For Zahonogo [31], non-agricultural activities contribute to expanding the rural economy and constitute a way out of poverty. Amegnaglo et al. [32] and Yegbemey [13] found in Benin that respectively 42.7 % and 48.51 % of farmers were engaged in off-farm activities. Moreover, Nonvide [33] showed in Benin that rice producers gain about 20,000 CFA from their participation in off-farm activities.

However, credit constraints can also negatively affect non-farm activities [34] since most activities require high fixed costs [17]. Income from non-farm activities that was intended to serve as alternatives to finance farm activities would then be reduced and impede the increase of farm returns. Although income from farm households' participation in non-farm activities alleviates credit constraints [35,36], there is no guarantee that non-farm income will finance farm activities due to possible new credit rationing in the non-farm market [17].

There is controversy in the empirical literature about the role played by credit constraints in farm households' decision to participate in non-farm business activities. On one hand, some studies have shown that credit constraints in the agricultural credit market can lead farmers to diversify their activities by engaging in non-farm entrepreneurship [17,37,38]. The existence of constraints in the agricultural credit market pushes farmers to allocate a part of their time to non-farm business activities to acquire income that can be used to finance agricultural activities. On the other hand, other studies have shown that credit constraints can affect rural development by preventing households from engaging in non-farm activities [18,39,40] because non-farm entrepreneurship also depends on credit access.

Previous studies undertaken by Adepoju et al. [26], Ma et al. [4] and Porgo, Traore et al. [17] failed to treat the endogeneity of the credit constraints variable, which is a behavioural variable that is determined by other variables. In this study, a new methodology called the endogenous switching probit regression model developed by Lokshin and Sajaia [41] where both the outcome and the selection variable are binaries was applied to assess the effect of credit constraints on non-farm entrepreneurship decisions in rural households in Benin. This paper answers the following research questions:

- > What are the drivers of credit constraints among rural households in Benin?
- > What factors influence the decision to enter non-farm entrepreneurship among rural households in Benin?
- > How do credit constraints influence non-farm entrepreneurship decisions among rural households in Benin?

The results should contribute to a better understanding of this subject and stimulate new studies and policies. As Antle [42], Di Falco and Chavas [43] and Chavas et al. [44] who make significant contributions to the ongoing debate on ex-ante risk management and crop diversification in agriculture, this study also contributes to this debate by examining credit default risk and its effect on off-farm entrepreneurship. This study would help understand in Benin's context how non-farm entrepreneurship can be an alternative for farmers to circumvent credit market constraints. The rest of this paper is divided into five sections. Next to the introduction section, followed the second section which is devoted to a literature review that examines the different theories related to the topic. Thirdly, we discuss the methodological framework of the study in which we present the model to be used and a description of the data of the study. Then, the following section presents and discusses the results of the study and finally, the last section is devoted to the conclusion and the formulation of some economic policy recommendations.

## 2. Literature review

### 2.1. Determinants of credit constraints

Several studies have been conducted in several regions of the world and have concluded that variables such as gender, age, marital status, cooperative membership, etc. affect farmers' credit constraints. The relationship between age and credit constraints is mixed in the literature. On one side, Amanullah et al. [6] in Ghana and Porgo, Kurwornu et al. [45] in Burkina Faso found that age is negatively related to credit constraints, meaning that older farmers are less credit constrained compared to younger farmers. Similarly, formal financial institutions trust older farmers because of their excellent creditworthiness and credit experience. In contrast, Asiamah et al. [46] and Sekyi et al. [47] found that young farmers were less credit constrained than older farmers. Regarding gender's effects on credit constraints, Asiamah et al. [46] found in Ghana that female household heads in urban areas have better access to credit than male household heads. In contrast, for Ojo and Baiyegunhi [11] and Kuwornu et al. [48], male-headed households are more likely to have credit constraints than female-headed households.

Amanullah et al. [6], Weldegebriel et al. [49], and Shehu and Abubakar [50] showed in Ghana, Ethiopia, and Nigeria, respectively, that household size increases the likelihood of being credit constrained. An increase in agricultural household size increases the likelihood of credit constraints as credit constraints positively influence family expenditures [6]. However, for Asiamah et al. [46] and Osondu et al. [37] household size reduced the constraints of households to access credit. An increase in the number of dependents increases the household's likelihood to be credit constrained [45,51] while Moahid and Maharjan [52] and Dong and Lu [53] found that dependency ratio decreases credit constraints. For Porgo, Traore et al. [17], the marital status of the household head has a negative effect on credit constraints. Chandio and Jiang [54] and Duniya and Adinah [55] have shown a negative relationship between land ownership and credit constraints. In contrast, for Amanullah et al. [6], Lin et al. [56] and Kuwornu et al. [48], an increase in land area increases the farmers' likelihood to be credit constrained. The plausible explanation is that producers with larger holdings are more likely to be credit constrained because larger holdings require a larger amount of money to purchase inputs and need to hire more labour to complete the work on time [6].

The household head's education level reduces credit constraints [46,57,58]. This implies that higher education puts household heads in a position to access credit. Similarly, highly educated household heads are likely to have permanent incomes and are better able to access credit from both formal and informal institutions. In addition, they may have connections to wealthy individuals in their social networks who can offer them informal loans. According to Porgo, Kuwornu et al. [45], access to information reduces farmers' credit constraints because it decreases transaction costs and helps master all the requirements related to the credit application process, which lessens the likelihood of being rationed in both the formal and informal credit sectors. Membership in a farmer cooperative reduces the likelihood of being credit constrained [45,58], indicating that being a member of a cooperative serves as collateral when farmers apply for credit.

### 2.2. Effect of credit constraints on non-farm entrepreneurship entry decision

The effect of credit constraints on farmers' participation in non-farm activities is contradictory in the literature. On one hand, some studies found that credit constraints push farmers to diversify their activities through engagement in non-farm entrepreneurship. Porgo, Traore et al. [17] found that credit-constrained farmers in Burkina Faso were less likely to engage in the non-farm sector. For the authors, this result implies that in credit constraints situation, among other strategies, young farmers practice non-farm employment to circumvent market imperfections. Similarly, Combarry [38] showed in Burkina Faso that the amount of credit obtained by the farmer significantly decreases the likelihood of shifting from a low diversification strategy to a medium or high diversification strategies, respectively. These results imply that rural households that can easily obtain credit to protect themselves from agricultural shocks are less likely to diversify their income sources. Credit constrained farmers have a higher probability of participating in non-farm activities. Osondu et al. [37] showed in Nigeria that access to credit affects women farmers' decision to engage in non-farm entrepreneurship negatively. Farmers who already have access to credit no longer have an incentive to participate in non-farm activities to finance on-farm activities. Indeed, participation in non-farm activities occurs when the credit market is imperfect and so the household decides to engage in non-farm activities to circumvent this constraint.

On the other hand, Ma et al. [4] found in China that credit constraints significantly decrease the probability of starting a business. For the authors, a decrease of 10 % in the probability of being credit constrained would be associated with 4.3 million newly created household businesses or equivalently 11 million jobs. Similarly, Cai et al. [59] showed empirically that credit constraints significantly decreased the probability of Chinese households to engage in entrepreneurship. Further analysis showed that credit constraints significantly decreased the propensity of households to enter enterprise operations, while it had no significant impact on small handicraft operations. Other studies, notably those conducted by Adepoju et al. [26] in Nigeria found a mixed effect of credit constraints on farmers' decision to participate in non-farm activities. Indeed, credit constrained households were more likely to participate in commercial transport activities compared to other non-agricultural activities such as trade and handicrafts where credit constraints decrease participation due to the less capital-intensive nature. For the authors, this result suggests that promoting access to credit is therefore relevant and should be a top priority in the design of any program for rural households.

### 3. Methodology

#### 3.1. Study area and sampling technique

The data used in this study was collected from agricultural producers as part of a doctoral thesis writing at the University of Ghana, Legon. The data were collected from march to June 2015. The questionnaire used to collect the data is in appendices. Benin is a coastal country located in West Africa (Fig. 1). It is divided into twelve departments including the Collines one which is in the centre of Benin and covers an area of 13,931 km<sup>2</sup>, that represents 12 % of the total area. According to the last general census of the population in 2013, it has 716,558 inhabitants, representing 7.2 % of the total population of Benin. The region is divided into six municipalities such as Bantè, Dassa-Zoumé, Glazoué, Ouessè, Savalou and Savè. Agriculture is the major economic activity (71 %) conducted by the population. The department is the largest producer of roots, tubers, and vegetables in Benin. Regarding cereals production, the department is usually ranked second or third supplier. However, this is one of the Beninese poorest departments, with an incidence of poverty estimated at 47.20 % in 2015 [60].

The study used a multistage sampling procedure which started with a purposive selection of the Collines department (Table 1). Firstly, it chose the region because the crop diversification level is extremely high, and households are engaged in growing on average more than three crops. At the same time, the region is one of the most food insecure in the country. There are six municipalities within the department. Secondly, based on the importance of agricultural activities in the municipalities, five municipalities out of six were selected, namely: Bantè, Dassa-Zoumé, Glazoué, Ouessè, and Savalou. The third stage of the selection process consisted of the selection of villages in each district. The fourth and final stage was the selection of farmers to be interviewed with a structured questionnaire in the randomly selected villages. Using Cochran [61] approach, the sample size was computed as follows:

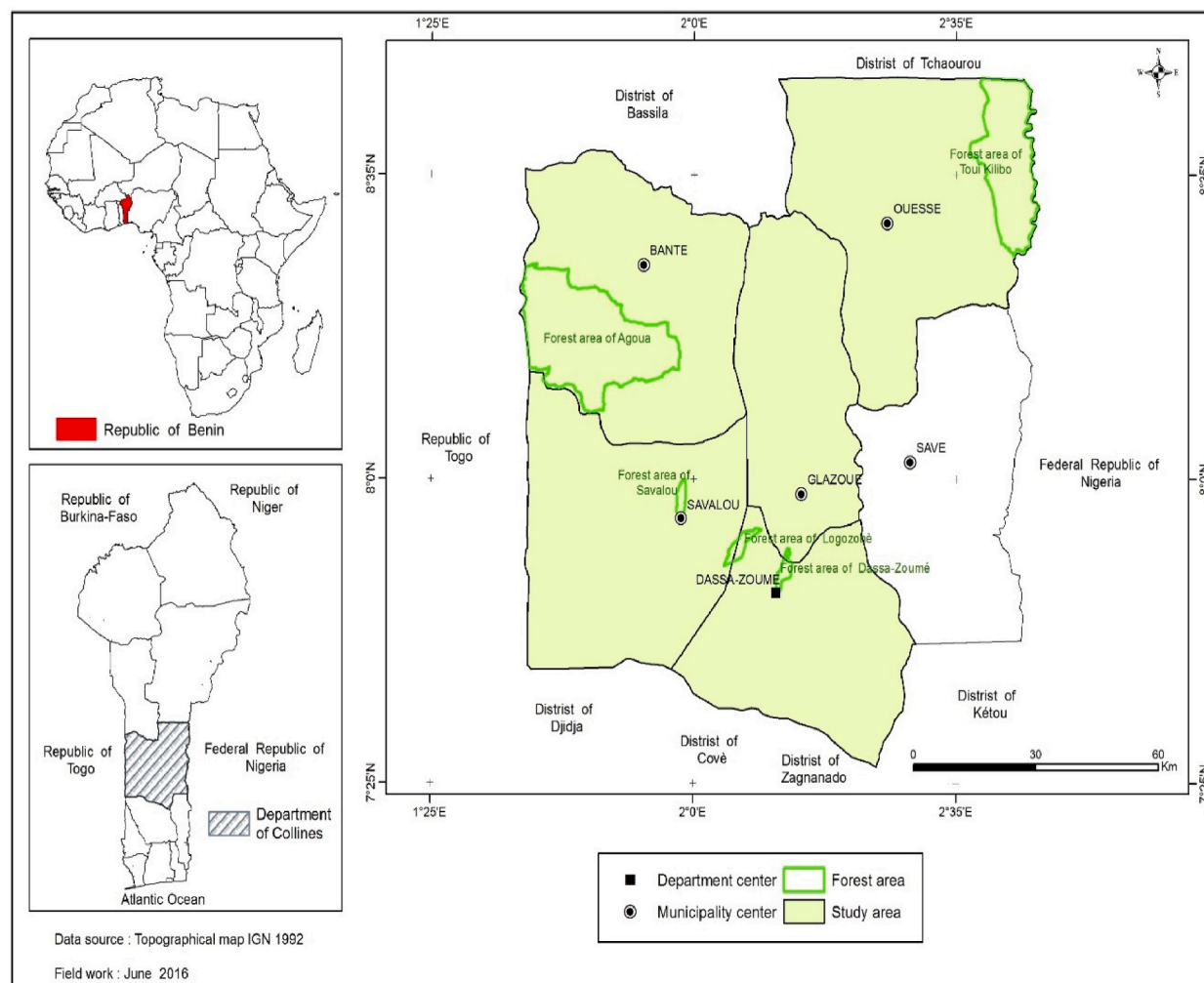


Fig. 1. Location of the study.

**Table 1**  
Summary of sampling procedure.

Sampling steps	Population	Techniques	Results
First	Communes: Selection of five communes out of 77	Purposive sampling: Identification of commune in Collines department. Random sampling: five communes are randomly picked	Bantè, Dassa, Glazoué, Ouèssè and Savalou are selected from the six communes in the departement
Second	Districts: Selection of 50 % of the district per selected communes	Random selection: 50 % of the districts are randomly picked per commune selected	Five districts from the 09 of Bantè; five districts from the 10 of Dassa and Glazoué respectively; four districts from the 08 of Ouèssè; seven districts from the 14 of Savalou
Third	Villages: Selection of one village per district	Random selection: one village is randomly picked per district selected	One village is randomly selected from each district making up 26 villages
Fourth	Farmers: Selection of farmers per village	Random selection: Random selection of farmers based on the list based on the availability	88 farmers are randomly selected from Bantè villages; 94 farmers are randomly selected from Dassa villages; 108 farmers are randomly selected from Glazoué villages; 130 farmers are randomly selected from Ouèssè selected villages; 114 farmers are randomly selected from Savalou villages

Source: Authors.

$$n = \frac{z^2 \times p(1-p)}{m^2}$$

$n$  = Farmers sample size for the survey

$z$  = Statistics of the normal distribution, with a value of 1.96 and a confidence level of 95 %

$p$  = Proportion of the total farm households in the Collines region, fixed at 65 % [62]

$m$  = Error margin (fixed at 5 %)

Based on this formula, the optimal retained size for the investigated sample is 349 farmers. To reach this optimal sample size, 88 farmers were randomly selected from Bantè selected villages; 94 farmers were randomly selected from Dassa villages; 108 farmers were randomly selected from Glazoué villages; 130 farmers were randomly selected from Ouèssè villages; 114 farmers are randomly selected from Savalou villages, totalling 524 farmers and indicating an increase of the sample size by 50 % to account for contingencies such as nonresponse or recording error. Our analysis is based on 512 respondents due to missing data.

### 3.2. Conceptual framework

To analyse the effect of credit constraints on the non-farm entrepreneurial decisions, this study uses occupational choice models [63,64], farm household models [65], and non-unitary models of household decision-making [66,67]. However, given the study context where the farm household allocates a portion of its labour force to off-farm activities, the farm household model [30,68,69] as well as the credit constraint model [58,70,71] were adopted.

The agricultural household model is defined as one in which the household produces goods, but some of the production is consumed by the household members [65,72]. Indeed, as a producer, the agricultural household buys inputs such as fertilizers, hires labour on the market and uses the members of its household (family labour) to produce goods to be sold on the market and consumed by its members. This situation results from the failure of markets (imperfect credit market, incomplete labour market, etc.) because if they were functioning perfectly, the allocation of resources in production can be decided independently of consumption decisions and is called the separability property. Access to credit plays a key role in the production decisions of farm households because it allows them to access agricultural inputs and adopt agricultural innovations.

In this study, we assume that the decisions of agricultural households to engage in non-farm entrepreneurship is characterised by a strictly increasing quasi-concave utility function  $U(c, l, \theta)$  where  $c$  is a vector of consumption goods,  $l$  is a vector of leisure goods, and  $\theta$  is a set of observable household characteristics that directly affect preferences. To produce a quantity  $Q$ , the household uses the following production technology  $Q = f(X, L, \theta)$  where  $X$  is the vector of variable inputs needed for production. We also assume that the household borrows an amount of money  $K$  at the domestic rate  $r$  to meet production, the maximum amount of which is  $\bar{K}$ . The total time available to the farm household  $T$  is divided between on-farm work  $L$ , off-farm work  $M$  (defined as off-farm self-employment) and leisure  $l$ . The household utility maximisation problem can be specified as follows using equations (1)–(4) et (5):

$$\text{Max } U(c, l, \theta) \quad (1)$$

$$\text{S.C. } Q = f(X, L, \theta) \quad (2)$$

$$p_q(-1)Q(-1) + wM + E + (1-r)K = p_c c + p_x X \quad (3)$$

$$T = L + M + l \quad (4)$$

$$K \leq \bar{K} \quad (5)$$

where  $p_c$ ,  $p_x$ ,  $p_q(-1)$  and  $w$  denote the price vector of consumption goods, the price vector of inputs, the price vector of the goods produced by the household in the past season, and the wage rate in the labour market, respectively.  $E$  and  $Q(-1)$  denotes the off-farm income of other households and the output of the past season, respectively.  $wM + E$  denotes the total income obtained from the off-farm activities of the household noted here *OFA*.

The solution of the system of equations related to the first-order conditions also yields the following reduced form of income from off-farm activities that is a function of consumption costs, inputs, and the socio-economic characteristics of the farm household, including its credit status:

$$OFA = f(p, K, Z) \quad (6)$$

Equation (6) above is the one used for estimation purposes and is scored 1 if the farm household has non-farm income and 0 otherwise.

### 3.3. Empirical framework

This study uses a regime-switching model Lokshin and Sajaia [41] to assess the effect of credit constraints on the non-farm entrepreneurship decision of rural households in Benin. Indeed, a direct estimation of credit constraints (1 = Constrained and 0 = Unconstrained) on the farmers' non-farm entrepreneurship decisions would lead to biased estimates. To account for the endogeneity of the credit constraints, we resorted to the regime-switching model that was used by Ojo et al. [23] to address the endogeneity problem. The regime-switching model consists of two parts, namely a credit constraint model (selection model) and a non-farm entrepreneurial decision model (output model). In this model, the regime equation classifies households into two groups based on their credit constraint status. Based on Ali et al. [58], credit constraint equation (7) is described as follows:

$$c_i^* = \delta' Z_i + \mu_i; \text{ with } c_i = \begin{cases} 0 & \text{if } c_i^* > 0 \\ 1 & \text{if } c_i^* \leq 0 \end{cases} \quad (7)$$

Where  $c_i^*$  is a latent variable that determines the probability that the household  $i$  is constrained,  $c_i$  is equal to zero if the household is not constrained and takes the value one if the household is constrained,  $Z_i$  is a vector of household characteristics that would influence the non-farm entrepreneurship decisions,  $\delta$  is a vector of parameters to be estimated,  $\mu_i$  represents the error term assumed to follow the normal distribution.

Given that a farmer may or may not be credit constrained, the non-farm entrepreneurship decisions were modelled as follows:

$$\text{Regime 1 : } y_{0i} = \beta_0 X_{0i} + \varepsilon_{0i} \text{ if } c_i = 0 \quad (8a)$$

$$\text{Regime 2 : } y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i} \text{ if } c_i = 1 \quad (8b)$$

where in equations (8a) and (8b),  $y_{0i}$  is the non-farm entrepreneurship decisions of non-credit constrained producers and  $y_{1i}$  is the non-farm entrepreneurship decisions of credit constrained producers. Table 2 summarizes the variables used for estimation.

The variable  $X_i$  is a vector of observed factors that explains the non-farm entrepreneurship decisions. All variables and the credit constraint status of farm households are presented in Table 1. The parameters,  $\beta_0$  and  $\beta_1$  are vectors of parameters to be estimated while  $\varepsilon_{0i}$  and  $\varepsilon_{1i}$  are the error terms assumed to be normally distributed.

The full information maximum likelihood approach was used to estimate the selection and outcome equations (8a), (8b) simultaneously [23,41,73]. After applying the estimation method, it is important to determine the average effect of the credit constraint on the decisions to undertake a non-farm activity. The counterfactual (control group) is defined as the probability for the constrained

**Table 2**  
Presentation of the model variables.

Variables	Measures
Dependent variables	
Non-farm entrepreneurship	1 if the household decides to undertake a non-farm activity; 0 otherwise
Credit constraints	1 if the household is constrained; 0 otherwise
Independent variables	
Age	Age of the respondent (continuous)
Sex of respondent	1 if male; 0 if female
Household size	Number of persons living in the household (continuous)
Marital status	1 if married; 0 if not married
Level of education	0 if none; 1 if primary and 2 if post-primary
Member of a cooperative	1 if a member of a cooperative; 0 otherwise
Farm size	Size of the farm exploitation (ha)
Access to extension	1 if access to extension services; 0 otherwise

Source: Authors.

farmer to undertake a non-farm activity if he or she were not constrained. For each option considered, the counterfactual is composed of the unconstrained farmers. The average treatment effect on treated individuals is  $ATT = E(Q_1 - Q_0)/T = 1$  which measures, for constrained farmers, the difference between the actual probability that they would engage in a non-farm activity and that which would exist if they were not constrained.

## 4. Results and discussion

### 4.1. Socio-demographic characteristics of respondents

More than three-quarters (77.73 %) of the 512 producers interviewed are credit constrained. Farmers who are constrained (almost 32.66 %) are less engaged in off-farm activity compared to unconstrained farmers (almost 38.60 %), but the difference is not significant (Table 3). Most of the farmers interviewed are women and only 26.17 % are men. The mean age of farmers is about 44 years old with most of the farmers surveyed who are married. Also, farmers who are credit constrained have fewer family members (almost 6 members) compared to the unconstrained farmers (almost 7 members). Among farmers who did not attend school at all and those who have primary level, 40.45 % and 52.26 % are credit constrained while 76.31 % and 17.54 % are unconstrained, respectively. Only 7.03 % of the farmers interviewed attained secondary and post-secondary schools. The mean farm size is estimated at 12.38 ha. About 40.82 % and 33.98 % of the farmers had access to the extension services and belonged to a cooperative, respectively. However, credit constrained farmers (almost 27.13 %) had less access to extension services compared to credit unconstrained farmers (almost 88.60 %).

### 4.2. Drivers of credit constraints and non-farm entrepreneurship entry decision

The results of the endogenous switching probit model aimed at assessing the effect of credit constraints on non-farm entrepreneurship decisions are presented in Table 4. The model is globally significant at 1 % level and the likelihood ratio test is also significant. That means that the outcome and the selection model can be estimated simultaneously.

The results of the selection model (column 2 of Table 4) showed that the determinants of credit constraint are age and access to extension services. The age of the farmers had an inverted U-shaped relationship with credit constraints, meaning that young farmers are more credit constrained than the elders. Also, the age at which the credit constraints of farmers decrease is estimated to be 42 years old. These results corroborate those of Amanullah et al. [6], and Porgo, Kuwornu et al. [45] in Ghana and Burkina Faso, respectively. A plausible explanation of the results is that formal financial institutions trust older farmers because of their creditworthiness and credit experience [6]. The findings of this study contrast with Asiamah et al. [46] and Sekyi et al. [47] who found that young farmers were less credit constrained than older farmers.

Access to extension services negatively and significantly affects credit constraints. This result implies that when the proportion of farmers who had access to extension rises by 1 %, credit constraint decreases by 1.58 %. This finding is in line with Chandio et al. [74], and Luan et al. [75] who found that access to extension services increases farmers' access to credit, indicating a reduction in credit rationing. However, our results contrast with Ojo and Baiyegunhi [11] and Owusu [76] in Nigeria who found that access to extension services increases credit constraints.

The determinants of non-farm entrepreneurship entry decisions both for constrained and unconstrained farmers are age, sex, household size, level of education and membership in farmers' cooperatives (columns 3 and 4 of Table 4). The age of the farmers had a non-linear relationship with the farmers' participation in non-farm entrepreneurship for credit constrained farmers. Indeed, farmers' age had a U-shaped relationship with participation in non-farm entrepreneurship. Older farmers who are credit constrained participate more in non-farm entrepreneurship than young farmers. Also, the age at which the participation in off-farm activities for credit constrained farmers increases is estimated at 64 years old. The results are in line with those of Osondu et al. [37] who found that the age of women decreased their participation in off-farm activities. For the author, this implies that age has an indirect influence on the women farmers' decision to engage in off-farm activities, the increase in age of an entrepreneur decreases the desire and quest for self-employment.

**Table 3**  
Socio-demographic characteristics of respondents.

Variables	All farmers (512)	Constraints (398)	Unconstrained (114)	Prob (T-value)
Engage in off farm activities (%)	33.98 (47.41)	32.66 (49.96)	38.60 (46.96)	0.2392
Age (years)	43.85 (10.55)	43.68 (10.09)	44.42 (12.03)	0.5124
Sex (% men)	26.17 (44.00)	26.63 (44.26)	24.56 (43.23)	0.6580
Household size (number)	06.50 (02.94)	06.33 (02.78)	07.09 (03.38)	0.0151**
Marital status (% married)	97.66 (15.15)	97.99 (14.05)	96.49 (18.48)	0.3520
<b>Level of education</b>				
Not educated at all (%)	48.44 (50.02)	40.45 (49.14)	76.31 (42.70)	0.0000***
Primary	44.53 (49.75)	52.26 (50.01)	17.54 (38.20)	0.0000***
Secondary and post-secondary	07.03 (25.59)	07.28 (26.02)	06.14 (24.11)	0.6738
FBO's membership (%)	33.98 (47.41)	33.42 (47.23)	35.96 (48.20)	0.6134
Farm size (ha)	12.38 (9.99)	11.98 (09.92)	13.72 (10.17)	0.1015
Access to extension (%)	40.82 (37)	27.13 (44.22)	88.60 (31.92)	0.0000***

\*, \*\* and \*\*\* denote 10 %, 5 % and 1 % significant levels, values in brackets are standard deviation.

**Table 4**  
Determinants of non-farm entrepreneurship decisions.

Variables	Constraint		Unconstrained		Selection model	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	1.960**	0.039	−1.650	0.562	−0.339	0.711
Age	−0.128***	0.002	0.147	0.279	0.093**	0.015
Age squared	0.001***	0.005	−0.002	0.227	−0.001**	0.018
Sex	0.467***	0.001	−1.786***	0.001	0.088	0.579
Household size	0.077***	0.001	0.040	0.394	−0.057	0.525
Marital status	−0.026	0.945	−1.257	0.111	0.026	0.945
Farm size	0.002	0.789	−0.013	0.359	−0.002	0.738
Primary	0.316**	0.011	−0.214	0.579		
Secondary	1.142***	0.000	−0.340	0.573		
FBO's membership	0.440***	0.000	0.059	0.883		
Access to extension					−1.577***	0.000
<b>Diagnostics</b>						
Sigma <sub>i</sub>	−14.392		0.298			
Rho <sub>i</sub> (i = 0, 1)	−01.000		0.290			
Log likelihood = −469.411	Wald ch2 (7) = 134.60				Prob > chi2 = 0.0000	
Likelihood ratio test	chi2 (2) = 20.95				Prob > chi2 = 0.0000	

(\*\*\*), (\*\*) and (\*) indicate significance at the 1 %, 5 % and 10 % statistical level respectively.

Source: Authors.

Gender is positively correlated with the participation in off-farm activities for credit constrained farmers but is negatively associated with the credit unconstrained farmers. Otherwise, male credit constrained farmers have 0.47 % more likelihood to engage in off-farm activity compared to female-constrained farmers while male credit unconstrained farmers have 1.77 % less likelihood to engage in off-farm activity compared to female unconstrained farmers. When credit constrained occurs, men can raise more extra resources and support through social networks to undertake off-farm activity than women. Also, rural society may be keener on supporting men in setting up businesses when the family has limited resources. Household size is positively and significantly correlated with the participation of credit constrained farmers in off-farm activities. So, an increase in family size of one additional member increases the participation in non-agricultural activities by 0.08 %. These findings are in line with the results from Porgo, Traore et al. [17] but contrary to Osondu et al. [37] who found a negative relationship. For Porgo, Traore et al. [17], households with large members tend to have higher expenditures, which increases their participation in non-farm activities, households then seek to diversify their income to meet expenses, and thus household members could constitute a labour supply to the off-farm sector.

The more credit constrained farmers are educated, the more they participate in off-farm activities. When farmers attained primary and secondary school levels, their participation in off-farm activities increased by 0.32 % and 1.14 %, respectively. This shows the importance of education in the access to credit because educated farmers can understand the loan conditions as well as to provide the requirement document to apply to loan than not educated farmers. Finally, being a member of a farmers' cooperative increases the probability of participating in off-farm activities for credit constrained farmers. Being a member of a cooperative increased the farmers' participation in off-farm activity by 0.44 %. These findings are in line with Osondu et al. [37] and Porgo, Traore et al. [17]. Indeed, cooperatives can serve as a social network and crucible for exchanging information on opportunities for the farmers and thereby encourage them to engage in non-farm entrepreneurship.

#### 4.3. Effect of credit constraints on non-farm entrepreneurship entry decisions

Table 5 shows the effect of credit constraints on non-farm entrepreneurship entry decisions using a propensity score matching method. The results showed that credit constraints decrease farmers' participation in non-farm entrepreneurship. Indeed, credit constraints were reduced by 0.191 in the farmers' participation in non-farm entrepreneurship for the Nearest Neighbour Matching method. Our findings support those of Adepoju et al. [26] who found in Nigeria that credit constraints decrease the farmers' decision to engage in non-farm entrepreneurship, such as trade and handicrafts, and those of Ma et al. [4] and Cai et al. [59] who found in China that credit constraints significantly decrease the probability of starting a business. But, contrary to the findings of Porgo, Traore et al.

**Table 5**  
Effect of credit constraint on non-farm entrepreneurship decision.

	Non-farm entrepreneurship decision
<b>Nearest Neighbour Matching method</b>	
Constraints	398
Unconstrained	89
ATT	−0.191
Std. Err.	0.039
t-test	−4.951

Source: Authors.

[17,38] in Burkina Faso, and Osondu et al. [37] in Nigeria who found that when the farmers were credit constrained, their likelihood to engage in a non-farm sector increases. However, credit constraints can negatively affect non-farm activities undertaken to diversify income sources [34] because the non-farm market can also be affected by imperfections and lack of credit can prevent, especially the self-employed, from taking advantage of new activity if fixed costs are high [17]. A plausible explanation of our results is that non-farm entrepreneurship also requires credit and so can be faced with credit constraints. Briefly, engagement in non-farm entrepreneurship is not a sustainable solution for farmers to invest in farm activities.

## 5. Conclusion and policy implications

In developing countries, communities living in rural areas are faced with credit constraints to invest in agricultural activities that are subject to climate variability. This situation leads farmers to diversify their activities by engaging in off-farm activities to get enough financial resources to invest in farm activities. However, the decision to engage in off-farm entrepreneurship is also faced by credit constraints. The main objective of this study was to assess the effect of credit constraints on non-farm entrepreneurship entry decisions in Benin. The study used data from a sample of 512 farmers to determine the factors that influence credit constraints and then assess the effect of agricultural credit constraints on non-farm entrepreneurship entry decisions by using an endogenous switching probit model and propensity score matching (PSM). The results found suggest that age had a non-linear relationship with credit constraints while access to extension services decreases credit constraints. Propensity score matching outcomes showed that credit constraints negatively influence farmers' decision to engage in non-farm entrepreneurship. Other variables used as control variables also determine farmers' decision to engage in non-farm entrepreneurship. Indeed, age, sex, household size, marital status, education level and FBO membership increase farmers' decision to engage in non-farm entrepreneurship.

The outcomes suggest that credit constraints constitute a brake for farmers to engage in off-farm entrepreneurship and that policy recommendations must be taken to ease farmers' decisions to engage in off-farm entrepreneurship. For example, as access to extension services decreases credit constraints, policymakers and governments must strengthen extension agents visits on farms. Indeed, access to extension services can constitute a channel through which farmers can be trained on financial literacy and get information on both public financial programmes and private financial institutions as well as to the requirement conditions to access loans. This will ease farmers' access to credit to engage in off-farm entrepreneurship. Similarly, improvement of education level enhances farmers' decision to engage in off-farm entrepreneurship. So, thanks to education, governments and policymakers can introduce entrepreneurship programmes to reinforce farmers' entrepreneurship abilities. Education also reduces credit constraints because educated farmers can access credit more than non-educated farmers who do not always have the documents they need to apply for a loan. Finally, policies to promote FBO are necessary to increase farmers' decision to engage in off-farm entrepreneurship. Indeed, the lack of confidence in others means that people who want to start their own business prefer to do it alone, because they fear that once the project has reached maturity, the other person will put them off. However, in Benin, people show solidarity when someone close to them loses a relative. They are even prepared to help the bereaved person financially and physically, which is not the case when it comes to entrepreneurial projects. So, the Beninese government needs to put in place an institutional framework that strengthens cooperation between individuals for the purposes of entrepreneurship, i.e. to benefit from entrepreneurship subsidy programmes, you have to be made up as a team, as in the case of the joint guaranteed loan applied by financial institutions, particularly microfinance institutions.

The application of all these recommendations will avoid credit constraints for off-farm entrepreneurship. Similarly, this study participates socially to the sustainable development goal 1 (SDG 1) which concerns no poverty. However, this study has some limitations which constitutes a room for futures research. For example, this study did not consider the role of FBO in the credit constraints – off-farm entrepreneurship nexus. Given the limitations of this study, further research is necessary. Future researchers could explore related topics by specifically examining the role of FBO.

## CRedit authorship contribution statement

**Cocou Jaurès Amegnaglo:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Armand Fréjuis Akpa:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Gilbert Onionkiton Adjimonti:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Conceptualization. **Ahoudou Waliou Yessoufou:** Writing – review & editing, Visualization, Validation, Methodology, Investigation, Formal analysis, Conceptualization.

## Data availability statement

Data will be made available on reasonable request.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e40900>.

## References

- [1] M.R. Carter, Equilibrium credit rationing of small farm agriculture, *J. Dev. Econ.* 28 (1988) 83–103, [https://doi.org/10.1016/0304-3878\(88\)90015-6](https://doi.org/10.1016/0304-3878(88)90015-6).
- [2] J. Foltz, Credit market access and profitability in Tunisian agriculture, *Agric. Econ.* 30 (2004) 229–240, <https://doi.org/10.1016/j.agecon.2002.12.003>.
- [3] J.E. Stiglitz, A. Weiss, Credit rationing in markets with imperfect information, *Am. Econ. Rev.* 71 (1981) 393–410.
- [4] S. Ma, X. Wu, L. Gan, Credit accessibility, institutional deficiency and entrepreneurship in China, *China Econ. Rev.* 54 (2019) 160–175, <https://doi.org/10.1016/j.chieco.2018.10.015>.
- [5] T. Haryanto, W.W. Wardana, I.R. Jamil, A.R.D. Brintanti, K.H. Ibrahim, Impact of credit access on farm performance: does source of credit matter? *Heliyon* 9 (2023) e19720 <https://doi.org/10.1016/j.heliyon.2023.e19720>.
- [6] G.R. Lathan Amanullah, S.A. Channa, H. Magsi, M.A. Koonther, J. Wang, N.A. Channa, Credit constraints and rural farmers' welfare in an agrarian economy, *Heliyon* 6 (2020) e05252, <https://doi.org/10.1016/j.heliyon.2020.e05252>.
- [7] O.S. Combar, Farm productivity under financial constraints in developing countries: evidence from maize smallholder farmers in Burkina Faso, *Agric. Resour. Econ. Rev.* 51 (2022) 380–390, <https://doi.org/10.1017/age.2022.8>.
- [8] A. Kumar, A.K. Mishra, S. Saroj, P.K. Joshi, Institutional versus non-institutional credit to agricultural households in India: evidence on impact from a national farmers' survey, *Econ. Syst.* 41 (2017) 420–432, <https://doi.org/10.1016/j.ecosys.2016.10.005>.
- [9] N. Key, Off-farm income, credit constraints, and farm investment, *J. Agric. Appl. Econ.* 52 (2020) 642–663, <https://doi.org/10.1017/aae.2020.25>.
- [10] A.F. Akpa, R. Osobohien, J. Ashraf, M.A.S. Al-Faryan, Financial inclusion and post-harvest losses in West African economic and monetary union, *Agric. Finance Rev.* 83 (2023) 320–332, <https://doi.org/10.1108/AFR-06-2022-0076>.
- [11] T.O. Ojo, L.J.S. Baiyegunhi, Determinants of credit constraints and its impact on the adoption of climate change adaptation strategies among rice farmers in South-West Nigeria, *J. Econ. Struct.* 9 (2020) 28, <https://doi.org/10.1186/s40008-020-00204-6>.
- [12] G.H. Houeninvo, C.V. Célestine Quenum, G.M.A. Nonvide, Impact of improved maize variety adoption on smallholder farmers' welfare in Benin, *Econ. Innovat. N. Technol.* 29 (2020) 831–846, <https://doi.org/10.1080/10438599.2019.1669331>.
- [13] R.N. Yegbeme, Farm-level land use responses to climate change among smallholder farmers in northern Benin, West Africa, *Clim. Dev.* 13 (2021) 593–602, <https://doi.org/10.1080/17565529.2020.1844129>.
- [14] World Bank, *Benin Financial Sector Review -Stability for a Better Inclusion*, 2018.
- [15] A. de Janvry, E. Sadoulet, N. Zhu, The role of non-farm incomes in reducing rural poverty and inequality in China by, Most (2005) 1–29, <http://escholarship.org/uc/item/7ts2z766>.
- [16] I.B. Katega, C.S. Lifuliro, Rural non-farm activities and poverty alleviation in Tanzania - a case study of two villages in Chamwino and Bahi districts of Dodoma region, *dar Es Salaam, REPOA, Res. Rep.* 14 (2014) 36.
- [17] M. Porgo, S. Traore, A. Seogo, P. Zohonogo, Contraintes de crédit et décisions d'entrepreneuriat non agricole chez les jeunes ruraux au Burkina Faso, *Les Cah. l'intégration* 3 (2020) 139–159.
- [18] P. Nagler, W. Naudé, Non-farm entrepreneurship in rural sub-Saharan Africa: new empirical evidence, *Food Pol.* 67 (2017) 175–191, <https://doi.org/10.1016/j.foodpol.2016.09.019>.
- [19] S. Wiggings, P. Hazell, Access to rural non-farm employment and enterprise development, *Backgr. Pap. IFAD Rural Poverty Rep* (2011) 1–53.
- [20] B. Rijkers, R. Costa, Gender and rural non-farm entrepreneurship, *World Dev.* 40 (2012) 2411–2426.
- [21] Y. Kuwayama, A. Thompson, R. Bernknopf, B. Zaitchik, P. Vail, Estimating the impact of drought on agriculture using the U.S. Drought Monitor, *Am. J. Agric. Econ.* 101 (2019) 193–210, <https://doi.org/10.1093/ajae/aaay037>.
- [22] R.S. Kingwell, V. Yayavong, How drought affects the financial characteristics of Australian farm businesses, *Aust. J. Agric. Resour. Econ.* 61 (2017) 344–366, <https://doi.org/10.1111/1467-8489.12195>.
- [23] T.O. Ojo, A.A. Adetoro, A.A. Ogundeyi, J.A. Belle, Quantifying the determinants of climate change adaptation strategies and farmers' access to credit in South Africa, *Sci. Total Environ.* 792 (2021) 148499, <https://doi.org/10.1016/j.scitotenv.2021.148499>.
- [24] R. Akrong, B.H. Kotu, Economic analysis of youth participation in agripreneurship in Benin, *Heliyon* 8 (2022) e08738, <https://doi.org/10.1016/j.heliyon.2022.e08738>.
- [25] H.T. Pham, Rural nonfarm employment under trade reform evidence from Vietnam, 1993–2002. <http://mpira.uni-muenchen.de/6476/>, 2006.
- [26] A.O. Adepoju, O.K. Omolade, O.A. Obayelu, Does credit constraint in agriculture influence choice of nonfarm activities? Evidence from rural Nigeria, *Int. J. Dev. Sustain.* 8 (2019) 329–345.
- [27] Y. Oladimeji, Z. Abdulsalam, A. Abdullahi, Determinants of participation of rural farm households in non-farm activities in Kwara state, Nigeria: a paradigm of poverty alleviation, *Ethiop. J. Environ. Stud. Manag.* 8 (2015) 635, <https://doi.org/10.4314/ejesm.v8i6.3>.
- [28] A.O. Idowu, J.O.Y. Aihonsu, O.O. Olubango, A.M. Shittu, Determinants of income diversification amongst rural farm households in southwest Nigeria, *Econ. Financ. Rev.* 1 (2011) 31–43. <http://www.businessjournalz.org/efr>.
- [29] B.C. Briggeman, The Importance of off-farm income to servicing farm debt. Fed. Reserv. Bank Kansas City, *Econ. Rev. First Quar.* 2011, pp. 63–82. <https://kansascityfed.org/publicat/econrev/pdf/11q1Briggeman.pdf>.
- [30] D. Benjamin, Household composition, labor markets, and labor demand: testing for separation in agricultural household models, *Econometrica* 60 (1992) 287, <https://doi.org/10.2307/2951598>.
- [31] P. Zohonogo, Determinants of non-farm activities participation decisions of farm households in Burkina Faso, *J. Dev. Agric. Econ.* 3 (2011) 174–182. <http://www.academicjournals.org/JDAE>.
- [32] C.J. Amegnaglo, A. Mensah-Bonsu, K.A. Anaman, Use and economic benefits of indigenous seasonal climate forecasts: evidence from Benin, West Africa, *Clim. Dev.* 0 (2022) 1–12, <https://doi.org/10.1080/17565529.2022.2027740>.
- [33] G.M.A. Nonvide, Reducing poverty through use of irrigation: evidence from rice farming in Benin, *African J. Sci. Technol. Innov. Dev.* 14 (2022) 976–987, <https://doi.org/10.1080/20421338.2021.1923123>.
- [34] O. Gajigo, Credit constraints and agricultural risk for non-farm enterprises, *African Dev. Rev.* 25 (2013) 648–662, <https://doi.org/10.1111/1467-8268.12059>.
- [35] J.R. Davis, G. Meskhidze, D.J.J. Bezemer, Survey among rural non-farm enterprises in Georgia: overview of findings, *SSRN Electron. J.* (2011), <https://doi.org/10.2139/ssrn.695221>.
- [36] S. Asfaw, B. Shiferaw, F. Simtowe, M. Hagos, Agricultural technology adoption, seed access constraints and commercialization in Ethiopia, *J. Dev. Agric. Econ.* 3 (2011) 436–447.
- [37] C.K. Osondu, K.C. Obike, S. Ogbonna, Determinants of decision to non-farm entrepreneurship by women farmers in Ikwuano Lga of Abia state, *Eur. J. Agric. For. Res.* 2 (2014) 41–52.
- [38] O.S. Combar, Determining factors of the strategies for diversifying sources of income for rural households in Burkina Faso, *J. Dev. Agric. Econ.* 7 (2015) 20–28, <https://doi.org/10.5897/jdae2014.0607>.
- [39] S.R. Boucher, C. Guiringer, C. Trivelli, Direct elicitation of credit constraints: conceptual and practical issues with an application to Peruvian agriculture, *Econ. Dev. Cult. Change* 57 (2009) 609–640, <https://doi.org/10.1086/598763>.

- [40] H. Swaminathan, R. Salcedo Du Bois, J.L. Findeis, Impact of access to credit on labor allocation patterns in Malawi, *World Dev.* 38 (2010) 555–566, <https://doi.org/10.1016/j.worlddev.2009.11.002>.
- [41] M. Lokshin, Z. Sajaia, Impact of interventions on discrete outcomes: maximum likelihood estimation of the binary choice models with binary endogenous regressors, *STATA J.* 11 (2011) 368–385, <https://doi.org/10.1177/1536867x1101100303>.
- [42] J.M. Antle, Incorporating risk in production analysis, *Am. J. Agric. Econ.* 65 (1983) 1099–1106, <https://doi.org/10.2307/1240428>.
- [43] S. Di Falco, J. Chavas, On crop biodiversity, risk exposure, and food security in the highlands of Ethiopia, *Am. J. Agric. Econ.* 91 (2009) 599–611, <https://doi.org/10.1111/j.1467-8276.2009.01265.x>.
- [44] J.P. Chavas, G. Riveccio, S. Di Falco, G. De Luca, F. Capitanio, Agricultural diversification, productivity, and food security across time and space, *Agric. Econ.* 53 (2022) 41–58, <https://doi.org/10.1111/agec.12742>.
- [45] M. Porgo, J.K.M. Kuwornu, P. Zahonogo, J.B.D. Jatoe, I.S. Egyir, Credit constraints and cropland allocation decisions in rural Burkina Faso, *Land Use Pol.* 70 (2018) 666–674, <https://doi.org/10.1016/j.landusepol.2017.10.053>.
- [46] T.A. Asiamah, W.F. Steel, C. Ackah, Determinants of credit demand and credit constraints among households in Ghana, *Heliyon* 7 (2021) e08162, <https://doi.org/10.1016/j.heliyon.2021.e08162>.
- [47] S. Sekyi, B.M. Abu, P.K. Nkegbe, Farm credit access, credit constraint and productivity in Ghana: empirical evidence from Northern Savannah ecological zone, *Agric. Finance Rev.* 77 (2017) 446–462, <https://doi.org/10.1108/AFR-10-2016-0078>.
- [48] J.K.M. Kuwornu, I.D. Ohene-Ntow, S. Asuming-Brempong, Agricultural credit allocation and constraint analyses of selected maize farmers in Ghana, *Br. J. Econ. Manag. Trade* 2 (2012) 353–374, <https://doi.org/10.9734/bjemt/2012/2270>.
- [49] Z.B. Weldegebriel, G. Folloni, M. Prowse, The determinants of non-farm income diversification in rural Ethiopia, *J. Poverty Alleviation Int. Dev. (JPAID)* 6 (2015) 110–130.
- [50] A. Shehu, N. Abubakar, Determinants of participation of farm households in non-farm enterprise activities in rural Nigeria, *Int. J. Econ. Commer. Manag. United Kingdom III* (2015) 57–71, <http://ijecm.co.uk/>.
- [51] S.e. Saqib, J.K.M. Kuwornu, S. Panezia, U. Ali, Factors determining subsistence farmers' access to agricultural credit in flood-prone areas of Pakistan, *Kasetsart J. Soc. Sci.* 39 (2018) 262–268, <https://doi.org/10.1016/j.kjss.2017.06.001>.
- [52] M. Moahid, K.L. Maharjan, Factors affecting farmers' access to formal and informal credit: evidence from rural Afghanistan, *Sustainability* 12 (2020) 1268, <https://doi.org/10.3390/su12031268>.
- [53] F. Dong, J. Lu, A.M. Featherstone, Effects of credit constraints on household productivity in rural China, *Agric. Finance Rev.* 72 (2012) 402–415, <https://doi.org/10.1108/00021461211277259>.
- [54] A.A. Chandio, Y. Jiang, Determinants of credit constraints: evidence from sindh, Pakistan, *Emerg. Mark. Finance Trade* 54 (2018) 3401–3410, <https://doi.org/10.1080/1540496X.2018.1481743>.
- [55] K. Duniya, I. Adinah, Probit analysis of cotton farmers' accessibility to credit in northern Guinea savannah of Nigeria, *Asian J. Agric. Extension, Econ. Sociol.* 4 (2015) 296–301, <https://doi.org/10.9734/ajaees/2015/13538>.
- [56] L. Lin, W. Wang, C. Gan, Q.T.T. Nguyen, Credit constraints on farm household welfare in rural China: evidence from fujian province, *Sustainability* 11 (2019) 3221, <https://doi.org/10.3390/su11113221>.
- [57] S. Tang, S. Guo, Formal and informal credit markets and rural credit demand in China, in: 2017 4th Int. Conf. Ind. Econ. Syst. Ind. Secur. Eng., IEEE, 2017, pp. 1–7, <https://doi.org/10.1109/IEIS.2017.8078663>.
- [58] D.A. Ali, K. Deininger, M. Duponchel, Credit constraints and agricultural productivity: evidence from rural Rwanda, *J. Dev. Stud.* 50 (2014) 649–665, <https://doi.org/10.1080/00220388.2014.887687>.
- [59] D. Cai, Q. Song, S. Ma, Y. Dong, Q. Xu, The relationship between credit constraints and household entrepreneurship in China, *Int. Rev. Econ. Finance* 58 (2018) 246–258, <https://doi.org/10.1016/j.iref.2018.03.024>.
- [60] INSAE, Enquête Modulaire Intégrée sur les Conditions de Vie des ménages 2ème Edition (EMICoV-Suivi 2015): Note sur la pauvreté au Bénin en 2015, 2015. Cotonou.
- [61] W.G. Cochran, Sampling Techniques, Third Edit, 1977.
- [62] INSAE, Evaluation de la pauvreté au Bénin, 2013. Cotonou, Benin.
- [63] R.E. Lucas, On the size distribution of business firms, *Bell J. Econ.* 9 (1978) 508–523.
- [64] D.S. Evans, B. Jovanovic, An estimated model of entrepreneurial choice under liquidity constraints, *J. Polit. Econ.* 97 (1989) 808–827, <https://doi.org/10.1086/261629>.
- [65] I. Singh, L. Squire, J. Strauss, Agricultural Household Models: Extensions, Applications and Policy, 1986.
- [66] M. Manser, M. Brown, Marriage and household decision-making: a bargaining analysis, *Int. Econ. Rev.* 21 (1980) 31, <https://doi.org/10.2307/2526238>.
- [67] P.-A. Chiappori, Collective labor supply and welfare, *J. Polit. Econ.* 100 (1992) 437–467.
- [68] T. Glauben, T. Herzfeld, X. Wang, Labor market participation of Chinese agricultural households: empirical evidence from Zhejiang province, *Food Pol.* 33 (2008) 329–340, <https://doi.org/10.1016/j.foodpol.2007.11.001>.
- [69] S. Lovo, Market imperfections, liquidity, and farm household labor allocation: the case of rural South Africa, *Agric. Econ.* 43 (2012) 417–428, <https://doi.org/10.1111/j.1574-0862.2012.00593.x>.
- [70] F. Simtowe, M. Zeller, A. Diagne, The impact of credit constraints on the adoption of hybrid maize in Malawi, *Rev. DEtudes En Agric. Environ.* 90 (2009) 5–22, <http://www.inra.fr/esr/publications/cahiers>.
- [71] M. Petrick, A microeconomic analysis of credit rationing in the Polish farm sector, *Eur. Rev. Agric. Econ.* 31 (2004) 77–101, <https://doi.org/10.1093/erae/31.1.77>.
- [72] E. Sadoulet, A. De Janvry, C. Benjamin, Household behavior with imperfect labor markets, *Ind. Relat.* 37 (1998) 85–108, <https://doi.org/10.1111/0019-8676.731998036>.
- [73] O.I. Ayuya, E.O. Gido, H.K. Bett, J.K. Lagat, A.K. Kahi, S. Bauer, Effect of certified organic production systems on poverty among smallholder farmers: empirical evidence from Kenya, *World Dev.* 67 (2015) 27–37, <https://doi.org/10.1016/j.worlddev.2014.10.005>.
- [74] A.A. Chandio, Y. Jiang, A. Rehman, M.A. Twumasi, A.G. Pathan, M. Mohsin, Determinants of demand for credit by smallholder farmers': a farm level analysis based on survey in Sindh, Pakistan, *J. Asian Bus. Econ. Stud.* 28 (2021) 225–240, <https://doi.org/10.1108/jabes-01-2020-0004>.
- [75] D.X. Luan, S. Bauer, R. Kühl, Income impacts of credit on accessed households in rural Vietnam: do various credit sources perform differently? *Agris On-Line Pap. Econ. Informatics* 8 (2016) 57–67, <https://doi.org/10.7160/aol.2016.080106>.
- [76] S. Owusu, Analysis of the determinants of credit constraints status of rural households, *Int. J. Agric. Ext. Rural Dev. Stud.* 6 (2019) 39–49, [www.eajournals.org](http://www.eajournals.org).