Credit access and intensity of borrowing by irrigated rice farmers in Ghana: the role of extension services

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Abstract

Purpose – Credit is essential in the farm business because it facilitates the adoption of productive technologies such as irrigation. However, access to credit remains a significant hurdle for sub-Saharan Africa, including Ghanaian farmers. Therefore, the authors assessed credit utilization and the intensity of borrowing by irrigated rice farmers in the Upper East region. In addition, how extension moderates the amount borrowed was analysed.

Design/methodology/approach – The multistage sampling approach was used in the study. The Tono and Vea irrigation schemes were purposively selected. Proportionally, 318 rice farmers were sampled from the Tono irrigation scheme and 159 from the Vea irrigation scheme. Cragg's double hurdle and moderation analysis were used.

Findings – It was uncovered that gender, age, years of farming, total farm size, rice farm size, contract farming and off-farm employment explain farmers' decision to borrow. On the other hand, the intensity of borrowing was influenced by gender, age, years of farming, rice farm size, contract farming and the number of extension contact. The moderation analysis revealed that extension contact improves the amount borrowed by farmers.

Research limitations/implications – While there are irrigated rice farmers in other regions of Ghana, this study was limited to rice farmers under the Tono and Vea Irrigation schemes in the Upper East region.

Originality/value – This study investigated the moderating role of extension contact on amount borrowed in Ghana. This makes a modest addition to the limited literature on the moderating role of extension and credit access.

Keywords Irrigation, Rice farming, Credit, Extension, Cragg double hurdle, Moderation

Paper type Research paper

1. Introduction

Most households in developing countries rely on agriculture to meet their daily needs. Yet, enduringly low agricultural production and miniature food system reform remain

significant obstacles to improving well-being (Fuglie and Nin-Pratt, 2012). Hence, increasing agricultural production is prioritized in recent and ongoing development initiatives as a practical means of enhancing farmers' well-being. It is advocated that agricultural credit can play a pivotal role in the quest to increase agricultural productivity and improve smallholder livelihoods (Yadav and Rao, 2022; Belek and Jean-Marie, 2020). Thus, credit improves production efficiency by creating and maintaining the adequate flow of inputs, capital accumulation, uptake of modern technologies and advanced practices (Salami et al., 2010). Moreover, credit enable farmers to meet the capital requirements of agricultural production cycle, which often spans many months and involves planting, cultivating and harvesting crops with little to no cash income. Owing to the significance of credit, innovative credit delivery methods, initiatives and policies have been advocated over the years (Sekyi et al., 2020). In Ghana, the Agricultural Development Bank (ADB) was established in 1965 with an exclusive mandate of lending to agriculture and allied industries at reduced lending rates (Sekyi et al., 2020). Aside from this, innovative informal credit schemes such as trade credit, out-grower credits, village savings and loans have been promoted in farming (Amrago and Mensah, 2022; Silong and Gadanakis, 2020; Bannor et al., 2020).

In the Upper East region particularly, Bolgatanga and Navrongo municipalities, credit is very imperative considering the intense cultivation of rice under irrigation system. Thus, the majority of rice is cultivated under the Tono and Vea irrigation scheme, gravity-based facilities that distributes water to farmer fields through canals. As such, the farmers pay seasonal water user fees for using the irrigation facilities. A preliminary interrogation with the farmers revealed that when they fail to pay the water fees, Irrigation Company of Upper Region (ICOUR) denies them water from flowing into their farms. Aside that, farm inputs and other costs associated with rice production makes the need for credit by these farmers very vital. Thus, bonding, nursery, transplanting, bird scaring, weed and pest control, harvesting, and so on, are all capital-demanding activities in rice production. Notwithstanding, credit accessibility remains a significant hurdle among farmers in the region and Ghana at large (Twumasi et al., 2020; Akudugu, 2016). Their difficulty accessing credit is primarily attributed to institutional policies such as credit rationing by financial institutions (Shete and Garcia, 2011; Luan, 2020; Asante-Addo et al., 2017; Xu et al., 2022). Apart from that, access problems are due to lack of collateral, lack of bank account, proximity to lenders, weak value chain linkage, and so on (Luan, 2020).

Notwithstanding the hurdles in credit access, empirical evidence suggest that there are factors that facilitate credit uptake by farmers (Silong and Gadanakis, 2020; Kiros and Meshesha, 2022). Among these variables, extension service is predominantly emphasized as a significant predictor (Cherotich et al., 2022; Kiros and Meshesha, 2022). It is important to add that the background of extension service, its effectiveness and impact in Ghana has been extensively explored in related studies (Buadi et al., 2013; Donkor et al., 2016; Danso-Abbeam et al., 2018). According to these studies, extension agents are needed to disseminate improved technologies to farmers and facilitate their adoption to improve production and overcome the drudgery that results from the use of traditional farm practices and tools (Buadi et al., 2013; Donkor et al., 2016; Danso-Abbeam et al., 2018). Also, extension visits increase the information base and decision-making abilities of farm households, including the ability to compare the pros and cons of choosing appropriate credit and production technologies (Hussein, 2007). As such, extension contact frequently expose farmers to new technologies that may require more funds to implement thereby increasing the tendency to borrow (Auma and Mensah, 2014). Likewise, they play an essential role in providing farm information to lenders and information on various affordable sources of finance to farmers (Cherotich et al., 2022).

This presuppose that there is possible synergy that exist between extension services and credit access. Hence, this study assumes that extension contact could significantly affect the decision to borrow and the amount borrowed. Generally, we grounded our argument on the fact that farmers who had contact with extension agents and decided to borrow are more likely to borrow huge amounts because the extension agents might have 1) disseminated a technology which they need a considerable amount to adopt 2) educated farmers on the sources and requirements to obtain loans 3) linked the farmers to lenders whom they have established a good rapport. In this sense, farmers may not just seek credit but they are likely to borrow more.

Meanwhile, even though studies on the influence of agricultural extension on credit access (Silong, 2017; Anang *et al.*, 2015; Kiros and Meshesha, 2022) and the extent of borrowing (Wongnaa *et al.*, 2022; Cherotich *et al.*, 2022) are abundant literature, there are rare studies on the moderating role of extension services on credit access and the amount borrowed. Moahid *et al.* (2021) noted that it is prudent to investigate credit access and the role of extension services because their synergies have tremendous implications for farmers' economic outcomes. This justify that the role of extension services towards credit access and the amount borrowed should not be overlooked. Against this background, the authors sought to unravel the determinants of credit access among irrigated rice farmers, focusing on the role of extension services. Particularly, the study assessed the determinants of credit access, the extent of uptake and the moderating role of extension services on the amount borrowed by rice irrigated rice farmers.

As such, the contribution of this study is multifold; first, credit utilization is not a one-time activity; thus, farmers will continuously demand credit to facilitate their farming activities, including payment of water user fees and adopting improved technologies. Consequently, there is the need for recency on determinants of credit utilization among the rice farmers to provide evidence for policymakers and relevant stakeholders like lenders to consider in designing policies and credit facilities. Further, though studies have evaluated credit access among rice farmers in Ghana (Denkyirah *et al.*, 2016; Wongnaa *et al.*, 2022), this study is peculiar to irrigated rice farmers. In addition, this study extends the empirical investigation on the binary decision to utilize credit and the intensity of utilization to ascertain the moderating role of extension services on the amount borrowed. The findings from this study will help to unearth the variables that impede credit access and develop strategies to re-align these variables whiles strengthening the favourable drivers of credit uptake. Also, the role of extension services on credit access and the intensity of borrowing would inform policymakers and relevant stakeholders to improve extension service delivery among farmers in Ghana.

2. Materials and methods

2.1 Study area

The study was carried out in Ghana's Upper East. It is situated between longitude 0^0 and 1^0 West and latitude 10^0 30"N and 11^0N. It shares boundaries with Burkina Faso to the north, Togo to the east, the Sissala district of the Upper West region to the west, and the West Mamprusi District of the Northern Region to the south. It has a total land area of 8,842 km^2 (GSS, 2014). The regions have extensive and predominately natural rice-growing lowlands (Alliance for a Green Revolution in Africa [AGRA], 2020). Again, three-year average estimates revealed that the Upper East region is Ghana's fourth largest rice producer (MOFA-SRID, 2020). The estimates show that Ghana's Upper East, Northern, and Volta regions produce more than 80% of rice (MOFA-SRID, 2020). Again, the existence of irrigation facilities influenced the choice of the study area. Figure 1 presents the map of the study area.
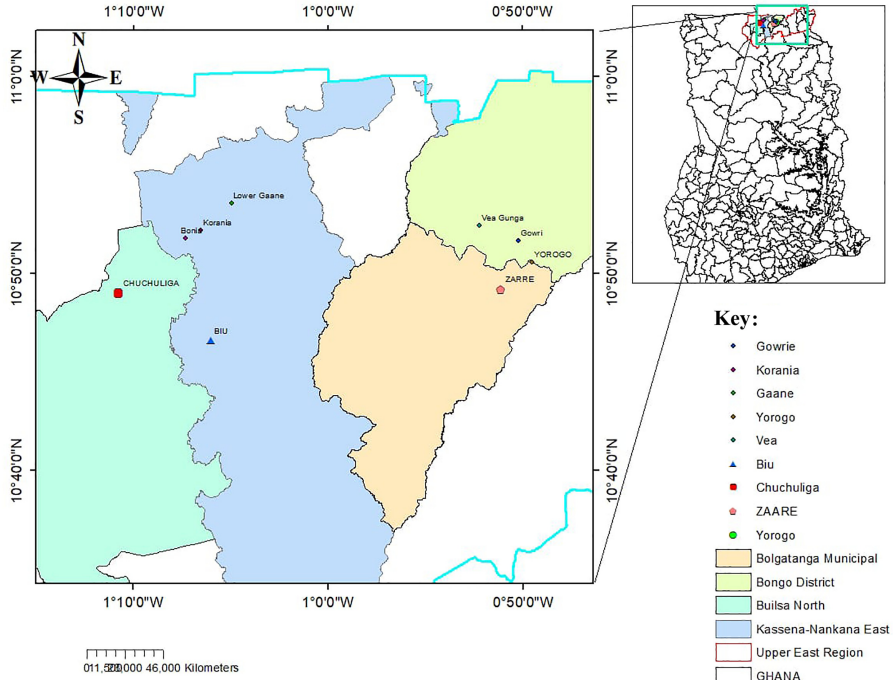
Figure 1.
Map of the study area

Source(s): Author's own creation/work

2.2 Source of data
Cross-sectional data from irrigated rice farmers were collected using a structured questionnaire. The questionnaire covered respondents socioeconomic, farm-level and institutional characteristics. Related literature informed the choice of variables inculcated in the questionnaire. The survey instrument was validated through a pre-test with 20 rice farmers. The necessary adjustments were made afterwards. The data collection took place between May to July 2022 and it was done digitally to reduce the time and errors associated with paper-based approach. Fourteen well-trained enumerators helped with the data collection exercise.

2.3 Sampling and sample size determination
A multistage sampling technique was followed in the study. Firstly, purposive sampling was employed to select the region and districts. Thus, the Upper East region was purposively selected. In addition, the Kassena-Nankana East, Builsa North, Bongo district and Bolgatanga municipal were chosen purposively. Thus, the Kassena-Nankana East and Builsa North host the Tono irrigation scheme, while the Bongo district and Bolgatanga municipal host the Vea irrigation scheme, hence the choice of these four districts. A list of farmers obtained from the ICOUR indicates that around 2,000 rice farmers cultivates under the Tono irrigation scheme whiles 1,000 rice farmers are under the Vea irrigation scheme, respectively. Through a simple random sampling approach, 477 rice farmers were sampled. The Yamane (1967) approach for sample size determination was employed to determine the appropriate sample size. The approach is stated as follows;

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

where n = sample size, N = population, e = random error. In this study, the total population of irrigation (N) is 3000, random error term used was 5%. This resulted in a sample size of 353 farmers. However, 124 farmers were added to increase the sample size to 477. This was necessary to improve the generalization of the study's findings. Nonetheless, the proportional sampling approach was utilized to sample farmers from each scheme. As such, 318 farmers were drawn from the Tono irrigation scheme and 159 from the Vea irrigation scheme.

2.4 Theoretical framework
Classically, a rational individual is a maximizer. Thus, among options, an individual chooses the alternatives that give the highest satisfaction. As such, a couple of theories like expected utility theory, prospect theory, random utility theory, utility maximization theory, and so on, has been propounded to explain decision-making involving choices (Azari *et al.*, 2012; Kahneman and Tversky, 2013; Moscati, 2017; Bannor *et al.*, 2022). However, this study is rooted in the utility maximization theory, which contends that economic agents are logical and exhibit regular decision patterns. This means they make choices that offer maximum satisfaction. Hence, in this study, we hypothezise that rice farmers will be willing to seek credit and borrow huge amount subsequently only if the anticipated level of satisfaction outweigh the decision not to borrow or borrow a smaller amount (Okoffo *et al.*, 2016; Masaood and Keshav, 2020). It is expected that farmers will consider a plethora of factors to inform their decision to borrow or otherwise. Given the need to pay water user fees, purchase inputs, hire farm machinery, and so on, farmers need to consider their current financial level to make judicious decision on borrowing. However, the decision to borrow is contingent on whether it will provide the farmers with maximum utility. Likewise, this study contend that the decision to engage with extension officers or otherwise is made rationally by farmers. Thus, farmers will contact extension agents supposing the outcome will provide the maximum utility among other options. There are instances where lenders rely on extension agents to ascertain the credit worthiness of farmers. Therefore, extension agents who have good rapport with lenders are able to ensure that their farmers obtain desirable amount of credit. Hence, according to the utility maximization theory, farmers who presume that extent agents can facilitate their credit request are likely to seek their services to satisfy this desire.

2.5 Analytical approach
2.5.1 Double hurdle approach. A plethora of factors influences the decision to utilize credit by farmers. Usually, this decision is heterogeneous and non-random. Thus, a couple of variables influence the decision to borrow and amount borrowed differently. In econometric modelling, if the same set of variables influences the decision (binary) to borrow and the amount borrowed (continuous), then the Tobit regression model is preferred. On the other hand, if the same set of variables does not jointly determine the decision, then the two-stage models (Cragg's double hurdle and Heckman's two-stage procedure) will suffice (Bannor *et al.*, 2019; Martey *et al.*, 2020). However, we were uncertain whether the explanatory variables considered jointly explain the two decisions. Hence, we conducted a separability test to statistically determine the appropriate model. The separability test relies on the likelihood ratio test statistics. Following up on (Katchova and Miranda, 2004; Iddrisu *et al.*, 2020), the likelihood ratio test statistic is estimated as follows;

$$\lambda = -2(LL_{probit} + LL_{truncreg} - LL_{tobit}) \tag{2}$$

where LL_{probit} denotes the log-likelihood from the probit estimation, $LL_{truncreg}$ represents the log-likelihood from the truncated regression and LL_{tobit} is the log-likelihood from the Tobit model. The test statistic has a chi-square distribution with degrees of freedom equal to the number of constrained parameters. The Tobit model is rejected in favour of the two-step model if λ exceeds the appropriate chi-square critical value (Burke, 2009). Again, to statistically select between the Cragg double hurdle and the Heckman model, the Inverse Mills Ratio (IMR) from the Heckman estimation was used (Bannor *et al.*, 2019). A significant IMR means there was selectivity bias in farmer's credit uptake decision, which makes the Heckman model more appropriate than Cragg's model.

2.5.2 Moderation analysis. We assumed that extension contact could improve the decision to utilize credit and increase the amount borrowed by farmers. In a moderation analysis, a particular moderator is instrumental in the relationship between two variables. Farmers may choose to take credit or otherwise, but we presumed that their contact with extension agents would inform their decision on the amount to borrow. In structural equation modelling, moderation analysis informs researchers whether the effect of a predictor variable (X) on an outcome variable (Y) depends on the level of another variable (Z) called a moderator (Daryanto and Lukas, 2022). In other words, the effect of X on Y depends on the influence of moderator Z. Following up on Daryanto and Lukas (2022), the moderation can be specified as follows;

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 X * Z + \varepsilon \tag{3}$$

where Y denotes the outcome variable (the amount borrowed), β_0 represents the intercept or constant term, X represents the decision to utilize credit, Z denotes the moderating variable (extension contact), whiles $X * Z$ shows the moderation or interaction effect created by multiplying X and Y, $\beta_0 \ldots \beta_3$ are the coefficients to be estimated, whiles ε is the random error term. The moderation analysis was conducted using lavaan package in R software version 2022.07.2 build 554 (Rosseel, 2012). The model fitness was assessed via Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) (Lee, 2021; Treglown *et al.*, 2016).

2.6 Conceptual framework and choice of variables

We conceptualized that farmers' socioeconomic characteristics, farm level and institutional features will affect the decision to utilize credit and the intensity of borrowing. Further, we assumed that contact with extension agents could strengthen the association between the decision to utilize credit and the amount borrowed. Figure 2 presents the conceptual framework of the study.

Age – Several studies demonstrate that an increase in farmer's age increases their credit demand (Denkyirah *et al.*, 2016; Chandio *et al.*, 2017; Mamuye, 2021). Wongnaa *et al.* (2022) disclosed that farmers' age influences the decision to utilize credit and the intensity of borrowing. Contrary, similar study reported a negative effect of age on credit utilization, thus, an increase in age decreases credit demand (Shete and Garcia, 2011; Isitor *et al.*, 2014). They argued that older farmers might not have the strength to work effectively on their farms, hence, are less likely to participate in credit schemes.

Gender – Further, Wongnaa *et al.* (2022) disclosed that the decision to utilize credit and the intensity of participating in credit schemes are jointly explained by farmers' gender. However, literature have it that male farmers are more likely to participate in credit schemes than females (Embaye *et al.*, 2018; Dubbert, 2019). Thus, males participate in credit schemes than females because they make the final household decisions.
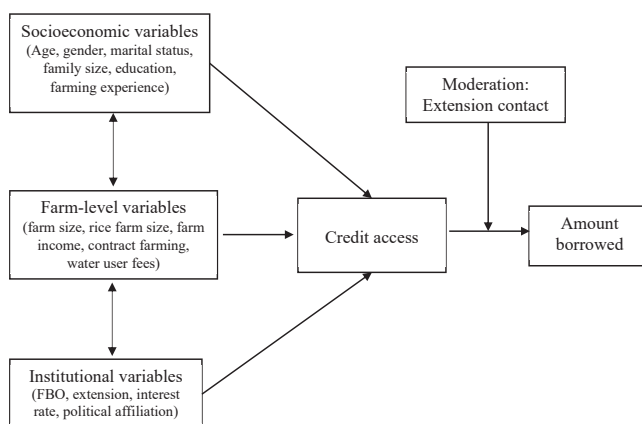
Source(s): Author's own creation/work

Figure 2.
Conceptual framework

Education – A couple of empirical studies have uncovered a significant nexus between education and credit utilization (Twumasi *et al.*, 2020; Cherotich *et al.*, 2022). Thus, it was discovered that education positively influences participation in agricultural credit schemes (Asante-Addo *et al.*, 2017; Isitor *et al.*, 2014). Moreover, Sebatta *et al.* (2014) underlined that the educational level of the household head is significant and positively predicts the intensity of borrowing by farmers. Nonetheless, Ayesu (2020) underlined that ordinary education does not warrant access to credit, but financial literacy augments individuals' decision to obtain credit.

Household size – A significant influence of family size on credit utilization has been reported in the literature (Twumasi *et al.*, 2020). Thus, a couple of literary evidence are in consensus that family size positively affects credit demand (Sekyi *et al.*, 2017). It was established that household size jointly explains farmers' decision to participate in credit schemes and the intensity of participation (Wongnaa *et al.*, 2022; Sebatta *et al.*, 2014; Shete and Garcia, 2011). It is assumed that as farmers' household size increases, the consumption requirements also increase. As a result, there is pressure on limited resources and compelling farmers to participate in credit schemes. Contrary, Kiros and Meshesha (2022) found a negative association between household size and credit utilization. They explained that large families could self-engage in the cultivation of farm crops and have an opportunity to get more family labour for production and generate more income. This inhibits their tendency to borrow.

Marital status – The marital status of farmers plays a pivotal role in their quest to obtain credit. Sometimes their spouses influence them to obtain credit, while sometimes; they need it to cater for their homes. The literature suggests that marital status affects farmers' credit utilization. Silong and Gadanakis (2020) underlined that married farmers solicit credit more than single farmers. Likewise, Kiros and Meshesha (2022) found a significant relationship between marital status and credit access. Similarly, Wongnaa *et al.* (2022) unravelled that marital status significantly influences smallholder farmers' participation in credit schemes.

Membership of Farmer-Based Organisation (FBO) – The significance of FBO on credit utilization is evident in the literature (Silong and Gadanakis, 2020; Sekyi *et al.*, 2020). Asante-Addo *et al.* (2017) indicated that membership in FBO has a statistically significant effect on access to credit by farmers. They explained that lenders usually prefer to extend credit to farmers in groups to serve as guarantors for each other. As such, Bannor *et al.* (2020) underlined that women participating in Village Savings and Loans (VSLA) are more likely to obtain credit.

Farming experience – Literature claims that years of farming has heterogeneous effect on credit uptake. Wongnaa *et al.* (2022) found that farming experience jointly explains rice farmers' decision to participate in credit schemes and the amount borrowed. On one strand, it is uncovered that more experienced farmers are less likely to participate in credit schemes (Diedong, 2019; Acheampong *et al.*, 2022) whiles Chandio *et al.* (2020) also argued that farmers with more farming experience would know how to use their resources more efficiently and, hence, be more likely to participate in credit schemes.

Political affiliation – The influence of political affiliation on farmers' access and utilization of services is acknowledged in the extant literature (Kofarmata and Danlami, 2019; Akudugu *et al.*, 2012). Due to farmers' political affiliations, they become highly connected to sources of technologies and services such as credit. As such, farmers affiliated with a political party will likely obtain credit from sources that political influence can penetrate. Yawson *et al.* (2010) attest to the significant role of political affiliation towards farmers' access to subsidized inputs in Ghana. Likewise, Akudugu (2012) underlined that political affiliation plays a substantial role in farmers' access to credit in the Upper East region of Ghana.

Total landholding and rice farm size – The significant nexus between farm size and borrowing has been underscored in earlier studies (Sekyi *et al.*, 2017; Chandio *et al.*, 2020; Kiros and Meshesha, 2022). It is argued that the capital requirement for production is assumed to increase as farm size increases. Hence, farmers with large farm sizes are expected to have a higher intensity of participation in credit schemes. In addition, Kumar *et al.* (2021) explained that institutional credit agencies favour commercial farmers, proxy for large farm size, as they have more collateral to offer. In contrast, Twumasi *et al.* (2020) discovered that farm size negatively predict farmers' credit access.

Extension and frequency of contact – Farmers usually access information and credit sources from extension agents. Empirically, studies have uncovered a significant nexus between extension contact and credit uptake among farmers (Silong and Gadanakis, 2020; Chandio *et al.*, 2020). Particularly, Denkyirah *et al.* (2016), Kiros and Meshesha (2022) and Cherotich *et al.* (2022) found that contact with extension agents positively stimulates farmer's credit uptake.

Farm income – Farm income represents the amount accumulated from the farm venture. The amount earned from farming significantly affects farmers' decision to seek credit. Thus, higher farm income indicates the availability of capital for farm investment and hence the less likelihood to borrow. For instance, Ibrahim and Aliero (2012) found that an individual's income level significantly influences their decision to borrow. In tandem, Chandio *et al.* (2017) revealed that farmers' income level determines their decision to borrow. Related studies have similarly discovered that farm income significantly affect the decision to borrow (Akudugu *et al.*, 2009; Chisasa, 2019).

Off-farm work – The influence of off-farm work on credit access is significantly highlighted in existing literature (Shete and Garcia, 2011; Cherotich *et al.*, 2022; Kiros and Meshesha, 2022). Whiles off-farm work can guarantee an additional source of income for farm investment to decrease the likelihood of obtaining credit, on the other hand, off-farm work participating can assure the creditworthiness of farmers (ability to repay the loan through off-farm income), which will inform credit providers to extend loans to farmers. Anang and Yeboah (2019) noted that off-farm income, an outcome of engaging in off-farm work, negatively affects participation in credit schemes.

Interest rate – The demand for credit among lenders depends mainly on the cost of capital. The higher the interest rate, the less likely an individual will take loans. Even when seeking loans, borrowers usually seek providers with lower interest rates. A group of studies reported the importance of interest rates on credit demand among farmers (Assifaw and Adeba, 2016; Julien *et al.*, 2021). Kiros and Meshesha (2022) iterated that a higher cost of capital could discourage household interest from taking credit.

Contract farming – Contract farming is viewed as a possible pathway to address challenges with access to the market by offering guaranteed markets (Abebe *et al.*, 2013; Oppong-Kyeremeh *et al.*, 2022). Thus, contract farming usually provides seasonal credit, access to inputs and guaranteed output markets (Bannor and Gyekye, 2022; Mwambi *et al.*, 2013).

Water user fees – It was observed during the preliminary survey that the water user fees paid by the farmers is a severe challenge. In this case, it is assumed that the amount paid per acre as water user fees will significantly affect farmers' decision to take credit and the amount to borrow.

Table 1 presents the description of variables included in the analysis and their respective summary statistics. The table indicates that farmers have an average age of 44 years.

Variable	Description	Measurement	Mean	Std. deviation
Dependent variables				
Credit	Farmer access credit	Binary (1 = Yes, 0 = No)	0.25	0.44
Amount	Amount of credit borrowed (GH¢)	Continuous	313.45	763.67
Explanatory variables				
Gender	gender of the farmer	Binary (1 = Male, 0 = Female)	0.77	0.42
Marital status	Marital status of the farmer	Binary (1 = Married, 0 = Otherwise)	0.81	0.40
Household size	The total number of dependents	Continuous	6.77	2.83
Age	Age of the farmer in years	Continuous	44.21	12.89
Education	Years of formal education	Continuous	5.97	5.14
FBO	Member of a farmer group	Binary (1 = Yes, 0 = No)	0.62	0.49
Political Affiliation	Member of a political party	Binary (1 = Yes, 0 = No)	0.47	0.50
Farming experience	Years of farming	Continuous	19.08	11.64
Extension contact	Contact with an extension agent in the previous season	Binary (1 = Yes, 0 = No)	0.44	0.50
Extension frequency	Number of contact with extension agents in the previous season	Continuous	1.12	1.58
Farm income	Annual farm income (GH¢)	Continuous	4479.37	8249.21
Total farmland	Farmers' total landholding (acres)	Continuous	5.58	3.79
Rice farm size	Size of rice farm (acres)	Continuous	2.38	1.49
Off-farm work	Engaged in an off-farm work	Binary (1 = Yes, 0 = No)	0.22	0.42
Contract farming	Engaged in contract farming	Binary (1 = Yes, 0 = No)	0.12	0.32
Interest rate	High-interest rates hinder the demand for credit	Likert Scale (5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree)	0.71	0.32
Water user fees	Amount paid as water user fee in the previous season (GH¢)	Continuous	294.94	338.23

Note(s): 1 US$ = GH¢ 7.39
Source(s): Author's own creation/work

This suggests that irrigated rice farmers are aged, which can affect their productivity and influence their intention to seek credit. Averagely, the farmers have six years of formal education. Possessing some level of education improves farmers' knowledge and understanding of credit facilities. In addition, the average number of people in a household was 7. The average farming experience is 19 years. Considerable years of farming will inform farmers' decision-making in their venture. On average, farmers have a total landholding of 6 acres. Moreover, the average rice farm size was 2 acres. This suggests that most of the farmers interviewed are smallholders. The mean annual farm income is GH¢ 4479 (US$ 606), while the average amount farmers borrow is GH¢ 313 (US$ 42). In addition, the average water user fee paid by the farmers is GH¢ 295 (US$ 40). Further, most farmers (77%) were males. It is not surprising because males have more access to resources, including land, than females in Africa (Kariuki *et al.*, 2023) and Ghana, especially in the Northern region, due to the patrilineal inheritance practised (Nyantakyi-Frimpong and Bezner Kerr, 2017; Bannor *et al.*, 2020; GSS, 2014). Approximately 62% of the farmers belong to a farmer group. In addition, only 44% of the farmers had access to extension agents. Also, most (81%) of the farmers are married, while the remaining are either single, divorced or widows. Further, most (75%) of the sampled farmers did not access credit. Access to credit by farmers is very challenging, which could explain why most farmers did not obtain credit (Wongnaa *et al.*, 2022; Twumasi *et al.*, 2020). Again, 53% of the farmers attested that they are not affiliated with any political party in Ghana. The results indicate that very few (12%) farmers were engaged in contract farming. Similarly, Bidzakin *et al.* (2020) highlighted that there are more non-contract irrigated rice farmers in Northern Ghana. Most (78%) farmers were not involved in any off-farm activity.

3. Results and discussion

3.1 Determinants of credit access and intensity of borrowing by irrigated rice farmers

Table 2 presents the determinants of farmers' credit uptake and the amount borrowed. The table indicates that the calculated likelihood ratio test statistic ($\lambda = 493.92$) is greater than the chi-square degree of free at a 1% significant level ($X^2 = 33.41$). As such, the two-stage estimation approach fits our data well. In addition, the Inverse Mills Ratio from the Heckman model is insignificant (p-value $= 0.763$), implying that the Cragg double hurdle is more appropriate than the Heckman model. Notwithstanding, the output of Tobit, Cragg's double hurdle and Heckman's two stages are presented for comparison and robustness check. However, the results of Cragg's double hurdle are discussed for brevity. Following up on the argument by Bannor *et al.* (2022), the multicollinearity test among the continuous explanatory variables used in the regression was computed using the variance inflation factor (VIF). The results are presented in Appendix. The result revealed the absence of multicollinearity since the mean VIF (1.63) was less than 10. Moreover, the results indicate that seven variables significantly explain farmers' access to credit, while six influence the amount of credit borrowed. Specifically, gender, age, years of farming, total landholding, rice farm size, participation in off-farm work and contract farming are the significant factors that explain farmers' decision to utilize credit. Also, gender, age, years of farming, the number of extension contact, rice farm size and contract farming explain the intensity of borrowing.

Inferring from the table, gender jointly explains farmers' decision to use credit and borrowing intensity. Thus, the decision to borrow and the amount borrowed are negatively associated with their gender. This means that males are unlikely to use credit and receive a high amount relative to females. Likewise, Kumar *et al.* (2021) reported that male farmers are unlikely to take credit. However, this finding contradicts other studies (Embaye *et al.*, 2018; Dubbert, 2019; Mamuye, 2021). Credit is often claimed to be more accessible by males than females, but this study uncovered otherwise. Exploratory explanations from respondents indicate that males are more resource-endowed than females, as confirmed

Variable	Model 1 Tobit model		Model 2: Cragg double hurdle				Model 3: Heckman selection model			
			Probit		Truncated		Probit		OLS	
	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E
Gender	−154.61	*90.14	−0.36	**0.17	−154.61	*90.14	−0.36	**0.17	1285.63	5043.20
Marital status	−35.89	101.17	−0.05	0.17	−35.89	101.17	−0.05	0.17	111.84	1266.04
Household size	2.62	12.39	0.02	0.02	2.62	12.39	0.02	0.02	−74.20	358.09
Age	−11.52	***3.87	−0.03	***0.01	−11.52	***3.87	−0.03	***0.01	131.61	441.08
Education	−5.87	8.05	−0.02	0.01	−5.87	8.05	−0.02	0.02	82.30	264.48
FBO	7.89	66.21	0.02	0.15	7.89	66.21	0.02	0.15	83.30	954.99
Party affiliation	108.46	68.24	0.09	0.13	108.46	68.24	0.09	0.14	−215.64	1574.83
Farming experience	6.87	*3.60	0.02	**0.01	6.87	*3.60	0.02	**0.01	−84.58	272.88
Extension contact	−204.01	135.19	0.24	0.21	−204.01	135.19	0.24	0.22	−1955.95	3573.73
Extension frequency	122.91	**59.15	0.00	0.07	122.91	**59.15	−0.00	0.07	465.54	454.13
Farm income	0.00	0.01	−0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.09
Total landholding	−19.65	13.53	−0.04	*0.03	−19.65	13.53	−0.04	0.03	173.59	582.50
Rice farm size	139.01	**56.40	0.17	**0.06	139.01	**56.40	0.17	**0.06	−526.53	2357.44
Off-farm work	−53.67	77.43	−0.28	*0.17	−53.67	77.43	−0.28	*0.17	1269.34	4047.19
Contract farming	292.41	**130.54	0.60	***0.19	292.41	**130.54	0.60	***0.20	−2255.44	7798.45
Interest rate	−135.59	121.94	−0.33	0.22	−135.59	121.94	−0.33	0.21	1036.14	4656.45
Water user fee	0.01	0.12	−0.00	0.00	0.01	0.12	−0.00	0.00	1.75	3.97
Constant	583.64	***216.27	0.56	0.39	583.64	***216.27	0.56	0.41	2659.94	7433.98
Log-likelihood	−3812.55		−246.96		−3812.55					
F(17, 460)	2.66									
Prob > F	0.00									
Wald χ²(17)			50.22		45.23		3.16			
Prob > χ²			0.00		0.00		1.00			
Pseudo R²			0.09							
λ	0.01									
X² (17) at 1%	493.92									
	33.41									
p-value (IMR)	0.763									

Note(s): *, **, *** denotes significance at 10%, 5 and 1%, respectively. λ represent the likelihood test statistic, X² denotes the degree of freedom of the explanatory variables at 1% significant level. IMR denotes the Inverse Mills Ratio

Source(s): Author's own creation/work

Table 2.
Determinants of credit access and intensity of participation

by earlier studies (Nyantakyi-Frimpong and Bezner Kerr, 2017; Bannor et al., 2020). As such, they are less likely to face financial challenges than females. Also, it was asserted that females are primarily in groups like the Village Savings and Loans Associations (VSLA) that extend credit to its members (Bannor et al., 2020). Further interaction with a female farmer group revealed that credit providers have an unpleasant experience with males in their community. They asserted that they took credit from a lender, and the repayment was higher for females than males. Since then, credit providers have preferred extending credit to females than males in the community. Likewise, Anang et al. (2015) acknowledged that relatively, women have higher loan repayment rates giving them more access to credit than males in Northern Ghana.

In addition, age explains the decision to borrow and the amount borrowed. Thus, farmers' age is negatively associated with their decision to borrow and the amount received. This demonstrates that a unit increase in farmers' age decreases their likelihood to borrow and the amount borrowed. It is suggested that elderly farmers are less inclined to participate in loan programs since they may not have the energy to operate productively on their farms to repay loans. In addition, even if these farmers may borrow, they will demand smaller amounts they can afford to repay. The finding from Isitor et al. (2014) is in tandem with these results. However, other studies have reported contradictory findings (Denkyirah et al., 2016; Mamuye, 2021; Wongnaa et al., 2022). These studies argue that aged farmers are usually capital constrained, and they are those who require credit to support their production activities.

Also, years of farming is significant and positively explain the joint decision to use credit and borrow more. This means that an increase in years of farming increases farmers' likelihood of obtaining credit and borrowing more. The adage "experience is the best teacher" explains that farmers with relevant years of experience are informed about decision-making in their venture. They understand the requirement for obtaining credit and might have established connections with lenders. This increases their probability of getting credit. Again, their long-term relationship with credit providers informs their ability to borrow more. In addition, lenders are mostly interested in farmers with enough working experience to ensure they understand their venture and can invest the credit judiciously. Thus, adequate farming experience gives the assurance that farmers can successfully manoeuvre through the production process and repay their loans. This finding is in tandem with earlier studies (Twumasi et al., 2020; Chandio et al., 2020; Acheampong et al., 2022). The results demonstrate that a unit increase in total farm size decreases farmers' likelihood of credit uptake. Similarly, Twumasi et al. (2020) discovered that farm size negatively affects farmers' credit access. Nonetheless, total farm size was expected to trigger credit uptake, as found by an earlier study (Kumar et al., 2021). Thus, the capital required for farming is assumed to increase when the farm size expands. However, exploratory interrogation with farmers revealed that millet, maize, groundnut, and other indigenous vegetables need relatively less capital besides the rice fields requiring colossal investment. As such, owning large farmland outside the irrigation field does not necessarily warrant huge investment to trigger credit demand.

Conversely, increasing rice farm size increases farmers' odds of obtaining credit and the amount borrowed. As espoused earlier, cultivation at the irrigation scheme requires enough capital to undertake several activities. For instance, farmers with large acreages pay huge water user fees and vice versa. These same farmers require capital to undertake bonding, nursing, transplanting, field preparation, harvesting and threshing, which cost more than those with pieces of rice land. Therefore, it is not surprising that an increase in acreages of rice cultivation at the irrigation scheme increases both the likelihood of obtaining credit and the amount borrowed. Again, the results show that engagement in off-farm work is significant and negatively associated with credit utilization. This demonstrates that farmers engaged in off-farm work are less likely to borrow. It can be explained that farmers engage in off-farm work to earn income to support their farm income. Therefore, ceteris paribus, the more a

farmer gets off-farm income from participating in off-farm employment, it decreases the likelihood of participating in credit schemes as the off-farm income can be used to support the capital requirements in the farming activities. Likewise, Anang and Yeboah (2019) contend that off-farm income negatively correlates with credit scheme participation. However, some studies found contradicting results. For instance, Cherotich *et al.* (2022) reported that off-farm activities positively affect women farmers' credit uptake. In addition, Bannor *et al.* (2019) argue that female farmers take loans from VSLA to invest in off-farm jobs.

Further, contract farming is significant and positively influences the decision to demand credit and the amount borrowed. This means that farmers engaged in contract farming are more likely to access credit and solicit a colossal amount. Expectedly, most contracts provide credit as undertakings for farmers (Bidzakin *et al.*, 2020). Thus, farmers are supported either in cash (Ruml and Parlasca, 2022) or in in-kind (Bannor and Gyekye, 2022) as part of the contractual arrangement. Therefore, the positive association between contract farming and credit uptake and the amount borrowed is tenable. Similarly, Bezabeh *et al.* (2020) disclosed that most farmers engaged in contract farming obtain more credit than non-contract farmers. Other studies agree that contract farming facilitates farmers' access to credit and the amount of credit received (Mwambi *et al.*, 2013; Abebe *et al.*, 2013).

Surprisingly, extension contact did not affect credit access or the amount borrowed. Likewise, the number of extension visits did not augment the decision to obtain credit. However, the amount borrowed was significant and positively associated with the number of extension contact. A plausible reason is farmers gain better access to information, including availability and procedures for getting loans from extension agents. Moreover, agricultural extension agents help to link formal credit sources to farmers. As such, financial institutions usually capitalize on extension agents to award farmers loans. Thus, the extension agents attest to credit providers the creditworthiness of farmers. Hence, farmers with frequent access to extension agents will likely be current on credit opportunities and have better connections to obtain huge loans. Earlier studies concur with this finding (Chandio *et al.*, 2020; Moahid and Maharjan, 2020). Aside from that, frequent extension contact infers that farmers are current with modern technologies, which demands capital for their uptake. As such, farmers are more likely to borrow a large amount of money to adopt such technologies (Auma and Mensah, 2014). The theoretical implication is that mere contact with extension agents does not induce farmers to presume that using credit provides maximum utility. However, frequent extension contact tends to orient farmers and align them with foreseeing higher satisfaction in obtaining huge credits.

3.2 The moderating role of extension service on credit utilization and amount borrowed

Table 3 presents the output from the moderation analysis. The model diagnostic revealed that our model is fit to various specifications. Thus, the RMSEA value is 0.00, SRMR is 0.00, and the TLI and CFI values are 1.00 each. This indicates that the structural model fits our data well. Variables such as years of formal education, farm income and rice farm size were included in the model as control variables. However, the explanatory variable considered is access to credit, whiles extension contact was used as a moderator. Among the control variables, only rice farm size significantly and positively predicted farmers' amount borrowed. In addition, credit access is significant and positively influences farmers' amounts borrowed. This is plausible because farmers need access to credit facilities before deciding on the amount to borrow. Those without access to credit are not expected to borrow. Further, it is claimed that a variable is a perfect moderator if it does not influence the outcome variable, in this case, the amount borrowed. Expectedly, the effect of the moderating variable (extension contact) on the amount of credit borrowed is insignificant. Similarly, estimates from the double hurdle in Table 2 found an insignificant relationship between extension access and credit access and the amount borrowed. This means that access to extension agents does not augment farmers' tendency to borrow.

	Amount borrowed				
Variable	Estimate	Std. Error	Z-value	p-value	Std. all
Control variables					
Education	5.748	4.517	1.273	0.203	0.039
Farm income	0.003	0.005	0.685	0.494	0.035
Rice farm size	75.289	33.751	2.231	0.026**	0.147
Explanatory variable					
Credit access	913.065	118.640	7.696	0.000***	0.521
Moderator					
Extension contact	−6.710	5.347	−1.255	0.210	−0.014
Interaction term	243.557	81.465	2.990	0.003***	0.304

Note(s): *,**,*** denotes significance at 10%, 5 and 1%, respectively. Std. all means Standard deviation for all records
Source(s): Author's own creation/work

Table 3.
Moderation of extension services on credit uptake and amount borrowed

However, when extension contact interacted with access to credit, it significantly and positively affected farmers' borrowed amount. This infers that when extension agents interact with farmers who utilize credit, the odds of these farmers borrowing huge amount increases. Perhaps when farmers who have taken loans contact extension agents, they heed extension advice and subsequently adopt good agronomic practices and improved technologies. These farmers probably take up credits to practice and adopt the technologies disseminated by extension agents. As such, these technologies augment farmers to become efficient in their production and increase their ability to produce to repay their loans. Therefore, it can be concluded that farmers who had contact with extension agents and access credit took huge amounts. This revelation explains that extension contact strengthens the relationship between credit access and the amount borrowed. Studies have also uncovered the significant impact of extension services on borrowing and the intensity of borrowing (Cherotich *et al.*, 2022; Chandio *et al.*, 2020). Figure 3 presents the structural model of the moderation analysis.

## 4. Conclusion and recommendations

4.1 Conclusion
This study assessed credit utilization and the intensity of borrowing by irrigated rice farmers in the Upper East region. Further, the moderating role of extension contact on the amount borrowed was evaluated. The probit estimates revealed that gender, age, years of farming, total landholding, rice farm size, contract farming and off-farm work participation explains farmers' decision to borrow, whiles the intensity of borrowing is influenced by gender, age, years of farming, rice farm size, contract farming and frequency of extension visit as revealed in the truncated regression model. Therefore, not all factors influencing the decision to access credit jointly explain the intensity of borrowing. Moreover, the moderation analysis revealed that extension contact strengthens the association between credit access and borrowed amounts. Thus, contact with extension agents augments the rice farmers to increase the amount borrowed.

4.2 Recommendations
Implication for practice: The study uncovered that women are more likely to obtain credit than men. Therefore, there is the need to educate males on credit services. Further, extension
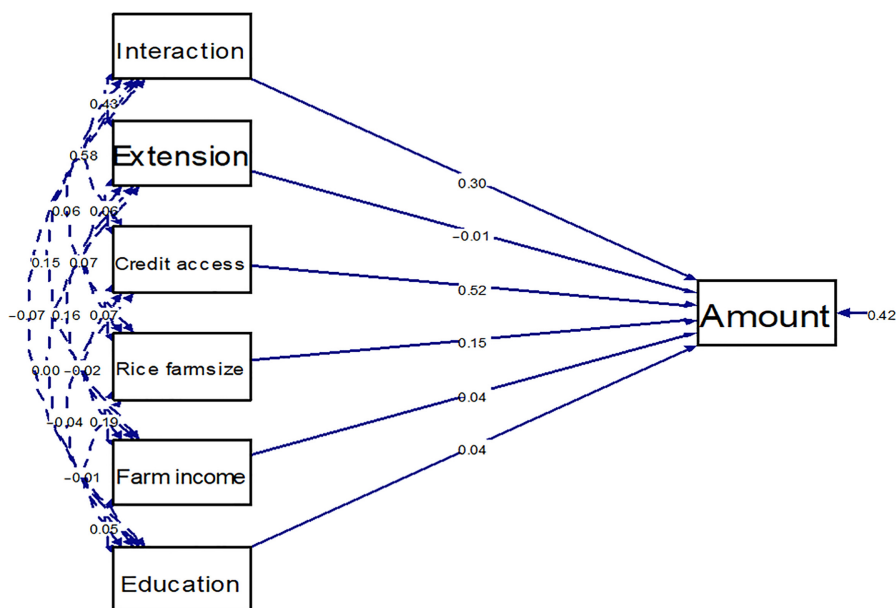
Figure 3.
Structural model of the
moderation analysis

Source(s): Author's own creation/work

agents should improve their service since it can moderate farmers to increase the amount borrowed. Banks and other lenders should also target farmers with large rice farms in the irrigation scheme when extending credit services since this group tends to utilize credit. Moreover, the District Department of Agriculture and the Regional Agricultural Development Unit (RADU) should encourage financial literacy by training extension officers on the sources, interest rates and other relevant credit issues to educate farmers on the same given their moderating role in the amount. Banks can also collaborate with the District Department of Agriculture and RADU to educate farmers. National projects and other out-grower schemes that give in-kind cash credit can use the extension officers to front the credit facilities, given that contract farming stimulates credit utilization.

Implication for Policy: Through the Agricultural Development Bank (ADB), the government should develop strategies or policies to make credit accessible to aged and smallholder rice farmers since these farmers are unlikely to obtain credit. Extension contact plays a significant moderating role in the amount borrowed by farmers. As such, the government, through the District Department of Agriculture and RADU, should invest in extension delivery through capacity building, logistics and incentives for extension agents to augment their work.

Theoretical implication: The utility maximization theory, which contends that farmers will contact extension agents provided their services will warrant credit access and improve the amount borrowed, is confirmed in this study.

Further studies: Subsequent studies should look into sources of credit available to the farmers in the study area and determine the factors influencing farmers' choice of a credit source. In addition, there is the need for qualitative investigation to unravel why water user fees do not affect credit uptake.

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Appendix

Variable	Variance inflation factor (VIF)	1/VIF
Age	2.28	0.438
Level of education	1.21	0.830
Household size	1.04	0.965
Farming experience	2.20	0.454
Extension frequency	1.07	0.935
Total farm size	2.33	0.429
Rice farm size	2.06	0.485
Annual farm income (GHc)	1.18	0.848
Water user fees (GHc)	1.32	0.758
Mean VIF	*1.63*	
Source(s): Author's own creation/work		

Table A1.
Multicollinearity test of continuous explanatory variables used in the analysis

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