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Choice of Agri-credit Source among Cavendish Banana Farmers: Evidence from Southern Philippines

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Abstract

The Cavendish banana industry presents various opportunities for the Philippine agricultural sector; however, the threats of high development, production, and maintenance costs and the persisting Fusarium Wilt issue impede farmers from harnessing these opportunities. With the high production cost, agricultural credit becomes the fastest solution to sustain production. This study examines the factors affecting the choice of agri-credit source of smallholder Cavendish banana farmers in the Philippines. Using a multinomial regression model, survey data from 187 Cavendish banana farmers in Davao del Norte, Philippines, were analyzed to determine the factors influencing the choice of credit source. The credit sources were classified as categorical variables with 'no credit' as the base outcome. Results showed that factors such as education, contract arrangement, and level of barangay infrastructure significantly affected the choice of credit source of the farmers. Key findings also show that farmers who loaned from formal sources had higher output and farm incomes than those who had no credit and those who loaned from informal credit. The results can potentially aid the government in crafting policies and interventions relating to improved access to formal credit. Very few studies have explored the credit choice of farmers in the context of an important export commodity such as the Cavendish banana industry. As such, this study can add to the body of knowledge on agricultural finance, especially in the context of an export industry.

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The choice of agricultural credit source affects the welfare of farmers, especially in input-intensive production systems like the Cavendish banana. Informal credit sources could be highly accessible yet exploitative due to high interest rates. Meanwhile, formal sources could be less accessible due to strict documentary requirements to qualify for a loan. Hence, it is important to understand the drivers behind the choice of agri-credit sources to create interventions that could potentially help farmers improve their welfare through fair capitalization.

Cavendish banana is a significant commodity in the global trade market. Global export volume in 2023 reached over 19.2 million metric tons. Among Asian exporters, the Philippines contributes around 60 percent of Asian shipments (Food and Agriculture Organization of the United Nations, 2023). Despite these numbers, production has been affected by several factors, which led to drastic declines in previous years and led the Philippines to slide down the ranks of top exporters globally (Food and Agriculture Organization [FAO], 2017; FAO, 2018a).

From 2018 until 2021, the Philippines regained and maintained its spot as the second largest exporter of Cavendish bananas worldwide behind Ecuador (FAO, 2018b; FAO, 2023). However, in recent years, particularly from 2022 to 2023, Guatemala has outranked the Philippines, falling to the third spot of top exporters (FAO, 2023). Poor productivity from severe damages caused by the spread of Fusarium Wilt Tropical Race 4 (TR4) has made farm management more challenging and costly, affecting banana growers, especially smallholder farmers. For one, the cost of production of Cavendish banana remains high, going up to almost PHP 500,000.00 per hectare annually. Further, the management and abatement of the rapid spread of plant diseases, such as fusarium wilt, along with the adverse effects of climate variabilities, have increased production costs. As such, farmers may still earn lower incomes despite the high demand for fresh bananas and the presence of established markets. Lower incomes from poor productivity lessen their capacity to protect their farms from various production threats, leading to a further decrease in the potential production levels. Agricultural credit becomes one of the fastest solutions to address this gap to help sustain production and invest in production inputs.

Credit is considered one of the critical inputs in agriculture (Abedullah et al., 2009; Iftikhar & Mahmood, 2017; Kumar, Singh, & Kumar, 2007; Kumar, Singh, & Sinha, 2010). It is important in alleviating capital constraints of agricultural households, especially in procuring needed agricultural inputs as well as adopting agricultural technologies to improve productivity (Abdallah, 2016; Adekanye, 1983; Barslund & Tarp, 2008; Diagne, Zeller, & Sharma, 2000). Diagne et al. (2000) further suggest that farmers with access to credit have higher risk-bearing capacities, which makes them more willing to adopt risky but promising technologies. Since credit access enables better procurement of good quality agricultural inputs, it is also associated with output and income improvement. Abdallah, Ayamga, & Awuni (2018) showed access to agricultural credit to have a positive and significant impact on the household incomes of farmers. The study by Girma (2022) highlighted that access to agricultural credit was significant in augmenting the financial constraints that impede the adoption of agricultural technology, such as using conservation practices, adopting modern and high-yielding varieties, and other ICT innovations. Also, Awotide et al. (2015) and Rashid (2021) suggested that credit access positively impacts productivity since farmers who chose to obtain credit had higher productivity levels.

Agricultural credit can be sourced from formal and informal sectors. According to Adekanye (1983), **formal sources** have standardized operating procedures and loan terms. Meanwhile, **informal sources** have interest rates, lending procedures, and security requirements that are not standardized, and transactions are usually private. Government credit institutions and banks, including rural banks, are considered formal sources, while friends, relatives, produce buyers, traders, and unregistered money lenders are considered informal sources (Adekanye, 1983). Access to credit can potentially

help address financial constraints faced by farmers. However, some credit sources are not always accessible and affordable, and some can be exploitative.

The formal sector can be considered a more reliable source of credit due to its standardized procedures and loan terms. However, access to these formal credit sources may be limited due to stringent requirements such as collateral and good credit standing. Moreover, most financial institutions, such as commercial banks, associate smallholder farmers with high risks due to the variable nature of their incomes and their vulnerability to external shocks (Adekanye, 1983; Geron, Llanto, & Badiola, 2016). Informal credit may be more accessible to smallholders, especially in remote areas, because of formal credit institutions' stricter institutional requirements and lack of presence in rural communities. Informal lenders are also observed to be more flexible in terms of providing loans (Castellani, 2014). Kumar et al. (2007), however, suggest that informal credit is exploitative due to high interest rates. Other studies have also shown similar findings on the inclination of informal credit sources to charge very high interest rates (Adekanye, 1983; Castellani, 2014; Doan, Gibson, & Holmes, 2010).

In the Philippines, agricultural credit has played an important role in the development of the agriculture sector (Llanto, 1993). Inadequate access to finance is considered a major constraint for smallholder farmers. Moreover, many rural households and smallholder farmers lack access to reliable and affordable sources of finance for agricultural and other livelihood activities (Geron et al., 2016). Considering the importance of agriculture in the country's economy, various credit programs have been crafted and implemented to help address the financial constraints experienced by farmers.

In 1986, the Agricultural Credit Policy Council (ACPC) was created to assist the Department of Agriculture (DA) in synchronizing credit policies and programs of the department. Various credit programs exist, such as the Production Loan Easy Access (PLEA) and the Agrarian Production Credit Program (APCP). The Agri-Agra Reform Credit Act of 2009 (RA 10000) was also implemented with the hopes of providing farmers with agriculture and agrarian reform credit and financing systems through banking institutions. Through the Agri-Agra Credit Act, all banking institutions, whether government or private, are required to set aside at least 25 percent of their loanable funds for the agriculture and fisheries sector, with 10 percent of which is made available for agrarian reform beneficiaries (Congress of the Philippines, 2009).

From this development in the credit landscape in the country, the common sources of credit for smallholders include informal creditors such as trade-financiers and agro-input suppliers; and formal lenders, which include banks, microfinance institutions (MFIs), and cooperatives. Banks and cooperatives are typical conduits of government programs on lending, as previously discussed. For instance, the Land Bank of the Philippines (LBP) has lending centers that serve these small farmers and fishers and cater to individuals who manage less than five hectares of land. However, some loan instruments in partnership with government agencies would require the farmer to be registered within the Registry System on Basic Sectors in Agriculture (RSBSA). Most farmers who are not frequent recipients of extension services tend to be unregistered in the RSBSA. LBP sets the payment term depending on the crop. For the case of bananas, staggered payments are made as soon as the farm yields its harvest. Rural banks also contribute to the provision of credit to smallholders. Similarly, agricultural or multipurpose cooperatives have various lending programs designed for farmers. This would require farmers to acquire membership from the cooperative at a minimal fee and put in a certain amount as share capital; the amount varies across cooperatives. Finally, MFIs also offer lending products to farmers, which offer credit at flexible payment terms, depending on the institution (Bayudan-Dacuycuy et al., 2020).

Despite the variety of lending products offered by different institutions, loans from Philippine

banks have remained below this threshold mandated by law as banks prefer to pay penalties rather than lend to farmers (Agcaoili, 2020). As such, the informal credit sector still thrives among rural communities despite the various government programs. Some reasons include the flexibility of payment terms, lack of documentary requirements, negotiable amounts for amortization and collateral, and accessibility of lenders (Bayudan-Dacuycuy et al., 2020).

Given the implications of various credit sources, exploring the reasons for choosing a specific source over another becomes relevant. As such, this study aims to identify the factors affecting the choice of agricultural credit source of Cavendish banana farmers. Many studies have proven that credit sources improved farm profit and production. Hence, this study also aims to determine how credit impacts the farm output and farm income of Cavendish banana farmers. A number of studies have explored the factors affecting the choice of credit source of farmers (Barslund & Tarp, 2008; Doan et al., 2010; Kumar et al., 2007; Pal, 2002; Pal & Laha, 2015). However, to the knowledge of the researchers, no study has been done to examine the factors affecting the choice of credit source of Cavendish banana farmers in Santo Tomas (Sto. Tomas hereafter), Davao del Norte in Southern Philippines, Sto. Tomas has made a significant contribution to the production of Cavendish bananas in the country with the presence of different stakeholders such as farmers, buyers/exporters, and even multinational companies. Key findings from this study may be used as a reference by other locations producing cavendish bananas and other export commodities. Moreover, the effect of factors such as contract arrangement (Mamba, 2016) and infrastructure level on the choice of agricultural credit source is unexplored. Hence, this study incorporates these variables in the analysis. Key findings on these variables can also be used as a reference in industries with similar grower-buyer structures.

Examining the distinguished characteristics of farmers borrowing from a source of credit can help understand the reasons for choosing one source as opposed to the other. Furthermore, the results of this study can potentially help in the re-assessment and re-orientation of credit policies and programs to make them more accessible and beneficial for farmers.

Materials and Methods

This study employed a multinomial regression method to model the likelihood of the cavendish banana farmers in Sto. Tomas, Davao del Norte, in choosing a source of credit vis-à-vis not availing of any lending product. It was hypothesized that socio-demographics, farm characteristics, infrastructure, membership in cooperatives, and contractual arrangements could affect farmers' choices.

Study Area

Cavendish banana production is highly concentrated on the island of Mindanao, which is located in the south of the Philippines. Mindanao produced 99 percent of the country's cavendish banana production in 2023 (PSA - OpenSTAT, 2024a). Over 82,000 hectares of land were planted with Cavendish bananas in 2023 (PSA - OpenSTAT, 2024b). The industry provides full-time jobs to approximately 183,000 people in Mindanao (World Bank, 2015), thus implying the importance of the industry to the island of Mindanao. Among its regions, the Davao Region or Region 11 is the largest producer, accounting for around 52 percent of the national production, with the province of Davao del Norte contributing 56 percent of the total regional production (PSA - OpenSTAT, 2024). A total of 32,561 hectares of Cavendish bananas were planted in the province (Provincial Agriculturist's Office, 2016). Among the cities/municipalities in the province, Sto. Tomas covers the largest production area of over 10,000 hectares (Provincial Agriculturist's Office, 2016). Various grower-buyer arrangements are also present in Sto Tomas, which include contract farming, independent farming (non-contract), growership under cooperatives, and lease/leaseback arrangements with multinational companies exporting bananas (Loquias et al., 2022). Considering these numbers, the first-class municipality of Sto. Tomas was found to be a highly suitable study area for exploring the credit choices of Cavendish

banana farmers. Moreover, since this study also explored the potential effects of contracts in the agri-credit choice of farmers, the presence of the different grower-buyer arrangements further justifies conducting the study in Sto. Tomas, Davao del Norte.

Materials and Sampling

Data used in this study is from a 2012 World Bank household survey among Cavendish banana farmers in Sto. Tomas, Davao del Norte. There were efforts to gather more recent survey data. However, some important information was missing, which caused inaccuracies. Due to the unavailability of more recent quality data, the 2012 World Bank household survey was used. A list of Cavendish banana farmers was obtained from the Municipal Agriculturist's Office, and respondents were determined through a simple random sampling. The sample size was determined using the Cochran's Formula below:

$$n_0 = \frac{z^2 pq}{e^2} \qquad \text{(Equation 1)}$$

where: Z = *z-value*; p = *percentage picking a choice*; q = *1-p*; and e = *confidence interval in decimal form*. The confidence level and confidence interval used were 95% and at least 7%, respectively, which has a z-value of 1.96. For general accuracy, 50% (0.5) was used for p. The ideal sample size determined through Cochran's formula was 196. Hence, the survey included 200 farming households, but only a total of 187 samples were used for analysis after the outliers were identified. The data were collected from December 2012 until February 2013, but the information acquired was for the 2012 annual production. A software called STATA was used to analyze the factors affecting the agri-credit choice of the farmers.

Multinomial Logistics Regression Model

To determine the factors affecting the choice of credit source of Cavendish banana farmers, a multinomial logit model (MNL) was applied in the study using the variables summarized in Table 1. A multinomial logit model is used in cases where a dependent variable has more than two categories (Lesschen, Verburg, & Staal, 2005). In this model, the dependent variable is categorical, and each category is compared to a base or reference category (Kumar et al., 2007; Lesschen et al., 2005). As adopted from Digal and Placencia (2019), the multinomial logit model can be specified as follows:

$$p(y = j|x) = \frac{exp(x\beta j)}{1+\Sigma_{h=1}^{J} exp(x\beta h)}, j=1, ..., J \qquad \text{(Equation 2)}$$

In this study, an MNL model predicts the probability that a farmer will choose to loan from one specific source of credit by assessing the effects of farm and farm household characteristics on the choice of credit source (Digal & Placencia, 2019). While the MNL model provides information on the direction and magnitude of the relationship between a predictor and the dependent variable, it does not give information on precise changes in the predicted probabilities (Wulff, 2015). As such, marginal effects are computed to make more sense of the results of an MNL model. Based on Digal and Placencia (2019) and Wulff (2015), the marginal effects can be shown by:

$$\frac{\partial P(y=j|x)}{\partial x_k} = P(y=j|x)\left[\beta_{jk} - \frac{\Sigma_{h=1}^{J} \beta_{hk} exp(x\beta h)}{1+\Sigma_{h=1}^{J} exp(x\beta h)}\right] \qquad \text{(Equation 3)}$$

Table 1

Summary of Variables Used in the Multinomial Regression Model, Sto. Tomas, Davao del Norte (2012)

Variables	Definition	Measurement	Source
Y_i	Agricultural Credit Source	= 0 if farmer did not avail of credit = 1 if farmer loans from formal credit = 2 if farmer loans from informal credit	Kumar et al. (2007)
X_1	Age	= age of farmer in years	Ping, Xiaosong, & Jinzhao (2022)
X_2	Education	= highest educational attainment of farmer	Rashid (2021)
X_3	Sex	= 1 if farmer is male = 0 if farmer is female	Boltana et al. (2023)
X_4	Household Size	= number of household members	Mohamed & Haji (2017)
X_5	Farming Experience	= number of years in Cavendish banana farming	Chandio et al. (2021)
X_6	Farm Size	= productive farm area in hectares (ha)	Chandio et al. (2021)
X_7	Level of Barangay Infrastructure	= 1 if barangay infrastructure is good = 0 if barangay infrastructure is poor	Setboonsarng (2008), Chandio et al. (2021)
X_8	Cooperative or Group Membership	= 1 if farmer is a cooperative member = 0 if otherwise	Bayudan-Dacuycuy (2020)
X_9	Contract Arrangement	= 1 if farmer is under contract growing = 0 if otherwise	Bayudan-Dacuycuy (2020)

Similar to Kumar et al. (2007), this study considered three credit choices: (1) no credit, (2) formal credit, and (3) informal credit. The data used for this study did not cover farmers who were loaned from both formal and informal credit. Only the three categories for the dependent variables were considered.

The selected base outcome for the model was "no credit" to provide a comparison of which factors affect the farmers' choice of credit source. Using no credit as a base outcome may provide insights into how important credit availability and accessibility are to farm households. A farmer has no credit when he/she uses their own money for capital in Cavendish banana production. Formal credit in this study includes commercial banks, rural banks, government-owned banks, cooperatives, and agribusiness companies. Meanwhile, informal credit includes rotating savings and informal moneylenders such as traders, other farmers, friends, and relatives (Adams & Nazarea-Sandoval, 1992; Llanto, 1993).

Ethical Considerations

The dataset was acquired from the Rural Connectivity project funded by the World Bank, where appropriate approvals were obtained for using the existing database. Ethical considerations in handling the data includes treating information with utmost confidentiality. Further, the analysis did not reflect any identifiable information that can be traced to the individual respondents. It was also ensured that digital database copies were only accessible to authorized researchers.

Results and Discussion

The results of the estimation using multinomial regression showed that education, contractual arrangement, and level of infrastructure quality are significant determinants of credit choice. The detailed discussions are shown in this section.

Descriptive Statistics

Results show that the majority of the Cavendish banana farmers availed loans for capital (62 percent), while 38 percent used their own money for capital. More specifically, 46.5 percent availed of loans from formal credit, while only 15.5 percent used informal credit sources such as traders, moneylenders, relatives, and other farmers.

Table 2 shows the mean values of key variables across credit sources. The results show that, on average, farmers who loaned from formal credit sources are relatively older than those who loaned from informal credit and had no credit. Farmers across all sources have an average farming experience of 14 years. In terms of production costs, farmers who loaned from formal credit had higher costs than those who loaned from informal credit and had no credit. However, there is a small difference between the production cost of farmers in formal and informal credit. Farmers who had loaned from formal sources also had higher profits of 2,405.00 USD compared to the negative profits of those who loaned from informal credit and those who had no credit. These farmers also had higher farm output. Farmers with formal credit produced 3,411 boxes of Cavendish bananas, while farmers with informal credit and no credit produced 2,818 and 2,988 boxes, respectively. From these values, the access to formal credit potentially leads to higher profit and higher production for the respondents. Farmers with access to credit may be able to purchase all appropriate inputs for optimal production, hence, the higher farm output than those who only used their money for capital.

Table 2

Descriptive Statistics of Variables across Credit Sources in Sto. Tomas, Davao del Norte, Philippines (2012)

Variables	No Credit		Formal		Informal	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age[a]	55	12.26	57	12.08	52.83	13.19
Household Size	5	2.94	5	2.31	5	2.25
Farm Experience[a]	14.5	9.39	14.14	10.73	14.44	10.68
Farm Size[b]	2.39	3.80	2.71	4.64	2.29	1.65
Production Cost[c]	6,526	1,583	6,757	1,287	6,753	1,306
Net Profit[c]	(704)	3,314	2,405	3,555	(889)	3,220
Farm Output[d]	2,988	922.07	3,411	1,161	2,818	756
Interest Rate[e]	-	-	8.83	6.68	9.63	8.56

[a]years, [b]hectares, [c]USD/hectare (annual), [d]boxes/hectare (annual boxes without rejects), [e]percentage (annual)

In terms of education, more high school graduates prefer loans from formal credit sources, while more college graduates use their own money for capital, as depicted in Table 3. Meanwhile, farmers who loaned from informal credit sources consist more of elementary and college undergraduates.

Most farmers from barangays with good infrastructure had informal credit and no credit. More than half of those who loaned from informal credit and those who did not have loans were from good infrastructure barangays. On the contrary, 59 percent of the farmers with formal credit came from barangays with poor infrastructure, while 41 percent came from barangays with good infrastructure. Results also show that cooperative members either avail of formal credit or forego the use of credit services. Additionally, between no credit and formal credit, more members avail of the latter. As seen in Table 3, none of the farmers with informal credit were cooperative members. Contract farmers also appear to prefer formal credit, as shown by the fact that 93 percent of the farmers with formal credit were under contract.

Table 3

Percentage Distribution of Credit Source by the Respective Variables in Sto. Tomas, Davao del Norte, Philippines (2012)

Variable	No Credit (%)	Formal (%)	Informal (%)
Gender			
Male	74	69	59
Female	26	31	31
Education			
Elementary Level	6	8	4
Elementary Graduate	9	20	29
High School Level	14	14	3
High School Graduate	24	39	14
College Level	11	13	29
College Graduate	36	6	21
Level of Barangay Infrastructure			
Good	51	41	59
Poor	49	59	41
Coop or Group Membership			
Member	24	39	0
Non-member	76	61	100
Contract Arrangement			
Contract	51	93	66
Non-contract	49	7	34

Factors affecting the choice of agri-credit source for farmers

The factors affecting the choice of agri-credit source were identified using a multinomial logit regression model. Before the regression, a test for multicollinearity was made to ensure that the variables were independent. The test indicates no severe multicollinearity issues among the independent variables, with the maximum variance inflation factor (VIF) value at 1.46 and the mean VIF at 1.25. With a 90 percent confidence level, the model is statistically significant with a Prob > chi2 = 0.000. As seen in Table 4, education and contractual arrangement appear to significantly affect the choice of both formal and informal agri-credit sources of farmers. Meanwhile, the quality of infrastructure significantly affected the choice of formal credit source. These variables and the results of the estimation are further discussed below.

Table 4

Results of the Multinomial Regression on the Factors Affecting the Choice of Credit among Cavendish Banana Farmers in Sto. Tomas, Davao del Norte

	Formal Credit vs. No Credit				Informal vs. No Credit			
	Coef	*M.E.*	*p-value*	*Std. Err.*	*Coef*	*M.E.*	*p-value*	*Std. Err.*
Age	-0.018	-0.001	0.368	0.020	-0.033	-0.003	0.188	0.025
Education	0.296*	0.030	0.078	0.168	0.421*	0.033	0.051	0.215
Sex (1-Male, 0-Female)	-0.102	-0.005	0.837	0.492	-0.266	-0.025	0.649	0.583
Household Size	-0.014	-0.001	0.877	0.085	-0.015	-0.001	0.893	0.110
Farm Experience (years)	0.004	-0.000	0.857	0.022	0.019	0.002	0.511	0.029
Farm Size (ha)	0.017	0.008	0.724	0.048	-0.104	-0.012	0.365	0.115
Level of Barangay Infrastructure (Good-1, Poor-0)	-1.414***	-0.273	0.010	0.548	0.833	0.157	0.142	0.567
Membership to Coop/Groups	0.010	0.802	0.863	0.579	-17.368	-1.938	0.984	885.635
Contract Arrangement (Contract-1, Otherwise-0)	3.178***	0.468	0.000	0.727	1.322**	0.003	0.024	0.587
Constant	-1.816	-	0.170	1.325	-0.845	-	0.563	1.463

**Significant at 10%; ** Significant at 5%; ***Significant at 1%;*
Coef = Coefficient; M.E. = Marginal Effects; Std Err = Standard Error; Wald chi2 (22) = 3109.16;
Log likelihood = -111.029; Prob > chi2 = 0.000; Pseudo R2 = 0.263.

Education (+). The highest educational attainment of a farmer is shown to have a positive and significant effect on choosing formal and informal credit over no credit. Specifically, a higher educational level increases the probability of farmers borrowing from formal and informal credit sources than having no credit by 0.030 and 0.033 points, respectively. Almost half (46.5%) of the respondents availed of formal credit. Some of the challenges in availing of formal credit include the strict requirements on documentation, which farmers find it difficult to comply. Various agricultural credit services offered by the government also often require the farmer to be registered under the Registry System for Basic Sectors in Agriculture (RSBSA), which farmers also find challenging to facilitate by themselves. Hence, those with higher educational attainment are more likely to access and avail of loans for capital than to use their own money. More educated farmers could be more capable of understanding and managing credit.

Furthermore, more educated farmers may have more skills to acquire alternative income to pay off loans, thus making them more confident in loans, whether from formal or informal sources. Rizwan et al. (2019) alluded that lower levels of education among farmers prevented them from availing both formal and informal credit as they are challenged to comprehend various loan terms and other tedious loan procedures, especially from formal institutions. Awareness of the available agricultural credit instruments may also be achieved through education. Additionally, formal education promotes proficiency and literacy, which are associated with improving the financial management skills of those

who underwent some years of schooling (Lyons, Grable, & Zeng, 2019; Poliquit, 2006).

Contract Arrangement (+). Results show that contract farmers are more likely to take out loans for capital than use their own money. Contract farming is significant at one percent for formal credit and at a five percent significance level for informal credit. Specifically, contract farming increases the probability of sourcing from formal credit by 0.468 percentage points and informal credit by 0.003 percentage points compared to no credit. Although contracting companies choose the materials and strategies to be used, farmers are still made to pay for these items, including disease eradication (de la Cruz & Jansen, 2018). As such, contract farmers may still need to loan additional capital for their farm production. In this study, companies are included among the formal sources of credit; hence, it is understandable that contract arrangement significantly affects the choice of credit source. It is also common for buyer-led chains such as the cavendish banana sector that those under contract arrangements are frequently under trade financing. This financing is facilitated through the provision of production inputs, training, development costs for facilities, or through cash advance payments. The payments of the value financed are usually subtracted from the sales of the harvested banana (Arouna, Michler, & Lokossou, 2021; Bayudan-Dacuycuy et al., 2020).

Infrastructure Level (-). Regression results show that the infrastructure level is only significant for formal credit. Farmers in good infrastructure barangays are less likely to borrow money from formal sources. The infrastructure level decreases the probability of loaning from formal credit by 1.414. This implies that farmers in good infrastructure barangay prefer to use their own money for capital that loan from formal credit. The level of barangay infrastructure is classified as good and poor with the assistance of the local government unit of Sto. Tomas, Davao del Norte. The classification of barangays with good infrastructure is based on good road conditions, the presence of farm cables, and packing plants, among others. Farmers in these barangays may have better access to more non-farm work as an alternative income source, making borrowing less necessary. This can be corroborated by a study indicating that improved physical infrastructure, such as good-quality roads, enables the generation of non-farm and off-farm incomes for rural households (Looney, 1994). Moreover, good physical infrastructure can lead to increased agricultural production (Looney, 1994), which may provide better take-home pay for the farmers. Furthermore, the availability and access to these infrastructure facilities potentially contribute to the reduction of costs for transportation, hauling, and losses. As such, availing of a loan may be less necessary due to higher incomes and lower costs.

Additionally, farmers expressed their apprehension about availing of formal loans due to the need for collateral. Higher risks of production failure would also translate to risks in their asset ownership. Some farmers also practice pole-vaulting to avoid subtracting their credit dues from their sales.

Robustness Test

A robustness test was performed using the checkrob command of STATA. To test the sensitivity and consistency of the three significant variables, education, barangay infrastructure, and contract arrangement, resulting from the multinomial logit model, conducting a test was set to identify these variables as the core variables. The other regressor variables were identified as the test variables. Sixty-four (64) models were estimated through the test. All those models contained the core variables, while the test variables appeared 32 times across different combinations and iterations. The summary of the test results is shown in Table 5. The level of barangay infrastructure and contract arrangement were significant in all estimations ($p<0.10$). Education, on the other hand, was significant in 87.5% of the models. This implies that these three factors have consistent effects on credit choice. Moreover, the signs of the coefficients are consistent across factors where education was positive, barangay infrastructure was negative, and contract arrangement was positive in all of the estimations.

Table 5

Results of the Robustness Test for the Multinomial Logit Model on Agricultural Credit Choice among Cavendish Banana Farmers in Sto Tomas, Davao del Norte

Core Variables	Max	Min	Mean	AvgSTD	PercSig	Perc+	Perc-	AvgT	Obs
Education	0.323	0.233	0.278	0.149	0.875	1	0	1.871	64
Level of Brgy Infra	-0.799	-1.432	-1.130	0.475	1	0	1	2.363	64
Contract Arrangement	3.236	2.378	2.801	0.639	1	1	0	4.381	64

Testing Variables	Max	Min	Mean	AvgSTD	PercSig	Perc+	Perc-	AvgT	Obs
Age	-0.004	-0.018	-0.011	0.019	0	0	1	0.600	32
Sex	0.017	-0.282	-0.129	0.457	0	0.125	0.875	0.295	32
Household size	-0.005	-0.017	-0.011	0.084	0	0	1	0.125	32
Farm Experience	0.006	-0.013	-0.003	0.021	0	0.5	0.5	0.324	32
Farm Size	0.038	0.012	0.024	0.049	0	1	0	0.496	32
Coop or group membership	0.390	0.057	0.208	0.551	0	1	0	0.384	32

Note: *The columns Max, Min, Mean, and AvgSTD show the maximum, minimum, mean, and average standard deviation of the resulting parameter coefficients respectively. PercSig, Perc+, Perc- display the percentage of the time wherein the factor appeared to be significant (p<0.10), positive, and negative respectively. AvgT shows the average T-values for each factor and Obs shows the number of models wherein the factor was included.*

In addition to the robustness test, the Small-Hsiao test for independent and irrelevant alternatives (IIA) and the Wald and Likelihood Ratio (LR) test for combining alternatives were performed. Findings of the Small-Hsiao test show that each alternative category of the dependent variable is independent of other alternatives, evidenced by p-values >0.05, failing to reject the null hypothesis that odds are independent of other alternatives. Wald and LR tests for combining alternatives were employed to test if alternatives can be combined. Consistently, results for both tests show that alternatives cannot be combined since the test for combinations has p-values <0.05. Hence, we reject the null hypothesis that alternatives can be combined.

Goodness of fit tests, moreover, were employed to test the baseline model with models that omitted insignificant variables. The baseline model had the lowest Akaike and Bayesian Information Criteria, AIC = 262.058 and BIC = 321.730. The second model removed insignificant variables and had higher AIC and BIC values of 290.629 and 333.856, respectively. The difference of 12.126 in BIC strongly supports the baseline model used in this study.

Table 6

Result of the Small-Hsiao Test for the Independent and Irrelevant Alternative Assumption of Unordered Multinomial Logit Models

Alternatives	lnL(full)	lnL(omit)	chi2	df	p>chi2
No Credit	-26.885	-22.557	8.658	5	0.124
Formal Credit	-26.746	-23.638	6.216	5	0.286
Informal Credit	-37.534	-34.814	5.44	5	0.365

Ho: Odds(Outcome-J vs Outcome-K) are independent of other alternatives
Note: A significant test is evidence against Ho.

Table 7

Results of Wald and Likelihood Ratio Tests for Combining Alternatives

Combined Alternatives	Wald test for combining alternatives			LR test for combining alternatives		
	chi2	df	P>chi2	chi2	df	P>chi2
No Credit & Formal Credit	28.022	4	0.000	40.759	4	0.000
No Credit & Informal Credit	9.963	4	0.041	24.080	4	0.000
Formal & Informal Credit	13.852	4	0.008	38.472	4	0.000

Ho: All coefficients except intercepts associated with a given pair of alternatives are 0 (i.e. alternatives can be combined)
Note: A significant result is evidence against Ho.

Suspicions of endogeneity between the dependent variable and some regressors were inspected through the control function approach. This approach mimics the two stage least squares procedure for continuous dependent variables and has been described and applied by Heckman (1976), Hausman (1978), Blundell and Powell (2004), and De Grange et al. (2024). The procedure includes the first estimation of the endogenous explanatory variable (EEV), instrumented by an exogenous variable. For the second stage, the residual is included as a variable of the main model, capturing the simultaneity. Similarly, the suspected EEV for this estimation is the contract arrangement. The type of contract arrangement may influence the access of the farmer to certain credit sources, which may also affect the credit choice. This EEV is a binary variable. Hence, the estimation of the residuals will be derived from the discrete model, i.e., binary logit, as discussed by (Lewbel, 2018). The variable used to instrument the contract arrangement was the buying price of bananas per box. Results were consistent with the estimation above, with the same resulting significant variables for the outcomes, as seen in Appendices 1 and 2. Also, the introduced residuals of the control function did not appear significant, indicating any evidence of endogeneity for the suspected variable.

Conclusion

The Cavendish banana industry in the Philippines presents multiple opportunities for the

country's agricultural sector. A growing demand for bananas produced in the Philippines is observed among Middle East and East Asian countries (Department of Agriculture, 2022). However, threats to productivity persist due to the pervasive *Fusarium* issue despite the investments in innovation to prevent and control the disease. This issue also threatens the smallholder farmers as protocols for the management of this disease could get very costly; agricultural credit has become one of the solutions to sustain the production of Cavendish banana amidst various production challenges, allowing the farmers to fund more focused and timely interventions for the disease Credit can be sourced from either formal and informal sources, each of which, have various implications to the farmers. Given this, the study aimed to explore and identify the factors affecting the choice of agricultural credit source of Cavendish banana farmers and determine the impact of credit on the farm output and profit of farmers.

It was observed that comparing the output quantity and input costs of farmers across credit sources implies that formal credit has better effects on the farmers than no credit and informal credit. Farmers with formal credit had higher farm output and farm profit. Increasing access to these formal lenders and arriving at more agreeable and fair lending terms would benefit the smallholder farmers and reduce their reliance on informal lenders.

Results also show that education, contract arrangement, and level of infrastructure quality significantly affect the choice of credit source. Higher educational attainment makes more capacitated and confident farmers to understand and manage loans. Contract farming allows access to credit by deducting loans from farm incomes. Meanwhile, a good infrastructure level lessens the likelihood of borrowing from formal sources since farmers in these areas have better access to alternative incomes, which may be useful for production capital. Although membership in cooperatives did not significantly affect the choice of credit, exploring their role through organizational strengthening may also be worthwhile, similar to the findings of Benson & Faguet (2023).

Given these results, having access to credit, in general, is beneficial for the farmers. Key results show that formal credit is better than informal credit due to potentially higher profit, productivity, and relatively lower interest rates. As such, access to credit, especially from formal sources, should be improved. Hence, a need to educate and capacitate farmers toward better access to reliable credit. Some impediments to availing loans include the difficulty of complying with documentary and collateral requirements; it is necessary to develop or match these farmers with instruments that have flexible loan repayments and couple this with increased access to crop insurance as well. This shares the risk of production failure and augments the risk on farmers' asset ownership.

Although this study heavily supported the idea that formal education has an important role in farmers' choice of credit, the study by Rudeloff (2019) suggested that informal education also presents an opportunity to promote financial literacy, especially among adolescents. Hence, the capacitation of these smallholder banana-growing communities in terms of financial management skills is needed to improve their ability to avail of these loans and subsequently promote their capacity to invest in production technologies, which could promote efficiency and aid in disease management. Improving credit access for communities with less access to infrastructure facilities may also promote the welfare of farmers as availing loans may be less costly transactionally. Moreover, it is vital to make formal and reliable credit more accessible to all Cavendish banana farmers regardless of contract arrangement. The study of Kiros and Meshesha (2022) described that farmers' linkage with extension agents significantly promoted their use of formal credit. Hence, extension programs for Cavendish banana farmers must also be targeted to promote awareness, access, and facilitate availing of these formal credit instruments. Further research and understanding must be pursued to determine the fairness of lending products available to small farmers.

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Conflict of Interest Statement

We have no conflict of interest to disclose.

AI Disclosure

We declare that this manuscript was prepared without the assistance of artificial intelligence. Hence, the content of this paper is original.

References

Abdallah, A.-H. (2016). Does credit market inefficiency affect technology adoption? Evidence from sub-Saharan Africa. *Agricultural Finance Review*, *76*(4), 494-511. https://doi.org/10.1108/AFR-05-2016-0052

Abdallah, A.-H., Ayamga, M., & Awuni, J. A. (2018). Impact of agricultural credit on farm income under the Savanna and Transitional zones of Ghana. *Agricultural Finance Review*, *79*(1), 60-84. https://doi.org/10.1108/AFR-02-2018-0009

Abedullah, A., Mahmood, N., Khalid, M., & Kouser, S. (2009). The role of agricultural credit in the growth of livestock sector: A case study of Faisalabad. *Pakistan Veterinary Journal*, *29*(2), 81-84. https://tinyurl.com/355s7pkj

Adams, D. W., & Nazarea-Sandoval, V. (1992). Informal finance in a semi-rural area of the Philippines. *Savings and Development*, *16*(2), 159-168. https://tinyurl.com/2svxvvmv

Adekanye, T. O. (1983). Agricultural credit in Africa: Implications of the Nigerian experience. *Agricultural Administration*, *14*(4), 203-211. https://doi.org/10.1016/0309-586X(83)90058-4

Agcaoili, L. (2020, January 3). Agri-agra loans grow 11% to P714 billion in 9 months. *Philippine Star*. https://tinyurl.com/v3m296x3

Arouna, A., Michler, J. D., & Lokossou, J. C. (2021). Contract farming and rural transformation: Evidence from a field experiment in Benin. *Journal of Development Economics*, *151*. https://doi.org/10.1016/j.jdeveco.2021.102626

Awotide, B. A., Abdoulaye, T., Alene, A., & Manyong, V. M. (2015). Impact of access to credit on agricultural productivity: Evidence from smallholder cassava farmers in Nigeria. *International Conference of Agricultural Economists (ICAE)*, 1-34. https://doi.org/10.22004/ag.econ.210969

Barslund, M., & Tarp, F. (2008). Formal and informal rural credit in four provinces of Vietnam. *Journal of Development Studies*, *44*(4), 485-503. https://doi.org/10.1080/00220380801980798

Bayudan-Dacuycuy, C., Magno-Ballesteros, M., Kryz, L., Baje, C., & Ancheta, J. A. (2020). Towards a more sustainable financing of small farmers and fisherfolk's agricultural production. *PIDS Discussion Paper Series, No. 2020-38*. https://www.pids.gov.ph

Benson, A., & Faguet, J.-P. (2023). Increasing access to formal agricultural credit: The role of rural producer organisations. *The Journal of Development Studies*, *59*(1), 21-38. https://doi.org/10.1080/00220388.2022.2102899

Boltana, A., Tafesse, A., Belay, A., Recha, J. W., & Osano, P. (2023). Impact of credit on household food security: The case of Omo microfinance institution in southern Ethiopia. *Journal of Agriculture and Food Research*, *14*, 100903. https://doi.org/10.1016/j.jafr.2023.100903

Blundell, R. W., & Powell, J. L. (2004). Endogeneity in semiparametric binary response models. *The Review of Economic Studies*, *71*(3), 655-679. https://doi.org/10.1111/j.1467-937X.2004.00299.x

Castellani, D. (2014). Shocks and credit choice in Southern Ethiopia. *Agricultural Finance Review*, *74*(1), 87-114. https://doi.org/10.1108/AFR-04-2013-0015

Chandio, A. A., Jiang, Y., Rehman, A., Twumasi, M. A., Pathan, A. G., & Mohsin, M. (2021). Determinants of demand for credit by smallholder farmers': A farm level analysis based on survey in Sindh, Pakistan. *Journal of Asian Business and Economic Studies*, *28*(3), 225-240. https://doi.org/10.1108/JABES-01-2020-0004

Congress of the Philippines. (2009). *Agri-agra reform credit act of 2009 (Republic Act. No. 10000).*

de Grange, L., González, F., Marechal, M., & Troncoso, R. (2024). Estimating multinomial logit models with endogenous variables: Control function versus two adapted approaches. *Transportation Research Part A: Policy and Practice*, *183*, 104068. https://doi.org/10.1016/j.tra.2024.104068

de la Cruz, J., & Jansen, K. (2018). Panama disease and contract farming in the Philippines: Towards a political ecology of risk. *Journal of Agrarian Change*, *18*(2), 249-266. https://doi.org/10.1111/joac.12226

Department of Agriculture. (2022). *The Philippine banana industry roadmap 2021-2025.*

Diagne, A., Zeller, M., & Sharma, M. (2000). Empirical measurements of households' access to credit and credit constraints in developing countries: Methodological issues and evidence. In *FCND Discussion Paper No. 90.* https://tinyurl.com/3ejxytxk

Digal, L., & Placencia, S. G. (2019). Factors affecting the adoption of hybrid and high-yielding rice varieties in the Philippines. *Agricultural Research*, *9*, 1-8. https://doi.org/10.1007/s40003-019-00403-z

Doan, T., Gibson, J., & Holmes, M. (2010). What determines credit participation and credit constraints of the poor in peri-urban areas, Vietnam? https://tinyurl.com/mt6ev9eu

Food and Agriculture Organization of the United Nations (FAO). (2017). *Banana market review 2015-2016.*

Food and Agriculture Organization of the United Nations (FAO). (2018a). *Banana Market Review 2017.*

Food and Agriculture Organization of the United Nations (FAO). (2018b). *Banana market review: Preliminary results for 2018*, 1-46.

Food and Agriculture Organization of the United Nations (FAO). (2023). *Banana market review-Preliminary results 2023.*

Geron, M. P. S., Llanto, G. M., & Badiola, J. A. R. (2016). Comprehensive study on credit programs to smallholders. *PIDS Discussion Paper Series.* https://tinyurl.com/ys99cx7a

Girma, Y. (2022). Credit access and agricultural technology adoption nexus in Ethiopia: A systematic review and meta-analysis. *Journal of Agriculture and Food Research*, *10*, 100362. https://doi.org/10.1016/j.jafr.2022.100362

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, *46*(6), 1251-71. https://doi.org/10.2307/1913827

Heckman, J. J. (1976). Simultaneous equation models with both continuous and discrete and endogenous variables with and without structural shift in the equations. *In Studies in Nonlinear Estimation* (pp. 931-59).

Iftikhar, S., & Mahmood, H. Z. (2017). Ranking and relationship of agricultural credit with food security: A district level analysis. *Cogent Food and Agriculture*, *3*(1). https://doi.org/10.1080/23311932.2017.1333242

Kiros, S., & Meshesha, G. B. (2022). Factors affecting farmers' access to formal financial credit in Basona Worana District, North Showa Zone, Amhara Regional State, Ethiopia. *Cogent Economics and Finance*, *10*(1). https://doi.org/10.1080/23322039.2022.2035043

Kumar, A., Singh, D. K., & Kumar, P. (2007). Performance of rural credit and factors affecting the choice of credit sources. *Indian Journal of Agricultural Economics*, *62*(3), 297-313. https://doi.org/10.22004/ag.econ.204524

Kumar, A., Singh, K. M., & Sinha, S. (2010). Institutional credit to agriculture sector in India: Status, performance and determinants. *Agricultural Economics Research Review*, *23*(2), 253-264. https://doi.org/10.22004/ag.econ.96935

Lesschen, J. P., Verburg, P. H., & Staal, S. J. (2005). Statistical methods for analysing the spatial dimension of changes in land use and farming systems. *LUCC Report Series No.7.* https://tinyurl.com/4ecvpepa

Lewbel, A. (2018). Identification and estimation using heteroscedasticity without instruments: The binary endogenous regressor case. *Economics Letters*, *165*, 10-12. https://doi.org/10.1016/j.econlet.2018.01.003

Llanto, G. M. (1993). Agricultural credit and banking in the Philippines: Efficiency and access issues. *Philippine Institute for Development Studies*, *93*. https://tinyurl.com/3azdxewt

Looney, R. E. (1994). The impact of infrastructure on Pakistan's agricultural sector. *Journal of Developing Areas*, *28*(4), 469-86. https://tinyurl.com/3hcxmh9n

Loquias, M. P., Digal, L. N., Placencia, S. G., Astronomo, I. J. T., Orbeta, M. L. G., & Balgos, C. Q. (2022). Factors affecting participation in contract farming of smallholder Cavendish banana farmers in the Philippines. *Agricultural Research*, *11*(1), 146-54. https://doi.org/10.1007/s40003-021-00544-0

Lyons, A. C., Grable, J. E., & Zeng, T. (2019). Impacts of financial literacy on the loan decisions of financially excluded households in the People's Republic of China. In *ADBI Working Paper 923. Asian Development Bank Institute.* https://tinyurl.com/9set4bfu

Mamba, T. X. (2016). *The role of contracts in improving access to credit in the smallholder livestock sector of Swaziland* [MSc thesis in Agriculture (Agricultural Economics), University of Pretoria]. https://tinyurl.com/mwhzn3xf

Mohamed, S., & Haji, J. (2017). *Impact of productive safety net program on household food security and asset building: The case of Goro Gutu District, East Hararghe Zone of Oromia National Regional State, Ethiopia* [Postgraduate Program Directorate, Haramaya University].

Pal, D., & Laha, A. K. (2015). Sectoral credit choice in rural India. *Journal of Choice Modelling, 14*, 1-16. https://doi.org/10.1016/j.jocm.2015.03.001

Pal, S. (2002). Household sectoral choice and effective demand for rural credit in India. *Applied Economics*, *34*(14), 1743-55. https://doi.org/10.1080/00036840210121228

Philippine Statistics Authority (PSA) - OpenSTAT. (2024a). *Other crops: Volume of production by Region and by Province, by Quarter and Semester, 2010-2024.*

Philippine Statistics Authority (PSA) - OpenSTAT. (2024b). *Other crops: Area planted/harvested, by Region and by Province, by Semester, 2010-2024.*

Ping, L., Xiaosong, S., & Jinzhao, L. (2022). Research on farmers' households credit behavior and social capital acquisition. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.961862

Poliquit, L. Y. (2006). *Accessibility of rural credit among small farmers in the Philippines.*

Provincial Agriculturist's Office. (2016). *Cavendish banana production area.*

Rashid, F. N. (2021). Achieving SDGs in Tanzania: Is there a nexus between land tenure security, agricultural credits, and rice productivity? *Resources, Conservation and Recycling, 164*, 105216. https://doi.org/10.1016/j.resconrec.2020.105216

Rizwan, M., Ping, Q., Iram, S., Nazir, A., & Wang, Q. (2019). Why and for what? An evidence of agriculture credit demand among rice farmers in Pakistan. In *ADBI Working Paper 995.* Asian Development Bank Institute. https://tinyurl.com/3f5tn4bk

Rudeloff, M. (2019). The influence of informal learning opportunities on adolescents' financial literacy. *Empirical Research in Vocational Education and Training*, *11*(1). https://doi.org/10.1186/s40461-019-0086-y

Setboonsarng, S. (2008). The impact of rural infrastructure and agricultural support services on poverty: The case of agrarian reform communities in the Philippines. In *ADBI Discussion Paper 110.* Asian Development Bank Institute. https://tinyurl.com/mtu98u49

World Bank (WB). (2015). *Mindanao jobs report: Jobs value chain analysis.*

Wulff, J. N. (2015). Interpreting results from the multinomial logit model: Demonstrated by foreign market entry. *Organizational Research Methods*, *18*(2), 300-25. https://doi.org/10.1177/1094428114560024

Appendices

Appendix A

Binary Logit Model Results from the First Stage of the Control Function Approach for Binary Endogenous Regressors

Contract Arrangement	Coef.	Std. Err.	z	p-value
Price per Box	0.128 ***	0.019	6.740	0.000
Constant	-13.183 ***	2.112	-6.240	0.000

Appendix B

Results of the Second Stage Multinomial Logit Estimation Using the Control Function Approach

	Formal Credit vs. No Credit			Informal vs. No Credit			
	Coef		*p-value*	*Std. Err.*	*Coef*		*p-value*	*Std. Err.*
Age	-0.022		0.280	0.021	-0.033		0.186	0.025
Education	0.281		0.104	0.173	0.405	*	0.064	0.219
Sex (Male-1, Female-0)	-0.152		0.759	0.495	-0.226		0.701	0.588
Household Size	-0.002		0.978	0.085	-0.029		0.807	0.118
Farm Experience (years)	0.006		0.795	0.022	0.015		0.614	0.029
Farm Size (ha)	0.012		0.802	0.048	-0.106		0.372	0.119
Level of Barangay Infrastructure (Good-1, Poor-0)	-1.791	**	0.004	0.620	1.113	*	0.071	0.616
Membership to Coop/ Groups	2.781	***	0.000	0.748	1.699	***	0.010	0.664
Contract Arrangement (Contract-1, Otherwise-0)	-0.162		0.791	0.611	-18.151		0.989	1368.224
Error	-0.635		0.110	0.397	0.221		0.208	0.176
Constant	-0.989		0.477	1.391	-1.211		0.424	1.513