



Determinants of agricultural credit accessibility: A case study of sugarcane (*Saccharum officinarum*) farmers in Muzaffarnagar district

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ABSTRACT

Access to credit is an important aspect that determines agriculture productivity and financial ability of the farmers. The study was carried out during October 2023 to November 2024 to analyse the factors that influence sugarcane (*Saccharum officinarum*) farmers' access to credit in Muzaffarnagar district, Uttar Pradesh, India. For this study data were collected from 390 farmers through a semi-structured questionnaire and to analyse the data, a logistic regression model has been employed. The study examined the socio-economic, demographic, and geographical factors affecting credit accessibility among sugarcane farmers. The results showed that education, annual income, landholding and collateral availability all have a significant effect on credit accessibility. Our results draw attention to the importance of improving financial awareness, enhancing adequate collateral, and reducing institutional barriers in order to expand credit accessibility. The study provides important insights for government interventions aimed at strengthening the financial security of sugarcane producers and promoting sustainable agriculture in the region.

Keywords: Agriculture economics, Formal credit, Sugarcane farmers

Agriculture, the most important sectors of the Indian economy, contributing 18.2% in GDP and employing a large share of the workforce (Economic survey 2024). Beyond providing livelihood, agriculture drives rural economic growth. However, the sector continues to struggle with persistent challenges such as low productivity, fragmented landholdings, and inadequate capital, which constrain in overall performance (Nayyar 2023).

Among agricultural activities, sugarcane holds a vital place in India's agrarian economy. During 2023-24, the country produced about 453.1 million tonnes of sugarcane (*Saccharum officinarum* L.), of which 34 million tonnes were utilized by sugar industry (Government of India 2024, ISMA 2024). The remaining crop was utilized for alternative purpose such as jaggery, ethanol production, and other by-products. Despite the presence of fair and remunerative price mechanism, the sugarcane sector continues to face challenges like delayed payments to farmers, fluctuations in sugar prices, rising input cost, etc. (FAO 2020, Government of India 2023).

Muzaffarnagar, district in western Uttar Pradesh, is a major sugarcane producing region, significantly contributing to both, state's agrarian economy and expanding sugar industry. However, the region's farmers face persistent credit

constraints that restrict investments in modern machinery, quality inputs, and efficient irrigation systems.

Empirical studies showed that education, extension service, saving practices, collateral, and institutional proximity significantly influence farmers access to institutional credit (Kiplimo *et al.* 2015, Mensah *et al.* 2019, Kiros and Meshesha *et al.* 2022). Despite policy interventions to promote rural credit, barriers like collateral requirements, and distance from banks continue to exclude many farmers (Taremwa *et al.* 2022). Institutional factors often have greater weight than individual characteristics, through access trends to favour male-headed households (Sehgal 2024).

Against the backdrop, the present study examines the determinants of access to credit among sugarcane farmers in Muzaffarnagar district. By analysing socio-economic, demographic, and institutional variables, the study aims to identify key obstacle in accessing agricultural finance and provide evidence-based recommendations to improve financial inclusion among the region.

MATERIALS AND METHODS

The study was carried out during October 2023 to November 2024 in Muzaffarnagar (29.51°N, 77.84°E; at an elevation of 272 m amsl) district in Uttar Pradesh. The district's total area is 4008 km² it is divided into 4 Tehsils, 498 Panchayats, and 704 villages with a total cultivable area of 2,19,269 ha. Five blocks were selected purposively

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(Kukda, Jansath, Khatauli, Purquazi, and Morna) from a total of nine blocks. These blocks were chosen as they have the highest canal irrigation and significant sugarcane farming. Using simple randomly sampling a total of 15 villages were selected, 3 from each block. The Cochran sample size formula was used to determine the required sample size, resulting in a selection of 390 sugarcane farmers, 26 from each village, for the study.

Data for this study have been derived from a semi structured interview scheduled. To verify the reliability of the responses, a questionnaire including both closed-ended and open-ended question has performed.

Descriptive statistics and binary logistic regression model have been used for the analysis. Descriptive statistics provide a broad overview of the socio-economics, demographic, institutional characteristics of sugarcane farmers surveyed in Muzaffarnagar.

Logistic regression has been widely applied by researchers such as Maddala (1983), Ololade and Olagunju (2013), and Obisesan (2013) to identify the variables that affect farmers' capacity to obtain loans. When predicting whether an outcome will occur or not based on the values of a group of predictor variables, logistic regression is helpful. Though it is more appropriate for models with dichotomous dependent variables, this model is similar to a linear regression model. The dichotomous response variable $Y=1$ shows that the relevant event has happened, while $Y=0$ shows that it hasn't. Dichotomous responses are defined by the dummy variables, commonly referred to as indicators and bound variables. Given that there were only two alternatives in this investigation, (access and no access to agricultural credit) a binary model is set up, $Y=1$ for situation where the farmer accessed agricultural credit and $Y=0$ when did not access agricultural credit. Assuming that p is the likelihood that $Y=1$ in a two-probabilistic relationship and that X is a vector of explanatory factors.

$$P(Y = 1) = e^{Bx}/(1 + e^{Bx}) \quad (1)$$

$$P(Y = 0) = e^{Bx}/(1 + e^{Bx}) \quad (2)$$

$$\text{Logit} [\theta, (x)] = \frac{\log_e(x)}{1 - \theta(x)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \quad (3)$$

Logistic regression can be specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \quad (4)$$

Where Y , Access to credit (1= Access to formal credit, 0 = Otherwise), X_1 , Explanatory factors that affect the dependent variable of credit accessibility for households. β_i , Unknown parameter that shows the effect of change in variables X on Y_i which will be calculated, ϵ_{1i} , Error term, and i , Number of observations. Consequently, the logit model is described as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \epsilon \quad (4)$$

The following independent variables are listed as determinants of access to credit i.e. β_0 , Constant term; X_1 , Relation of HH head; X_2 , Religion; X_3 , Caste; X_4 , Sex of HH head; X_5 , Age of HH head; X_6 , Martial status; X_7 ,

Education; X_8 , Main occupation; X_9 , Farming experience; X_{10} , Family size; X_{11} , Annual income; X_{12} , Requirement of inputs; X_{13} , Extension contacts; X_{14} , Saving account; X_{15} , Credit awareness; X_{13} , Registered in social group; X_{17} , Training; X_{18} , Total land; X_{19} , Irrigation; X_{20} , Labour; X_{21} , Awareness of MSP; X_{22} , Bank proximity; X_{23} , Collateral; X_{24} , Interest rate (Table 1).

RESULTS AND DISCUSSION

Descriptive statistics reported in Table 2 depicts that nearly 89.5% of households reported having access to credit, which indicates a relatively high level of financial inclusion. This demonstrates that formal financial institutions are increasingly reaching farming households, although a small share (10.5%) still remains outside the system.

Education plays a vital role, with 83.08% of household's being literate, thereby strengthening the farmers ability to understand credit procedures and interact with formal institutions. Ownership of saving accounts (90.26%) reflects a strong level of integration with financial system, which can ease the credit application process. Similarly, credit awareness (87.18%) emerges as a key enabling factor, showing that information dissemination has been effective in this region. Collateral availability is high, with 80.51% of households possessing collateral assets, which significantly improves their chances of loan approval. Institutional linkages, however, remain relatively weak. Only 15.38% of household had regular extension contract, and just 10.26% were registered in social groups, suggesting asymmetry information and lack of collective bargaining, restrict wider participation in formal credit markets. Bank proximity is favourable for most households, with 60.26% reporting convenient access, which reduces transaction costs in borrowing. Awareness of Minimum Support Price (MSP) (69.49%) also strengthen financial credibility, as lenders often view such awareness as a signal of market participation and repayment ability. Demographically, the sample is dominated by male-headed households (99.49%), married farmers (98.46%), and Hindus (8.23%). Most households belong to SC/ST groups (66.41%), reflecting the social composition of the study region. In terms of age, significant proportion falls within the 36–45 age group (42.31%), which indicates that middle-aged farmers are the main borrowers.

Overall, the descriptive statistics indicate that households with education, saving accounts, collateral, landholdings, and awareness of credit/MSP are structurally advantaged in accessing institutional credit. These findings are consistent with earlier studies conducted in South Asia and Africa (Chandio *et al.* 2020, Asante-Addo *et al.* 2021, Bashir *et al.* 2022), which highlights education, collateral, and credit awareness as primary determinants of access

Table 3 depicts that farmers obtained loan from financial institutions, predominantly from commercial banks (86.67%), followed by cooperative banks (8.97%) and scheduled commercial banks (4.36%). The majority of farmers availed loans ranging from ₹1.5–3.0 lakhs, reflecting

Table 1 Definition and measurement of the variable

Variable	Type	Description
Access of Credit (dependent variable)	Dummy (yes-1, no-0)	Farmer's ability to obtain credit
Relation of Household head	Categorical (self-1, father-2, mother-3, son-4, other-0)	Relation of the respondent with the household head
Religion	Categorical (hindu-1, islam-2, sikh-3, other-0)	Religion of farmer
Caste/ Caste-category	Categorical (General-1, OBC-2, SC/ST-3, Other-0)	Farmers belongs to which Social Characteristics
Gender	Categorical (male-1, female-0)	Sex of the household head
Age	Categorical (18-35-1, 35-50-2, 51-75-3, 75 and above-4)	Age of the household head
Marital status	Categorical (married-1, unmarried-2, divorced-3, widow-4)	Marital status of farmer
Education	Dummy (yes-1, no-0)	Whether the household's head is educated
Main occupation/ Diversification	Categorical (farming-1, business-2, service-3, other-1)	About main occupation
Farming Experience	Continuous (years)	Years of farming experience
Family Size	Continuous (in numbers)	Total members in family
Annual Income	Continuous (in numbers)	Annual income of the farmers
Requirements of inputs	Categorical (high-1, low-0)	Need for inputs
Extension Contact	Dummy (yes-1, no-0)	Do Farmers have contact with extension agents
Saving account	Dummy (yes-1, no-0)	Whether farmers have a saving account in any bank
Awareness of credit institutions	Dummy (yes-1, no-0)	Are farmers aware of credit institutions
Registered in social group	Dummy (yes-1, no-0)	Whether farmer belongs to any social group
Received formal training in agriculture (%)	Dummy (yes-1, no-0)	Whether farmer have ever attended any training program
Total land (ha)	Continuous (in bigha)	Total available land
Irrigation Facilities	Dummy (yes-1, no-2)	whether farmers acquiring irrigation facility
Source of labour	Categorical (only family labour-1, only hired labour-2, both family and hired labour-3)	What is the source of labour
Aware of (MSP)	Dummy (yes-1, no-0)	Do farmers aware about MSP
Bank proximity	Dummy (yes-1, no-0)	Physical distance from farmer resident to lending source
Collateral	Dummy (yes-1, no-0)	Whether household has any asset on which they can borrow
Interest rate (%)	Categorical (high-1, low-0)	Level of interest rate

Table 2 Descriptive statistics

Access to credit	Numbers	Percentages	Annual income	Numbers	Percentages
0 = No	41	10.51	1 = 20k- 2.9L	266	68.21
1 = Yes	349	89.49	2 = 2.9L- 5.6L	88	22.56
Relation of HH head			3 = 5.6L- 11L	36	9.23
1 = Self	324	83.08	Extension contacts		
2 = Father	47	12.05	0 = No	330	84.62
3 = Mother	3	0.77	1 = Yes	60	15.38
4 = Son	16	4.09	Saving a/c		
Religion			0 = No	38	9.74

Contd.

Table 2 (Concluded)

Access to credit	Numbers	Percentages	Annual income	Numbers	Percentages
1 = Hindu	348	89.23	1 = Yes	352	90.26
2 = Muslim	42	10.77	Credit awareness		
Caste			0 = No	50	12.82
1 = General	27	1.03	1 = Yes	340	87.18
2 = OBC	259	6.92	Registered in social groups		
3 = SC/ST	100	66.41	0 = No	350	89.74
0 = Others	4	25.64	1 = Yes	40	10.26
Sex of HH head			Training		
0 = Female	2	0.51	0 = No	254	65.13
1 = Male	388	99.49	1 = Yes	136	34.87
Age of HH head			Total land		
1 = 18–35	15	3.85	1 = 3–20	192	49.23
2 = 36–50	106	27.18	2 = 21–38	137	35.13
3 = 51–75	268	68.72	3 = 39–56	48	12.31
4 = 75 and above	1	0.26	4 = 57–74	11	2.82
Marital status			5 = 75–90	2	0.51
1 = Unmarried	5	1.28	Irrigation		
2 = Married	384	98.46	0 = No	13	3.33
3 = Divorced	1	0.26	1 = Yes	377	96.67
Education			Labour		
0 = Illiterate	66	16.88	1 = Family labour	47	12.05
1 = Literate	324	83.08	2 = Hired labour	53	13.59
Main occupation			3 = Both	290	74.36
1 = Farming	373	95.64	Awareness of MSP		
2 = Business	10	2.56	0 = No	119	30.51
3 = Service	7	1.79	1 = Yes	271	69.49
Farming experience			Bank proximity		
1 = 5–15	14	3.59	0 = No	235	60.26
2 = 16–26	99	25.38	1 = Yes	155	39.74
3 = 27–37	107	27.44	Collateral		
4 = 38–48	82	21.03	0 = No	76	19.49
5 = 49–60	88	22.56	1 = Yes	314	80.51
Family size			Interest rate		
1 = 4–7	260	66.67	0 = No	105	26.92
2 = 8–11	120	30.77	1 = Yes	285	73.08
3 = 12–16	10	2.56			

the medium credit requirement for cultivation. Regarding utilization, credit was primarily used for purchase of farm inputs (40%), irrigation and machinery investment (32.82%), land preparation and hired labour (18.21%), while a smaller share was used for household needs and loan repayment. In terms of repayment behaviour, 85.13% of farmers repaid their loan on time, whereas 14.87% experienced repayment delays, mainly due to fluctuations in sugarcane process and delayed payments from sugarcane mill.

Fig. 1 clearly depicts that majority of farmers borrowed from commercial banks followed by co-operative and scheduled banks and Fig. 2 indicates that most of farmers

availed loans ranging from ₹1.5–3.0 lakhs.

Econometric analysis: To ensure the reliability of the model, diagnostic tests for multicollinearity and autocorrelation were conducted. Variance Inflation Factor (VIF) was computed, the mean VIF value of 1.62 indicates very low multicollinearity, well below the critical threshold of 5 (O'Brien 2007) and as the data are cross-sectional, autocorrelation is not a concern.

Logistic regression analysis: The model, demonstrates a satisfactory overall fit through a highly significant Wald chi-square statistic ($\chi^2=87.99, p<0.01$), indicating that the explanatory variables collectively contribute meaningfully to

Table 3 Pattern of institutional credit access, utilization, and repayment

Institutional credit sources	Number	Percentage	Purpose and activity of credit use	Number	Percentage
1 = Commercial banks	338	86.67	1 = Purchase of farm inputs	156	40.00
2 = Scheduled Commercial banks	17	4.36	2 = Irrigation and machinery investment	128	32.82
3 = Co-operative banks	35	8.97	3 = land preparation and hired labour	71	18.21
Amount of loan farmers accessed (₹)			4 = loan repayment and household consumption	35	8.97
1 = 10k- 50k	47	12.05	Repayment Capacity		
2 = 50k- .5L	42	10.77	1 = Repaid on time	332	85.13
3 = 1.5L- 2L	54	13.85	2 = delayed repayment	58	14.87
4 = 2L- 2.5L	63	16.15			
5 = 2.5L - 3L	98	25.13			
6 = 3L- 3.5L	38	9.74			
7 = 3.5L – above	48	12.31			

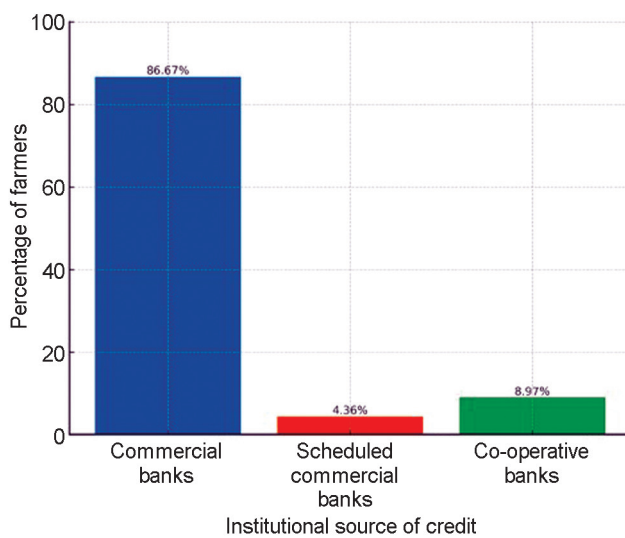


Fig. 1 Distribution of farmers based on institutional source of credit.

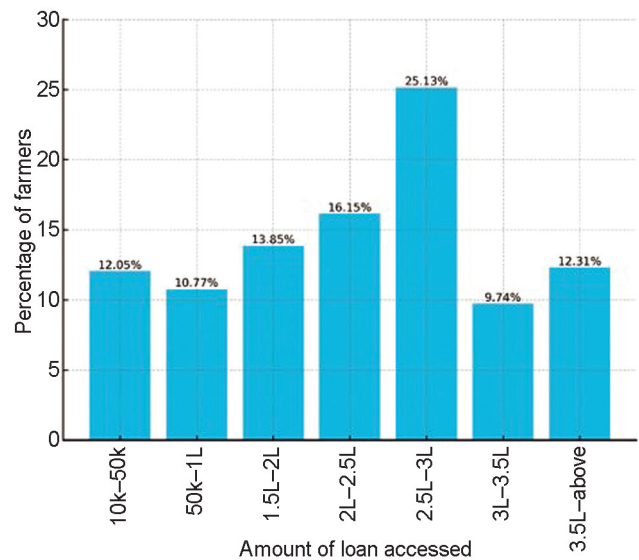


Fig. 2 Pattern of loan size access among farmers.

predicating farmer's access to credit (Table 4). The pseudo- R^2 value of 0.3981 may appear modest when compared to R^2 values from linear regression, but in logistic regression especially in cross-sectional studies values between 0.2–0.4 are generally considered indicative of a strong model fit (Hosmer and Lemeshow 2000). Therefore, a value of 0.3981 signifies that the model explains approximately 39.8% of the variation in the probability of accessing institutional credit. Additionally, log-likelihood value (-78.72), combined with robust standard errors, support the reliability and robustness of the estimates.

Education: Education emerged as a strong determinant of access to institutional loan. At 5% level of significance, educated farmers were approximately 206.8% more likely to access credit than uneducated counterparts. Education enhances farmers understanding of financial procedure, repayment obligations, and documentation, thereby reducing transaction costs and improving lender confidence. These findings were consistent with earlier works of Amjad and

Hasnu (2007), Ibrahim and Aliero (2012), Duniya and Adinah (2015) and Saqib *et al.* (2016) and were further supported by recent studies, such as Tetteh *et al.* (2020), who emphasized the role of financial literacy in Ghana and Ogundeji *et al.* (2022), who reported that better-educated farmers in South Africa were more likely to secure formal loans. More recently, Haryanto (2023) confirmed that education positively shapes financial inclusion in South-east Asia.

Annual income: At 10% significance level, annual income shows a positive but marginal effect on access to credit. An odds ratio of 1.0004 means that for every 1-unit increase in income, the odds of accessing credit rise by about 0.0004 while this effect is very small for a single-unit increase, it is quite noticeable for higher increases in income. This would entail that higher-income farmers as more creditworthy because such farmers have higher repayment capacity. Kumar *et al.* (2022), using a national survey in India, similarly found that farm credit is disproportionately

accessible to higher-income households, indicating that income inequality affects credit distribution.

Credit awareness: It has a highly significant and strong positive impact on access to credit, with an odds ratio of 45.13 and a p -value of 0.000. This implies that individuals who are aware of credit facilities are more likely to access credit compared to those who lack such awareness. This aligned with Chandio *et al.* (2020), who noted that awareness campaigns significantly improve credit participation in Pakistan, and with Hussain *et al.* (2021), who stressed that financial literacy is one of the most powerful enablers of rural credit uptake. Recent evidence by Adepoju and Oni (2023) from Nigeria also demonstrated that awareness and trust in institutions significantly raise loan uptake among rural farmers.

Total land: The size of landholding positively influences credit access, with each additional unit of land increasing the likelihood of obtaining credit by 4.37%. Larger landholdings often serve as collateral, enhancing credit access. Studies consistently highlighting the link between land size and agriculture credit (Obboh and Kushwaha 2009), noting the landholding classification (large, medium, and small). Additionally, it's critical to remember that farmer categories differ throughout nations and regions (Akram and Hussain 2008, Hussain and Thapa 2012). Large landholdings also made it easier to obtain agricultural loans (Amjad and Hasnu 2007, Akram and Hussain 2008).

Collateral: At the 1% likelihood level, the availability of collateral has a strong and significant impact on credit

Table 4 Logistic regression

Variables	Odds ratio	Robust standard error	Z	P>z	[95% conf. interval]
Relation of HH head	1.472779	.4000951	1.43	0.154	.8647693 2.508274
Religion	2.757438	3.087371	0.91	0.365	.3072247 24.74887
Cast	1.250986	.3026337	0.80	0.422	.7243082 2.160634
Sex of HH head	3.833163	2.053011	1.12	0.262	.5028239 12.4845
Age of HH head	1.735137	.8056822	1.19	0.235	.6983809 4.310971
Marital status	3.75204	3.402081	1.46	0.145	.6345401 22.18584
Education	3.06812	1.573307	2.19	0.029**	1.123009 8.382267
Main occupation	.3846093	.1786483	-2.06	0.040	.1547543 .9558656
Farming experience	.9712471	.0171904	-1.65	0.099	.9381323 1.005531
Family size	.7947507	.0804353	-2.27	0.023	.6517519 .9691244
Annual income	1.000004	2.03e-06	1.87	0.062*	.9999998 1.000008
Requirement of input	1.893487	.9914345	1.22	0.223	.6785333 5.283887
Extension contacts	.3801213	.3998221	-0.92	0.358	.0483732 2.987029
Saving account	.8757689	.6734468	-0.17	0.863	.1940146 3.953161
Credit awareness	45.13259	39.5536	4.35	0.000***	8.10044 251.4617
Registered in social group	1.051331	.7870874	0.07	0.947	.2423712 4.560351
Training	.8484297	.4628763	-0.30	0.763	.2912241 2.471749
Total land	1.043369	.0277215	1.60	0.100*	.9904267 1.099142
Irrigation	1.290544	1.729462	0.19	0.849	.0933417 17.8431
Labour	1.058813	.3780066	0.16	0.873	.5259353 2.131604
Awareness of MSP	1.300614	.622389	0.55	0.583	.5091189 3.322599
Bank proximity	.6847662	.3325745	-0.78	0.436	.2643225 1.773987
Collateral	3.183925	1.675568	2.20	0.028**	1.135039 8.931306
Interest rate	.8431507	.4365447	-0.33	0.742	.3056273 2.326046
_cons	.0237919	.0776842	-1.14	0.252	.0000395 14.31295
Logistic regression					
Number of obs				390	
Wald chi ² (24)				87.99	
Prob > chi ²				0.0000	
Log likelihood				-78.72489	
Pseudo R ²				0.3981	

Note: Robust standard errors (SE) in parentheses; ^ denotes binary variable; HH, Household head; No stars p -value > 0.05; ***, $p < 0.01$ (significant at 1%); **, $p < 0.05$ (significant at 5%); *, $p < 0.10$ (significant at 10%).

availability. The odds of having formal credit access are 8.14 ($p < 0.01$) times higher for farmers who have collateral compared to those without. This reflects the importance of this factor to credit institutions in reducing the level of risk. Dlamini *et al.* (2021) observed similar evidence in Eswatini, noting that collateral requirements often restrict smallholder's access. Moreover, Ali *et al.* (2022) highlighted that collateral-free lending models, such as self-help groups and digital microfinance, could provide a sustainable solution.

In contrast, several other variables such as farmers' relation to household head, religion, cast, gender, age, and marital status were not found to be statistically significant in determining access to credit. Similarly, variables related to farming and institutional support, including farming experience, family size, input requirements, labour, irrigation, saving account, etc. did not show any significant influence. Some of the variables also demonstrated negative but insignificant coefficient, indicating no meaningful association with credit access in the present model.

This study's main goal was to find out what factors influence the access to agriculture credit in Muzaffarnagar district. Three hundred ninety farmers provided primary data, which was then analysed using logistic regression. Where access to credit serves as the dependent variable, while explanatory variables include individual, socio-economic and household characteristics. The results indicated that education, annual income, credit awareness, landholding size, and collateral availability are significant factors affecting farmer's access to credit.

To improve credit access for sugarcane farmers, targeted strategies are essential. First, enhancing rural education and integrating financial literacy within agricultural training can strengthen farmers' understanding of credit processes and loan management. To address income related barriers, policymakers should promote diversified farming, value addition, and market linkages while offering customized credit schemes with adaptable repayment terms for lower income farmers.

Landholding size remains a key factor in securing credit. Therefore, policies that ensure land tenure security, simplify land documentation, and encourage cooperative land use can support smallholders. Additionally, to ease collateral constraints, expanding collateral-free loan options, and implementing innovative credit scoring system based on productivity and repayment behaviours are recommended. Together, these interventions can enhance financial inclusion, support agricultural investment, and ensure the sustainable growth of the sugarcane sector in the region.

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