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THE IMPACT OF CREDIT CONSTRAINT ON PRODUCTIVITY AND TECHNICAL EFFICIENCY OF SUGARCANE IN INDONESIA

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Abstract: Credit constraints on banks in the sugarcane plantation sector hinder efforts to achieve sugar self-sufficiency. Farmers' access to banking is often deemed difficult due to the dominance of small-scale farmers who lack collateral. In reality, farmers who successfully access banking sources also face constraints as the amount of credit received does not match the amount requested due to information imperfections between banks and farmers. Therefore, this research aims to identify the characteristics of farmers facing credit constraints, analyze the impact of credit constraints on productivity and technical efficiency, and identify the factors influencing technical inefficiency. The sample size consists of 4885 farmers who were then analyzed using ordinal probit regression, stochastic frontier analysis (SFA), total factor productivity (TFP), partial productivity, and propensity score matching (PSM) methods. Based on the research findings, it can be concluded that land area and participation in agricultural organizations such as cooperatives and partnerships strengthen the degree of credit constraint. Meanwhile, land ownership and irrigated decrease the degree of credit constraint. The negative impact of credit constraints on productivity and technical efficiency is evident. Factors influencing technical efficiency include land status, land type, seed varieties, and participation in cooperatives and partnerships. This research has implications for bank policies that should not hinder farmers' access to banking services. This can be achieved by designing specific agricultural loans that view agriculture not as a risk but as a long-term investment.

Keywords: credit constraint, propensity score matching (PSM), stochastic frontier analysis (SFA), technical efficiency

Abstrak: *Pembatasan kredit terhadap perbankan dalam sektor perkebunan tebu menghambat upaya tercapainya swasembada gula. Akses petani terhadap perbankan seringkali dianggap sulit karena dominasi petani kecil yang tidak mempunyai agunan. Faktanya, petani yang berhasil mengakses sumber perbankan juga menghadapi kendala karena jumlah kredit yang diterima tidak sesuai dengan jumlah kredit yang diajukan akibat ketidaksempurnaan informasi antara bank dan petani. Oleh karena itu, penelitian ini bertujuan untuk mengetahui karkateristik petani yang menghadapi pembatasan kredit, menganalisis dampak pembatasan kredit terhadap produktivitas dan efisiensi teknis, serta faktor-faktor yang mempengaruhi inefisiensi teknis. Jumlah sampel petani sebanyak 4885 yang kemudian dianalisis menggunaka metode regresi ordinal probit, stochastic frontier analysis (SFA), total factor productivity (TFP), produktivitas parsial dan propensity score matching (PSM). Berdasarkan hasil penelitian dapat disimpulkan variabel luas lahan dan keikutsertaan dalam kelembgaan pertanian seperti koperasi dan kemitraan memperkuat derajat kendala kredit. Sedangkan kepemilikan lahan dan lahan sawah menurunkan derajat kendala kredit. Dampak pembatasan kredit negatif terhadap produktivitas dan efisiensi teknis. Faktor-faktor yang mempengaruhi efisiensi teknis antara lain status lahan, jenis lahan, varietas benih, partisipasi dalam koperasi dan kemitraan. Penelitian ini berimplikasi pada kebijakan bank yang mestinya tidak mempersulit petani untuk akses pada produk layanan perbankan. Hal ini dapat dilakukan dengan merancang kredit khusus pertanian yang memandang pertanian bukan sebagai risiko melainkan suatu investasi jangka panjang.*

Kata kunci: *pembatasan kredit, propensity score matching (PSM), stochastic frontier analysis (SFA), efisiensi teknis*

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INTRODUCTION

The dominance of sugarcane land by smallholder farms, identically with small-scale farmers and limited land, and there's capital constraints, affects farmers' ability to adopt technology for sugarcane production enhancement. Many farmers still cultivate sugarcane conventionally. Consequently, many sugar mills face raw material shortages despite the continuous increase in sugar consumption due to population growth. Data from BPS (2021) indicates that sugar production is 2.35 million tons, while sugar consumption is 6 million tons, resulting in a sugar deficit of 3.65 million tons that needs to be fulfilled by imports. This is evidence of the unattained self-sufficiency target despite multiple government initiatives.

Efforts to increase sugarcane production can be made through extensification and intensification measures. The emergence of Presidential Regulation Number 40 of 2023 supports accelerating Sugar Self-Sufficiency by expanding 700 thousand hectares of land and increasing productivity to 93 tons/ha. The availability of capital for sugarcane farmers is crucial to support these efforts. However, farmers face a shortage of capital ownership, need access to external funding. Sugarcane is a high-cost commercial commodity, thus utilizing credit from banking institutions, which have more capacity than non-bank institution.

The credit originating from banking institutions encompasses both commercial credit and program credit. Program credit constitutes loans facilitated by governmental initiatives, delegated to banks, and earmarked for specific purposes such as agriculture. A prominent example of program credit widely accessed by the real sector, particularly in agriculture, is the People's Business Credit (KUR). The allocation of KUR, as evidenced by data from the Ministry of Finance (Kemenkeu, 2023), reveals a comparison between targeted and realized disbursements. Interestingly, from 2015 to 2023, the KUR target has consistently increased, indicating a favorable reception and beneficial impact on farmers' welfare. Initially set at Rp50 trillion, the target for KUR disbursement surged dramatically to Rp297 trillion by 2023. However, the actual disbursement of KUR is often less than the predetermined.

The minimal utilization of bank credit is suspected to be a consequence of farmers choosing alternative financing from non-bank sources. Numerous studies in developing countries indicate that the majority of farmers access informal sources (Manig, 1990; Moahid et al. 2020; Ullah et al. 2020; Maharani, 2023). The causes can be observed from two perspectives: demand and supply. Firstly, banks adhere to the 5C principles (character, capacity, capital, collateral, and economic conditions) that borrowers must meet. Subsequently, banks rationalize the amount of loan requested, considering potential risks, resulting in loans typically being smaller than the requested amount. Additionally, even if more collateral or guarantees are provided, it does not necessarily lead to a higher amount of credit granted due to imperfect assessments by banks, which may not be fully understood by borrowers (credit market imperfection) (Balana et al. 2022).

Another side contributing to farmers' limited access to formal credit is observed from the perspective of farmers' demand, whereby they choose not to borrow for various reasons such as difficult access, unsuitable repayment timelines, restricted quantities, complex procedures, and concerns over collateral loss (Balana et al. 2022). Farmers are aware that banks can reject loan applications, thus ultimately reluctant to apply for credit (Sivak et al. 2013).

In research relate to credit, the condition where the amount of credit is restricted and farmers' reluctance to borrow from banking sources is referred to as credit rationing and interpreted using the terminology of credit constraint (Asiamah et al. 2021; Dong et al. 2010; Sawada, 2005). Previous research has been carried out regarding the impact of farmers' access to formal and informal as well as credit and non-credit on farming performance (Tuan Anh et al. 2020; Haryanto et al. 2023; Jimi et al. 2016). However, in accessing credit there could be potential credit limitations in terms of the number or reluctance of farmers. Credit constraints have consistently been found to have a negative effect on technical efficiency and productivity (Murali et al. 2017).

Furthermore, credit constraints are ultimately felt by farmers as business actors who utilize capital, so the impact of this phenomenon can be seen from the results of farming performance. This research wants to answer whether credit constraint to banks actually affects farmers' ability to carry out farming, considering that most farmers are small farmers who can also use alternative financing outside banks. Credit constraint

have the effect of reducing the ability to provide a variety of inputs (Ali et al. 2014). The use of input is closely related to productivity as a measure of the performance of a farm. High productivity cannot be achieved if the production process is not technically efficient (Abubakar et al. 2019). Therefore, the hypothesis in this research is that credit constraint have a negative effect on farming performance measures, namely productivity and technical efficiency. Based on the description that has been presented, the objectives of this research are as follows: 1) Analyzing the impact of credit constraints on the productivity and technical efficiency of sugar cane farming; 2) Analyze the factors that influence the technical efficiency of sugarcane farming.

METHODS

The data utilized in this study consist of secondary data derived from the 2013 Agricultural Census (ST2013) and the 2014 Household Agricultural Survey, encompassing Indonesia. The total number of farmers amounted to 4,885, comprising 1,712 farmers facing credit constraints and 3,173 farmers without credit constraints. The 2013 data represents the most recent census data available from the Central Bureau of Statistics (BPS), given that agricultural censuses are conducted every ten years. The relevance of using 2013 data is also underscored by the research topic, which addresses ongoing issues regarding credit access.

Farmer Classification Method

This study addresses the research question by dividing farmers into two groups: those facing credit constraints and those without credit constraints. Basically, credit constraint is an unobservable variable that cannot be directly measured. Therefore, both direct and indirect approaches are employed. Direct methods involve questioning farmers about the amount of credit they have received and applied for, as conducted in prior research (Boucher et al. 2009; Widodo, 2020; Balana et al. 2022). Indirect methods involve the selection of appropriate indicators to classify farmers facing credit constraints. The method used to identify credit constraints in this research is shown in Figure 1.

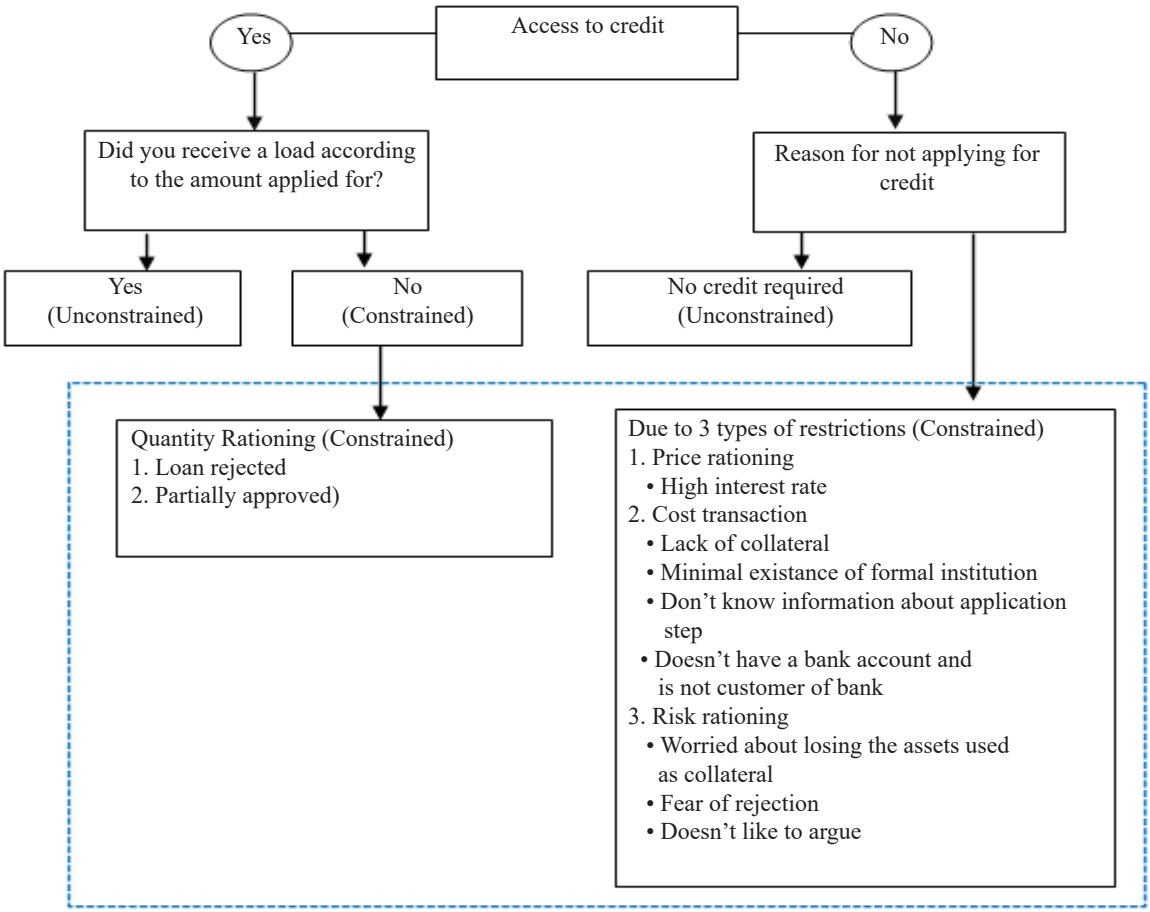

Figure 1. The method of credit constraint classification

The indicators used to determine credit constraints in this study follow the approach by (Cao et al. 2020) who conducted an analysis at the firm level using the ordinal probit analysis method. Given the similarity in methodology and issues, this approach can also be applied to research in the agricultural sector. Credit constraints are expressed in weak, moderate, and strong degrees. The indicators used to assess the degree of credit constraint are as follows Table 1.

Ordered Probit Regression

Ordinal probit regression is used to analyze variables that significantly affect the degree of credit constraint. Ordinal probit regression is used because it can estimate the influence of the dependent variable on an ordinal scale. The higher the level, the stronger the degree of credit constraint. In the interpretation, if the sign is positive then the degree of constraint is stronger and vice versa. The operational model used in this research is as follows:

$$Y = b_0 + \sum_{i=1}^{12} b_i X_i + \varepsilon$$

Where Y= degree of credit constraint (1=weak, 2=medium, 3=strong) X1=land area (ha); X2=operational costs (million rupiah); X3= Farmer's age (years); X4= Education (years); X5= Number of household members (people); X6= Gender (1=male, 0=female); X7= Land status (1=own, 0=not owned); X8= Land type (1=irrigated, 0=non irrigated); X9=Seed variety (1=certified, 0=non-certified); X10= Cooperative participation (1=member, 0=not member); X11= Farmer group participation (1=member, 0=not member); X12= Partnership (1=partnered, 0=not partnered); bi= Variable coefficient value.

Productivity Measurement

The common productivity calculation used is land productivity. In fact, producing output requires not only land but also a set of other inputs such as seeds, fertilizer, and labor. Productivity for each input is called partial productivity. A measure of productivity that is able to capture the contribution of other inputs is total productivity (TFP) which will turn all inputs into an index. Therefore, this research tries to measure productivity with partial productivity and TFP. Partial productivity measure by output/input, TFP will measure by output/indeks of input.

Technical Efficiency

Technical efficiency is measured by comparing an individual's production with the highest production possible from the use of an input (Farrell, 1957). The highest production that farmers can possibly achieve cannot be known directly, so estimates must be made using the production function in a group of farmers cultivating the same commodity. Mathematically, the technical efficiency of sugarcane farming is expressed by where is sugarcane production for the farmers being observed, is frontier production, is non-negative inefficiency >0) and i is the number of farmers being observed. Initially efficiency was expressed in terms of the logarithm in kind l (ln) ie , however, this form can be transformed into a ratio, namely $\exp(-u_i) = Y_i /$ so that it can be translated into a percentage. By using this ratio, the inefficiency value is between 0 and 1. If the value is 1 then the farmer is efficient, conversely if it is less than 1 then the farmer is not yet efficient.

To calculate the level of efficiency above, it is necessary to know the production frontier which will be estimated using the stochastic frontier production function, namely where X_i is the input used for sugar cane production and ε_i is the error term. The error term in the stochastic model is decomposed into vi, namely noise, and ui, namely the effect of inefficiency. Therefore the error term can be expressed as (Aigner et al. 1977; Coelli et al. 1998; Kumbhakar et al. 2015). The empirical model used is Cobb Douglas to estimate the production function. The specific functions of Cobb Douglas production are as follows:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + (v_i - \mu_i) \quad (2)$$

Where Y=Cane production (Tons); X1 = Land area (ha); X2= Amount of seed used (Kg); X3= Amount of N fertilizer use (Kg); X4= Amount of P fertilizer use (Kg); X5= Amount of K fertilizer use (Kg); X6= Number of workers (HOK); β0= Intercept; βi = Estimated coefficient of the independent variable; vi-μi = Error term (vi is noise effect, and ui is technical inefficiency effect); i= i-th farmer. With the hypothesis that $0 < \beta_j < 1$ for all j.

After estimating the production function to calculate the level of technical efficiency. The next analysis is to determine the factors that influence inefficiency using the model:

$$u_i = \delta_0+\delta_1 Z_1+\delta_2 Z_2+\delta_3 Z_3+\delta_4 D_1+\delta_5 D_2+\delta_6 D_3+\delta_7 D_4+\delta_8 D_5+\delta_9 D_6+\delta_{10} D_7+\delta_{11} D_8+w \quad (3)$$

Where ui= Inefficiency effect; and the independent variables used are the same as the equation (1) except land area and operational costs, δ= Variable coefficient value; w= Random variable.

Equations (2) and (3) are estimated simultaneously. The expected sign is δ 1 to δ 11 <0, which means that this variable has a negative effect on inefficiency but a positive effect on efficiency

Propensity Score Matching

The impact of credit constraint on productivity and technical efficiency was analyzed using the Propensity Score Matching (PSM) method proposed by (Rosenbaum et al. 1983). This method is superior to directly comparing with the T test in regression because it is able to minimize bias that may occur when carrying out impact analysis by comparing two groups with characteristics that are as similar as possible use the logit function as follows first:

$$P = ln\left(\frac{P}{1-P}\right) = b_0 + \sum_{i=1}^{11} b_i X_i + \varepsilon$$

Where P is a dummy variable for farmers facing credit constraint. The independent variable that is thought to influence farmers' chances of facing credit constraint is the same as the independent variable used in equation (3).

After observing the characteristics of farmers, we then estimate the impact of credit constraint. The estimation method used looks at the average impact, which is called Average Treatment on Treated (ATT). The ATT model is as follows (Khandker et al. 2010):

$$ATT = E\,[Y1_i \mid D_i=1] - E\,[Y0_i \mid D_i = 0] \quad (5)$$

Where ATT=Impact calculated from the outcome variable (productivity, technical efficiency) which is estimated from the results of the productivity and technical efficiency of farmers who face credit constraint (E [Y1i|Di=1) minus those of farmers who do not face credit constraint (E [Y01| Di=0]).

The framework for this research is depicted in Figure 2. Capital constraints faced by sugar cane farmers in order to increase sugar cane production. Farmers generally have access to non-banks because of limited access to banking. Even though banking capacity is greater for financing farmers' credit needs compared to non-banks, It is suspected that the existence of credit constraint to banks will not be able to meet farmers' credit needs, which ultimately affects efforts to provide input. Therefore, the hypothesis in this research is that credit constraint have a negative effect on productivity and technical efficiency. Productivity will be measured using total and partial productivity, technical efficiency is estimated using stochastic frontier analysis (SFA). The impact of credit constraint is measured using propensity score matching (PSM).

Table 1. Indicators of the degree of credit constraint

Group	Degree of credit constraints	Description
Unconstrained	Degree 0 (not constrained)	Farmers who don't need loans
		Farmers who receive loans from banks as requested
Constrained	Degree 1 (weakly constrained)	Farmers who do not have loans, but have the hope of receiving assistance in the form of convenience and interest subsidies from banks.
	Degree 2 (moderately constrained)	Farmers are forced to access non-banks, for certain reasons, such as difficult procedures, not having collateral and high interest rates.
	Degree 3 (strongly constrained)	Farmers who have used credit from the bank but it does not match what was proposed

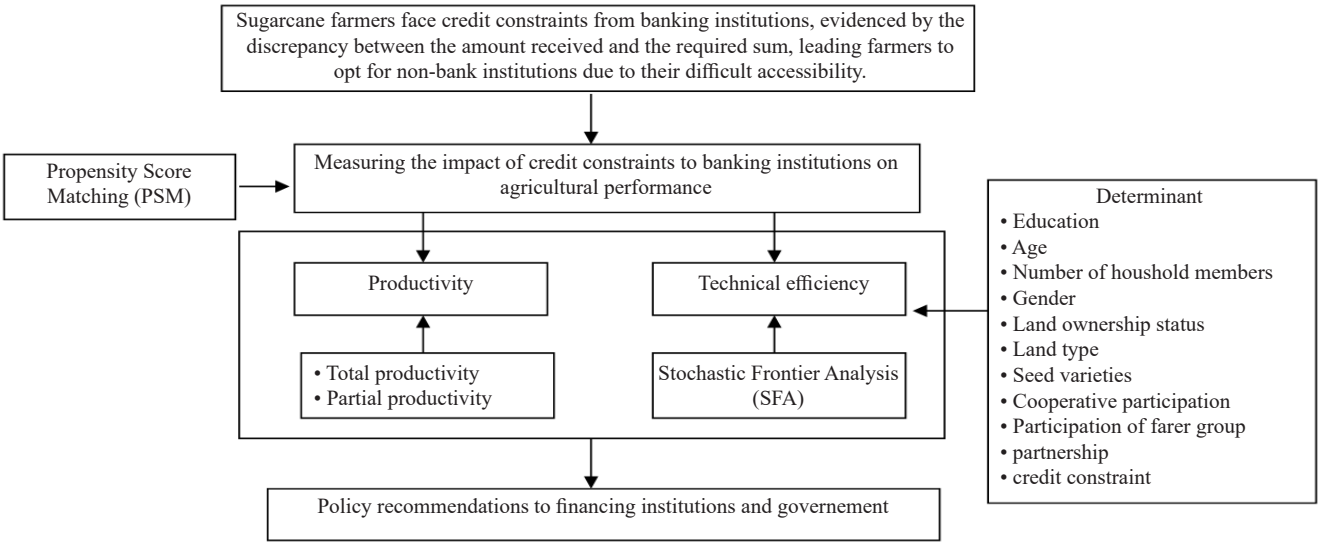

Figure 2. Research framework

RESULTS

Characteristic Of Farmer

The profile of sugar cane farmers in Indonesia can be described by looking at the demographic characteristics of farmers, farming characteristics and institutional characteristics. There are 4,885 farmers divided into two groups, namely 1,712 farmers who face credit constrained and 3,173 farmers who unconstrained. Farmer characteristics are explained descriptively through individual characteristics, farming, agricultural institutions and farmer participation in utilizing credit sources. The majority of sugar cane farmers in Indonesia are still of productive age and are elementary school graduates. Furthermore, the characteristics of farming between the two groups of farmers are not much different because the majority cultivate their own land with a medium land area (1.19–2.23 ha). This land grouping is based on the data's standard deviation. So the grouping pays attention to the distribution of research data. From an institutional perspective, the majority of sugar cane farmers in the credit limitation group are not members of cooperatives, but are members of farmer groups and partnerships. Meanwhile, in farmer groups that do not face credit constraint, the majority of farmers are members of cooperatives, but not farmer groups and partnerships.

An illustration of credit constraint and the participation of sugar cane farmers in utilizing financing sources is presented in Figure 3. Based on Figure 3, credit limitations in sugarcane farming occur not only in the form of quantity but also in limited access. Of the 4885 sugar cane farmers, only 196 farmers have access to banks, 1,478 farmers have access to non-banks and 3,221 have no access to credit. This shows that bank credit participation is still low. Apart from that, the large number of access to non-banking also indicates other forms of constraint that also occur due to high interest rates, long distances, fear of losing collateral, and not knowing the procedures. For this reason, in the end farmers are reluctant to borrow from banks and prefer other alternatives, namely non-bank institutions such as farmer groups, cooperatives, sugar factories, individuals and other institutions. There is a tendency for farmers to have non-bank institutions because these institutions are also farmer organizations so that farmers can receive convenience and relaxed requirements even though there are limited funding (Hardana et al. 2021).

Degree of Kredit Constraint of Sugarcane Farmers and Factors Determine

Credit constraint are a phenomenon that is difficult to observe directly. There needs to be an approach and indicators to see the existence of credit constraint in a farming business. In this research, credit constraints are expressed in 3 degrees, namely strong, moderate and weak. The characteristics of farmers who face credit constraint in this research are seen through the factors that influence the degree of credit in Table 2.

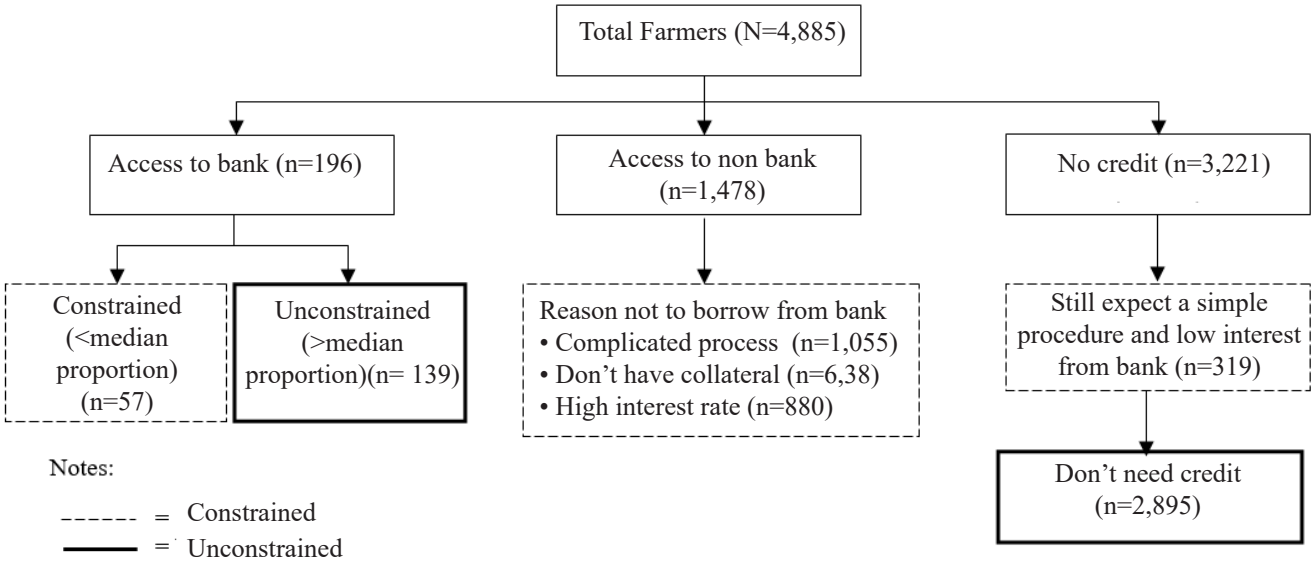

Figure 3. Distribution of the number of farmers based on access to financing sources

Table 2. Factors influencing the degree of credit constraints for sugar cane farmers

Independent Variable	Coefficient	Std Err	Z
Planted area (ha)	0.049	0.020	2.37***
Operational costs (million rupiah)	0.000	0.000	1.47
Age (years)	-0.000	0.002	-0.28
Education (years)	-0.013	0.010	-1.25
Number of household members (people)	-0.013	0.015	-0.91
Gender (1=male. 0=female)	0.024	0.093	0.26
Land status (1=own 0=not owned)	-0.127	0.062	-2.03***
Land type (1=irrigated 0=not irrigated)	-0.102	0.056	-1.83**
Seed varieties (1=certified. 0=not certified)	-0.089	0.068	-1.31
Cooperative membership (1=yes. 0=no)	0.305	0.061	4.93***
Farmer group membership (1=yes. 0=no)	0.048	0.060	0.81
Partnership (1=yes. 0=no)	0.495	0.058	8.41***

Notes: *** Significant at α=1%; ** Significant at α=5%; * Significant at α=10%

Based on Table 3, the degree of credit constraint is weaker and more significant for farmers who cultivate their own land. Large areas of land strengthen the degree of credit constraints in this study because the majority of large areas of land are rented land and not owned by farmers. Thus, farmers do not have assets to use as collateral for banks (Maharani, 2023). In addition, other factors such as farmers' membership in cooperatives and partnerships strengthen the degree of credit constraint on banks because farmers can take advantage of loans from their own organizations. Cooperatives and partnerships have procedures and conditions that are easier for farmers to access (Alamsyah et al. 2023)

The degree of credit constraint is weaker for farmers who own their own land and cultivate irrigated area. This shows that by owning their own land, farmers are not subject to strong constraints because they have collateral to use as collateral for banks. Credit needs are also lower because own land tends to be smaller, so they can be met through non-banks. Moreover, when farmers use irrigated, the potential for production results is greater because there is good irrigation for sugar cane.

Impact of Credit Constraint On Productivity and Technical Efficiency Of Sugarcane in Indonesia

The impact of credit constraints on productivity can be seen from two methods of measuring productivity:

partial productivity (land, seeds, fertilizer, labor) and total productivity, which considers all input contributions used to produce sugar cane. Apart from that, the size of the impact is also seen on the technical efficiency of farming.

Credit constraint have a negative effect on productivity and technical efficiency. The consistency of the negative relationship can be seen in various productivity measures, namely total, land, seeds, fertilizer and labor. The availability of a variety of inputs becomes less for farmers who face credit constraint (Gebeyehu, 2019). This is in line with research (Awotide et al. 2015; Uthamalingam et al. 2019), which concludes that farmers with access to credit can use more input, which also increases productivity. If credit is limited, input needs will not be met , so farmers' total productivity will be lower.

Before analyzing further, it is important to look at the components of sugarcane production costs. The structure of production costs in sugar cane farming has been analyzed in previous research in (BPS, 2016; Sandita, 2023) which shows that the largest proportion of production costs is land rent reaching 32.37%, labor reaching 26.21%, seeds reaching 12.62 %, fertilizer reached 12.04%, and other expenses. Land rental and labor costs occupy the highest position.

The use of credit is based on its purpose, the majority of farmers use credit not to rent land and labor but to buy other inputs such as fertilizer and seeds. In Chaiya et al. (2023), the greatest use of credit was for purchasing seeds and fertilizer, while the least was for labor which was only 0.05% of the total credit. On this basis, the need for labor costs is large but cannot be met due to credit constraint, so labor productivity becomes very low and significant. Meanwhile, fertilizer and seeds still receive a larger portion of credit, although the amount is limited, so the impact is negative but not significant. Credit constraints mean that the inputs used by farmers cannot be optimally used to produce the highest possible output. Even though there are credit constraint on banks, farmers can take advantage of alternative sources of financing from non-banks. However, the financing capacity of banks is much greater than non-banks (Haryanto et al. 2023). A comparison of the number of farmers and the amount of credit received by farmers between banks and non-banks can be seen in Table 4.

Credit constraints also negatively and significantly impact the technical efficiency of sugarcane farming. These results align with research that concludes a negative relationship between credit constraint and technical efficiency (Mehmood et al. 2018; Abubakar et al. 2019; Komicha et al. 2007). Credit constraint cause farmers to have less access to inputs. Not only that, better management in utilizing input is not optimal. Limited costs prevent farmers from carrying out cultivation practices that can increase production. The distribution of technical efficiency of sugar cane farming is presented in Table 5.

Table 3. Impact of credit constraint on productivity and technical efficiency of sugarcane farming

Variable	Constrained	Unconstrained	Difference	T-Test
Land productivity	90.930	259.105	-168.175	-1.30
Seed productivity	0.0723	1.761	-1.689	-1.45
Fertilizer productivity	0.288	0.313	-0.024	-0.99
Labor productivity	0.761	2.258	-1.497	-2.09**
Total productivity (TFP)	16.935	17.150	-0.214	-0.46
Technical Efficiency	0.816	0.830	-0.013	-2.89***

Notes: ***significant at α=1% |t| ≥ 2.58; ** significant at α=5% |t| ≥ 1.96; * significant at α=10%, |t| ≥ 1.65

Table 4. Average amount of credit of farmers by group land and sources of financing

Variable	Sources of financing	
	Bank	Non bank
Average credit amount (Rp 000)		
Small (<0.19 ha)	7,346	1,718
Medium (0.19 ha-2.23 ha)	11,645	8,086
Large (>2.23 ha)	115,098	95,413

Table 6 shows that credit constraint reduce the level of technical efficiency. The average technical efficiency level of farmers who face credit constraint is 0.817, while farmers who do not can achieve a technical efficiency level of 0.828. The technical efficiency of farmers with credit constraint is relatively lower than those who do not face credit constraint. Assuming no credit constraint exists, technical efficiency can increase by 12% (Komicha et al. 2007). To increase potential sugarcane production, it is important to look at what factors influence the technical efficiency of sugarcane farming.

Factor Influencing The Technical Efficiency Of Sugarcane Farming

Based on the previous discussion, credit constraints negatively impact technical efficiency. To increase farmers' production potential, it is necessary to look at what factors influence the technical efficiency of sugar cane farming as shown in Table 6.

Factors that have a significant influence on the technical efficiency of sugarcane farming include land status, land type, seed varieties, participation in cooperatives and partnerships. Farmers who have their own land and irrigated have a higher level of technical efficiency. Farmers who cultivate their own land can make independent decisions and do not depend on the land owner so that the resulting production can be higher. Another variable that also influences technical efficiency is the type of land where irrigated are more efficient because sugar cane is a crop that requires a lot of water availability (Ardiyansyah et al. 2015). In this study, the majority of farmers cultivated sugar cane on non-irrigated. Because the availability of irrigated is also less than non-irrigated (Asyarif et al. 2018; Susilowati et al. 2020). Moreover, land is the most responsive input for sugar cane production, so expansion efforts are needed to increase sugar cane, especially rice fields (Rosidah et al. 2023).

Table 5. Distribution of sugarcane technical efficiency levels

Level of effciency	Constrained		Unonstrained	
	Frequency	%	Frequency	%
<0.7	107	6.25	178	5.61
0.7-<0.8	318	18.57	579	18.25
0.8-<0.9	1160	67.76	2003	63.13
0.9-1	127	7.42	413	13.02
Total	1712	100	3173	100
Average	0.817		0.828	
Minimum	0.009		0.024	
Maksimum	0.957		0.977	

Table 6. Factors influencing the technical inefficiency of sugarcane farming

Variable	Coefficient	Std. Errr	z
Farmer's age (years)	-0.003	0.006	-0.48
Education (years)	-0.026	0.028	-0.92
Number of household members (people)	0.020	0.027	0.77
Gender (1=male, 0=female)	0.320	0.227	1.41
Land status (1=own, 0=not own)	-0.446***	0.165	-2.70
Land type (1=irrigated, 0=non irrigated)	-0.718***	0.178	-4.02
Seed varieties (1=certified, 0=non-certified)	-0.734***	0.188	-3.90
Cooperative (1=member, 0=not member)	0.800***	0.185	4.31
Farmer groups (1=member, 0=not member)	-0.049	0.171	-0.29
Partnership (1=ask, 0=not partner)	-0.842***	0.198	-4.24
Credit constraint (1=Yes, 0=not faced)	0.231	0.155	1.49

Notes: *** Significant at α=1%; ** Significant at α=5%; * Significant at α=10%

Another factor is seed variety. Certified seeds have higher technical efficiency than non-certified seeds. But unfortunately, Farmers still use non-certified seeds more often due to difficult access to finding certified seeds and the price of non-certified seeds is cheaper. Even though many commodities such as potatoes and sugarcane,certified cocoa seeds are needed to increase productivity (Parnidi and Mastur, 2021; Nugraheni et al. 2022).

Farmers' participation in cooperatives actually results in lower technical efficiency. This is in contrast to Wafi (2023), who sees cooperatives as positively affecting technical efficiency. The role of cooperatives becomes real if the members also have the intention to learn and follow the processes therein well. If you are only limited to being a member, then in the end the benefits of the cooperative will not have an impact on better farming. Apart from that, participating in other agricultural institutions, namely partnerships, can improve the technical efficiency of farming. Because in the farmer partnership contract provisions are given that ultimately force farmers to produce maximum production.

Managerial Implications

The policy implications in this case focus on banking and non-bank financial institutions. Non-bank financial institutions have an important role in providing credit, especially for small-scale farmers, while the credit needs of large-scale farmers can only be met through funding from banks. For this reason, banks must adjust specific agricultural credit policies with terms and conditions that are in accordance with the characteristics of agricultural commodities. The farmers do not own the majority of large areas of land, so the requirements for land as collateral are irrelevant for banks to apply. There must be alternative banking policies when great potential cannot be realized simply because of procedural or administrative constraint.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Credit constraints negatively and significantly impact labor productivity and technical efficiency of sugarcane farming in Indonesia. Credit constraint can be expressed in degrees where the constraints will become stronger when farmers cultivate large areas of land and join agricultural institutions. On the other hand, credit constraints weaken if farmers cultivate their own land, especially irrigated. Research Factors that influence technical efficiency include land ownership status, land type, seed varieties, participation in cooperatives and partnerships.

Recommendations

Recommendations are submitted to policy makers and the banking sector that serves the financial services needs of farmers. Agricultural credit policies from banks should be reformulated by assuming that the financing provided to the agricultural sector is not a risk but an investment whose benefits will be received in the future. Steps that can be taken are designing risk management efforts for agricultural credit, developing special agricultural financial products, designing requirements that suit the characteristics of agricultural commodities and providing assistance and supervision of credit lent to farmers. With this, the feeling of security in utilizing credit according to its function is not only felt by farmers but also by banks as credit distributors. Suggestions for further research are to analyze the impact of each degree of credit constraint on farming performance measures using the PSM method for ordered probit analysis.

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