

Comparative analysis of the effect of credit from FECECAM and SIAN'SON microfinance on the economic efficiency of maize production in northern Benin

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Disclosure Statement :	Authors are not aware of any findings that might be perceived as affecting the objectivity of this study
Conflict of Interest :	The authors report no conflicts of interest.
Cite this article :	AWO, S. J.-M., OLLABODE, N., YAI, E. D., & YABI, J. A. (2022). Comparative analysis of the effect of credit from FECECAM and SIAN'SON microfinance on the economic efficiency of maize production in northern Benin. International Journal of Accounting, Finance, Auditing, Management and Economics, 3(5-2), 350-362. https://doi.org/10.5281/zenodo.7121414
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Received: August 28, 2022

Published online: September 30, 2022

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Abstract

The economic inefficiency of production in developing countries constitutes a threat to food security in these countries where poverty levels are critical. One of the explanatory factors for this economic attribute of production is the lack of investment in agriculture and the low access to agricultural credit.

The objective of the research is to evaluate the effect of credit on the economic efficiency of maize producers in northern Benin in order to test the thesis that access to credit for maize producers constitutes a credible alternative for boost the economic efficiency of corn production in Benin.

A socio-economic survey was carried out on a random sample of 150 producers receiving agricultural credit from SIAN'SON microfinance, 150 producers receiving agricultural credit from FECECAM and 150 non-beneficiary producers in three municipalities in northern Benin. A stochastic frontier model was estimated and mean comparison tests were performed to assess the effect of credit on beneficiaries and non-beneficiaries of credit at the level of the two microcredit institutions.

The results obtained show that the average technical efficiency of maize producers is 72.49%. The average allocative efficiency of maize producers is 0.8391 and that of economic efficiency is 0.6063. There is greater economic efficiency for credit recipients compared to non-credit recipients. The mean of the efficiency scores is positively significant at the 1% level.

Access to credit improves the economic efficiency of production. The SIAN'SON microfinance credit is economically efficient in the production of maize, therefore it would seem more suitable for the production of maize compared to that of FECECAM.

Keywords. FECECAM, SIAN'SON microfinance, economic efficiency, Northern Benin.

JEL Classification: G23

Paper type: Empirical research

1. Introduction

Maize (*Zea mays*) is the most cultivated cereal in the world, ahead of wheat (Moussa et al. 2018). It represents 41% of world cereal production (Traoré et al. 2020). Maize is the staple food for most Third World countries and represents about 75% of cereal production in Benin (Macauley and Ramadjita, 2015). It is the second cash crop in Benin (Hinnou et al. 2021). Its culture is found in almost all farms. It is the only cereal for which the country generates surpluses towards neighboring countries (Sohinto and Aïna, 2011). According to Baco et al. (2011), maize will become a cash crop in the coming decades and will ensure food security better than any other crop. The diversity of maize, the most consumed cereal in Benin far ahead of rice and sorghum, is therefore essential to guarantee the sustainable food security of populations. This production must increase to cover an ever-increasing demand from the populations (Choukou et al 2017).

Despite the efforts made, the agricultural reforms and the specialized programs adopted to stimulate the growth of the maize sector in sub-Saharan Africa, many constraints are hampering the development of the sector. Among these major constraints to maize production in Benin are the vagaries of the weather, the lack of an information system and technical support, the weak financing capacity, the limited access to adequate and adapted agricultural inputs, transport difficulties, the attack of diseases and pests and especially soil depletion and degradation (Houssou et al. 2019) and (Adifon et al. 2017).

These constraints could be explained by the low financing of agriculture by commercial banks that go to agriculture (FAO, IFAD and WFP, 2015). This weak financing of agriculture is likely to constrain producers in their perspective of increasing agricultural productivity, which remains low (Loaba et al. 2021). For these authors, one of the main measures aimed at improving the productivity and income of farmers in Sub-Saharan Africa has been the granting of agricultural credit. To this end, Sagbo and Floquet (2018) report that the lack of own capital and access to external capital is often identified as one of the key factors for the stagnation of the agricultural sector and one of the reasons for this lack of access. to credit is the lack of knowledge of the agricultural sector by financial institutions and the doubts that these institutions have about the ability of producers to repay credit, their poor knowledge of agricultural activities, their profitability, the return on investment and their level of risk. For their part, producers have difficulty expressing their needs in a manner acceptable to financial institutions and presenting acceptable guarantees. The lack of adequate credit for agriculture aggravates the level of poverty of a large segment of the population and hampers the process of intensification of agricultural production (Le Roy, 2011). Credit is a very determining factor in agricultural production. Farmers' access to this factor allows them to meet their cash flow and consumption needs induced by the agricultural production cycle (Osabohien et al., 2018) Agricultural credit allows farmers to buy agricultural inputs (fertilizers, seeds quality products, herbicides and pesticides) and agricultural equipment and materials (hoes, tractor, sprayer, cutter, etc.) necessary to improve productivity, income and market accessibility for their agricultural products (Girabi & Mwakaje, 2013).

Studies carried out on agricultural credit in relation to agricultural production often focus either on the determinants of access to credit, or on the effect or impact of credit on productivity, or on the economic profitability of agricultural production. Chandio et al., (2018) showed that agricultural credit has a positive and highly significant effect on wheat productivity in smallholder farms in Sindh, Pakistan. Most studies on the economic efficiency of maize producers content themselves with measuring the effects of agricultural practices on efficiency indices without establishing a link with the economic efficiency and access to the credit of MFIs and making comparative studies. This could guide producers in the choice of structures for financing agricultural activities. However, few published studies have focused on evaluating the effect of credit according to MFIs on the economic efficiency of maize production. This research

through the financing of agriculture by the private sector aims to compare the effect of credits from SIAN'SON microfinance and FECECAM on the economic efficiency of maize production in Northern Benin.

2. Literature review

2.1. Concept of efficiency

Any production activity involves inputs constituting the productive resources to be transformed or used and outputs that are the results of production. The relationship between inputs and outputs will make it possible to measure performance and assess the types of allocation of resources to production. Thus, to take into account the criterion maximally of the product obtained, on the one hand, and the possibility of a lesser use of the means of production, on the other hand, one often has recourse to the concept of efficiency.

The notion of efficiency used for the first time by Koopmans in 1951 constitutes, from that moment to the present day, an increasingly privileged reference in the performance analysis of production units. The term efficiency encompasses certain notions of microeconomic theory such as the production function, costs, profit and price. The terms effectiveness or ineffectiveness are common in the literature. This concept is full of diversity of more or less similar definitions (Biaou et al. 2021). The purpose of efficiency is to judge the capacity of a production system to produce "at best" by the implementation of all the means of production such as operating capital, land and labor (Coelli et al. 2002).

According to Issiaka (2002), efficiency in agriculture can be defined as the degree to which producers obtain the best result with the available resources and the given technologies. The concept of efficiency has three components: technical, allocative and economic efficiency (Biaou et al. 2021, Hountondji et al. 2018, Sharma et al. 1999). Simultaneous obtaining of technical and allocative efficiency is a necessary and sufficient condition to speak of economic efficiency. It is possible for a production unit to obtain technical or allocative efficiency without having economic efficiency (Djato, 2001). These efficiencies are necessary and once achieved simultaneously, are the sufficient conditions for obtaining economic efficiency. This overview of the concept corresponds to that of (Gupta et al. 1988) who notes that the achievement of one of the two types of efficiency may be a necessary but not sufficient condition for obtaining economic efficiency.

Economic efficiency therefore appears as the result of technical efficiency (maximum possible output) and allocative efficiency (minimum costs), exclusive and exhaustive components of economic efficiency (Honlonkou, 1999).

2.2 Credit and agricultural development

The history of agricultural crédit goes back to the end of the 19th century with a law of 1884 allowing free professional association which authorizes, among other things, the formation of agricultural unions, and the creation of banks or local mutual funds. The activities from the start were exclusively made up of short-term loans. These were advances on harvests allowing farmers to live better. These activities were then extended to medium-term and then long-term loans which enabled them to equip themselves. However, difficulties were not lacking in the sector. The Local Banks are quickly confronted with financial problems such as the lack of capital or the insufficient guarantees of the small farmers, on the one hand, and, on the other hand, the underuse of the capital by the small farmers.

But it must be pointed out that this underutilization of capital in small farms can be corrected according to Rao (1970) by a credit program which can improve the productivity of these farms. For Nowak (1993), credit policies are positive, constitute an instrument of development and not

failures engulfing enormous sums of money as certain authors believe in their studies of the impact of credit on productivity and economic efficiency

Hypothesis 1: Credit improves the economic efficiency of maize production in northern Benin

3. Methodology

3.1. Sampling and data collected

The observation units are maize producers in northern Benin. In each municipality, three (03) types of producers were randomly selected, namely producers receiving credit from FECECAM, producers receiving credit from SIAN'SON microfinance, and producers not receiving credit. According to the list of producers obtained from the officials of FECECAM, SIAN'SON microfinance and the Heads of Communal agricultural institution (CCeC). As for the non-beneficiaries, the list obtained from the CCeCs were used after a sieve that made it possible to separate the beneficiaries from the non-beneficiaries before randomly selecting the 50 producers from the list of non-beneficiaries indeed, in the whole of the study area a total of 450 producers were sampled (Table 1).

Table 1: Distribution of respondents in the study area

Study area	FECECAM	SIAN'SON Microfinance	Non-beneficiary of credit	Total
Banikoara	50	50	50	150
Bembèrèkè	50	50	50	150
Kalalé	50	50	50	150
Ensemble	150	150	150	450

Source: AWO (2021) based on survey results

The data collected relates to the 2020-2021 crop year and is broken down as follows: the conditions for obtaining credit; the perceptions of producers of the monitoring and support strategies of FECECAM and SIAN'SON microfinance; inputs and outputs, socio-economic characteristics are collected in the study area. Thus, using the questionnaire and interview guides, these data were collected by surveys and focus groups in the form of structured, semi-structured and unstructured interviews.

3.2. Empirical framework

The methodology used was based on the studies of Biaou et al. (2021), Toleba et al. (2018), who estimated the technical efficiency indices of farms. A stochastic frontier of dual cost (expressed as a function of the price of inputs and the level of production) has been deduced analytically following the approach of the stochastic frontier of production of Schmidt and Lowel (1979).

The stochastic frontier model was used to determine and compare technical, allocative and economic efficiency indices by type of producer by means of the derivation by duality of the Cobb-Douglas production frontier function. This function takes the functional form defined by its primal equivalent which is the production boundary function. The Cobb-Douglas production frontier is defined by Coelli (1995) in the following equation:

$$\ln(Q_i) = \beta_0 + \beta_1 \ln(K_i) + \beta_2 \ln(L_i) + v_i - u_i,$$

Q represents output, K and L are inputs, respectively, capital and labor, with v and u. According to a normal law of zero expectation and considered as non-negative random variables, and i the observations of 1,2,...,N. The empirical specification is as follows:

$$\ln(Redi) = \beta_0 + \beta_1 \ln(Q_UREEi) + \beta_2 \ln(Q_NPKi) + \beta_3 \ln(Q_SEMi) + \beta_4 \ln(Q_HERBi) + \beta_5 \ln(Q_MOFi) + v_i - u_i$$

The ratio of the minimum cost, compared to the observed cost, measures the economic efficiency EEi; thus, the model for estimating the scores of economic efficiency is as follows:

$$EE_i = C_{imin} C_i = (Y_i, \alpha) e^{V_i} C(Y_i, P_i, \alpha) + U_i = e - U_i.$$

Then, $0 \leq EE_i^* \leq 1$; C_{imin} is the minimum cost. Economic efficiency accounts for the institution with which the maize producer minimizes his production costs on the basis of access to credit for maize production, price of purchased inputs and the price of the product of crops sold on the market. Economic efficiency can therefore be broken down into technical efficiency TE_i and allocative efficiency AE_i . The empirical specification of the Cobb-Douglas form of the function is as follows:

$$\ln(CTProdi) = \beta_0 + \beta_1 \ln(P_{Semi}) + \beta_2 \ln(CouMOSi) + \beta_3 \ln(P_{HERBi}) + \beta_4 \ln(P_{NPKi}) + \beta_5 \ln(P_{UREEi}) + \beta_6 \ln(CouAMORTi) + v_i - u_i$$

\ln representing the natural logarithm and i the corn producer. The error consists of the components v_i and u_i . The v component represents the random variables outside the control of the producers, and assumed to be independently and identically normally distributed with zero expectation and variance σ_v^2 ($V_i \sim [0, \sigma_v^2]$), independent of the u . The component u represents the technical inefficiency random variables that are assumed to be independently and identically distributed as non-negative random variables, obtained by truncation at zero, of the N-type distribution (μ, σ_u^2). According to Coelli et al. (1998), the u_i provide information on the level of cost efficiency or economic efficiency (EE_i) of producer i by the formula:

$$EE_i = AE_i * TE$$

The variables introduced in the analysis model are represented (Table 2).

Table 2: Variables introduced into the efficiency estimation models

Code	Definition of the code of the variables introduced in the model	Expected Signs
AC_HL	average total cost of hired labor used (CFA Franc /h.j/ha)	+/-
AC_DEM	Average total cost of depreciation of equipment and materials used (CFA Franc per hectare),	+
P_UREA	The average price of Urea corn fertilizer used (CFA Franc /kg)	+
P_NPK :	The average price of corn NPK fertilizer used (CFA Franc /kg)	+
P_SEED	The average price of corn seed used (CFA Franc /kg)	+/-
P_HERB	The average price of the maize herbicide used (CFA Franc /L)	+
A_AFL	The average amount of family labour used (hj/ha)	+/-
A_UREA	The average amount of Urea corn fertilizer used (Kg/ha)	+
A_NPK :	The average amount of corn NPK fertilizer used (Kg/ha)	+/-
A_SEED	The average amount of corn seed used (kg/ha) ;	+
A_HERB	The average amount of the maize herbicide used (L/ha)	+/-

Source: AWO (2021) based on survey results

4. Results

4.1. Analysis of the economic efficiency of maize production

4.1.1. Technical efficiency

The estimated production function models are globally significant at the 1% level as shown in Table 3. Therefore, technical inefficiency in maize production exists. The presence of technical inefficiency or not was analyzed through the efficiency parameter γ .

The null hypothesis tested is that all maize producers surveyed are technically efficient.

The value of γ is 0.868 at FECECAM and 1.919 at SIA'NSON microfinance and significantly different from zero at the 1% level. This indicates that 86.80% of the variation in maize production (observed production and potential production) by FECECAM beneficiaries is partly due to the technical inefficiency of the producers studied and that 13.20% of this variability is

attributed to random factors. Consequently, resources are not allocated taking into account their quantity in the maize production systems in the study area.

All the variables introduced in the models are significantly different from zero. The coefficients of the quantity of family labor per hectare and of NPK fertilizer are negative and significant at 1% at FECECAM and at SIAN'SON MICROFINANCE respectively. The elasticity of maize production by FECECAM beneficiaries is -0.254, 0.310, -0.1467, 0.174 and -0.068 respectively with respect to family labor, seed, NPK, urea and weed-killer. As for the beneficiaries of SIA'NSON MICROFINANCE, the elasticity of maize production is respectively -0.213; 0.027; -0.105; 0.139 and 0.001 for family labor, seed, NPK, urea and weed-killer. All other things being equal, when the amount of NPK fertilizer increases by 1 kg per ha, the maize yields obtained decrease by 0.1467 kg per ha for FECECAM beneficiaries and by 0.105 kg per ha for SIAN'SON MICROFINANCE beneficiaries. Similarly, when the amount of family labor increases by 1 man-day/ha, the maize yields obtained decrease by 0.254 kg per ha for FECECAM beneficiaries and by 0.213 kg per ha for SIA'NSON MICROFINANCE beneficiaries. Thus, a variation in the input of NPK fertilizer and family labor leads to a higher variation in production. Furthermore, when the quantities of herbicide, urea and seed increase by 1 kg per ha, the yield of maize for the beneficiaries of SIA'NSON MICROFINANCE increases respectively by 0.001%, 0.139% and 0.027%, while the maize yield of FECECAM beneficiaries increases by 0.310% and 0.174% when the quantities of seed and urea are increased by 1 kg per ha. On the other hand, the maize yield of FECECAM beneficiaries decreases by 0.068% when the quantity of weed-killer is increased by 1 L per ha.

Tableau 3: Estimation of the stochastic production function (Technical efficiency)

Variables	parameters	FECECAM		SIAN 'SON MICROFINANCE	
		Coefficient	Std. Err,	Coefficient	Std. Err,
Constant	Φ_0	7.204	0.374	8.200	0.292
Ln (A_AFL)	Φ_1	-0.254***	0.051	-0.213***	0.055
Ln (A_SEED)	Φ_2	0.310***	0.065	0.027	0.066
Ln (A_NPK)	Φ_3	-0.1467***	0.029	-0.105***	0.026
Ln (A_UREA)	Φ_4	0.174***	0.039	0.139***	0.034
Ln (A_HERB)	Φ_5	-0.068	0.053	0.001	0.054
		Efficiency	parameters		
/lnsig2v	σ^2v	-1.377	0.238	-2.247	0.222
/lnsig2u	σ^2u	-1.659	0.843	-0.943	0.211
sigma_v	σv	0.502	0.059	0.325	0.036
sigma_u	σu	0.436	0.183	0.623	0.066
sigma2	σ^2	0.442	0.109	0.495	0.069
lambda	λ	0.868	0.239	1.919	0.094
Likelihood-ratio test of sigma_u=0: chibar2(01)		0.48		12.95	
=					
Prob>=chibar2 =		0.245		0.000	
Log likelihood =		- 251.116		-186.049	
Wald chi2(5) =		62.58***		24.24***	
Average technical efficiency		0.7294		0.6519	

Significance level : *=10%, **=5%, ***=1%

Source: AWO (2021) based on survey results

4.1.2. Allocative Efficiency

The stochastic frontier models of the cost of production carried out are globally significant at 1% (Table 4). Therefore, allocative inefficiency in maize production exists. The presence of allocative inefficiency or not was analyzed through the efficiency parameter γ . From this table

and from the variables introduced in the models, the coefficients of all the variables NPK, urea, depreciation and hired labor are significant at 1%. It was observed that the coefficient of the seed is negative for the beneficiaries of FECECAM and the coefficient of the herbicide is negative for the beneficiaries of SIA'NSON MICROFINANCE. These translate that, when the cost of herbicide increases by 1 CFA Franc, the cost of maize production for the beneficiaries of SIA'NSON microfinance decreases by 0.661 CFA Franc while the cost of maize production for the beneficiaries of FECECAM decreases of 0.130 CFA Franc when the cost of seed increases by 1 CFA Franc. On the other hand, when the costs of depreciation, urea, and hired labor increase by 1 CFA Franc, the cost of maize production increases respectively by 0.437 CFA Franc, 0.080 CFA Franc, and 0.274 CFA Franc for the beneficiaries. of FECECAM while the cost of maize production for the beneficiaries of SIA'NSON MICROFINANCE increases respectively by 0.417 CFA Franc, 0.848 CFA Franc and 0.675 CFA Franc. When the cost of NPK increases by 1 CFA Franc, the cost of maize production for FECECAM beneficiaries increases by 0.626 CFA Franc.

Table 4: Estimation of the stochastic cost function

Variables	parameters	FECECAM		SIAN 'SON Microfinance	
		Coefficient	Std, Err,	Coefficient	Std, Err,
Constant	β_0	4.783	0.616	6.165	2.667
Ln (AC_DEM)	β_1	0.437***	0.030	0.417***	0.071
Ln P_UREA)	β_2	0.080**	0.042	0.848***	0.095
Ln (P_NPK)	β_3	0.626***	0.028	--	--
Ln (AC_HL)	β_4	0.274***	0.032	0.675***	0.058
Ln (P_SEED)	β_5	-0.130	0.096	0.511	0.312
Ln P_HERB)	β_6	--	--	-0.661***	0.175
Efficiency parameters					
/lnsig2v		-1.568	0.196	-0.375	0.233
/lnsig2u		-1.826	0.667	0.239	0.376
sigma_v	σ_v	0.456	0.044	0.828	0.096
sigma_u	σ_u	0.401	0.133	1.127	0.212
sigma2	σ^2	0.369	0.077	1.957	0.367
lambda	λ	0.879	0.172	1.360	0.293
Likelihood-ratio test of sigma_u=0:		1.38		4.79	
chibar2(01) =					
Prob>=chibar2 =		0.120		0.014	
Log likelihood =		-183.04		-332.84	
Wald chi2(5) =		1385.85***		252.93***	
Average allocative efficiency		0.7470		0.4936	

Significance level: *=10%, **=5%, ***=1%

Source: AWO (2021) based on survey results

4.2. Estimation of technical, allocative and economic efficiency indices

The cost frontier made it possible to estimate and break down economic efficiency into its two components. The averages of the technical, allocative and economic efficiency indices by type of producer are given in Table 5. Table 5 shows that the average technical efficiency of maize producers is 72.49%. It could be said that producers have great control of maize production in northern Benin.

The degree of inefficiency of producers is 27.51%. Corn yield can then be increased by 27.51% at no additional cost.

The technical efficiency of FECECAM beneficiaries is higher than that of SIA'NSON microfinance beneficiaries (71.36%) and non-beneficiaries (71.74%). This explains why FECECAM beneficiaries are technically more efficient than SIA'NSON beneficiaries and non-beneficiaries. The file test carried out for the technical efficiency of the beneficiaries is significant

at 5% ($F=3.94$; $p=0.02$). This means that the technical efficiency of the beneficiaries depends on the access to credit and the credit granting structure. The average allocative efficiency of maize producers in the study area is 0.8391. Allocative efficiency is higher for SIA'NSON microfinance beneficiaries (0.99) than for FECECAM beneficiaries (0.76) and non-beneficiaries (0.72).

The allocative efficiency of credit recipients is higher than that of non-beneficiaries. The mean difference between the levels of allocative efficiency is positively significant at 1% ($F=830.56$; $p<0.001$).

These results therefore indicate that access to production credit had an influence on the beneficiaries of credit from MFIs who effectively allocated productive resources, unlike non-beneficiaries. The average economic efficiency for all the producers surveyed is 0.6063. There is greater economic efficiency for the beneficiaries of SIA'NSON microfinance (0.7418) compared to the beneficiaries of FECECAM and non-beneficiaries of credit. The mean of the efficacy scores is positively significant at the 1% level ($F= 224.89$; $p<0.001$). This means that the beneficiaries of the credit, in particular those of SIA'NSON microfinance, are more economically efficient in the production of maize than the non-beneficiaries. This is explained by their high allocative efficiency through obtaining agricultural credit for maize production.

Indeed, the beneficiaries of credit to SIA'NSON microfinance and FECECAM operate respectively on average 71.36% and 74.16% of their capacity. Their degrees of technical inefficiency are respectively 28.64% and 25.84%. Maize yield can then be increased by 28.64% for SIA'NSON microfinance beneficiaries and 25.84% for FECECAM beneficiaries at no additional cost. Credit recipients allocate on average 99.36% and 76.35% of resources in maize production respectively. Their degree of allocative inefficiency is 0.64% and 23.65%. The beneficiaries of SIA'NSON microfinance make an average of 74.18% of their savings while the beneficiaries of FECECAM make an average of 56.32% of their savings. Their degree of economic inefficiency is 25.82% and 43.68% respectively for the beneficiaries of SIA'NSON microfinance and FECECAM.

Table 5: Statistics of the different types of efficiency by category of producers and for the whole.

DESCRIPTION	FECECAM	SIAN'SON	Non-beneficiaries credit	Total
Technical efficiency	0.7416	0.7136	0.7174	0.7249
Allocative efficiency	0.7635	0.9936	0.7296	0.8391
Economic efficiency	0.5632	0.7418	0.5189	0.6063

5. Discussion

The estimation of the cost function was carried out by the cost frontier function of the Cobb-Douglass type. The estimated models are globally significant at 1%. The λ value greater than zero and significant at 1%. These results indicate that there is a presence of allocative inefficiency at the producer level. The λ values show that growers could achieve current yields with less input. Consequently, we retain that the variation in cost observed at the level of the production units studied is partly due to the effects of producer inefficiency. In estimating the stochastic production function, four variables are significantly different from zero to 1%. These are the quantities of family labor, seed, NPK fertilizers and urea. As for the estimation of the cost frontier function, the depreciation of equipment, the prices of fertilizers (NPK and urea) and herbicide and the cost of hired labor have positive and significant effects at 1 % on the cost of production. The results obtained through the estimation of efficiencies are consistent with those obtained by

Choukou et al. (2017) in maize production in the oases of Kanem. These authors have come to the conclusion that the efficiencies show that there are still reserves of productivity to be developed in order to increase the production of maize and increase the income of producers. They also reported that maize productivity growth will thus play a major role in the overall growth of the cereals sector in Africa.

Moreover, the average technical efficiency index in the study area is 0.72. This average is 0.74 for beneficiaries of credit to FECECAM; 0.713 for beneficiaries of credit to SIAN'SON microfinance and 0.717 for non-beneficiaries of credit. This explains why the beneficiaries of credit to FECECAM are more efficient than the other two categories of producers. It follows from this that the beneficiaries of credit to FECECAM are relatively very efficient and can serve as a reference for improving the productivity of maize in northern Benin through access to credit. Nevertheless, these FECECAM beneficiaries have possibilities of reducing production costs. This corroborates with the results obtained and the observations made by Biaou et al. (2021), Amoussouhoui and Arouna (2012).

The overall allocative efficiency score for the study area is 0.83 and is positively significant at only 1%. This score is 0.76 for beneficiaries of FECECAM credit; 0.99 for those of SIAN'SON microfinance (Awo and Ollabodé, 2022) and 0.72 for non-beneficiaries (Awo and Ollabodé, 2022). We note that the allocative efficiency score of the beneficiaries of the loan to SIAN'SON Microfinance is higher than that of the two other types of producers. This is explained by the fact that the beneficiaries of SIAN'SON Microfinance efficiently allocate resources in production than their counterparts. Efficient use of credit reduces production costs and increases returns for credit recipients. This result is contrary to that of Huynh and Mitsuyasu (2011) who found that soybean producers in Vietnam obtain more technical efficiency but poor in allocative efficiency. Our study also reveals that the average score of economic efficiency achieved by respondents in the study area is 60.63%. This result is relatively lower than that of headed cabbage producers (85.3%) in southern Benin obtained by Ahouangninou (2013) as well as that of tomato producers in Mymensingh (83%) in Pakistan obtained by Mitra, and Yunus (2018), and is close to that of producers in Greater Morelle (60.7%) in southern Benin obtained by Ahouangninou (2013), and maize producers in the oases of Kanem in Chad (Choukou et al (2017). The result is higher than that of Adékambi et al. (2010) who estimated at 0.42 the economic efficiency index of cashew nut production units in Benin, the average of which varied from 0.41 to 0.60 between classes. Indeed, the economic efficiency scores of credit recipients is higher than the score of non-credit recipients. In addition, the economic efficiency score of the beneficiaries of the SIAN'SON Microfinance loan (0.74) is higher than the scores of the beneficiaries at FECECAM (0.56) and non-beneficiaries (0.51). These results show that there are still potentials not yet valued in saving the cost of inputs and in maize production at the level of FECECAM beneficiaries and non-beneficiaries. Consequently, there are still productivity reserves to be developed in order to increase maize production and increase the incomes of FECECAM beneficiaries and non-beneficiaries. Improving their economic production efficiency requires access to adequate and suitable credit for non-beneficiaries, and strengthening credit services for FECECAM beneficiaries by multiplying training sessions. The establishment of a sustainable productivity improvement policy requires a good understanding of the conditions of access to agricultural credit according to the levels of efficiency.

6. Conclusion

This article analyzed and compared the effect of credit from FECECAM and SIAN'SON microfinance on the economic efficiency of maize production in northern Benin. Specifically, it was a question, on the one hand, of estimating the technical, allocative and economic efficiency indices of maize productivity and, on the other hand, of identifying the effect of the credit from

FECECAM and SIAN 'SON Microfinance on economic efficiency. It appears that the values of the estimated parameters which represent the elasticities of the unit variation of the prices of the inputs compared to the variation of the cost, shows that, the prices of herbicide, fertilizers (NPK and urea), depreciation and the cost of hired labor significantly influences the cost of maize production. The elasticities of the unit variation in the quantities of inputs in relation to the variation in yield show that the quantities of family labor, seeds, fertilizers (urea and NPK) significantly affect maize productivity. Indeed, access to credit contributes to improving the different levels of technical, allocative and economic efficiency of maize productivity in northern Benin. We note that the average of the efficiencies according to the financing structures is very significant at the 1% level. The average economic efficiency score of SIAN'SON microfinance beneficiaries is higher than those of the other two types of producers. We therefore deduce that the credit of SIAN'SON microfinance is economically efficient in the production of maize, consequently the credit of SIAN'SON microfinance would seem more adapted to the production of maize compared to that of FECECAM.

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