International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 41 No. 1 October 2023, pp. 138-153

Agribusiness Cluster Impact Analysis on Economics Efficiency of Soybean smallholders in Benin

Arouna ASSOUMA[1;] Epiphane SODJINOU[2;] Zakou AMADOU[3] and Jacob A. YABI[1]

1- Laboratoire d'analyse et de recherches sur les dynamiques Economiques et sociales (LARDES), Sociology and Rural Economy Department, Faculty of Agronomy, University of Parakou, Parakou, Benin

2- Faculty of Agronomy, University of Parakou, Parakou, Benin

3- Sociology and Rural Economy Department, Faculty of Agronomy, University of Tahoua, Tahoua, Niger

Abstract – The purpose of this study is to analyze the impact of agricultural clusters on the economic effectiveness of Benin's soybean smallholders. The questionnaire has been sent to a total of 360 of producers those belonging to an Agribusiness Cluster (ABC) and who do not participate. The invested producers were selected randomly. The data have been analyzed by the process of propensity scores matching (PSM), but before that the technical, allocative and economic efficiencies of these producers were estimated using the function of the stochastic borders. At the end of the analyses, the producers in the study area are average effectively at 53.64%. The results show that some of the method of estimating the ABC membership effect, the agribusiness cluster has a positive and significant positive effect on economic efficiency. So policies can be based on this tool in this perspective to make more produce producers globally. Keywords: Agribusiness Cluster (ABC); Economic efficiency; Pairing of propensity scores; Soybean

Keywords – Agribusiness Cluster (ABC); Economic efficiency; Propensity Score Matching (PSM); Soybean and Benin.

I. Introduction

Soybean has been a long time one of the largest agricultural products on the current global market (Jia et al., 2020). Soybean (Glycine Max (L.) Merr.) is not an indigenous culture in sub-Saharan Africa. It was introduced for the first time in sub-Saharan Africa by Chinese traders in the 19th century. (Khojely et al., 2018). Soy is a major cultivation of the world (Zinsou et al., 2015) and a source of food, protein and oil, that is why it is essential to conduct other researches in order to increase its performance in different conditions (Pagano & Miransari, 2016). In Benin, the production of soybean is constantly conquering other foreign markets (TOSSOU et al., 2023). According to the MAEP statistics, the roofing soy area is increased from 3648 ha to 203572 hars over the last twenty years. On the local market, soyaly came in the Beninese businesses, and the high protein value of its bypins produced by the population (Baris et al., 2016, Hounhouigan et al., 2020). Soybean is a legumenous that is a source of sustainable diet for humans and animals because it contains most nutrients. (Bambani et al., 2021). The soybean sector is selected in the National Food and Nutritional Investment Plan (PNASAN 2017-2021) and the Government of Action Program (PAG 2016-2021) in particular at the level of agricultural development poles (PDA) 2 and 4. This insurance of soybean is to contribute to food security and nutritional by generating additional incomes to small producers (Ministry of Agriculture, Foreign and Fisheries, 2019). Several studies focused on the impact of the Farming Contract on Food Security (Ndlovu et al., 2022); income (Ağir & Akbay, 2022a); The technical effectiveness of producers (Hariento et al., 2019a, Paltashingh & Jena, 2023A, Selim et al., 2023) and on the economic efficiency of farms ... Most studies have therefore been interested in the impact of the Farming Contract on several indicators as cited above. On the very victory work very little on the agribusiness cluster that is a particular form of Farming contract. This type of contract has the particularity of grouping producers and offering them services such as inputs, machine, technical support, training and facilitation to credit access. This research is therefore intended to analyze the impact of Agribusiness Clusters (ABC) on the economic efficiency of soybean production units in Benin. The small producers in the developing regions face a certain number of constraints that limit their productivity (Minot & Sawyer, 2016) which makes the levels of production too low, as well as growth rates of yields. (Cornelius & Goldsmith, 2019). In Benin, as in most countries in sub-Saharan Africa, the population continues to depend mainly from low productivity agriculture for its livelihoods and employment (Lihoussou & Limburg, 2022). Previous investigations have made it possible to diagnose the factors that hinder the implementation of this program, namely the insufficiency of financial resources and lack of lands and technical knowledge. (Magbondé et al., 2023). Agricultural activities are considered laborious work with low productivity and income, and their dependence on precipitation and low membership and capital advice make activities related to agriculture. (Akrong & Kotu, 2022, Sumberg & Okali, 2013, Yami et al., 2019). Access to Agricultural credits in the perpetuation of agricultural productivity is undeniable because it is a means of achieving optimal productivity (Taremaw et al., 2021). Agricultural mechanisms is the application of mechanical technology and increased power to agriculture to improve labor productivity and achieve results that exceed human capacity. (Mukasa et al., 2017). The agricultural sector of developing countries is characterized by low productivity, partly due to the low use of modern agricultural technologies and also very limited access to credit that is considered a major obstacle to the adoption of these technologies. (Balana & Oyeyemi, 2022). The agricultural mechanization to which farmers do not have access is essential to increase labor productivity and exploitation and add value to primary products. (Sims & Heney, 2017, Sims & Kienzle, 2016). Contracting Agriculture is defined as an agreement concluded before the plantation between a farmer and a buyer, whereby the farmer is committed to producing a specific product in a specific or non-manner and the buyer is committed to buying this product. The latter often involves the provision of key inputs in the form of credit and technical assistance to farmers (Minot & Sawyer, 2016, Swinnen & Maertens, 2007). The importance and impact of agribusiness and agri-food systems increase throughout the world and require special attention. (Valencia-Cárdenas et al., 2021). This importance is manifestly in many ways. One of them is that agri-food supply chains have become fundamental for food security around the world (Medina & Thomé, 2021). More and more companies and independent experts consider inclusive agribusiness industry is essential to achieve sustainable goals and fair development for small farmers (SchoneVeld, 2022). Small farm farms are essential for the production of foodstuffs and the maintenance of millions of livelihoods in developing countries (Garzón delvaux et al., 2020). A form of contractual agriculture, are subject to addressing market failures and to improve the adoption of technologies, productivity and well-being (Ragasa et al., 2018). This paper is structured as follows: The next section is dedicated to the methodology. After that come from the results that include socio-economic characteristics, the estimation of technical, allocative and economic efficiency. Then, the results from the proprecing scanning method will be presented still in this same section. Finally, the discussion, the conclusion and the political implications will be presented for the last section.

II. Methodology

2.1. Area of study

The exploratory phase, three common houses hosted as a soybean clusters were selected for this study. These three communes were chosen according to their level of soybean production. Thus a greater commune in soybean production, a community where the production of soybean is in the country average and finally a small silent producer. It should be noted that each of these three communities has agribusiness clusters soybean.

District	Production (ton)
Kandi	5 263
Nikki	23 687
Copargo	1 712
Bénin	**253 954**

Therefore, the communities of Nikki, Kandi and Copargo were identified for this study based on the criteria listed above. Two villages with soy clusters and a village without cure clips were selected for this study in each of these three communes. Concretely regarding villages, Biro is the clusterless village while Nikki Center and Danri are the locations with clusters in the town of Nikki. Sam and Kassakou are the clusters villages of the town of Kandi, while Sonsororo is the village No Agibusiness Cluster. Finally, in the commune of Copargo, the soil crusters of soy are found in the villages of Cana and Anandana. However, Pabégou is the only village in the town of Copargo not to have clusters of Soybean.

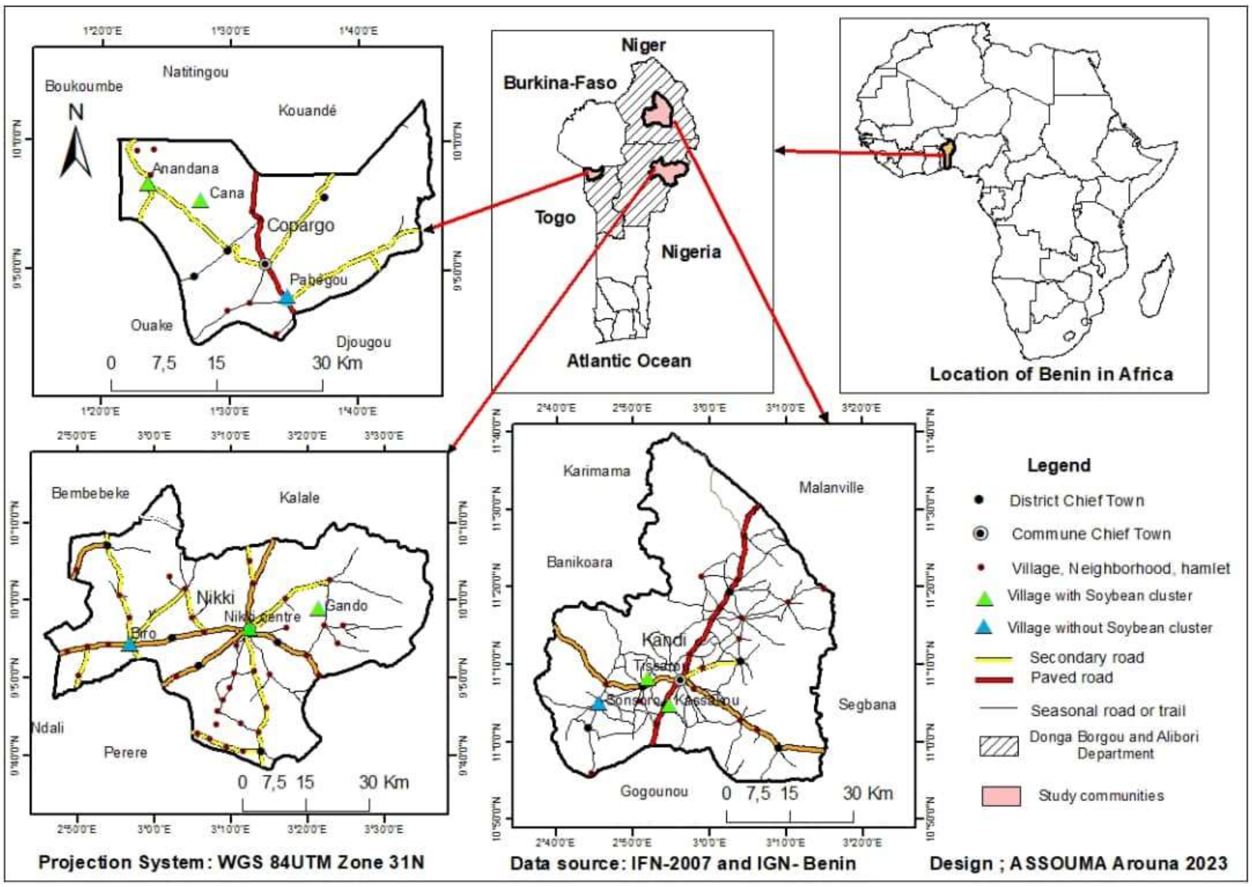

Figure 1: Map of area study

Table: Sharing of sample study

	Villages	Members of cluster	No member de cluster	Total
Nikki	Nikki centre	37	07	44
	Biro	00	38	38
	Gourou	22	16	38
Kandi	Tissarou	45	18	63
	Kassakou	30	15	45
	Sonsororo	00	12	12
Copargo	Cana	30	15	45
	Anandana	30	15	45
	Pabégou	00	30	30
Total		194	166	360

2.2. Data

The data collection is in two stages. First, an exploratory inquiry was made to identify villages and farmers who will participate in this study. Although primary and secondary data is used in this research, the vast majority of data used for analysis are primary data collected from households selected for the survey. Primary data include socio-economic data, income, costs and other factors in the study area. Primary data were collected through structured interviews with the Kobocollet application and group discussions.

2.3. Sampling

In their studies, Mathenge et al., (2020) and Hirpesa et al., (2021) and before them, Cochran's (1997) determines the size of the sample by the formula.

$$n = \frac{t^2 p(1-p)}{m^2} \qquad \text{(Eq. 1)}$$

Where n: Minimum sample size required to produce significant results T: level of trust (the value corresponding to a 95% confidence level is 1.96)

P is the estimated percentage of the population belonging to an ABC (when it is unknown, p (0.5, the correspond to the most unfavorable scenario, or the wider width).

m = Margin error (for example, we want to know the actual proportion to about 5%).

To determine the size of the sample of the study with a 95% confidence level and an error margin of 5%.

$$n = \frac{(1{,}96)^2(0{,}5)(1-0{,}5)}{(0{,}05)^2} = 384.$$

This study was conducted with 360 smallholder soybean producers, including 184 had contracts with aggregators and 176 did not. Data loss and non-responses have been a factor in reducing the size of the sample. The observation unit under this study is the soil-based exploitation of an agribusiness cluster. In the municipalities of the study area 59 to 75 producers belonging to an Agribusiness Cluster have been identified randomly. In this way, 45 to 61 soybean producers who participate in an agribusiness cluster were sample. A structured questionnaire was then administered individually to the household head by the Kobocollect application on smartphone.

2.4. Justification for the variables choice:

Age of smallholder: The age of farmers may have an influence on their participation in the ABC. The risks associated with this lack of management, however, could affect the dedication of the partner to the provisions of the contract. The young farmer has no risk aversion (Hirpesa et al., 2021, Mzyece et al., 2023, Sawadogo et al., 2020). The age is therefore taken into account for these reasons.

Input availability in the area: Small farmers who do not have access to production inputs can be inclined to participate in the ABC (Wossen et al., 2017). Today producers are more and turned towards intensive agriculture because of the production that is for the market. This state of the leads leads to adopting cultural practices with the use of agricultural inputs. The producer can therefore be inclined to belong to programs or politics in the sole purpose of having these inputs. **Education level**: A farmer who has formal education can adopt the ABC. Participation in the ABC is therefore related to education level (Hoang & Nguyen, 2023, Wossen et al., 2017). The producer with formal education includes priority the benefits of a program. Remember that the level of education has been seized here in the work in three categories: none, primary, secondary (1st and 2nd cycle) and higher.

Difficulty to sell of farm produce: The market plays an important role in production, without market-driven, production is not sense. Market access may decrease the probability of participation in ABC (Ruml & Qaim, 2020, Swain, 2018). A producer who has no guarantee of an outlet will be willing to participate in program that will offer it a market.

Sell-off: The sell-off is the fact for a farmer to sell his harvest at a lower price because he wants to cover certain expenses at the beginning of the harvest (Erl et al., 2023). The sell-off is a very sufficient reason for belonging to an agribusiness cluster because the sell-off is to generally solve problems at the beginning of the harvest. So a partnership in partnership that offers resources can be abandoned by this practice.

Location: Suggest the existence of fixed space effects that affect farmers' decisions to participate in the agri-food system in China (MA et al., 2021). It should be noted that here three regions (Nikki, Kandi and Copargo) were identified according to three levels of production. These three levels of production are: small, medium and large. The other very important thing to note is that the promotion of ABC is not made by the same actors. So there will be effects that will be due to the quality of implementation. Membership of a cooperative:

Participation to a cooperation: may allow the producer to have access to information on ABCs. In addition, the association is an easy entry door for the ABC (Hoang & Nguyen, 2023, Rokhani et al., 2020; Sawadogo et al., 2020).

Access to credit: The credit factor can encourage producers to take part in the ABC. The majority of farmers practicing contract agriculture had access to credit because the Contractors lent them seeds at the beginning of the agricultural season. During production, win-win relationships were established between farmers and contractors, as some Contractors have controlled production and supported farmers by organizing competitions in the form of field days (Dube-Takaza et al., 2022).

Experience in Agriculture: The farmers experience can increase their participation in the ABC (Chang et al., 2022, Hoang & Nguyen, 2023, Sodjinou et al., 2015). The experienced farmer who meets difficulties in the soybean production can participate in the ABCs. In the same way, this experience can lead it to not to share the ABC because of the bad experiences.

Gender: Men are land owners, have more factors of productions compared to women (Sawadogo et al., 2020, Sodjinou et al., 2015). The kind therefore influences the participation or not to the ABC. Here it was considered the household heads belonging to Agribusiness Cluster. What they are men or women.

Contact with agricultural service: Farmers who have received more extension visits over a year have a higher level of participation than those who have not received it (Abdul-Rahaman et al., 2022, Dube-Takaza et al., 2022). Farmers with agricultural extension have the intention of participating in the ABC because they have more information on this subject.

ABC Price: This variable is included in the model to determine if the ABC prices affected in one way or another accession to the ABC (Hirpesa et al., 2021). The price may be a motivation factor or not to adhere to the ABC. If the ABC despite the many benefits it offers producers do not practice a good price, this can lead producers not to participate to ABC.

Table 1: Justification of variables choice

Variables	Definition	Modality	Expect sign
Age	Age of smallholder	Continued variable	-/+
Access input	Access to input	Binary variables (1 if access and 0 otherwise)	+
Access market	Access to market	Binary variables (1 if access to market and 0 otherwise)	+/-
Sell-off	Sell-of	Binary variables (1 if sell-off market and 0 otherwise)	+
District	District of smallholder	Kandi (1= Yes et 0= No) ; Copargo (1= Yes et 0= No) ; Nikki (1= Yes et 0= No)	+/-
Cooperative membership	Belonging to cooperative	Binary variables (1 if belonging to cooperative 0 otherwise)	+
Credit Access	Access to agricultural credit	Binary variables (1 if access to agricultural credit and 0 otherwise)	+
Experience in agriculture	Year of experience in agricultural	Continued variable	-
Gender	Gender	Binary variable (O if female and 0 for male	+/-

Level Education	Level of education	Nothing (1= Yes et 0= No) ; Primary (1= Yes et 0= No) ; Secondary (1= Yes et 0= No) ; University (1= Yes et 0= No)	+
Price ABC	Price pratice by ABC	Continued variable	+
Area (ha)	Area	Continued variable	+
Subvention	Subvention	Binary variable (O if producer have subvention and otherwise)	+
Quantity ABC	Quantity sell to ABC	Continued variable	+/-
Vulgarisation	Contact with vulgarisation services	Binary variable (O if contact and 0 otherwise)	+

III. THE METHODS OF ESTIMATING THE EFFICIENCY

The literature classify the methods of estimating the border in three categories: the planned form of the border, the estimation technique used to obtain the border and depending on the nature and the properties supposed to the difference between the observed production and the production (Ocemilia, 1996, Debrueu, 1951; Koopmans, 1951).

Thus, according to the form of the border it can be distinguished two approaches to parametric and non-parametric parametric. With regard to the parametric approach, it has a function with explicit parameters (COBB-Douglas, these, translog,). By the disposal that non-parametric, the particularity of imposing any pre-established form at the border. These are the descriptive methods of non-parametric borders that use as the linear programming or quadratic programming as support. Both approaches differ primarily by resort resorts (Albouchi et al., 2005, Corelli et al., 1998).

As for the nature of the differences between the observed production and the maximum production differs the stochastic borders of the deterministic boundaries. Indeed, if it is assumed that the differences are explained solely by the inefficiency of the producer, the border is qualified as a deterministic nature. But by admitting that the differences are explained by both the inefficiency of the producer and by random elements which do not depend on the producer, it is then said that the border is of stochastic nature. In short, in the evaluation and estimation of the effectiveness of production Two main approaches are used: the non-parametric approach and the parametric approach (Albouchi et al., 2005, Amara & Roman, 2000, Pugoué et al., 2019). The estimation of efficiency makes it possible to determine the maximum output level that a production unit can obtain or alternatively to evaluate the maximum level of input that this unit can be limited to use in its different combinations. The efficiency level of an operation is therefore the deviation from the optimum, that is to say, its total potential. Indeed, in the technical efficiency, all the technical optimals is the production border. The efficiency level of production units on this border is equal to 1. These production units are effective effective hundred percent (Abikou et al., 2023, Amara & Roman, 2000, Selmint et al., 2023). Allocative efficacy is the maximum profit, choosing the least expensive method compared to the inputs in the only purpose of generating a given level of production. However, production units can maximize profits while distributing inputs in inefficient proportions, given the prices of inputs and outputs. A farm unit is considered efficiently on the non-competent plan if it produces a level of production given with the optimal combination of inputs given their prices (GNIZA, 2023; Kumbhakar & Wang, 2006, Omonona et al., 2010).

III.1. Method of modeling of technical, allocative and economic efficiency

Two approaches are used to estimate the technico-economic efficiency of producers: These are translog and cobb-douglas functions. The approach of the stochastic border of Cobb-Douglas-type functional was used in this study for the estimation of different efficiencies because the Likelihood Ratio test rejected the fact that the COBB-Douglas function is nested in Translog form (Bravo-Ureta et al., 2007). The general functional function of COBB-Douglas used in this study is as follows:

$$Ln(Y) = LnC + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + Vi - Ui$$

- ✓ **Technical efficiency**

As noted above, the COBB-Douglas function has also been used specifically for the estimation of technical efficiency.

Where i: represents the producer of soybean:

rend: the total production harvested (Kg / ha)

qsem: the quantity of seed used (kg / ha)

qnpk: the total amount of NPK used (kg / ha)

Quree: the total amount of urea used in (kg / ha)

qherb: the total amount of the herbicide used in L / ha

MO: The total amount of labor used in man-day / ha

vi: random variables out of the producers and are assumed to be independently and identically distributed. $\sigma^2 V[Vi \approx N(O, \sigma^2 u$ Independents des $U_i s$ UiS

Ui: Are-wide random variables not independently and identically distributed as a non-negative random, variable, the type distribution are the parameters to be estimated by the maximum likelihood method at the model. These parameters are the coefficients of the production border whose residues determined the technical efficiency indices and more precisely by the following formula defined by (Corelli et al., 1998, Selim et al., 2023).

✓ **Estimating the allocative efficiency indices**

$$Ln(CTAi) = \beta 0 + \beta 1 Ln(rendAi) + \beta 2 Ln(punqsemAi) + \beta 3 Ln(punqnpAi) + \beta 4 Ln(punqureeAi) + \beta 5 Ln(CFAi) + B6 Ln(punherbAi) + \ (Vi + Ui)$$

where i: represents the producer of soybean

ct: represents the total cost of soybean production (FCFA / ha); -

Rend: the physical production of soy (KG / ha); -

punqsem: the unit price of the soybean seed (FCFA / Kg)

PunqnPK: the unit price of the amount of NPK in (FCFA / Kg);

Punquree: the unit price of the amount of urea in (FCFA / Kg)

CF: the fixed cost of soybean production (FCFA / ha).

Punherb: The unit's cost of the herbicide

VI: Error term

Ui: allocative inefficiency term

β, are the parameters to be estimated by the maximum likelihood method at the model.

These parameters are the coefficients of the production border whose residues determined the allocative efficiency indices and more precisely by the following formula defined by (Coelli et al., 1998)

✓ **Estimation des indices d'efficacité économique**

Estimation of economic efficiency indices (EE) is therefore the product of technical efficiency and allocative efficiency (EA) given by the formula: $EE = ET * EA$

III.2. The method of propensity of score matching.

The purpose of this study that is to analyze the impact of ABC on the economic efficiency of soybean producers between experimental and quasi-experimental methods two impact methods for impact assessment exist to identify the result of an intervention or program, experimental and quasi-experimental methods. Experimental methods are critically criticized in literature. These reviews are mainly on: the effect of experimentation, the nature of the program offered, the composition of the participants and the behavior of non-participants (Heckman, 2010). The quasi-experimental or non-experimental method is an alternative to the experimental method that seeks to create a control group that is designated by counterfactual (Dillon, 2011, Winters et al., 2011, Wonde et al., 2022). As for the quasi-experimental method, several methods are used to know: the Propensity Score Matching (PSM), Difference-in-Difference (DID), Random Discontinuity Design (RDD), and Instrumental Variables (IV) Estimate. In this study, the PSM was preferred to other master's methods. Indeed, the DID is used when there is reference data during a baseline study. With regard to the RDD approach, this cannot be used as the ABC program has not been assigned taking into account an observable feature but it was voluntarily in the level of soybean producers. For instrumental variables, they are useful when considering the presence of endogeneity (Diallo & Ndiaye, 2022). So the PSM is the best-added method for this study because producers have voluntarily chosen to take part in Agribusiness Cluster (ABC) and it does not have available reference data. In this work, the Treaty Group is the producers who participate in the ABC and the counterfactual group consists of producers who do not participate in the ABC. There are several methods of pairing the propensity scores: the nearest neighbor, stratification and caliper. The nearest neighbor: This method is to appear a group participant with a control group participant taking into account the nearest nearly scope of the propensity. The matching can be done in two forms: with or without delivery. In the method without removal, during pairing unprocessed individuals are used only one time. On the other hand for the method with discount, individuals can be used more than once. This technique is preferred when the distribution of the propensity score is very different between the two groups (Smith & Todd, 2005). The stratification known under the English-class subclassification is used to avoid twice two too remote individuals known as the English subclassification. This method allows strata where the propensity scores are classified by intervals and the treated and unread treatment individuals are then paired within strata. The choice of stack size can be done freely, but Cochran & Chambers, (1965) and Imbens, (2004) show that the use of five strata is sufficient to control 95% of the bias. The stratification has disadvantage it generates more unpaired individuals than the nearest neighbor method. It then occurs a decrease in the size of the sample and therefore a loss of statistical power. The Calipper is the fact that a Control Group participant is related to a participant group participant based on the nearest area of propensity, subject to a certain maximum distance called the Caliper

IV. Results and discussion

Estimates from the stochastic border model are summarized in the table3. The model is globally significant at 1%. Results, it also occurs that the value of the likelihood parameter (LR = 28.24) is significant to 1%. This includes the hypothesis that there is no technical inefficiency in soy production is rejected in the study area. Also the table 3 indicates that the significant Lambda (λ = 2.36) also shows that the producer to a problem to be able to combine the factors of production. For estimating economic efficiency, this study uses the stochastic border method. This approach is also adopted by (Bidzakin et al., 2020, Chogou et al., 2017, Gniza, 2023; Hariento et al., 2019B, Houngue & Nonvidis, 2020, Paltashingh & Jena, 2023B) in estimating technical, allocative and economic efficiencies. As in this article, to assess the impact of agricultural contracts on the technical effectiveness of soybean producers in Ghana. In their work (SelmoM et al., 2023), (Ağir & Akbay, 2022B), (Mpeta et al., 2018), (Bellemare & Lim, 2018). After the estimation of efficiencies used the pairing of propensity scores to assess the impact of agricultural contract on income, food security and productive efficiency. According to these same results, variables such as the amount of seed, fertilizer, hands of work, insecticide, innoculum and the herbicide specific to the production of soybean are all significant to 1%. On the other hand, the capital is not significant by taking into account the parameters of this same model. Thus, the variables that fertilizer, labor, and insecticide will positively affect the production of soybean. But the innoculum factor at a negative and positive influence on soybean production in the study area. In addition, the technical effectiveness of each producers have been estimated and it follows that, in the mean, the technical effectiveness of the soybean producer is equal to 54% is to say in the combination of factors of production.

Table 2: Estimation of technical effectiveness µ

Ln(yield)	Coef.	Std.Err.	z	P>|z|
Ln(QSemen)	0.067	0.028	2.400	0.016
Ln(Engrais)	0.054	0.014	3.860	0.000
Ln(Capital)	0.005	0.034	0.170	0.865
Ln(Main d’œuvre)	0.317	0.024	13.500	0.000
Ln(QInno)	-0.067	0.024	-2.840	0.004

Ln(insec)	0.022	0.007	2.990	0.003
Ln(Hebicide)	0.682	0.038	18.080	0.000
_cons	6.789	0.324	20.980	0.000
/lnsig2v	-2.732	0.204	-13.360	0.000
/lnsig2u	-1.012	0.149	-6.780	0.000
sigma_v	0.255	0.026		
sigma_u	0.603	0.045		
sigma2	0.429	0.047		
lambda	2.364	0.064		
	Prob > X^2 =0.0000		Number of obs =360	
	sigma_u=0:Chibar2(01) =28.24		Prob>=chibar2=0.000	
Test	Wald chi2(6)=880.87		Log likelihood = -209.23659	

The results have shown that the herbicide, labor, workstand, innoculum and insecticide positively influence and sortly influence the. These results are in accordance with those of (Henningsen et al., 2015, Selim et al., 2023, Villano et al., 2015) that also find a positive effect of seed, fertilizer on soybean performance. As for (Azumah et al., 2016), the performance of the soybean production is impacted by the use of herbicide.

For the estimate of allocative efficiency, the summary is presented in Table 3. Responsible for the model is generally significant at the threshold of 1%. From the table, it appears that the variants that are herbicide, fertilizer and innoculum are the variables that significantly influence the production of soybean in the study area. The coefficients of the variables are: seed, herbicide, fertilizer, innoculum and employee employed represent the elasticities of these variables. In their work (Tidjani et al., 2022) align with the results of this article. According to the latter, the costs of labor and fertilizer affect significantly and positively the effectiveness of soy producers. Against their conclusion contradicted that of this work with regard to the influence of innoculum and seed. For them, these inputs have no influence on allocative efficiency. All the otherwise as part of this research. Indeed, the above variables have a significant influence on the production of soy respectively at the threshold of 1%. In addition, the sum of the elasticities is equal to 0.595. This value is less than 1, this indicates that the soil-interests of the study area have decreasing scale yields. This implies that a soybean producer of the study area will increase the cost of 0.595% as a whole increases its entire production facility simultaneously 1%. With regard to elasticities, an increase in the quantity of seed of 1% increases the amount of production of 0.5% every equal elsewhere. Also a 1% elevation of the quantities of fertilizers, herbicide, and innoculum will allow growth of soybean production by 0.031% respectively; 0.077%; 0.01%. On the other hand, an increase in the amount of labor of 1% will reduce the production of -0.022%.

Table 3: Estimation of allocative efficiency

Ln (Coût total)	Coef.	Std.Err.	Z	P>|z|
Ln (Engrais)	0.031	0.007	4.750	0.000
Ln (Herbicide)	0.077	0.010	7.350	0.000
Ln (Semence)	0.502	0.032	15.850	0.000
Ln (Innoculum)	0.020	0.007	2.910	0.004
Ln (Main d'œuvre)	-0.022	0.006	-3.470	0.001
Constante	5.752	0.386	14.890	0.000

/lnsig2v	-1.290	0.075	-17.250	0.000
/lnsig2u	-10.129	94.327	-0.110	0.914
sigma_v	0.525	0.020		
sigma_u	0.006	0.298		
sigma2	0.468	0.035		
lambda	0.010	0.326		
Prob>chi2	0.000	Wald chi2(4)	531.580	
Nombre d'observation	359	LR test of sigma_u=0: chibar2(01)	0	
Log likelihood	-277.783	Prob >= chibar2	1.000	

Estimation of propensity score matching

Before estimating the propensity scores, an Probit model of determinants of participation in agribusiness Cluster is first implemented. This probit model allows to conclude that variables such as: education, gender, experience in soybean production, membership of a cooperative and contact with the extension services are the factors that influence the participation of small soybean producers at the soybean agribusiness. The model shows a total significance at the 1% threshold and an adjusted square of 0.4579. After this match, the effect of treatment on treaties (ATT) was calculated according to the nearest neighbor, radius, Kernel and stratification methods. From the table, it appears that some of the method, the ATT is significant. Thus, for the nearest neighbor method, the ATT 3.907 is a significant at the 5% threshold. As for the methods of radius, Kernel and stratification means the treatments on treaties are respectively equal to 5.313 respectively 4.528 and 5.117 also at the 5% threshold. In fact, for the nearest neighbor method the effect of treatment on treaties is equal to 3.907, this stipulates that the ABC producers are more effectively efficiently from 3.907% than those who do not participate in the ABC. With regard to the radius method, sowing participants participating in soybean agricultural clusters improve their economic efficiency of 5.313% than those who refuse to take part. Then considering the Kernel method, the ABC improves the technico-economic efficacy of soy producers that belong to the soybean cluster soya of 4.528%. Finally, the economic efficiency of producers is improved by 5,117% when they choose to take part in agribusiness clusters by estimating efficiency by the stratification method. In short, the method used to calculate the average effect of the treatment, the latter increases by 3.907% to 5,117% for producers of agribusiness clusters. So it can be concluded that the Agribusiness Cluster is a tool that increases the economic efficiency of producers who take part in it.

Table 4: Estimation of Propensity Score Matching Probit regression

abc		Coef	Std. Err	z
Level of education				
Nothing		-0,493	0,713	-0,690
Primary		-0,071	0,711	-0,100
Secondary	First level	-0,131	0,747	-0,170
	Second level	0,303	0,782	0,390
Situation Matrimoniale				
Single		0,815	0,848	0,960
Maried		1,025	0,678	1,510
Divorced		-0,013	1,247	-0,010
Gender		0,967***	0,327	2,960

District			
Kandi	2,620***	0,406	6,450
Nikki	1,086***	0,360	3,020
Age	0,002	0,013	0,120
Expérience in soybean production	0,094**	0,044	2,110
Commerce comme activité principale	-1,104	0,749	-1,470
Member of Cooperative	3,025***	0,363	8,330
Contact with extension services	1,529***	0,303	5,040
Cons	-6,091	1,309	-4,650
Log likelihood	-112,085		
LR $chi^2(16)$	256,90		
Pseudo R^2	53,40%		
Nomber of observation	360		

Table 5: PSM estimation

Methods	Number of treat	Number of control	ATT	Std.Err.	t
NN	194	49	3,907	5,602	0,697**
Radius	194	127	5,313	3,401	1,563**
Kernel	194	140	4,528	3,717	1,218**
Stratification	194	140	5,117	3,637	1,407**

The results of this study show that producers who belong to the agricultural cluster are more effective than those who do not participate. (Maerten & Velde, 2017, Paltashingh & Jena, 2023B), (Sharma, 2016), (Mishra et al., 2017), (Saigenji & Zeller, 2009) and (Mpeta et al., 2018) align with the same conclusions.

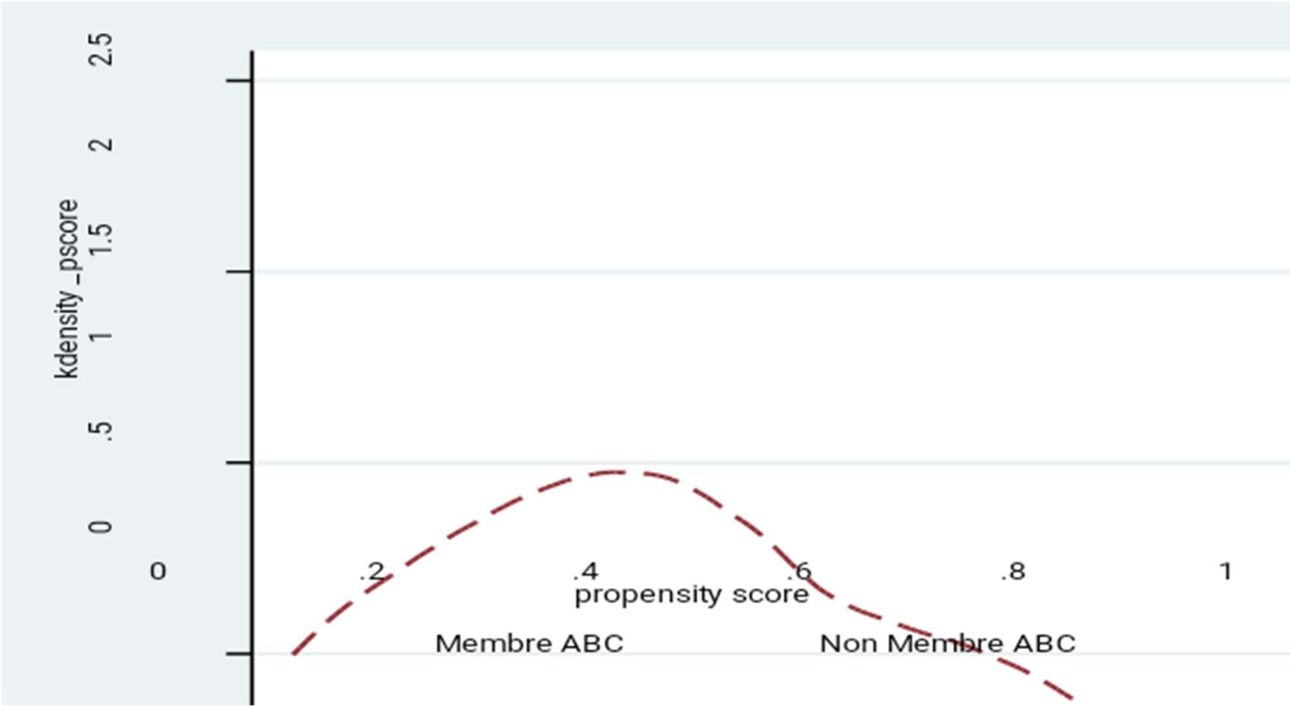

Figure 2 : Density curve of the core of the distribution of the propensity score before pairing.

The figure2 shows the density curve of the core of the distribution of the propensity score before pairing. So it appears that curves have the same trends that allows that all combinations of the characteristics of the treatment group can be observed also in the control group.

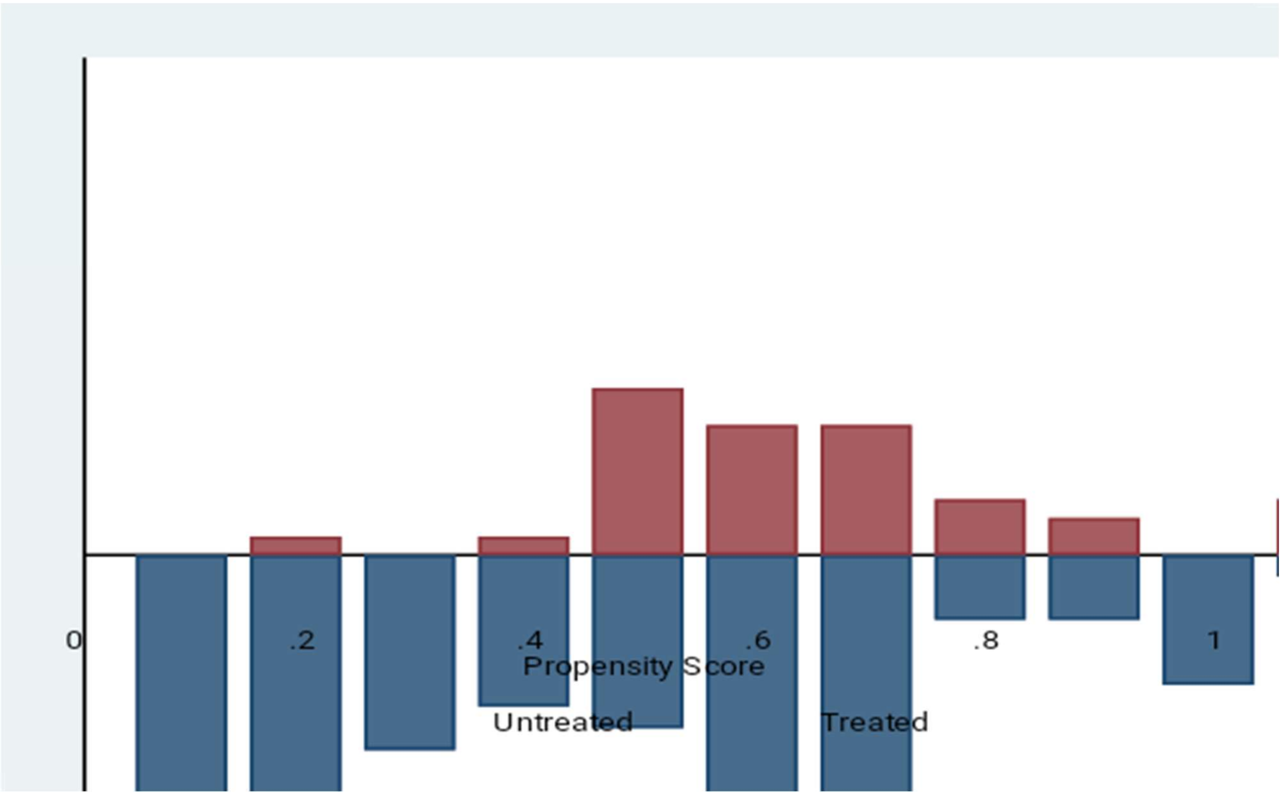

Figure 3 : Propensity score distribution

ISSN: 2509-0119

The figure illustrates the distribution of scores on the common support depending on whether the producers is a member or not from an agricultural cluster. Thus, the support obtained from this estimate varies from 0.001 to 0.999 with an average of 0.858 and a standard deviation of 0.331. This implies that farms with the propensity score is less than 0.001 and greater than 0.999 were not taken into account in the matching.

V. CONCLUSION

The ultimate goal of the producer is to maximize its profit. To achieve this, there is a number of ways to decide to adopt a new technology or to share part programs or projects. Among these, Agribusiness Cluster (ABC) is increasingly present in low-income countries and to help small producers. This article aims to analyze the impact of agribusiness clusters on the economic effectiveness of soybean producers in Benin. The results from the analyses have shown that the producers in the study area are economically effective at 53.64%. Also these results have shown that by the radius method to estimate the average effect of treating on treaties, soybean-sensories participating in soybean agricultural clusters improve their economic efficiency of 5.313% than those who refuse to take part. Then considering the Kernel estimation method, the ABC improves the technico-economic efficacy of soy producers that belong to the soybean cluster soya of 4.528%. Finally, the stratification method, the economic efficiency of producers is improved by 5,117% when they choose to take part in agribusiness clusters. In short, the ABC membership allows an improvement in the technological and economic efficacy of these production units. So agricultural policymakers can help explore this tool and even contribute to its quality implementation. But questions still stay like: what are the impact of ABCs producing who produce them? How can this tool (ABC) use in mitigation policies in climate change?

REFERENCES

[1]. Abikou, J. M., Gouwakinnou, J. Y., Sero, I. C., & Yabi, J. A. (2023). *Analyse de l'Efficacité Économique des Systèmes de Culture du Riz en Bas-fonds dans la Commune de Malanville, au Nord-Benin*.

[2]. Ağir, H. B., & Akbay, C. (2022a). Impact of Contract Farming on Beef Cattle Farmers' Income : A Propensity Score Matching Analysis. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*, *25*(2), 392-399.

[3]. Ağir, H. B., & Akbay, C. (2022b). Impact of contract farming on beef cattle farmers' income : A propensity score matching analysis. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*, *25*(2), 392-399.

[4]. Akrong, R., & Kotu, B. H. (2022). Economic analysis of youth participation in agripreneurship in Benin. *Heliyon*, *8*(1), e08738.

[5]. Albouchi, L., Bachta, M. S., & Jacquet, F. (2005). Estimation et décomposition de l'efficacité économique des zones irriguées pour mieux gérer les inefficacités existantes. *Les instruments économiques et la modernisation des périmètres irrigués*, 19-p.

[6]. Amara, N., & Romain, R. (2000). Mesures de l'efficacité technique : Revue de la littérature. *Centre de Recherche en Économie Agroalimentaire, Faculté des Sciences de l'Agriculture et de l'Alimentation, Université Laval, Série Recherche SR. 00.07*, 1-34.

[7]. Azumah, S. B., Donkoh, S. A., & Ehiakpor, D. S. (2016). Examining the determinants and effects of Contract Farming on Farm Income in the Northern Region of Ghana. *Ghana Journal of Science, Technology and Development*, *4*(1), 1-10.

[8]. Balana, B. B., & Oyeyemi, M. A. (2022). Agricultural credit constraints in smallholder farming in developing countries : Evidence from Nigeria. *World Development Sustainability*, *1*, 100012.

[9]. Bambani, R. C., Kombienou, P. D., & Yabi, J. A. (2021). Profitability and Technical Efficiency of Soybean Producers in the Municipality of Tanguiéta in Benin. *Agricultural Science*, *3*(2), p1-p1.

[10]. Baris, P., Lagandre, D., Gogan, A. C., Gandonou, M., & Afomasse, M. (2016). *Etude des filières soja et piscicole au Bénin*. Rapport final, dans le cadre de l'étude de faisabilité du Projet d'Appui au ….

[11]. Bellemare, M. F., & Lim, S. (2018). In All Shapes and Colors : Varieties of Contract Farming. *Applied Economic Perspectives and Policy*, *40*(3), 379-401. https://doi.org/10.1093/aepp/ppy019

[12]. Bidzakin, J. K., Fialor, S. C., Awunyo-Vitor, D., & Yahaya, I. (2020). Contract farming and rice production efficiency in Ghana. *Journal of Agribusiness in Developing and Emerging Economies*, *10*(3), 269-284.

[13]. Bravo-Ureta, B. E., Solís, D., Moreira López, V. H., Maripani, J. F., Thiam, A., & Rivas, T. (2007). Technical efficiency in farming : A meta-regression analysis. *Journal of productivity Analysis*, *27*, 57-72.

[14]. Chogou, S. K., Gandonou, E., & Fiogbe, N. (2017). Mesure de l'efficacité technique des petits producteurs d'ananas au Bénin. *Cahiers Agricultures*, *26*(2), 25004.

[15]. Cochran, W. G., & Chambers, S. P. (1965). The planning of observational studies of human populations. *Journal of the Royal Statistical Society. Series A (General)*, *128*(2), 234-266.

[16]. Coelli, T. J. (1996). *A guide to FRONTIER version 4.1 : A computer program for stochastic frontier production and cost function estimation*. CEPA Working papers.

[17]. Coelli, T. J., Rao, D. P., O'Donnell, C. J., & Battese, G. E. (1998). An Introduction To Efficiency Efficiency. *Productivity and Risk Analysis in Turkish Banks: A Bootstrap DEA Approach*, *129*.

[18]. Cornelius, M., & Goldsmith, P. (2019). The state of soybean in Africa : Soybean yield in Africa. *farmdoc daily*, *9*(221).

[19]. Debreu, G. (1951). The coefficient of resource utilization. *Econometrica: Journal of the Econometric Society*, 273-292.

[20]. DIALLO, M. A., & NDIAYE, I. (2022). Adoption de variétés améliorées de mil dans le Bassin arachidier du Sénégal : Déterminants et impact sur le rendement et le bien-être. *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, *10*(1).

[21]. Dillon, A. (2011). Do differences in the scale of irrigation projects generate different impacts on poverty and production? *Journal of Agricultural Economics*, *62*(2), 474-492.

[22]. Garzón Delvaux, P. A., Riesgo, L., & Gomez y Paloma, S. (2020). Are small farms more performant than larger ones in developing countries? *Science Advances*, *6*(41), eabb8235. https://doi.org/10.1126/sciadv.abb8235

[23]. Gniza, I. D. (2023). Analyse de l'efficacité allocative des ressources utilisées dans les petites exploitations de riz de bas-fond au centre-ouest de la Côte d'Ivoire. *African Journal of Agricultural and Resource Economics*, *17*(4), 287-297.

[24]. Harianto, H., Kusnadi, N., & Paramita, D. A. (2019a). The impact of vertical integration intensity on broiler farms technical efficiency : The case of contract farming in West Sumatera. *Tropical Animal Science Journal*, *42*(2), 167-174.

[25]. Harianto, H., Kusnadi, N., & Paramita, D. A. (2019b). The impact of vertical integration intensity on broiler farms technical efficiency : The case of contract farming in West Sumatera. *Tropical Animal Science Journal*, *42*(2), 167-174.

[26]. Heckman, J. J. (2010). Building bridges between structural and program evaluation approaches to evaluating policy. *Journal of Economic literature*, *48*(2), 356-398.

[27]. Henningsen, A., Mpeta, D. F., Adem, A. S., Kuzilwa, J. A., & Czekaj, T. G. (2015). *A meta-frontier approach for causal inference in productivity analysis : The effect of contract farming on sunflower productivity in Tanzania*.

[28]. Hirpesa, M., Legesse, B., Haji, J., & Bekele, K. (2021). Determinants of Participation in Contract Farming Among Smallholder Dairy Farmers : The Case of North Shewa Zone of Oromia National Regional State, Ethiopia. *Sustainable Agriculture Research*, *10*(1), 10-19. https://doi.org/10.22004/ag.econ.309795

[29]. Houngue, V., & Nonvide, G. M. A. (2020). Estimation and determinants of efficiency among rice farmers in Benin. *Cogent Food & Agriculture*, *6*(1), 1819004.

[30]. Hounhouigan, M. H., Kounouewa, K. M., Ayesiga, C., & Ingenbleek, P. T. (2020). Sojagnon : Shaping the Beninese soy system to meet the challenges of an emerging market. *International Food and Agribusiness Management Review*, *23*(1), 143-156.

[31]. Imbens, G. W. (2004). Nonparametric estimation of average treatment effects under exogeneity : A review. *Review of Economics and statistics*, *86*(1), 4-29.

[32]. Jia, F., Peng, S., Green, J., Koh, L., & Chen, X. (2020). Soybean supply chain management and sustainability : A systematic literature review. *Journal of Cleaner Production*, *255*, 120254. https://doi.org/10.1016/j.jclepro.2020.120254

[33]. Khojely, D. M., Ibrahim, S. E., Sapey, E., & Han, T. (2018). History, current status, and prospects of soybean production and research in sub-Saharan Africa. *The Crop Journal*, *6*(3), 226-235.

[34]. Koopmans, T. (1951). *Activity analysis of production and allocation*.

[35]. Kumbhakar, S. C., & Wang, H.-J. (2006). Pitfalls in the estimation of a cost function that ignores allocative inefficiency : A Monte Carlo analysis. *Journal of Econometrics*, *134*(2), 317-340.

[36]. Lihoussou, M., & Limbourg, S. (2022). Towards a sustainable production of maize and soybean in the department of Borgou. *Cleaner Logistics and Supply Chain*, *4*, 100039.

[37]. Maertens, M., & Velde, K. V. (2017). Contract-farming in staple food chains : The case of rice in Benin. *World Development*, *95*, 73-87.

[38]. Magbondé, K. G., Mignouna, D., Manyong, V., Adéoti, R., & Sossou, A. O. (2023). Impact of informal institutions on youth agribusiness participation in Southern Benin. *Agricultural and Food Economics*, *11*(1), 11.

[39]. Mathenge, M., Sonneveld, B. G., & Broerse, J. E. (2020). A spatially explicit approach for targeting resource-poor smallholders to improve their participation in agribusiness : A case of nyando and vihiga county in Western Kenya. *ISPRS International Journal of Geo-Information*, *9*(10), 612.

[40]. Medina, G., & Thomé, K. (2021). Transparency in global agribusiness : Transforming Brazil's soybean supply chain based on companies' accountability. *Logistics*, *5*(3), 58.

[41]. Ministère de l'Agriculture, de l'Elevage et de la Pêche. (2019). *Programme National de Développement de la Filière Soja 2019—2021*.

[42]. Minot, N., & Sawyer, B. (2016). Contract farming in developing countries : Theory, practice, and policy implications. *Innovation for inclusive value chain development: Successes and challenges*, 127-155.

[43]. Mishra, A. K., Khanal, A. R., & Pede, V. O. (2017). Is direct seeded rice a boon for economic performance? Empirical evidence from India. *Food Policy*, *73*, 10-18. https://doi.org/10.1016/j.foodpol.2017.08.021

[44]. Mpeta, D., Kuzilwa, J., & Sebyiga, B. (2018). Analysis of contract farming effects on efficiency and productivity of small-scale sunflower farmers in Tanzania–a propensity score method approach. *Acta Scientiarum Polonorum. Oeconomia*, *17*(1), 75-84.

[45]. Mukasa, A. N., Woldemichael, A. D., Salami, A. O., & Simpasa, A. M. (2017). Africa's agricultural transformation : Identifying priority areas and overcoming challenges. *Africa Economic Brief*, *8*(3), 1-16.

[46]. Ndlovu, P. N., Thamaga-Chitja, J. M., & Ojo, T. O. (2022). Impact of value chain participation on household food insecurity among smallholder vegetable farmers in Swayimane KwaZulu-Natal. *Scientific African*, *16*, e01168.

[47]. Omonona, B. T., Egbetokun, O. A., & Akanbi, A. T. (2010). Farmers Resource—Use and Technical Efficiency in Cowpea Production in Nigeria. *Economic Analysis and Policy*, *40*(1), 87.

[48]. Pagano, M. C., & Miransari, M. (2016). 1—The importance of soybean production worldwide. In M. Miransari (Éd.), *Abiotic and Biotic Stresses in Soybean Production* (p. 1-26). Academic Press. https://doi.org/10.1016/B978-0-12-801536-0.00001-3

[49]. Paltasingh, K. R., & Jena, P. K. (2023a). Does contract farming enhance farm efficiency? A case of wheat growers of Haryana, India. *Heliyon*, *9*(4).

[50]. Paltasingh, K. R., & Jena, P. K. (2023b). Does contract farming enhance farm efficiency? A case of wheat growers of Haryana, India. *Heliyon*, *9*(4).

[51]. Pougoué, E. B. S., Manu, I., Labiyi, I. A., & Bokossa, T. (2019). Efficacité technique des exploitations avicoles productrices d'øeufs au sud du Bénin. *Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux*.

[52]. Ragasa, C., Lambrecht, I., & Kufoalor, D. S. (2018). Limitations of contract farming as a pro-poor strategy : The case of maize outgrower schemes in upper west Ghana. *World Development*, *102*, 30-56.

[53]. Saigenji, Y., & Zeller, M. (2009). *Effect of contract farming on productivity and income of small holders : The case of tea production in north-western Vietnam*.

[54]. Schoneveld, G. C. (2022). Transforming food systems through inclusive agribusiness. *World Development*, *158*, 105970.

[55]. Selorm, A., Sarpong, D. B. S., Egyir, I. S., Mensah Bonsu, A., & An, H. (2023). Does contract farming affect technical efficiency? Evidence from soybean farmers in Northern Ghana. *Agricultural and Food Economics*, *11*(1), 1-22.

[56]. Sharma, N. (2016). *Determining Growers' Participation in Contract Farming in Punjab*. *2*.

[57]. Sims, B., & Heney, J. (2017). Promoting Smallholder Adoption of Conservation Agriculture through Mechanization Services. *Agriculture*, *7*(8), Article 8. https://doi.org/10.3390/agriculture7080064

[58]. Sims, B., & Kienzle, J. (2016). Making Mechanization Accessible to Smallholder Farmers in Sub-Saharan Africa. *Environments*, *3*(2), Article 2. https://doi.org/10.3390/environments3020011

[59]. Smith, J. A., & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of econometrics*, *125*(1-2), 305-353.

[60]. Sumberg, J., & Okali, C. (2013). Young people, agriculture, and transformation in rural Africa : An" opportunity space" approach. *Innovations: Technology, Governance, Globalization*, *8*(1), 259-269.

[61]. Swinnen, J. F., & Maertens, M. (2007). Globalization, privatization, and vertical coordination in food value chains in developing and transition countries. *Agricultural economics*, *37*, 89-102.

[62]. Taremwa, N. K., Macharia, I., & Bett, E. (2021). Characterization of smallholder farmers and agricultural credit institutions in Rwanda. *African Journal of Food, Agriculture, Nutrition and Development*, *21*(1), 17343-17364.

[63]. Tidjani, N., Zakari, F. T., Ollabode, N., & Yabi, J. A. (2022). Evaluation de l'effet de l'innovation sur l'efficacité économique de la productionde soja dans le Borgou au Nord du Bénin. *International Journal of Accounting, Finance, Auditing, Management and Economics*, *3*(6-2), 1-19.

[64]. Tossou, B. W., Chogou, S. K., & Sossou, C. H. (2023). Analysis of the competitiveness of soybean production in Benin. *Scientific African*, *19*, e01491.

[65]. Valencia-Cárdenas, M., Restrepo-Morales, J. A., & Día-Serna, F. J. (2021). Big Data Analytics in the Agribusiness Supply Chain Management. *Aibi revista de investigación, administración e ingeniería*, *9*(3), 32-42.

[66]. Villano, R., Bravo-Ureta, B., Solís, D., & Fleming, E. (2015). Modern rice technologies and productivity in the Philippines : Disentangling technology from managerial gaps. *Journal of Agricultural Economics*, *66*(1), 129-154.

[67]. Winters, P., Maffioli, A., & Salazar, L. (2011). Introduction to the special feature : Evaluating the impact of agricultural projects in developing countries. *Journal of Agricultural Economics*, *62*(2), 393-402.

[68]. Wonde, K. M., Tsehay, A. S., & Lemma, S. E. (2022). Training at farmers training centers and its impact on crop productivity and households' income in Ethiopia : A propensity score matching (PSM) analysis. *Heliyon*, *8*(7).

[69]. Yami, M., Feleke, S., Abdoulaye, T., Alene, A. D., Bamba, Z., & Manyong, V. (2019). African rural youth engagement in agribusiness : Achievements, limitations, and lessons. *Sustainability*, *11*(1), 185.

[70]. Zinsou, V. A., Afouda, L. A. C., Zoumarou-Wallis, N., Dossou, L., Gomez, J., Soumaïla, F., Afloukou, F., & Kotchofa, R. (2015). Importance of cowpea mild mottle virus on soybean (Glycine max) in Benin and effect of planting date on soybean (G. max) virus level in northern Benin. *Crop Protection*, *72*, 139-143. https://doi.org/10.1016/j.cropro.2015.03.006