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

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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, soyalu came in the Beninese businesses, and the high protein value of its byproducts 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
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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 (Lihousou & 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 propercscanning 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.

<table>
<thead>
<tr>
<th>District</th>
<th>Production (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kandi</td>
<td>5 263</td>
</tr>
<tr>
<td>Nikki</td>
<td>23 687</td>
</tr>
<tr>
<td>Copargo</td>
<td>1 712</td>
</tr>
<tr>
<td>Benin</td>
<td>253 954</td>
</tr>
</tbody>
</table>

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 Agribusiness Cluster. Finally, in the commune of Copargo, the soil clusters 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

<table>
<thead>
<tr>
<th>Villages</th>
<th>Members of cluster</th>
<th>No member de cluster</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nikki</td>
<td>Nikki centre</td>
<td>37</td>
<td>07</td>
</tr>
<tr>
<td>Biro</td>
<td>00</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Gourou</td>
<td>22</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Kandi</td>
<td>Tissarou</td>
<td>45</td>
<td>18</td>
</tr>
<tr>
<td>Kassakou</td>
<td>30</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Sosororo</td>
<td>00</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Copargo</td>
<td>Cana</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Anandana</td>
<td>30</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pabégou</td>
<td>00</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td>166</td>
<td></td>
</tr>
</tbody>
</table>
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.

\[ n = \frac{T^2 p(1-p)}{m^2} \]  

(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 Kobocollet 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 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.
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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

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

\[ \ln(Y) = \ln(C) + \beta_1 \ln(X_1) + \beta_2 \ln(X_2) + \beta_3 \ln(X_3) + V_i - U_i \]

✓ 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 \( U_i \) and \( U_i S \)

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 (Coelli et al., 1998, Selim et al., 2023).

✔ Estimating the allocative efficiency indices

\[
\ln(CTAi) = \beta_0 + \beta_1 \ln(\text{rendAi}) + \beta_2 \ln(\text{punqsemAi}) + \beta_3 \ln(\text{punqnpAi}) + \beta_4 \ln(\text{punqureeAi}) + \beta_5 \ln(\text{CFAi}) + \\
\beta_6 \ln(\text{punherbAi}) + (Vi + Ui)
\]

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
\( \beta, \) 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: \( EE = ET \times EA \)

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,
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.

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 ($\lambda = 2.36$) 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, inoculum 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 inoculum 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.

### IV. RESULTS AND DISCUSSION

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| 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|
The results have shown that the herbicide, labor, workstand, inoculum 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 inoculum are the variables that significantly influence the production of soybean in the study area. The coefficients of the variables are: seed, herbicide, fertilizer, inoculum 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 inoculum 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 0.031% every equal elsewhere. Also a 1% elevation of the quantities of fertilizers, herbicide, and inoculum will allow growth of soybean production by 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 |
Estimation of propensity score matching

Before estimating the propensity scores, a 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

<table>
<thead>
<tr>
<th>abc</th>
<th>Coef</th>
<th>Std. Err</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nothing</td>
<td>-0.493</td>
<td>0.713</td>
<td>-0.690</td>
</tr>
<tr>
<td>Primary</td>
<td>-0.071</td>
<td>0.711</td>
<td>-0.100</td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First level</td>
<td>-0.131</td>
<td>0.747</td>
<td>-0.170</td>
</tr>
<tr>
<td>Second level</td>
<td>0.303</td>
<td>0.782</td>
<td>0.390</td>
</tr>
<tr>
<td>Situation Matrimoniale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>0.815</td>
<td>0.848</td>
<td>0.960</td>
</tr>
<tr>
<td>Married</td>
<td>1.025</td>
<td>0.678</td>
<td>1.510</td>
</tr>
<tr>
<td>Divorced</td>
<td>-0.013</td>
<td>1.247</td>
<td>-0.010</td>
</tr>
<tr>
<td>Gender</td>
<td>0.967***</td>
<td>0.327</td>
<td>2.960</td>
</tr>
</tbody>
</table>
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, Paltasingh & Jena, 2023B), (Sharma, 2016), (Mishra et al., 2017), (Saigenji & Zeller, 2009) and (Mpeta et al., 2018) align with the same conclusions.
The figure 2 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.

The figure 3 shows the propensity score distribution.
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


Agribusiness Cluster Impact Analysis on Economics Effectiveness of Soybean Producers in Benin


