



TECHNICAL ASSISTANCE AND RURAL EXTENSION (TARE): EVALUATION OF PUBLIC SERVICE PROVIDERS IN BRAZIL

ASSISTÊNCIA TÉCNICA E EXTENSÃO RURAL: UMA AVALIAÇÃO DOS PRO- VEDORES DE UM SERVIÇO PÚBLICO NO BRASIL

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Resumo

Este estudo objetivou avaliar o desempenho das empresas que realizam o serviço de Assistência Técnica e Extensão Rural (ATER) no Projeto Bahia Produtiva, no Estado da Bahia, por meio da metodologia da Análise Envoltória de Dados (DEA). 24 empresas que oferecem o serviço de ATER foram avaliadas; destas, seis (n=6) apresentaram nível máximo de eficiência e cinco (n=5) foram classificadas como ineficientes. As empresas restantes (n=11) devem ter um melhor desempenho para aumentar sua eficiência. Em geral, este estudo revela quais os prestadores dos serviços de ATER ficam aquém do desejável em termos de eficiência na utilização dos recursos transferidos permitindo, conseqüentemente, que as próprias empresas prestadoras do serviço, órgãos financiadores e o governo do Estado possam tomar decisões baseadas nestes achados.

Palavras-chave

Assistência Técnica. Extensão Rural. Agricultura Familiar. Avaliação de Eficiência. Análise Envoltória de Dados.

Abstract

This study aimed to evaluate the performance of the agencies that conducted Technical Assistance and Rural Extension (TARE) services in the Bahia Produtiva Project, by means of Data Envelopment Analysis (DEA) methodology, in the State of Bahia, Northeast region of Brazil. Twenty-four (n=24) companies that offered TARE services were analyzed, and among these, eight (n=8) reached a maximum efficiency level and five (n=5) were classified as inefficient. The remaining companies (n=11) should present better performance in order to increase their efficiency level. In conclusion, this study reveals which TARE service providers demonstrated inadequacy in terms of what is desirable for efficiency in the use of transferred resources, and thus allowing the service providers themselves, financing agencies and the state government to make decisions based on these findings.

Keywords

Technical Assistance. Rural Extension. Family Farming. Efficiency Evaluation. Data Envelopment Analysis.

INTRODUCTION

The World Bank Group (WB), founded in 1944 at the Bretton Woods Monetary Conference, is constituted from five institutions: International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), International Finance Corporation (IFC), Multilateral Investment Guarantee Agency (MIGA) and International Center for Settlement of Investment Disputes (ICSID).



Since its foundation, the World Bank Group has financed infrastructure projects in several countries aiming to eradicate poverty. For this purpose, objectives such as the construction of dams, electrical networks, and irrigation systems were defined.

In Brazil's case, studies by the United Nations (UNIDAS BRASIL, 2019) and the World Bank (THE WORLD BANK, 2019) indicate that the WB granted more than 430 financing endowments, including donations and guarantees, which add up to almost US \$50 billion. The studies also show that, in 2019, the Bank made available around US\$ 3 billion annually in new funds, in addition to acting in programs such as the Bolsa Familia Program, in the fight against STDs, specifically SIDA and in operations to maintain the biodiversity in Amazon region.

In this context, one of the projects financed by WB in Brazil is the Sustainable Rural Development Project implemented in the state of Bahia and known as Bahia Produtiva Project.

This project was signed between the Government of the State of Bahia and the IBRD, it was carried out by a public company linked to the Secretariat for Rural Development (SDR) known as Regional Development and Action Company (CAR in Portuguese). Bahia Produtiva Project were financed without reimbursement for the social and productive inclusion of low-income communities in Bahia State, such as water supply and home sanitation.

In addition, the Project aimed in the institutional development of the beneficiaries based on the provision of the Technical Assistance and Rural Extension (TARE) service, which was carried out by companies or institutions that are interested in offering training and technical support to rural community agents. These TARE companies or institutions were hired by the Productive Organizations of Family Farmers as for the monitoring of the activities supported by the Bahia Produtiva Project.

For this Project, Bahia State was divided into 27 regions called “territory identity”. To ensure the achievement of the objective proposed, the Project had three operational components: I) Productive Inclusion and Market Access; II) Water Supply and Home Sanitation Systems; and III) Institutional Development, Technical Assistance and Project Management (CAR, 2019).

In Brazil, agriculture is a segment of great socioeconomic importance with a high diversity of community and practices. However, in some cases, rudimentary production techniques predominated for centuries, with little technological innovation and low-cost

labor.

Thus, the ‘Technical Assistance and Rural Extension’ policy emerged in Brazil in the 1940s aiming to ensure people to stay in the countryside through modernization and improvement of the agrarian environment, with the objective of increasing the raw material production in the emerging industrial sector in the country and generating foreign exchange with exports. Since then, extension rural studies has been of great importance in Brazilian rural development (BRITO; OLIVEIRA; PETTAN, 2010; CASTRO, 2012). However, in spite the importance of the Technical Assistance and Rural Extension policy, most small family farmers continue to be marginalized and excluded from many public policies for rural development up today (OLIVEIRA; WEHRMANN; SAUER, 2015; MENDES; ASSIS, 2020).

In this sense, this study has as objective to answer the following research question: *which companies performed the Technical Assistance and Rural Extension (TARE) service in the Bahia Produtiva Project efficiently?* This question is justified by a gap in the project, whose performance assessments of TARE service are merely descriptive in the face of a considerable expenditure of resources financed by an international entity.

For this, the study aims to analyze the efficiency of execution of TARE service in Bahia Produtiva Project – the third project component. Therefore, Data Envelopment Analysis (DEA) – a mathematical programming technique commonly used to measure efficiency, once it allows comparing the technical efficiency of organizations or organizational units (Decision-Making Units – DMU) that operate in a similar environment and are characterized by having multiple inputs (inputs) and outputs (outputs) (BENITO *et al.*, 2019) – was the methodology used, once it contemplates the generation of an evaluation parameter of the companies and institutions that provide TARE service, aiming at presenting the losses and gains of resources used with the best and worst companies.

The efficiency of the TARE’s service depends on the service provider’s ability to meet the needs of rural producers. Thus, the relevance of this article is justified based on the importance of TARE service in a Brazilian context and the need to measure the efficiency of this type of service provided to better serve the beneficiary and, consequently, boost the country’s economic development.

Thus, the main contribution of this research is to show that, not only at Bahia Produtiva Project, but in other projects of this nature, the companies that provide the TARE service must be evaluated, in terms of efficiency, by an adequate index, since the



erroneous measurement of efficiency inhibits beneficiaries from receiving an efficient service. Furthermore, by measuring the service providers' efficiency, it is possible to funders to better allocate the resources and monitor the performance of providers. On the other hand, when receiving an efficient service, the beneficiary is more likely to participate in other TARE services and "spread the word" about the good service received. Consequently, the inputs of this research can help the authorities to develop better selection strategies for institutions providing TARE services and, as a result, improve the quality of beneficiaries.

In addition to this introduction, this article is structured as follows: section 2 will address the theoretical framework around the presentation of Bahia Produtiva Project related to other scientific studies. Section 3 refers to DEA methodology used for data analysis, whose discussion and analysis will be addressed in the next section (4). Finally, section 5, will present the final considerations of the study resulting from the references used (section 6).

BAHIA PRODUTIVA PROJECT

As stated by Pereira (2016), since its conception, the World Bank objective has undergone several considerable changes, which implied the union of several institutions that currently make up the World Bank Group (GAMEIRO; MARTINS, 2018). According to Cruz (2003) because the group operates in different sectors, countries and themes, it has, over the years, adopted concepts internationally used to define certain phenomena, such as the concept of "poverty", for example, proposing projects of different levels and segments covering agriculture, education, energy, finance, health, industry, information, communication, public administration, transport, water, sanitary waste, economic policy, management of environmental resources and human and gender development and social protection, in public and private spheres from the urban to the rural segment (THE WORLD BANK, 2019).

In addition, as claimed by Pereira (2016), since 1994s, the Bank has made viable operations involving the modernization of the technical base of agriculture, by adding land issues such as agrarian reform and resettlement policies. In general, the group's initiatives worldwide have contributed positively on issues related to visibility, participation and appreciation mainly of the countryside, providing different forms, degrees and incidence of modernization projects in agriculture (PEREIRA, 2016). These initiatives have



the objective of promoting new social organizations and rural entrepreneurship (VIEIRA, 2008) and, mainly, the increase in food production and, consequently, fight against hunger (GAMEIRO; MARTINS, 2018).

In urbanized countries such as in most of Latin America, the Caribbean, Europe and Central Asia, a possible way of reduction of rural poverty is through the strengthening of agricultural practices, such as the intermediary extinction between the producer and the final consumer. Other possibility bases in an incentive of technical qualification that would result in greater opportunities for producers to face the market competition (GAMEIRO; MARTINS, 2018).

In Brazil, the World Bank Group's activities take place mainly in projects creation for the rural area development, specifically in the Northeast region, whose individuals face serious problems of social inequality (GALVÃO, 2019). Thus, the government seeks to attract investments with the objective of eradicating poverty in the region and providing a better life quality through sustainable development actions (FIGUEIREDO, 2009; GALVÃO, 2019).

In this scenario, Bahia Produtiva Project was part of the strategy to promote sustainable rural development, with actions to promote production, agro-industry, commercialization and infrastructure improvement in the field, whose objectives include increasing the integration of products in the market, increasing revenue and guaranteeing food security for beneficiaries organized in associations and cooperatives, as well as improving access to water supply and sanitation services at home.

Among the beneficiaries of Bahia Produtiva Project, can be listed family farmers, solidarity economy entrepreneurs, indigenous peoples, communities of funds and pasture closures, quilombola communities and settled families of agrarian reform.

With the largest economy, territorial area and population in the Northeast region, approximately 14,873,064 inhabitants, and with vegetation characterized by tropical forest, coastal mangroves, scrub and woody pasture, Bahia State holds, in national terms, the fourth-largest population, the fifth-largest territorial extension and the sixth-largest economy, whose tourism activities occupy the second economic source of the State. However, Bahia concentrates the largest poor rural population in the country, where 60% of the population receives assistance from “Bolsa Familia Program” and 47% of the individuals do not have food security (IBGE, 2019; LIMA FILHO, 2019).

According to some project coordinators, through semi-structured interviews, Bahia Produtiva Project was signed in August 2014. The total value of the Project was US \$260 million, of which US \$150 million (58%) was financed by IBRD with a counterpart of US \$110 million (42%) granted by the State of Bahia. The project started its execution in 2015 and ended on March 2021. For the execution of the project, the Superintendence of Economic and Social Studies of Bahia carried out a study to verify the poverty levels of Bahia territory, considering five dimensions: education, health, income, housing, and demography. The regions that most presented a critical level relating to the typical absences or shortages of precarious living conditions of the populations were scored to be prioritized in the performance of the Bahia Produtiva Project.

Piot-Lepetit and Nzongang (2014) point out that the provision of financial assistance to low-income groups has a potential and positive effect on the economic and social development of the area served. Therefore, the authors point out that the lack of access to credit through the traditional financial system is one of the main reasons why in developing countries there are poor people.

As mentioned above, Bahia State was divided into 27 regions and, to ensure the achievement of the objective proposed by the project, Productive Bahia had three operational components: I) Productive Inclusion and Market Access; II) Water Supply and Home Sanitation Systems; and III) Institutional Development, Technical Assistance and Project Management (CAR, 2019).

For the execution of the actions foreseen in component III, companies and institutions were hired, through a selection process based on the qualifications of the consultant, to offer TARE service both for training and technical support of Rural Community Agents (RCAs), to be hired by the productive organizations of family farmers, as for the monitoring of the subprojects supported by the Bahia Produtiva Project (CAR, 2019).

The project coordinators informed, during the interviews, that in each of the 27 Bahia Identity Territories, there was only one institution contracted for TARE services for a period of 36 months. The main responsibilities of a TARE service provider were to train family farmers through technical assistance and to train a Local Community Agent to monitor the development of the project. This Agent, on the other hand, was a young person aged between 16 and 29 years old, with at least a high school diploma, who was hired to dedicate himself exclusively to serving the benefited families. TARE activities were based on I) technical visits; II) community meetings; III) training workshops and

monitoring of Agents and; IV) territorial seminars by representatives of the beneficiaries.

Family farming in Brazil is responsible for a large part of the food that “reaches the Brazilian table” (OLIVEIRA; WEHRMANN; SAUER, 2015). However, the strengthening of agriculture was faced for years with challenges to harmonize production, market demand and technology (MENDES; ASSIS, 2020). In this sense, TARE service has great importance in the country's rural development, especially when seeking to know the local natural and cultural potentials, to associate agriculture with other activities, contributing to the promotion of local sustainable development (MARTINS *et al.*, 2014; MENDES; ASSIS, 2020).

In Bahia Produtiva Project, technical visits were responsible for guiding the realization of agricultural practices to increase the production and productivity of crops and livestock, as well as to promote the sustainable management of natural resources with environmental protection (CAR, 2019). The “sustainable development” concept proposed in Bahia Produtiva Project aims to meet current needs without compromising the needs of future generations (GALVÃO, 2019; OLIVEIRA; LIBONI, 2019).

According to the definition by Luther and Gerhardt (2019), rural residents are classified as family farmers, extraction activity, artisanal fishermen, riverside dwellers, settlers and land reform campers, rural wagedworkers, “quilombolas”, “caíçaras”, forest peoples, caboclos among others who produce their material conditions of existence from work in rural areas. The authors (LUTHER; GERHARDT, 2019) point out that this “diversity” demands specific and differentiated education that starts to produce new discourses on rural development. In this sense, rural education seeks, within the countryside scenario with its identity, culture, practices and forms of socialization, the training of the individual so that he can perform activities inherent to the peasantry that returns in an increase in income generation and employment and in socioeconomic dynamism (BARROS *et al.*, 2016).

The project also defined some priority groups, among them: women, youth, indigenous people, “quilombolas” and pasture funds and closures. Relating to the main production chains of family farming were beekeeping, dairy cattle, goat farming, aquaculture and fishing, manioc crops, fruit, and oil seed cultivation (CAR, 2019).

To have access to the project, interested parties enrolled in the program in accordance with the launch of notices – Environmental and Market Access – which promote all from access to basic services, such as regular access to water and basic sanitation, to

greater opening to the market by cultivating the main production chains already mentioned. The project's execution flow was divided into several stages: the first comprises a selection process based on the expression of interest. Subsequently, there was the evaluation of municipal councils and territorial collegiate bodies and, if the proposal was approved in this instance, the next phase included a technical field visit carried out by CAR professionals. Finally, the last stage involved everything from the business planning phase – carried out by SEBRAE and CAR consultants for the preparation of business plans – to the effective implementation of the project.

The coordinator informed that by 2018, the project had 6,070 proposals submitted. Of these, 862 were selected prioritizing the categories of poverty in the region and priority groups, which sum up a total of R \$287.6 million (US \$7.19 million). Likewise, 465 Rural Community Agents (RCA) were contracted: 27 contracts with TARE service providers were signed, 102 technicians were put into the field and 32,416 families were assisted. Approximately 56,2 thousand people were benefited – 39 thousand in the production and market access inclusion component and 17,200 in the water supply and sewage system component. A total of 51,432 projects were assisted and a total of R \$10,340,131.58 was transferred.

Institutions that provided TARE service were assessed through quantitative and qualitative surveys of satisfaction conducted with direct beneficiaries and through indicators proposed by CAR. In July 2019, 2,625 families were randomly selected in 202 municipalities in Bahia to assess the impact of TARE service through interviews. In addition to assessing the impact of the service, the survey sought to describe the beneficiary audience and the evolution of the project. CAR, in turn, evaluates eight performance indicators for component III service in addition to satisfaction, namely: degree of execution performed versus planned, number of beneficiaries trained versus number of training, number of productive projects implemented versus number of farmers, number of access to conventional markets versus number of farmers, number of access to institutional markets versus number of farmers, number of clients who have accessed policies to strengthen family farming, number of trained Rural Community Agents (RCA) versus number of training and number of young people first job versus number of RCAs. Based on this information, CAR determines whether contracts are renewed or terminated.

As mentioned in the introduction to this article, the evaluation of TARE services was purely descriptive, considering the scope of the project and of a financing provided



by an international institution. In an attempt to optimize the evaluation of this service, which holds a large share of the responsibility for executing the project, this study proposes an analysis of these companies providing TARE service using Data Envelopment Analysis technique, which will be better described in the following section.

METHODOLOGICAL ASPECTS

This study is classified as descriptive, as it aims to analyze the efficiency of companies and institutions that provide TARE service in the Bahia Produtiva Project. As for the approach, the present research is characterized as quantitative. In agreement with Prodanov and Freitas (2013), research of a descriptive nature brings together as many elements as possible in the studied reality, allowing the researcher to go beyond the simple description by adding questions about the subject. Also, according to the authors, the quantitative approach translates opinions and information into numbers that can be statistically analyzed using various techniques.

In general, this study sought to evaluate the providers of a service offered in a component of a public project: TARE service. According to Ramos and Schabbach (2012), the evaluation of public projects is important for improving the efficiency of public spending, the quality of management and for publicizing government actions. Also, according to the authors, public assessments improve the decision-making process, envision the appropriate allocation of resources and promote accountability for the decisions and actions of government (RAMOS; SCHABBACH, 2012).

In this sense, as mentioned above, the data analysis technique chosen in this study is Data Envelopment Analysis (DEA). DEA is a deterministic and non-parametric technique that was developed to determine the relative efficiency of Decision-Making Units (DMUs) (ANDRADE, 2015; BENITO *et al.*, 2019; CASADO, 2007; SILVA, 2017; ULUCAN; ATICI, 2010). In these contexts, each TARE service provider in Bahia Produtiva Project can be considered as a DMU.

DEA was chosen because it provides the best practices to be followed to achieve efficiency in the service offered, in addition to setting goals for inefficient DMU, or inefficient TARE service providers (ANGULO-MEZA *et al.*, 2019).

The method has also the capacity to evaluate the efficiency of different sectors (ULUCAN; ATICI, 2010). For this, production frontiers are created for each DMU – it has the objective of evaluating the relative efficiency of operation production plans target

by each DMU, once it is assumed that similar technological processes are used to transform multiple inputs into multiple products. These frontiers are also considered as a reference source for the establishment of efficient goals for each DMU (BENITO *et al.*, 2019; CASADO, 2007).

DEA is capable of evaluating the efficiency of different sectors, both public and private (ULUCAN; ATICI, 2010). According to Silva (2017), it is important for companies to evaluate their performance relating to others in the same sector. In this sense, DEA methodology allows, through benchmarking, to identify the best practices that result in greater efficiency. Piot-Lepetit and Nzongang (2014) state that the concept of benchmarking is based on the principle that in a highly competitive environment only companies that manage to optimize their resources and results will survive, that is, those with high levels of performance. Applied in DEA, benchmarking can be defined as an action (or a process) of analyzing an entity within a sector – in this case, a company in the sector of TARE providers, for example – through comparisons, against a reference that represents the optimum performance point.

When using DEA, it is necessary to choose the orientation of the model, by input or output (CASADO, 2007). According to Sant'Anna (2002), the terms “input” and “output” have a broad meaning when used in DEA. Furthermore, for the application of DEA methodology, it is necessary to follow some protocols, such as the homogeneity of the DMUs, the minimum number of DMUs, the standard of selection of inputs and outputs, the data format, in addition to not accepting missing data (SILVA, 2017).

Among the various DEA application models, Silva (2017) points to two main ones: the CRS (Constant Returns to Scale), whose outputs are proportional to the inputs, that is, the model is linear and the VRS (Variable Returns to Scale), in which the scale return is variable, and the benchmarking is in curve format, that is, the outputs are not necessarily proportional to the inputs, or yet, the enhancement of the input does not immediately impact the optimization of the output, since the final result is supported according to the way in which the processing is conducted (FERRAZ *et al.*, 2019).

Thus, DEA differentiates itself among other performance analysis techniques by allowing, in addition to identifying more and less efficient DMUs, the frontiers for improving performance (CASADO, 2007; SANT'ANNA; 2002; SILVA, 2017). This frontier, or benchmark, is determined by the projection of inefficient DMUs at the efficiency frontier. The benchmark allows decision-making to be oriented towards inputs (which

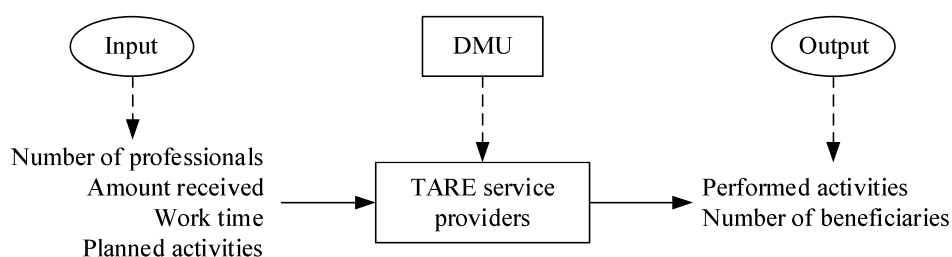
means minimizing them and maximizing or maintaining outputs) and outputs (when it is aimed at maximization of results with the maintenance of resources) (CASADO, 2007).

Casado (2007) uses a practical example to explain the fundamental assumption of DEA technique. The author argues that if a DMU called “A” manages to produce X (A) units from Y (A) inputs, then DMU “B” could have the same degree of execution if it meets the protocols, being homogeneous and being operating efficiently. The “A” DMU, in this case, would be the benchmark for the other DMU. In this sense, it is sought, for the Bahia Produtiva Project, to find out which companies are providing TARE service that are more efficient and forming the border and which ones are inefficient.

In this study, the data used come from secondary sources, more specifically from CAR, which has information about the execution of the 27 companies and institutions that provided TARE service. Data are from August 2019. The software used for this analysis was DEA-SOLVER (LV 8.0).

According to Figure 1, the independent variables (or inputs) of the proposed model here are: number of professionals available to perform TARE service, the amount received by them, the period of work – which may vary according to the selection of the submitted proposals – and the planned activities. DMUs are the respective 27 companies and institutions providing the service. Finally, the dependent variables (or outputs) are the activities performed and the number of beneficiaries of the service.

Figure 1 – Proposed model for efficiency analysis of the TARE service



Source: created by the authors (2021)

The model used in this study is the VRS (Variable Returns to Scale – Table 1), in which the return to scale is variable, and the benchmarking is in curve format (FERRAZ *et al.*, 2019). The orientation is relating to the output because it is desired to maximize, or obtain maximum efficiency, in the activities performed of TARE services and in the number of beneficiaries without reducing the number of professionals, the amount passed on

to the service providers, in the period of proposed work and complying with the schedule of planned activities.

ANALYSIS AND RESULTS DISCUSSION

This section seeks to discuss the results of the proposed model by analyzing through Data Envelopment Analysis. Of the 27 companies initially hired, only 24 will be present in the analysis due to missing data that make it impossible to apply the methodology.

Ulucan and Atici (2010) state that when a set of DMUs are evaluated, they are separated into two groups: the inefficient and the efficient ones. Also, according to the authors, the results for these groups vary, respectively, between 0 and 1. Therefore, these numbers indicate that either these DMUs do not perform identical activities or there are situations in which the input and output compositions exhibit wide variations in exogenous factors.

Initially, the results are shown in Table 1. Eight companies performed 100% TARE services, according to the inputs and outputs. Figure 2 illustrates the boundary of this representation of efficiencies regarding virtual inputs and outputs, that is, for each input and product a weight was assigned, and a weighted average was calculated and, therefore, it became possible to graphically represent the efficiency on a logarithmic basis (COSTA; MELLO; ANGULO-MEZA, 2016).

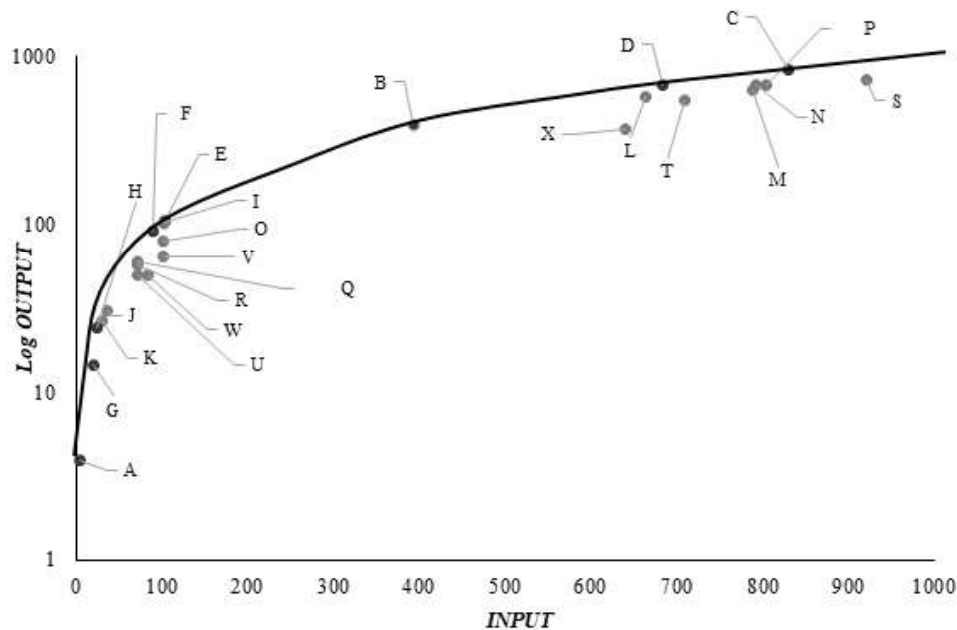
However, in the same classification of Table 1, there are clearances in two institutions. DEA makes it possible to identify, for each input and output, the consequent clearances, that is, the excess of inputs and products. Thus, although DEA presents eight companies that provide TARE service whose efficiency reaches 100%, the clearances can be used as a tiebreaker criterion to classify the institutions with stronger efficiency (that is, without any input and / or output slack) from institutions with weaker efficiency, that is, with surpluses (TORRES, 2017).

In this sense, companies A, B, C, D, E and F were the providers of TARE with strong efficiency. In other words, these six companies work within the borders of the “relative optimum point”, in which the expected results are achieved through the expenditure of inputs. On the other hand, companies G and H, despite achieving maximum efficiency, have input and output clearances.

Table 1 – DEA results including slacks values

RANK	COMPANY	EFFICIENCY	ISLACK		OSLACK			
			WORK TIME	AMOUNT RECEIVED	NUMBER OF PROFESSIONALS	PLANNED ACTIVITIES	NUMBER OF BENEFICIARIES	PERFORMED ACTIVITIES
1	A	100%	0	0	0	0	0	0
1	B	100%	0	0	0	0	0	0
1	C	100%	0	0	0	0	0	0
1	D	100%	0	0	0	0	0	0
1	E	100%	0	0	0	0	0	0
1	F	100%	0	0	0	0	0	0
1	G	100%	0	0	0	0.004	0.038	0
1	H	100%	0	1.158	0	0.004	0	0
9	I	98.73%	0.491	0	0	0	176.11	0
10	J	90.63%	0	0	0.923	0.004	508.53	0
11	K	88.61%	0	0	0	0.004	0	0
12	L	86.01%	1.293	0	1.556	0	0	0
13	M	84.57%	0.57	0	0	0	0	0
14	N	84.14%	2.076	0	0.015	0	184.058	0
15	O	84.02%	2.036	0	0.576	0	0	0
16	P	83.81%	0.804	0	0.673	0	0	0
17	Q	83.52%	0.03	0	0	0	0	0
18	R	82.79%	0	0	0	0.004	423.241	0
19	S	81.84%	0.587	0	0	0	0	0
20	T	77.58%	3.288	0	0.258	0	294.659	0
21	U	68.67%	1.147	0	0	0	0	0
22	V	65.75%	2.315	0	0.341	0	0	0
23	W	58.33%	0.976	0	0	0	181.822	0
24	X	56.75%	2.317	0	0.463	0	444.9	0

Source: created by the authors (2021)

Figure 2 – Traditional DEA two-dimensional representation

Source: created by the authors (2021)

According to Silva (2017), efficiency levels above 80% are considered sufficient, as with few improvements, it is expected that full efficiency will be achieved. For results below 77%, improvement proposals require greater complexity. In these cases, DEA methodology allows less efficient DMUs to make benchmark-based decisions (SANT'ANNA, 2002).

For each company with efficiency below “100%” there is a benchmark projection as a reference. In this present case, of the 24 companies that make up the analysis, 16 companies not reached the full efficiency level. Thus, in Table 2, the benchmark projections of these 16 companies are presented together with the projection of the amount of reference output for each one. In summary, for these companies to be 100% efficient, they should result in the output values of each one of the numbers presented in Table 2.

Table 2 – Benchmarks projection results'

DMU RANK	DMU	EFFICIENCY	BENEFICIARIES			PERFORMED ACTIVITIES		
			INITIAL QUANTITY	PROJECTION	DIFFERENCE (%)	FINAL QUANTITY	PROJECTION	DIFFERENCE (%)
9	I	98.73%	1174	1365	16%	347	351	1%
10	J	90.63%	1094	1716	57%	270	298	10%
11	K	88.61%	2700	3047	13%	252	284	13%
12	L	86.01%	1942	2258	16%	242	281	16%
13	M	84.57%	2156	2549	18%	254	300	18%
14	N	84.14%	1238	1655	34%	270	321	19%
15	O	84.02%	2580	3071	19%	261	311	19%
16	P	83.81%	1910	2279	19%	296	353	19%
17	Q	83.52%	2103	2518	19.731	240	287	20%
18	R	82.79%	1131	1789	19.731	245	296	21%
19	S	81.84%	1933	2362	19.731	294	359	22%
20	T	77.58%	950	1519	19.731	223	287	29%
21	U	68.67%	2078	3026	19.731	192	280	46%
22	V	65.75%	1525	2319	19.731	203	309	52%
23	W	58.33%	608	1224	19.731	153	262	71%
24	X	56.75%	544	1404	19.731	147	259	76%

Source: created by the authors (2021)

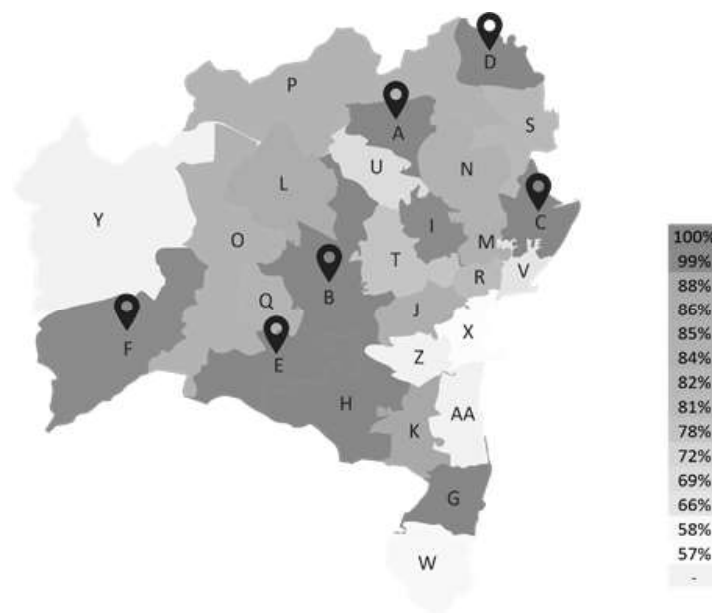
It can be seen, also in Table 2, that there were companies that with the same available resource (inputs) could have achieved better results in the respective outputs. Furthermore, in terms of outputs, one could have, from the improvement of the efficiency of each company, an increase between 16% to 34% of beneficiaries and from 1% to 76% of the quantity of activities carried out without changing the quantity of inputs from each of them. Therefore, this information has managerial implications for TARE service managers (CAR), as well as for the project financier (IBRD), since through DEA it is possible to set goals for adjustments in the result for each non-efficient company.

Figure 3 illustrates the results of DEA. The color gradient, starting with the most intense, represents the areas in which TARE providers perform their services most efficiently. As the color intensity decreases, the company's efficiency is lower. The six featured lots are the efficient ones without clearance. For the three lots, whose color on the scale is represented by a hyphen (“-”), there is an absence of data, as they terminated the

contract based on the performance analysis of TARE service, which is done descriptively on a monthly basis.

Based on the results presented, it can be considered that, in the study carried out with 27 companies, it has: a) six companies with 100% efficiency without slack and/or oslack (A, B, C, D, E and F); b) two companies with 100% efficiency with slack and/or oslack (G and H); c) 11 efficient companies, with results above 80% (I, J, K, L, M, N, O, P, Q, R and S) and frontiers projected; d) five inefficient providers (T, U, V, W and X), also with projection data for goals to improve project execution efficiency; e) and three companies not analyzed because they terminated the contract (Y, Z and AA).

Figure 3 – DEA efficiencies map



Source: created by the authors (2021)

FINAL CONSIDERATIONS

This study aimed to evaluate the efficiency of TARE service provided by 27 companies in order to offer training and technical support to the RCAs in Bahia Produtiva Project, in Brazil. These companies were submitted to DEA, which analyzed which one were more or less efficient and the benchmarks for each one that did not reach the maximum efficiency level.

DEA was used because it compares units that perform the same functions in order to identify the weaknesses of poorly evaluated systems for management intervention, in

the sense of their improvement (ANDRADE, 2015). Thus, in addition to the internal benchmark, DEA can be used to create external benchmarks, that is, to evaluate companies relating to the competition.

In total, 27 companies provided TARE service in Bahia Productive Project, but three of them, terminated the contract before the projects' end. Thus, 24 companies were analyzed through DEA. From these 24 companies, it was found that eight were efficient in using the available resources (inputs) obtaining the best result (outputs). However, among these eight companies, only six were considered in the tiebreaker criterion adopted, as those of strong efficiency. In summary, of the 24 executing companies, six companies made the best use of the execution time, amount received, number of professionals and activities planned to result in the number of beneficiaries served and the number of activities actually performed. The other non-efficient companies had notes on the projection of what would be expected as the number of beneficiaries served, as well as activities performed considering the inputs used by them.

In sum, DEA use allowed to understand that, within a project, the services' execution scope is standard, but the know-how is flexible to each company. Although, each DMU had different conditions to carry out its activities, DEA assigns different weights to each factor in the equation, evaluating, individually, each DMU and providing benchmarks from the total sample.

This study is important because it has three mainly contributions. First, it presents an innovative management tool for the agribusiness sector, allowing companies in this sector to adopt a new way of evaluating performance in terms of efficiency when providing TARE service, especially those that receive international and public resources to perform the service. This is mainly because TARE service in Brazil, according to the literature, has a great importance, given the context of marginalization of small and family farmers.

Second, the proposed management tool was developed from a replicable, rational, mathematical and structured methodology, based on a consolidated theory, being less subjective and fallible. Third, typically, projects subsidized by the World Bank Group are applied in developing countries. In the same way, this study worked with real data, from an existing project, in a representative place, such as the State of Bahia, where contains numerous smallholders, located in a developing country (Brazil). Thus, the results offered

from this research allowed the project coordinators to redefine their contractual conditions. New goals and semi-annual evaluations using the DEA were established by the end of the project carried out in Bahia and for future projects.

Furthermore, as pointed out by Ramos and Schabbach (2012), the assessment results provide to the government information that can be used to improve the implementation of public actions and inform decisions. In addition, the evaluation of efficiency can expand the government's area of influence with social programs and, at the same time, increase social participation in projects.

Despite the zeal and methodological rigor, this study has some limitations. This study analyzed only one of the components of Bahia Produtiva Project, with TARE services as the “target audience”. Therefore, the results proposed here do not extend to other project approaches. Furthermore, by analyzing a project that received an investment from IBRD with specific design and characteristics, the theoretical and literary support became scarce at the same time the application of the unprecedented DEA methodology in the context of analysis.

Finally, with the suggestions of Silva (2017), the use of the second stage DEA, that is, the use of a parallel statistical analysis, allows a greater understanding of the phenomenon. Thus, it is suggested that a regression analysis be performed with the results of the satisfaction survey so that it is possible to understand what are the differentials of TARE service providers that result in greater and lesser efficiency. In addition, service performance analysis can be performed in other periods of execution, so that a history of the performance of these companies can be generated, and a longitudinal analysis can be performed.

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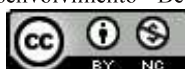
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