

***Using Data Envelopment Analysis (DEA) Method to Measure
Municipalities' Efficiency in managing School Feeding Programs:
A Case Study of Guelma Province Municipalities in 2023***

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Abstract:

Employing the Data Envelopment Analysis (DEA) methodology, this study seeks to evaluate the relative efficiency of municipalities in Guelma Province with respect to their management of the school feeding program.

The study included a sample consisting of 34 municipalities during the year 2023, and the study variables were the number of students benefiting from school feeding as outputs, the number of workers and the financial cover allocated to this file as inputs, while the constant return to scale model (CRS) and variable return to scale model (VRS) with an input orientation were adopted in measuring the efficiency.

Keywords: Data Envelopment Analysis, Relative Efficiency, CRS, VRS.

Jel Classification Codes : C41, D61, D72, D73.

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1. Introduction

School nutrition represents a critical determinant of children's health and well-being. Consequently, the Algerian government has consistently prioritized the provision of comprehensive nutritional meals in schools, with the inception of school nutrition programs in Algeria dating back to 1970. Initially, these programs were limited to primary schools, but by 1989, they were extended to encompass all educational levels. This expansion reflects the recognized significance of school nutrition, both in mitigating the prevalence of malnutrition among children by providing balanced meals and in promoting healthy growth and development through the encouragement of nutritious dietary habits. Nevertheless, the management of this initiative encountered challenges and inefficiencies when overseen by the Ministry of National Education, prompting the Algerian authorities to transfer its administration to the Ministry of the Interior in 2017. During this period, school canteens underwent significant improvements in infrastructure, equipment, and operational frameworks.

Hence, this research came to apply the data envelopment analysis (DEA) method, based on data for a sample of municipalities in Algeria, and it concerns the municipalities of Guelma province in 2023, with the aim of measuring the municipalities' relative efficiency in managing the school nutrition file, given its extreme importance, as this file was known for shifting its management to the municipalities in 2017, in order to activating their performance and achieving the quality of school feeding services and ensuring their continuity. Based on the above, Executive Decree N:18-03 dated January 15, 2018 was issued, which included defining them as “accompanying structures affiliated with primary schools concerned with the daily preparation of hot meals or in the form of Classes throughout the year and distributed to students studying in the same school or neighboring schools.” The study's issue becomes clear from the above: What is the relative efficiency of the municipalities under investigation in terms of

resource management in the school nutrition file, as determined by the Data Envelopment Analysis (DEA) method?

The study aims to offer responses to the following inquiries:

- Which municipalities were most efficient in converting resources into outcomes?
- Which municipalities are failing to maximize their potential output?
- How much should the inputs of inefficient municipalities be lowered to improve efficiency?
- How much must the outputs of inefficient municipalities be increased in order to achieve efficiency?
- Which municipalities serve as references for each inefficient municipality?

The study seeks to evaluate the relative efficiency of a selection of Algerian municipalities using the data envelopment analysis (DEA) method, as it offers several advantages and provides the following valuable detailed information:

- Recognizing efficient municipalities that have successfully utilized the minimal amount of inputs to generate their achieved level of outputs.
- identify inefficient municipalities with unused resources that do not contribute to the production of the desired level of output.
- Identifying refers municipalities for all inefficient municipalities.

The study highlights the crucial role of administrative efficiency in organizational success. Decision-makers must prioritize this factor to ensure their organizations thrive.

By employing the Data Envelopment Analysis (DEA) methodology in the present study, we aim to address the research problem and propose a viable solution. The study is structured around

two primary axes. The first axis focuses on the theoretical foundations of the DEA method, elucidating its core concepts and models. The second axis encompasses the empirical component of the study, wherein we will measure and evaluate efficiency to identify both efficient units and peers.

2. DEA Framework:

The Data Envelopment Analysis (DEA) method is one of the modern quantitative approaches grounded in linear programming, designed to evaluate the efficiency of homogeneous units. This methodology focuses on identifying best practices among the studied units, referred to as Decision Making Units (DMUs), by establishing a benchmark known as the efficiency frontier curve. Through this process, DEA highlights deficiencies in underperforming units relative to their more efficient counterparts and quantifies the requisite improvements. These enhancements may pertain to inputs (input-oriented), outputs (output-oriented), or a combination of both dimensions (Mahmoud, 2017).

Data Envelopment Analysis (DEA), rooted in Farrell's 1957 work and popularized by Charnes, Cooper, and Rhodes in 1978, posits a convex production frontier. This frontier, constructed using linear programming, outlines the maximum achievable output for a given input level. The term 'envelopment' arises from the frontier's encompassing nature, enveloping the observed data points (António Afonso, 2017).

2.1 Definition of data envelopment analysis method:

In their original study Charnes, Cooper and Rhodes (1978) described DEA as “a mathematical programming model applied to observational data [that] provides a new way of obtaining empirical estimates of the relationships such as production functions and/or effective production possibilities—that are the cornerstone of modern economics.” (Charnes, 1978).

The DEA-model computes the efficiency measure as a ratio of a weighted sum of outputs over a weighted sum of inputs. The nonparametric nature of DEA reveals itself in the manner in which this ratio is computed: in the absence of detailed knowledge on the exact relative importance of the inputs and outputs in the production or cost function, DEA assumes that information on the relative importance weights can be retrieved a posteriori from the observed data themselves. That is, the DEA-model determines the weights of the inputs and outputs in the efficiency measure in an endogenous manner. In particular, DEA sets the observed input and output data of the evaluated municipality within a relative perspective to the input and output data of the other municipalities in the sample set and looks for those weights that evaluate each municipality in the best possible light. Any other set of input and output weights than the one specified by the DEA-model would only worsen the municipality's cost efficiency estimate. Formally, this yields the following linear programming model (Nicky Rogge, 2012):

$$\begin{aligned} \text{Max } e_k^a &= \frac{\sum_{r=1}^q w_{k,r} y_{k,r}}{\sum_{i=1}^p v_{k,i} x_{k,i}} \\ \text{s.t.} \end{aligned} \quad (1)$$

$$\frac{\sum_{r=1}^q w_{k,r} y_{j,r}}{\sum_{i=1}^p v_{k,i} x_{j,i}} \leq 1 \quad \forall j = 1, \dots, n \quad (1a)$$

$$\sum_{i=1}^p v_{k,i} x_{k,i} = 1 \quad (1b)$$

$$v_{k,i}, w_{k,r} \geq \varepsilon \quad \forall i = 1, \dots, p; \quad \forall r = 1, \dots, q \quad (1c)$$

In the general setting, there are n DMUs ($j=1, \dots, n$) that produce q outputs y_{jr} ($r=1, \dots, q$) using p inputs x_{ji} ($i=1, \dots, p$). The inputs, the outputs and the DEA cost efficiency measure of the municipality under evaluation are denoted by respectively $x_{ki}=(x_{k1}, \dots, x_{kp})$,

$y_{kr}=(y_{k1}, \dots, y_{kq})$. assume that $x_{ji} \geq 0$, $y_{jr} \geq 0$ and, further, that each DMU has at least one positive input and output value. The input and output weights and are supposed to reflect the relative importance of the inputs and outputs. Note that the DEA- method relies in its essence on Pareto Optimality, which states that “any decision-making unit is inefficient if another unit or a combination of other administrative units is able to produce the same amount of output with a smaller amount of input and without an increase in any other resource.”, and the administrative unit has Pareto efficiency if the opposite is true, and the relative efficiency is calculated by finding the ratio of the sum of the weighted outputs to the sum of the weighted inputs. Farrell's study is considered Farrell in 1957 provided the basis for both Pareto optimization and data envelopment analysis. However, Farrell's method is criticized for measuring the technical efficiency of one output and one input only, while the data envelopment analysis method is characterized by its dealing with a group of outputs and a group of inputs (Farrell, 1957).

The DEA method does not require the formulation of any function before starting to use it to measure efficiency, and it is not necessary to include any assumptions about the form of the relationship between inputs and outputs. It is also distinguished by the fact that it takes into account the most efficient institutions when forming the boundary efficiency curve (Wade D Cook, 2005). From the previous definitions, we can conclude the following:

- The presence of a number of administrative units, or so-called decision-making units, called in short (DMUs) These units work in the same field or perform the same function as a group of universities, colleges or a group of hospitals. The efficiency of these branches is measured by comparing each branch or unit with the rest of the units.
- These DMUs use the same set of inputs and outputs.
- Maximizing the amount (or number) of these units' outputs or minimizing the quantity (or number) of their inputs is the method's overarching objective.

The Data Envelopment Analysis (DEA) methodology serves as an analytical instrument that elucidates the underlying causes of inefficiency within a business organization for decision-makers. It provides actionable insights into the measures required to transition the organization from its current state of inefficiency to one of optimal efficiency.

2.2 Areas of application of the data envelopment method: While the data envelopment analysis (DEA) method gained prominence in 1978, its potential has quickly captivated both academics and practitioners. Extensive research across various fields demonstrates this growing interest. However, the application of DEA to the industrial sector remains relatively unexplored. Within the Arab world, DEA is still considered a cutting-edge tool in scientific research.

2.3 Presenting examples of the data envelopment analysis method: In his 1957 paper, Farrell introduced the concept of Data Envelopment Analysis (DEA) as a method for measuring economic efficiency. He defined efficiency as a blend of **technical** and **allocative** efficiency. DEA provides two orientations for calculating technical efficiency indicators: **input-oriented** and **output-oriented**. Among the most prevalent DEA models are the **Constant Returns to Scale (CRS)** and **Variable Returns to Scale (VRS)** models. Efficiency indicators can be derived from either the input or output perspective within both models.

Constant returns to scale model (Cooper, 2006): It is also called the CCR method, developed by Charnes, Cooper, and Rhodes in 1978. This model is based on the assumption of constant returns to scale, meaning that an increase in input units by a certain percentage results in an increase by the same percentage in output levels. The linear formulation of the model, with input and output orientation, is as follows:

Constant returns to scale model for output oriented	Constant returns to scale model for input oriented
$\begin{aligned} &\text{Max } (\Theta.y^j) \\ &\text{st} \\ &(\Theta.y^j) - (\pi.x^j) \leq 0, j=1, \dots, n : \\ &(\pi.x^j) = 1 : \\ &\pi, \Theta \geq 0 \end{aligned}$	$\begin{aligned} &\text{Min } (\pi.x^{j*}) \\ &\text{st} \\ &(\pi.x^j) - (\Theta.y^j) \geq 0, j=1, \dots, n : \\ &(\Theta.y^j) = 1 : \\ &\pi, \Theta \geq 0 \end{aligned}$

By applying the appropriate model (duality) in linear programming, the two preceding problems can be expressed in the following format:

Constant returns to scale model for input oriented	Constant returns to scale model for output oriented
$\begin{aligned} &\text{Min } \theta \\ &\text{St} \\ &\sum_j x^j \lambda_j - x^{j*} \theta \leq 0, j=1, \dots, n : \\ &{}_j y^j \lambda_j \geq y^{j*} : \sum \\ &\lambda \geq 0 \end{aligned}$	$\begin{aligned} &\text{Max } \phi \\ &\text{st} \\ &\sum_j x^j \lambda_j \leq x^{j*}, j=1, \dots, n : \\ &{}_j y^j \lambda_j - y^{j*} \phi \geq 0 : \sum \\ &\lambda \geq 0 \end{aligned}$

The vector λ signifies the weights of the items, while ϕ and θ denote the values of the efficiency indicators for the input routing model and the directive, respectively.

Note that the use of the assumption of constant returns to scale in the model when all institutions do not operate at their optimal level of size leads to mixing technical efficiency indicators with scale efficiency. To separate the effect of technical and scale efficiency, the property of changing the return to scale of production (constant, increasing or decreasing) is used, that is any increase in the enterprise's inputs by a certain percentage may lead to a greater, lesser, or equal increase in the volume of production.

Variable returns to scale model (H.David Sherman, 2006): This model is based on the hypothesis of variable returns to scale, meaning

that the operational processes of decision-making units can be at an increasing, constant, or decreasing return to scale level. This model was presented by Cooper - Charnes and Banker in 1984, and it is the linear formula of the model with the input and output directions are as follows:

Variable returns to scale model for output oriented	Variable returns to scale model for input oriented
$\text{Max } (\Theta \cdot y^{j*}) + \varepsilon$ st $(\Theta \cdot y^j) - (\pi \cdot x^j) + \varepsilon \leq 0,$ $j=1, \dots, n:$ $(\pi \cdot x^{j*}) = 1:$ $\pi, \Theta \geq 0$	$\text{Min } (\pi \cdot x^{j*}) + \varepsilon$ st $(\pi \cdot x^j) - (\Theta \cdot y^j) + \varepsilon \geq 0,$ $j=1, \dots, n:$ $(\Theta \cdot y^j) = 1:$ $\pi, \Theta \geq 0$

Using the corresponding form, the previous two problems can be written as follows:

Variable returns to scale model for input oriented	Variable returns to scale model for output oriented
$\text{Min } \theta$ St $\sum_j x^j \lambda_j - x^{j*} \leq 0, j=1, \dots, n:$ $y^j \lambda \geq y^{j*}:$ $\sum_j \lambda_j = 1:$ $\lambda \geq 0$	$\text{Max } \phi$ st $\sum_j x^j \lambda_j - y_j \leq x^{j*}, j=1, \dots, n:$ $y^j \lambda_j - y^{j*} \phi \geq 0:$ $\sum \lambda \geq 0$

Unlike the CCR model, where input and output efficiency scores are identical, they typically differ in BCC models.

Following the discussion of the fundamental concepts of the model and its various forms, we will delve into the applied study. Here, we will measure and analyse relative efficiency, and subsequently identify the key variables that may influence the relative efficiency indicators.

3. Methods and Materials

In this section, the Data Envelopment Analysis (DEA) methodology will be applied to a sample of Algerian municipalities, comprising 34 municipalities. The analysis commences with an exposition of the DEA method, delineating its inputs, outputs, and pertinent models used in our study. Subsequently, the DEA approach will be utilized to compute technical efficiency scores for each municipality under investigation. Finally, these scores will be analyzed to identify potential efficiency enhancements for inefficient municipalities by benchmarking them against their peers.

3.1 Study Methodology:

The research methodology encompasses the procedures, quantitative tools, and software applications utilized throughout the study. These instruments were employed to assess the efficiency scores of the 34 municipalities constituting the study sample and to analyze the resultant data. The primary objective was to address the research questions and validate or refute the proposed hypotheses. To this end, the Data Envelopment Analysis (DEA) method was implemented using DEAP software to estimate the efficiency of each municipality.

3.2 Study population and sample:

The study population represents the total number of municipalities in Guelma province as shows the table (1) below, which equal 34 municipalities, according to the latest administrative organization of the country under Law 1984. Where various information related to the study variables was collected from documents related to Guelma province.

Table (1): Inputs and outputs of Guelma state municipalities for the school nutrition file in 2023

Municipality code	Municipality	Number of workers running school canteens	Financial cover	Number of students benefiting from school feeding
2401	Guelma	58	35 600 598	3 022
2402	Nashmaya	58	20 943 005	1 608
2403	Bouati Mahmoud	42	17 647 135	1 498
2404	Ouadi Zenati	79	59 619 107	4 753
2405	Tamluka	39	35 946 112	2 924
2406	Wadi Faragha	18	15 730 815	1 208
2407	Ain Sandal	17	8 163 870	693
2408	Ras Aqaba	14	6 942 580	462
2409	Dahwara	31	13 853 840	1 176
2410	Belkhair	55	32 613 447	2 451
2411	Ben Jarrah	15	11 933 622	1 013
2412	Bouhamdan	22	7 258 514	542
2413	Ain Makhlouf	49	26 609 414	2 089
2414	Ain Ben Baidha	53	22 664 295	1 839
2415	Lakhzara	70	22 935 246	1 862
2416	Bani Mazlin	31	10 967 623	931
2417	Bouhchana	17	8 328 797	707
2418	Bousbaa Qalaa	31	11 944 062	929
2419	Hammam- D	63	32 135 798	2 643
2420	Al-Fajuj	65	18 270 178	1 466
2421	Bordj Sabat	58	18 753 177	1 507
2422	Hammam Nabeel	32	31 205 140	2 564
2423	Ain Arabi	37	14 406 182	1 138

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2424	Ammar Majaz	45	17 869 642	1 432
2425	Bushqof	38	53 657 387	4 385
2426	Heliopolis	192	45 802 491	3 888
2427	Houari Boumediene	30	15 099 889	1112
2428	El Roknia	110	19 106 592	1 537
2429	Salawa Anouna	7	6 442 580	462
2430	Majaz safa	24	15 848 620	1 218
2431	Boumhra Ahmed	73	31 842 627	2 703
2432	Ain Raqqada	28	17 186 374	1 374
2433	Ouadi Shaham	51	30 161 898	2 433
2434	Jabala Al-Khamisi	31	9 306 576	790
Total		1 583	746 797 232	60 359
Average		47	21 964 624	1 775
Standard Deviation		34	13 189 925	1 087

Source: Prepared by the researcher based on the data of Guelma province for the year 2023.

3.3 Choosing the model: We relied on the variable returns to scale model (VRS) to calculate efficiency levels because it is more dynamic than the fixed returns to scale model (CRS), and we employed the input oriented considering that the outputs are predetermined, as municipalities are obligated to feed all students, so all that remains is for us to focus on the input oriented. Referring to previous studies, one of the most significant investigations concerning the measurement of the relative efficiency of municipalities in service delivery is identified. This study applied the Data Envelopment Analysis (DEA) methodology to data from the municipalities of Boumerdès Province in the context of waste management for the year 2015. The analysis

adopted the variable returns to scale (BCC) model to calculate efficiency levels, as it is considered more dynamic than the constant returns to scale (CRS) model. (Ali, 2020)

3.4 Determine the inputs and outputs of the DEA method:

Drawing on field experience and referencing prior studies, such as "Assessing the Efficiency of Oklahoma Public Schools: A Data Envelopment Analysis," which utilized a dataset encompassing multiple socioeconomic indicators (e.g., student eligibility for subsidized lunch programs, parental education levels, family income, etc.) across over 600 school districts in Oklahoma, and the study "Municipalities as Educational Producers – An Efficiency Approach," which leveraged data from the Swedish National Agency for Education (Skolverket) and included variables such as teachers and teaching materials (measured in thousand SEK) as inputs, and complete grades and aggregate grade sums as outputs, covering 268 of Sweden's 289 municipalities in 1998 (Rassouli-Currier, 2007) , this research identifies two inputs and one output for the application of the Data Envelopment Analysis (DEA) method, as outlined below:

Input:

- Number of workers (employees) in school canteens per municipality, (1st input).
- The financial resources allocated to this file comprise funds derived from the municipal budget, the provincial budget, and the state budget.

Outputs: Number of students benefiting from school feeding for each municipality (one output).

It's important to note that the number of Decision-Making Units (DMUs) included in the evaluation should be at least three times the sum of the inputs and outputs. In our study, this condition was met as there were 34 municipalities, which is more than three times the combined number of inputs and outputs. The specific details of these variables are provided in Table (01).

4. Results and discussion

As previously discussed, the Data Envelopment Analysis (DEA) methodology offers numerous advantages, chief among them being the identification of efficient units, the designation of reference units or peers, and the pinpointing of inefficiency sources in terms of inputs or outputs for inefficient units. Furthermore, this study will propose specific input reductions for each inefficient unit to elevate their operational efficiency. By emphasizing input minimization while preserving output levels, the objective is to assist municipalities in optimizing their resource allocation and utilization

4.1 Efficiency level indicators: We present in Table (2) below, the efficiency index values for the 34 DMUs (34 municipalities) according to the variable returns to scale model (VRS) with input oriented. The DEAP program was used to obtain these results. To ensure the reliability of the model and its outputs, we checked the one-third rule, which stipulates that the number of units with perfect efficiency should not exceed one-third of the total sample size. In our study, this condition was met as:

Number of efficient DMU have $100\% \leq 1/3 * S$, where S: number of DMUs.

In our study: $8 < (34/3)$

The efficiency's average of all units according to the CRS model is 0.53 and according to the VRS model it is 0.60, and the standard deviation reached 33 % and 30 %, respectively, according to the CRS and VRS models. This shows significant variation in technical efficiency among the municipalities. Regarding the average volumetric efficiency of the municipalities in the study sample, it reached 83 % with a standard deviation of 15 % this means that, on average municipalities that have not achieved complete scale efficiency can reduce their sizes by 17 % without affecting their current output levels, other saying it is possible for municipalities to obtain the same results (the same level of output) using only 83 % of the inputs.

According to the VRS model, which is based on the variable returns to scale hypothesis, the municipalities of Guelma, Ain Sandal, Ben Jarrah, Beni Mezline, Bouchhana, Boucheqouf, Salawa Announa, Jbala El Khamisi and Qalaat Bou Sabaa have achieved full efficiency, which reflects their ability to optimally exploit inputs, and can

continue its activity with the same combination of current inputs and outputs.

It is also noted in the same context that, all the above-mentioned municipalities achieved 100 % technical efficiency and complete volumetric efficiency as well, except the municipality of Bousbaa Kalaa, which did not achieve a complete level of volumetric efficiency. This can be explained by the fact that this municipality is internally efficient, meaning that the combination between input and output elements is optimal. However, it does not operate within the optimal size of its activity. As for the rest of the municipalities, they represent the second group that did not achieve complete relative efficiency, as its value ranged from 0.14 to 0.88, which requires them to make a change in the quantity of one of their inputs, which is the number of workers or the financial cover allocated to the school feeding file.

Table (2): Efficiency index values for study units using inputs oriented

DMU	CRS efficiency index	VRS efficiency index	Volumetric efficiency	Volume yield
Guelma	1.000	1.000	1.000	-
Nashmaya	0.162	0.259	0.625	irs
Bouati Mahmoud	0.212	0.357	0.593	irs
Ouadi Zenati	0.493	0.511	0.964	drs
Tamluka	0.487	0.581	0.838	irs
Wadi Faragha	0.500	0.833	0.600	irs
Ain Sandal	1.000	1.000	1.000	-
Ras Aqaba	0.787	0.847	0.930	irs
Dahwara	0.372	0.484	0.769	irs
Belkhair	0.374	0.412	0.908	irs
Ben Jarrah	1.000	1.000	1.000	-
Bouhamdan	0.878	0.878	1.000	-
Ain Makhoulf	0.578	0.650	0.890	drs
Ain Ben Baidha	0.179	0.283	0.633	irs
Lakhzara	0.125	0.214	0.583	irs
Bani Mazlin	0.999	1.000	0.999	drs

Badly	1.000	1.000	1.000	-
Bousbaa Qalaa	0.915	0.996	0.919	drs
Hammam- D	0.301	0.360	0.836	irs
Al-Fajuj	0.166	0.231	0.717	irs
Bordj Sabat	0.173	0.259	0.670	irs
Hammam Nabeel	0.594	0.708	0.838	irs
Ain Arabi	0.344	0.405	0.848	irs
Ammar Majaz	0.216	0.333	0.647	irs
Bushqof	1.000	1.000	1.000	-
Heliopolis	0.190	0.205	0.924	drs
Houari Boumediene	0.424	0.500	0.848	irs
El Roknia	0.109	0.136	0.799	irs
Salawa Anouna	1.000	1.000	1.000	-
Majaz safa	0.413	0.625	0.661	irs
Boumhra Ahmed	0.266	0.311	0.855	irs
Ain Raqqada	0.301	0.536	0.562	irs
Ouadi Shaham	0.398	0.444	0.896	irs
Jabala Al-Khamisi	0.998	0.999	0.999	drs

Source: Prepared by researcher based on the results of the DEAP.

4.2 Refers and target values: Rational control of the resources available to municipalities is considered one of the most important challenges that the latter faces in order to achieve efficiency. The waste of resources in light of their limitations is considered a negative indicator for evaluating their performance. As we mentioned previously, one of the advantages of the DEA method is that it helps inefficient units according to the introductory model in determining the quantity the inputs that you can reduce while obtaining the same quantity of outputs are called target values and they represent the values that must be dealt with.

It also helps in identifying reference units, which represent units that operate under the same conditions but have managed to achieve a complete efficiency rate, allowing inefficient units to take them as a reference, those called refers.

Table (3): references units for study units using inputs oriented:

The code	DMU	Reference municipalities
2	Nashmaya	Ben Jarrah
3	Bouati Mahmoud	Ben Jarrah
4	Ouadi Zenati	Guelma, Bushqouf
5	Tamluka	Ben Jarrah
6	Wadi Faragha	Ben Jarrah
7	Ain Sandal	Qalma, Bin Jarrah, Bouchhana
8	Ras Aqaba	Bin Jarrah, Bouchhana , Salawa Announa
9	Dahwara	Ben Jarrah
10	Belkhair	Ben Jarrah, Bushqouf
12	Bouhamdan	Guelma, Beni Mezlin , Bouchhana
13	Ain Makhoulf	Guelma, Ben Jarrah, Bushqouf
14	Ain Ben Baidha	Ben Jarrah
15	Lakhzara	Ben Jarrah
18	Bousbaa Castle	Beni Mezlin , Bouchhana
19	Tanning bath	Ben Jarrah, Bushqouf
20	Al-Fajuj	Ben Jarrah
21	Bordj Sabat	Ben Jarrah
22	Hammam Nabeel	Ben Jarrah, Bushqouf
23	Ain Arabi	Ben Jarrah
24	Ammar Majaz	Ben Jarrah
26	Heliopolis	Guelma, Ben Jarrah, Bushqouf
27	Houari Boumediene	Ben Jarrah
28	El Roknia	Ben Jarrah
30	Majaz safa	Ben Jarrah
31	Boumhra Ahmed	Ben Jarrah, Bushqouf
32	Ain Raqqada	Ben Jarrah
33	Ouadi Shaham	Ben Jarrah, Bushqouf
34	Jabala Al-Khamisi	Guelma, Beni Mezlin, Bushqouf

Source: Prepared by researcher based on the results of the DEAP.

Table (3) lists the reference municipalities for each municipality based on the variable returns to scale model for input orientation. For instance, the reference municipalities for Ain Sandal are Bouchhana, Ben Jarrah, and Guelma. These are the municipalities that serve as benchmarks for comparing Ain Sandal's performance, and their weights (look Appendices Table 4), respectively, are (0.98), (0.011), (0.009), knowing that the relative weights of the refer units for each inefficient municipality is 100 %. In general, the municipality of Ben Jarrah recorded the highest number of appearances as a refer unit (12 times). It was followed by the municipality of Bushqouf with 10 appearances as a refer unit for incompetent units, then the municipality of Guelma with 6 times as a refer, while the municipalities of Beni Mezlin appeared. And Bouchhana, respectively, 3 and 4 times, while the municipalities of Bousbaa Castle, Jbala El Khamisi, and Ain Sandal did not appear as reference municipalities.

5. Conclusion

Measuring the efficiency of local groups in general and municipalities in particular is considered an important process and must be applied periodically, to determine the level of their actual performance and identify deficiencies. This is done by highlighting the comparative performance of local groups with themselves over time or with other local groups. We have tried through this research paper to measure the efficiency of the total municipalities of Guelma Province - as a model for Algerian local communities - using the DEA method according to the variable returns to scale model employing input oriented. The following are the most important conclusions and recommendations reached:

-Of the total municipalities of the state under study during the fiscal year 2023, it was found that only 9 municipalities are fully efficient, which are: the municipality of Guelma, Ain Sandal, Ben Jarrah, Beni Mezline, Bouchhana, Bouchqouf, Salawa Anouna, Jbala El Khamisi and Qalaat Bou Saba;

-Regarding to input-oriented, it was found that there is a waste of

resources or inputs from inefficient units.

Based on the findings, we propose several recommendations to enhance the overall efficiency of the municipalities in Guelma province. These recommendations include the following:

- Officials in the province under study to benefit from Efficiency indicators and levels of improvement in inputs and outputs obtained through the input-oriented model for municipalities that have not achieved the required relative efficiency, and then providing suggestions and recommendations that lead to improving the performance of municipalities.

- Officials in the guardianship authority must measure the relative efficiency of municipalities in various provinces on a periodic basis with the aim of comparing the performance of these municipalities over time to ensure the optimal exploitation of resources to achieve their efficiency in performance.

- Municipal officials in municipalities that have not achieved the required efficiency (inefficient municipalities) should study the factors that led to this in order to identify the deficiencies and weaknesses in the inputs so that they can exploit the resources available to them well, and in other side study the factors that led the refers to achieve relative efficiency and that the results of the efficient municipalities be reference serves as the goals they seek to achieve.

- Municipal officials that have achieved efficiency will continue to conduct further applications of the DEA method over successive periods of time with another group of municipalities that work under the same conditions to ensure good exploitation of their resources and that they enjoy relative efficiency.

- In view of the good results provided by implementation the DEA method, organizing a specialized training program in this field for the benefit of municipal officials is extremely important, with the aim of improving the efficiency of municipal performance.

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