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Evaluating the Operational Efficiency of Public Primary Schools in Gombe Local Government Area Using Data Envelopment Analysis (DEA)

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Abstract

This study evaluates the operational efficiency of public primary schools in Gombe Local Government Area (LGA) using the Data Envelopment Analysis (DEA) methodology. By applying the output-oriented DEA model under variable returns to scale, the research identifies the relative efficiency of each school in converting educational resources into academic outcomes. The inputs considered include staff salary, number of classrooms, number of academic staff, and total number of students enrolled in each school. The output is measured by the number of graduates from the 2023/2024 academic session. Data was collected from Gombe Local Government Education Authority (LGEA) of public primary schools within the local government area. The DEA results provide insights into which schools are operating efficiently and which are underperforming, offering a data-driven foundation for targeted policy interventions and resource allocation, and ultimately, the study contributes to improving educational service delivery by identifying best practices and performance gaps across public primary schools in the LGA.

Keywords: Operational Efficiency, Public Primary Schools, Data Envelopment Analysis, FSLC, Gombe Local Government, Educational Resources, School Performance Evaluation

Introduction

Education is a key factor in the advancement of society, and public primary schools' operational effectiveness is essential to guaranteeing high-quality instruction, especially in areas with limited resources like Nigeria's Gombe Local Government Area (LGA). One of the most efficient means of combating poverty and fostering social and economic progress is primary education. Graduates might thus feel more

empowered to take charge of their lives, make better choices about their potential and social mobility, improve the nutrition and health of themselves and their family (particularly women), and regulate their reproduction (The World Bank, 2006). Due to issues including low funding, poor infrastructure, and inconsistent academic performance, public primary schools may not be able to use resources efficiently enough to produce the intended learning results (Abdulkareem & Bello, 2020). These issues have the potential to worsen educational disparities and impede regional growth, thus policymakers should prioritize evaluating school effectiveness. In the context of education, operational efficiency is the ability of a school to optimize results, like academic success and student graduation rates, given inputs like facilities, funding, and human capital. Suboptimal results might result from inefficient resource use; hence performance evaluation requires strong analytical techniques.

By comparing several inputs and outputs without making assumptions about the production function, Data Envelopment Analysis (DEA), a non-parametric technique, is frequently used to evaluate the relative efficiency of decision-making units such as schools (Thanassoulis et al., 2021). To assess the effectiveness of public primary schools in Gombe LGA, this study uses an output-oriented DEA model under variable returns to scale. It takes into account inputs that represent the schools' resource base, such as staff salaries, the number of classrooms, academic staff, and student enrollment. As a stand-in for academic achievement, output is determined by the proportion of graduates who received average scores on the First School Leaving Certificate (FSLC) exams for the 2023/2024 academic session. According to Ogundari and Ojo (2022), the DEA results offer a data-driven foundation for focused interventions and resource distribution by identifying schools that are both effective and underperforming. By identifying best practices and performance gaps, this study helps Gombe LGA provide better educational services. Global and national educational goals, like Sustainable Development Goal (SDG) 4, which prioritizes inclusive and equitable quality education, are in line with the findings. To improve educational outcomes in areas with low resources, this study promotes evidence-based policymaking by reducing inefficiencies (UNESCO, 2023).

Statement of the Problem

Gombe Local Government Area's public Primary schools struggle to maximize operational effectiveness, which has a direct effect on the caliber of academic results. Although resources like staff, classrooms, and funding have been allocated, little is known about how well these resources are being used to achieve desired academic outcomes, like student graduation rates and performance on the First School Leaving Certificate (FSLC) exams. The general objective of delivering high-quality education may be hampered by inefficiencies in resource use, which could result in differences in student achievement. Policymakers and educational administrators lack the knowledge necessary to carry out focused interventions, distribute funds wisely, or close performance gaps in the absence of a precise, data-driven evaluation of school efficiency. By assessing the operational efficiency, this study aims to alleviate this issue.

Objectives

The primary objective of this study is to assess the operational efficiency of public primary schools in the Gombe Local Government Area using the Data Envelopment Analysis (DEA) methodology. Specifically, the study aims to:

1. Measure the relative efficiency of each school in converting educational inputs (staff salary, number of classrooms, number of academic staff and total number of pupils in the school) into academic outputs (number of graduates with average grade in the first school leaving certificate (FSLC) for the 2023/2024 academic session).

2. Identify schools that are operating efficiently and those that are underperforming so as to give those inefficient primary schools useful advice on how to become more efficient.
3. Offers a standard or reference school for every inefficient primary school to aspire to.

Literature Review

Assessing Public Primary Schools' Operational Effectiveness in the Gombe Local Government Area Applying DEA (Data Envelopment Analysis) Studying operational efficiency in public elementary schools is crucial, especially in emerging areas like Gombe Local Government Area where educational outcomes and resource limitations are major issues. The ability of Data Envelopment Analysis (DEA) to compare the relative performance of decision-making units (DMUs) with various inputs and outputs has made it a popular methodological tool for evaluating school efficiency worldwide.

Operational Efficiency in Education

In the context of education, operational efficiency is the best possible use of financial, human, and infrastructure resources to optimize educational outcomes, including student accomplishment and advancement rates. According to recent research, ineffective school administration and resource distribution might impair student learning, especially in environments with few resources. By using DEA to evaluate school efficiency throughout Middle East and North Africa (MENA) and Organization for Economic Co-operation and Development (OECD) nations, Bhutoria and Aljabri (2022) discovered that technical inefficiencies continue because of poor resource management and insufficient teacher support. In a similar vein, Cordero et al. (2020) emphasized that contextual elements such student socioeconomic status and school infrastructure have an impact on operational efficiency and are especially important in low-income areas. Teacher shortages, poor infrastructure, and a lack of finance sometimes hinder operational effectiveness in developing nations. According to Agasisti and Zoido (2021), improved resource use, especially in primary education, might increase school efficiency by 20–22% in low- and middle-income countries (LMICs). These results highlight the need for context-specific research in areas like Gombe, where public elementary schools deal with particular difficulties like packed classrooms and restricted access to instructional resources.

Public Primary Schools in Developing Nation Contexts

Public primary schools in developing nations are essential to reaching the aim of universal education, yet they frequently face severe limitations. Research suggests that insufficient infrastructure, low teacher motivation, and high Learner-teacher ratios are the main causes of inefficiency in public primary schools in sub-Saharan Africa, especially Nigeria. Public primary schools in northern Nigeria, particularly Gombe, struggle to maintain consistent educational quality because of budget discrepancies and inadequate resource allocation, according to Obasi et al. (2021). The necessity of performance evaluation frameworks to pinpoint inefficiencies and direct policy actions was underlined by their study. Additionally, Adeyemi and Adeyemi (2022) looked at Nigerian public primary schools and discovered that operational efficiency is greatly influenced by school size, instructor credentials, and parental participation. These results are consistent with global research, including Yang et al. (2023), which found that classroom resources and teacher experience are important school-level elements that determine the effectiveness of primary education systems. Understanding these elements is essential to enhancing educational results in the Gombe Local Government, where public primary schools serve a variety of frequently underprivileged communities.

Data Envelopment Analysis (DEA) in Educational Efficiency

Data Envelopment Analysis (DEA) is a popular non-parametric technique for evaluating schools' relative effectiveness, which compares inputs like financing, infrastructure, and teachers to outcomes like graduation rates and test scores. Many inputs and outputs can be handled by DEA without necessitating assumptions about the production function, according to recent research. Using a two-stage DEA, Cordero et al. (2022) evaluated secondary schools in OECD nations and discovered that socioeconomic status and other environmental factors have a major impact on efficiency scores. The evaluation of Taiwan's compulsory education system by Lin et al. (2023) also used a dynamic network DEA, highlighting the significance of longitudinal data to capture efficiency trends over time.

In the African context, DEA has been used to evaluate school effectiveness with an emphasis on resource optimization. Essid et al. (2021) evaluated Tunisian primary schools using DEA and found that infrastructure and teacher qualities were important factors influencing efficiency. According to their findings, DEA is especially helpful for locating best practices in environments with limited resources. This study intends to fill the gap left by the dearth of DEA studies that concentrate on Nigerian public primary schools, specifically those in Gombe.

First School Leaving Certificate (FSLC) as a Performance Metric

In Nigeria, completing primary school is indicated by the First School Leaving Certificate (FSLC), a standardized test. It is a crucial output metric for assessing academic achievement. The FSLC's function in evaluating the quality of education has been examined in recent research. According to Adebayo and Ojo (2021), family involvement, teacher credentials, and school resources all affect FSLC pass rates; however, inefficient use of resources can result in less than ideal results. Similar to Gombe, Olanrewaju et al. (2022) observed that high student-teacher ratios and insufficient instructional aids hinder FSLC performance in northern Nigeria. Despite being a useful metric, the FSLC is not often used in efficiency studies. The majority of DEA research focuses on international tests such as Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA), which are not specifically relevant to the primary education system in Nigeria. According to Agasisti et al. (2023), because localized indicators like the FSLC represent regional educational priorities and issues, they are crucial for context-specific efficiency evaluations. This supports the planned study's use of FSLC as an output variable for the public primary schools in Gombe.

Educational Resources and School Performance

The efficiency of schools is largely dependent on educational resources, including teachers, classrooms, textbooks, and ICT. According to recent studies, efficient use of resources is crucial; their availability alone is insufficient. After reviewing 43 high-quality researches, Hanushek et al. (2020) concluded that while excessive inputs without adequate management result in decreasing returns, teacher competence and the availability of basic resources like desks have a substantial impact on learning results. Using PISA 2018 data, Aparicio et al. (2022) showed that ICT availability improves school efficiency in Latin America, but only when successfully incorporated into instructional strategies. Public primary schools in Nigeria face severe resource shortages. According to Okonkwo et al. (2021), Gombe Local Government schools lack essential amenities like science labs and libraries, which have a detrimental impact on FSLC performance. In a similar vein, Musa and Ibrahim (2023) discovered that increasing efficiency in northern Nigerian schools requires both availability of instructional aids and teacher training. These studies show that in order to determine how resources might be maximized in Gombe's public primary schools, a DEA-based study is required.

School Performance Evaluation

Evaluation of school performance is crucial for spotting inefficiencies and guiding policy. Current research highlights the use of quantitative techniques, such as DEA, to give performance metrics that are objective. Contextual factors, such as student demographics, have a considerable impact on performance rankings, according to Cordero and Polo's (2021) robust non-parametric evaluation of secondary schools in OECD nations. Agasisti et al. (2021) used DEA to analyze PISA for Development data in developing nations and found that schools in LMICs might increase productivity by resolving inequalities in resource distribution. Studies on performance evaluation are scarce in Nigeria, especially at the primary level. Adeyemi (2023), in a DEA study of secondary schools in Lagos discovered that resource allocation and management techniques are important factors influencing efficiency. There aren't many comparable studies for Gombe primary schools, though; therefore localized research is needed to guide state education policy.

Contextual Relevance: Gombe Local Government Area

Northeastern Nigeria's Gombe Local Government Area has particular educational difficulties, such as a lack of money, a teacher shortage, and socioeconomic inequality. These problems are highlighted by recent studies. According to Ibrahim et al. (2022), Gombe's public primary schools suffer from high student-teacher ratios and poor facilities, which affect FSLC results. Similarly, Yusuf and Ali (2021) pointed out that regional educational disparities are made worse by inefficient resource allocation. These results highlight the necessity of conducting a DEA-based analysis in order to measure inefficiencies and suggest focused improvements. Although international research offers methodological insights, contextual factors limit their relevance to Gombe. Bhutoria and Aljabri (2022), for example, discovered that school management techniques had a major impact on efficiency in MENA nations. However, because governance and resource availability differ in Gombe, these findings might not be entirely applicable. Therefore, local research is essential to addressing Gombe's unique problems.

Justification for the Study

Numerous gaps in the literature support the suggested investigation. First, DEA is not generally used in Nigerian primary education, especially in Gombe, despite being widely used in OECD and MENA nations. Primary schools are understudied because the majority of research focuses on secondary or higher education. Second, DEA studies frequently rely on international evaluations like PISA, and the FSLC is rarely employed as an output metric, despite its significance in Nigeria. Third, despite their particular difficulties, there is a dearth of context-specific research on public primary schools in Gombe. By using FSLC pass rates as a primary output indicator and applying DEA to assess the operational effectiveness of public primary schools in the Gombe Local Government Area, this study fills these gaps. By taking into account local contextual issues, like resource limitations, the study seeks to give policymakers useful information to enhance educational outcomes in Gombe.

Methodology

The study adopts a quantitative approach using the Data Envelopment Analysis (DEA) BCC model to evaluate the efficiency of decision-making units (DMUs) under a Variable Returns to Scale (VRS) assumption. The BCC model, developed by Banker, Charnes, and Cooper in 1984, extends the CCR model by accounting for VRS, allowing for the measurement of input excesses and output shortfalls (Cooper et al., 2006; Ong et al., 2003, as cited in Othman et al., 2016). The output-oriented approach is selected to maximize outputs while maintaining input levels, suitable for scenarios where output expansion is the primary objective.

Variable return to scale (VRS) Model

The first extension of basic CCR model is called the DEA BCC model developed by BCC in 1984, with other criteria are the same as CCR except it complements the equation to measure input excesses and output shortfalls (Cooper et al., 2006; Ong et al., 2003as cited in Othman, et.al., 2016). The BCC model is the DEA model used in frontier analysis when a variable return to scale relationship is assumed between inputs and outputs. The study used Excel Add- In to conduct the necessary analysis. The mathematical formulation of the output-oriented BCC model is as follows (Banker et al., 1984):

$$Max\ \phi + \varepsilon\left(\sum_{i=1}^{m} S_i^- + \sum_{r=i}^{S} S_r^+\right) \quad (1)$$

Subject to

$$\sum_{j=i}^{n} X_{ij}\lambda_j + S_i^- = X_{io} \quad (2)$$

$$\sum_{j=i}^{n} Y_{rj}\lambda_j - S_r^+ = \phi Y_{ro} \quad (3)$$

$$\sum_{j=1}^{n} \lambda_j = 1 \quad (4)$$

$$i = 1, 2, 3, 4 \quad (5)$$

$$r = 1, 2 \quad (6)$$

$$j = 1, 2\ldots 38 \quad (7)$$

Where;

X_{io} = Amount of input i into unit o

Y_{ro} = Amount of output r from unit o

λ_r = Variable representing Weights

ε = Positive non-Archimedean infinitesimal

S^- = Input slack

S^+ = Output slack

ϕ = Efficiency score

n = Total Number of DMUs

The analysis was done using Thirty - Eight (38) public primary schools on the basis of four inputs: staff salary, number of class rooms, number of academic staff and the total number of pupils in the schools with two outputs: number of graduates and the average grade in first school leaving certificate. Data for the 2023/2024 academic session which was obtained from the Gombe Local Government Local Education Authority (LEA) database was used.

Relative Technical Efficiency

Relative performance within a sample is indicated by the Relative Technical Efficiency ratings. Public primary schools with an efficiency score of one are considered to be on the efficient frontier, whereas those with a score higher than one are considered inefficient in comparison. In addition to identifying a group of public primary schools that are efficient, a reference set (benchmark or peer) was also identified for every inefficient school. If those inefficient units want to become efficient, they must imitate their counterparts. Appendix I contain the data used. Table 1 displays the results of the Data Envelopment Analysis (DEA) Excel Add-in. Table 1 also shows the peers or reference sets for the inefficient schools to emulate.

Table 1: Data Envelopment Analysis Excel Solver Results

DECISION MAKING UNITS (DMU)	EFFICIENCY SCORE	REFERENCE (PEERS) SET
1. ORJI ESTATE PRIMARY SCHOOL	1	
2. ABUBAKAR UMAR MEMORIAL PRIMARY SCHOOL	1.326783777	DMU1(0.190), DMU6(0.004), DMU25(0.191), DMU27(0.009), DMU29(0.606)
3. ALABURA MODEL PRIMARY SCHOOL	1	
4. GANDU PRIMARY SCHOOL	1.433983796	DMU1(0.782), DMU27(0.218).
5. GABUKKA PRIMARY SCHOOL	1	
6. BUBAYERO PRIMARY SCHOOL	1	
7. KAGARAWAL PRIMARY SCHOOL	1	
8. MALAM INNA PRIMARY SCHOOL	1.060330046	DMU5(0.230), DMU7(0.299), DMU25(0.168), DMU29(0.303).
9. MU'AZU PRIMARY SCHOOL	1.09274821	DMU25(0.476), DMU30(0.524).
10. KARANGADA PRIMARY SCHOOL	1.204097888	DMU1(0.320), DMU25(0.680).
11. WURO LADDE PRIMARY SCHOOL	1.672034211	DMU1(0.869), DMU25(0.131)
12. T/WADA J/ABARE PRIMARY SCHOOL	1.951252104	DMU1(0.046), DMU6(0.003), DMU27(0.795), DMU29(0.138), DMU35(0.018)
13. YELONGURUZA PRIMARY SCHOOL	1.314432536	DMU1(0.086), DMU25(0.914)
14. HERWAGANA PRIMARY SCHOOL	3.124535039	DMU1(0.808), DMU25(0.192)
15. KAMARA PRIMARY SCHOOL	1.537147291	DMU25(0.684), DMU30(0.315).
16. JEKADAFARI PRIMARY SCHOOL	1.32388664	DMU25(0.600), DMU27(0.400).
17. IDI II PRIMARY SCHOOL	1.821794872	DMU25(0.520), DMU27(0.480).
18. JAURO ABARE PRIMARY SCHOOL	3.128658777	DMU1(0.494), DMU25(0.021), DMU25(0.485)
19. USMAN MEMORIAL PRIMARY SCHOOL	1	

20.	SABON GARIN NASARAWO PRIMARY SCHOOL	1.053427815	DMU1(0.016), DMU25(0.152), DMU27(0.453), DMU29(0.379).
21.	JALO WAZIRI PRIMARY SCHOOL	1.205237316	DMU1(0.105), DMU25(0.895).
22.	NASARAWO PRIMARY SCHOOL GOMBE	1.1461933	DMU1(0.561), DMU25(0.439).
23.	BUHARI ESTATE PRIMARY SCHOOL	1.169791667	DMU1(0.671), DMU25(0.224), DMU27(0.105).
24.	MODEL PRIMARY SCHOOL	1.280015198	DMU25(0.571), DMU30(0.429).
25.	HASSAN CENTRAL	1	
26.	LIMAN PRIMARY SCHOOL	1.371681416	DMU1(0.778), DMU25(0.044), DMU27(0.178).
27.	GIRL CHILD GANDU PRIMARY SCHOOL	1	
28.	MANAWACHI PRIMARY SCHOOL	1.189957612	DMU1(0.222), DMU25(0.436), DMU27(0.342).
29.	JAURO GOTEL PRIMARY SCHOOL	1	
30.	PANTAMI PRIMARY SCHOOL	1	
31.	T/WADAN PANTAMI PRIMARY SCHOOL	1.261935484	DMU25(0.720), DMU27(0.280).
32.	MADAKI PRIMARY SCHOOL	1.544983416	DMU1(0.273), DMU25(0.487), DMU27(0.240).
33.	FAMILY SUPPORT PRIMARY SCHOOL	1.744617903	DMU1(0.436), DMU25(0.564).
34.	IDI PRIMARY SCHOOL	1.226395953	DMU25(0.592), DMU30(0.408).
35.	NURUDDEEN PRIMARY SCHOOL	1	
36.	JAURO T/WADA PRIMARY SCHOOL	1.401325999	DMU1(0.098), DMU25(0.902).
37.	SPECIAL EDUCATION CENTRE PRIMARY SCHOOL	1.299394867	DMU1(0.253), DMU27(0.747).
38.	TSANGAYA M/INNA PRIMARY SCHOOL	1.21318599	DMU1(0.184), DMU25(0.056), DMU27(0.697), DMU29(0.063).

Table 2: Efficient Public Primary Schools

DECISION MAKING UNITS (DMU)	EFFICIENCY SCORE
1. ORJI ESTATE PRIMARY SCHOOL	1
2. ALABURA MODEL PRIMARY SCHOOL	1
3. GABUKKA PRIMARY SCHOOL	1
4. BUBAYERO PRIMARY SCHOOL	1
5. KAGARAWAL PRIMARY SCHOOL	1
6. USMAN MEMORIAL PRIMARY SCHOOL	1
7. HASSAN CENTRAL PRIMARY SCHOOL	1
8. GIRL CHILD GANDU PRIMARY SCHOOL	1
9. JAURO GOTEL PRIMARY SCHOOL	1
10. PANTAMI PRIMARY SCHOOL	1
11. NURUDDEEN PRIMARY SCHOOL	1

According to Table 2, 11 out of 38 public primary schools achieved an efficiency score of 1, representing approximately 28.9% of the sample. These schools are classified as being on the efficient frontier, indicating that they maximize output (number of graduates and the average grade in first school leaving certificate) relative to their inputs (staff salary, number of class rooms, number of academic staff and the total number of pupils in the schools). The remaining 27 (71.1%) schools, with efficiency scores above 1, exhibit varying degrees of inefficiency, suggesting potential for improvement in resource utilization.

The analysis of Table 2 reveals that 11 of the 38 public primary schools operate at peak efficiency, achieving an efficiency score of 1. These schools serve as models of excellence, demonstrating optimal resource utilization in delivering services. By leveraging insights from these efficient facilities, the remaining 27 schools can address inefficiencies and improve their performance

Reference Set Frequency Analysis

The frequency of the reference set allows the analyst to understand how many times an efficient unit appears in an efficient unit's reference set. That is, how many times each efficient unit is used in calculating virtual efficient units for each inefficient unit. Table 1, shows the efficient schools, the analysis shows that 11, (28.9%) out of the thirty - eight public primary schools of Gombe local government area of Gombe State were efficient each with an efficiency score of one. The remaining 27, (71.9%) were classified as inefficient each with an efficiency score of greater than one (See Table 1).

The reference set frequency analysis is shown in Table 4 and figure 1 shows the reference sets frequencies respectively. This analysis is useful because it helps to indicate the most efficient schools since the higher the inclusion in the reference sets of other schools the more likely the efficient school is an example of best performer among the schools. The analysis shows that 'Hassan Central primary school (DMU25)' is the most frequently occurring reference set, since it appears in the reference sets of seventeen (24). As such, its

unique attributes should be examined more closely. However, Alabura Model Primary School (DMU2) and Usman Memorial Primary School (DMU19) with zero occurring reference set are a classic example of a weakly efficient DMU. A major advantage of the reference set frequency analysis is that it provides a means of ranking the efficient schools. Table 4.5, presents the rankings of the efficient schools.

Table 4: Efficient Public Primary Schools and Frequency of Reference Sets

DECISION MAKING UNITS (DMU)	FREQUENCY OF REFERENCE SETS
1. ORJI ESTATE PRIMARY SCHOOL	19
2. ALABURA MODEL PRIMARY SCHOOL	0
3. GABUKKA PRIMARY SCHOOL	1
4. BUBAYERO PRIMARY SCHOOL	2
5. KAGARAWAL PRIMARY SCHOOL	1
6. USMAN MEMORIAL PRIMARY SCHOOL	0
7. HASSAN CENTRAL PRIMARY SCHOOL	24
8. GIRL CHILD GANDU PRIMARY SCHOOL	13
9. JAURO GOTEL PRIMARY SCHOOL	5
10. PANTAMI PRIMARY SCHOOL	4
11. NURUDDEEN PRIMARY SCHOOL	1

According to Table 4, Hassan Central primary school (DMU25) is the most frequently referenced school, appearing in 17 reference sets. This accounts for a significant portion of the total reference sets analyzed, indicating that DMU25 is a standout performer among the evaluated public primary schools. The reference sets counts chart in Figure 1 further illustrates DMU25's dominance, visually confirming its high frequency compared to other efficient schools. Other schools in the sample appear less frequently in reference sets, suggesting that DMU25 possesses unique operational characteristics that warrant closer examination.

The prominence of Hassan Central primary school (DMU25) in 24 reference sets underscores its role as a benchmark for efficiency in public primary schools. The high frequency of inclusion suggests that DMU25 optimizes its inputs—such as staff salary, number of class rooms, number of academic staff and the total number of pupils in the schools — to achieve superior outputs, such as number of graduates and the average grade in first school leaving certificate. This finding has significant implications for school management, as DMU25's practices could serve as a model for improving efficiency across other schools

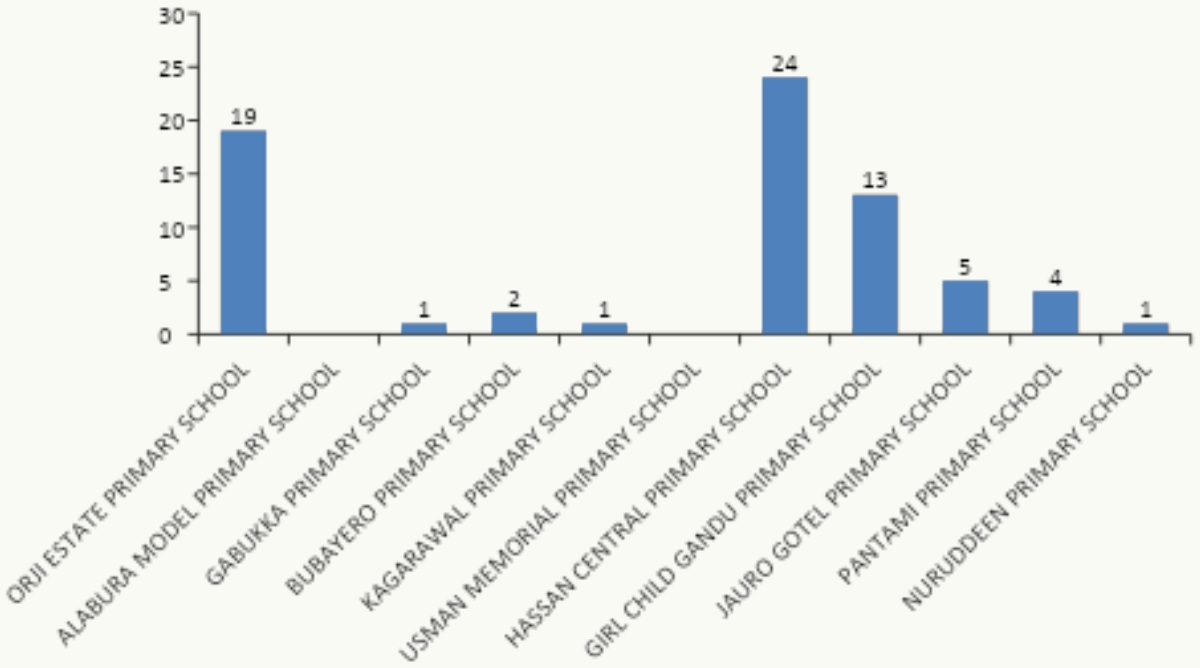

Figure 1: Reference Set Frequencies

Table 5: Efficient Public Primary Schools Frequency in Reference Sets and Ranks

DECISION MAKING UNITS (DMU)	FREQUENCY OF REFERENCE SETS	RANK
1. ORJI ESTATE PRIMARY SCHOOL	19	2
2. ALABURA MODEL PRIMARY SCHOOL	0	10
3. GABUKKA PRIMARY SCHOOL	1	7
4. BUBAYERO PRIMARY SCHOOL	2	6
5. KAGARAWAL PRIMARY SCHOOL	1	7
6. USMAN MEMORIAL PRIMARY SCHOOL	0	10
7. HASSAN CENTRAL PRIMARY SCHOOL	24	1
8. GIRL CHILD GANDU PRIMARY SCHOOL	13	3
9. JAURO GOTEL PRIMARY SCHOOL	5	4
10. PANTAMI PRIMARY SCHOOL	4	5
11. NURUDDEEN PRIMARY SCHOOL	1	7

The efficiency rankings presented in Table 5 provide a compelling evaluation of public primary schools based on their operational performance, as determined through reference set frequency analysis. This methodology ranks schools by how frequently they appear in the reference sets of other schools, with

higher frequencies indicating greater efficiency and influence as benchmarks. Table 5 identifies Hassan Central primary school (DMU25) as the top-ranked school, securing the number 1 position. This result highlights DMU25's exceptional efficiency and its critical role as a benchmark for others.

The rankings in Table 5 offer a scalable approach to improving efficiency in school systems, with potential applications beyond the studied schools. By highlighting DMU25 as the top performer, the analysis sets a benchmark for excellence that can guide system-wide improvements, ultimately leading to better resource utilization and pupil's outcomes. However, the reliance on reference set frequency has limitations. The rankings do not reveal specific operational details or contextual factors, such as DMU25's location, pupil's demographics, or service scope, which may influence its performance. Additionally, the focus on top-ranked schools may overshadow incremental progress in lower-ranked ones. Future studies should integrate qualitative insights, additional performance metrics to provide a more holistic view of efficiency drivers and to translate its exemplary performance into actionable improvements across the school system.

Inputs used by Hypothetical Composite Unit (HCU) in Inefficient Schools

For inefficient schools to benefit from the study, the amount by which these inefficient schools should decrease their inputs to become efficient is calculated (See Table 6). In this study, the composite unit (HCU) represents the amount of inputs that should be utilized by the inefficient Schools in order to become efficient. Table 6, details the analysis of inputs utilized by Alabura Model Primary School. The analysis shows, the school would have 23 staff, the 24th has to work at 32%, with excess inputs of (7) academic staff and ₦26,790.27 salary. Also, the analysis indicates that there are an excess of (1) classrooms and (127) students in the school. Deduction of excess inputs is needed for it to emulate its peers to become efficient. For the inputs utilized by Yelonguruza Primary School, the analysis shows that the school is operating with excess inputs of (30) academic staff, ₦1,077,047.33 staff salary and (27) unutilized or excess classrooms. Also, the analysis indicates that there are an excess of 2235 students in the school. Deduction of excess inputs is needed for it to emulate its peers to become efficient.

The study shows that Jekadafari Primary School is operating with excess inputs of (3) academic staff, ₦29,430.44 staff salary and an excess of 595 students. Also, the analysis indicates that there are no excess classrooms in the school. Deduction of excess inputs is needed for it to emulate its peers to become efficient. The study also shows that Buhari Estate Primary School is operating with excess inputs of (13) classrooms, (17) academic staff and ₦602,496.16 staff salary and 1,037 students. Deduction of excess inputs is needed for it to emulate its peers to become efficient. The study shows that T/Wadan Pantami Primary School is operating with excess inputs of (8) academic staff and ₦10,054.69 staff salary, (1) classrooms and (429) students. Also, deduction of excess inputs are needed for it to emulate its peers to become efficient.

Table 6: Inputs Used by Composite Unit (CU) and Inefficient DMUs

INPUTS	REFERENCE SETS		HCU	DMUS	EXCESS INPUTS
	Abubakar Umar Mem. Pri. Sch. Nuruddeen Pri. Sch.			**Alabura Model Pr. Sch.**	
Staff Salary	(0.667)* 556458.3 (0.094)* 502326.37	+	₦418,376.36	₦445166.64	₦26,790.27
Number of classrooms	(0.667)* 17 (0.094)* 18	+	13.03	15	1.97
Number of Academic Staff	(0.667)* 32 (0.094)* 21	+	23.32	31	7.68
Number of students in the School	(0.667)* 776 (0.094)* 723	+	585.55	713	127.45
	Girl Child Gandu. Pri. Sch. Special Ed. Cen. Pri. Sch.		**CU**	**Yelonguruza Pr. Sch.**	**Excess Inputs**
Staff Salary	(0.114)* 443229.15 (1.035)* 709166.64	+	₦784,515.10	₦1861562.43	₦1,077,047.33
Number of classrooms	(0.114)* 3 (1.035)* 9	+	9.66	37	27.34
Number of Academic Staff	(0.114)* 13 (1.035)* 22	+	24.25	55	30.75
Number of students in the School	(0.114)* 14 (1.035)* 207	+	215.84	2451	2,235.16
	Herwagana Pri. Sch. Girl Child Gandu Pri. Sch.		**CU**	**Jekadafari Pr. School**	**Excess Inputs**
Staff Salary	(0.924)* 1506979.11 (0.592)* 443229.15	+	₦1,654,840.35	₦1684270.77	₦29,430.44

Number of classrooms	(0.924)* 21 (0.592)* 3	+	18	18	0
Number of Academic Staff	(0.924)* 56 (0.592)* 13	+	59.44	63	3.56
Number of students in the School	(0.924)* 1128 (0.592)* 14	+	1,050.56	1646	595.44
	Girl Child Gandu Pri. Sch. Special Ed. Cen. Pri. Sch.		**CU**	**Buhari Estate Pr, School**	**Excess Inputs**
Staff Salary	(0.71)* 443229.15 (0.29)* 709166.64	+	₦520,351.02	₦1122847.18	₦602,496.16
Number of classrooms	(0.71)* 3 (0.29)* 9	+	4.74	18	13.26
Number of Academic Staff	(0.71)* 13 (0.29)* 22	+	15.61	33	17.39
Number of students in the School	(0.71)* 14 (0.29)* 207	+	69.97	1107	1,037.03
	Hassan Central Pri. Sch. Girl Child Gandu Pri. Sch.		**CU**	**T/Wadan Pantami**	**Excess Input**
Staff Salary	(0.474)* 3102604.05 (0.527)* 443229.15	+	₦1,704,216.08	₦1714270.77	₦10,054.69
Number of classrooms	(0.474)* 37 (0.527)* 3	+	19.12	21	1.88
Number of Academic Staff	(0.474)* 93 (0.527)* 13	+	50.93	59	8.07
Number of students in the School	(0.474)* 4551 (0.527)* 14	+	2,164.55	2594	429.45

Findings

The study assesses the Technical Efficiency of 38 Public Primary Schools in Gombe Local Government of Gombe State. Results obtained indicate that 11, (28.9%) were efficient while the remaining 27, (71.1%) were inefficient (Table 1).

The reference set analysis shows that Hassan Central primary school (DMU25) appeared in the reference set of (24) out of the (27) inefficient schools, thus making it the highest ranking school (i.e. the most efficient School in Gombe local government area). Alabura Model Primary School (DMU2) and Usman Memorial Primary School (DMU19) did not appear as a reference set and so could not offer examples of best practice for inefficient schools to emulate. Thus, rank least in the efficient schools. An inputs analysis shows that all inputs variable Number of Academic Staff, Staff Salary, Number of Classrooms and Number of Students are the major reasons for inefficiency in the majority of the Schools.

Conclusion

In this study, we assessed the Technical Efficiency of Public Primary Schools in Gombe local government area of Gombe State. 2023/2024 academic session Data was used, using Data Envelopment Analysis (DEA).

The findings of this study which indicates that 11(28.9%) schools are efficient while 27 (71.1%) schools are inefficient, DMU(25) (i.e. Hassan Central Primary School) is the most efficient Primary School with highest reference sets appearing 24 times and as such ranked 1st and the best example for other inefficient DMUs to emulate. The findings will help the management of Gombe State government to evaluate more critically, its resource allocation strategy in a manner that would reflect fairness and objectivity. Finally, anticipating future research work, it is worth pointing out that these results need to be contrasted by introducing other factors that can significantly affect the performance of Schools. These variables include factors outside the control of School management such as: socioeconomic conditions, community support and parental involvement initiatives. Understanding the influence of these variables is crucial for improving the overall quality of education.

Recommendations

Drawing on the DEA findings this study proposes the following policy-oriented recommendations to enhance the operational efficiency of public primary schools in Gombe L.G.A:

First, education authorities should institutionalize Data Envelopment Analysis as a core performance evaluation tool within the school management system. Periodic DEA based assessment would enable consistent monitoring of efficiency trends, support timely identification of inefficiencies, and provide an objective analytical foundation for resource allocation and policy intervention. Embedding DEA in routine planning processes would strengthen accountability and evidence based governance in primary education.

Second, operating on the efficiency frontier should be formally designated as benchmarks for performance improvement. In particular, Hassan Central Primary School, identified as the most influential reference unit, should be subjected to in-depth managerial and operational analysis. Best practices derived from such benchmark schools should be systematically transferred to inefficient schools through structured mentoring, leadership training, and peer-learning mechanisms.

Third, policy efforts should focus on optimizing existing inputs rather than expanding resource provision. The results indicate that inefficiency is largely attributable to surplus academic staff, excessive salary expenditure, underutilized classrooms, and imbalance enrollment level. Strategic redeployment of teachers,

rationalization of class sizes, and improved enrollment management are therefore essential for improving output performance under prevailing fiscal constraints.

Finally, future efficiency evaluations should extend beyond purely quantitative measures by incorporating relevant contextual and environmental factors. Socioeconomic conditions, parental involvement, community support, and school location are likely to mediate efficiency outcomes and should be integrated into subsequent DEA models or complementary quantitative analysis. Such an expanded framework would yield more nuanced insight and support the formulation of equitable and context-sensitive education policies

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Appendix I: Summary of the Data Collected for Period of 2023/2024 Session

S/N	Name of Public Primary Schools (DMUs)	Staff Salary	No. of Class Rooms	No. Academic Staff	Total No. Students in the School	No. of Graduates 2032/24	No. of Students with Average Grade in FSLC
1	ORJI ESTATE	6677499.6	17	32	776	167	120
2	ABUBAKAR UMAR MEMORIAL	9348499.4	19	43	1361	202	145
3	ALABURA MODEL	5341999.7	15	31	713	75	54
4	GANDU	9793666.1	16	45	610	92	66
5	GABUKKA	16025999	36	76	3359	556	400
6	BUBAYERO	6677499.6	21	34	2009	307	70
7	KAGARAWAL	9383332.8	26	41	2454	304	219
8	MALAM INNA	11729166	28	45	2299	354	255
9	MU'AZU	31026041	39	93	4569	637	459
10	KARANGADA	27302916	25	73	2023	350	252
11	WURO LADDE	13474166	19	34	1017	129	93
12	T/WADA J/ABARE	5744249.8	7	16	226	23	17
13	YELONGURUZA	22338749	37	55	2451	387	279
14	HERWAGANA	18083749	21	56	1128	76	55
15	KAMARA	28366666	42	89	3458	413	297
16	JEKADAFARI	20211249	18	63	1646	247	178
17	IDI II	21356249	16	37	1601	156	105
18	JAURO ABARE	13288333	14	23	446	31	22
19	USMAN MEMORIAL	6169583.2	16	17	565	77	55

20	SABON GARIN NASARAWO	8067916.4	20	23	856	161	116
21	JALO WAZIRI	24111666	31	76	2416	416	300
22	NASARAWO	18615624	23	53	1581	289	208
23	BUHARI ESTATE	13474166	18	33	1107	200	144
24	MODEL	37231249	37	93	4551	522	376
25	HASSAN CENTRAL	17019999	28	42	2609	541	390
26	LIMAN	14183333	15	38	722	113	65
27	GIRL CHILD GANDU	5318749.8	3	13	14	6	6
28	MANAWACHI	11701250	17	36	1314	231	166
29	JAURO GOTEL	7836291.4	17	27	1166	217	156
30	PANTAMI	31912499	49	97	5296	838	603
31	T/WADAN PANTAMI	20571249	21	59	2594	310	223
32	MADAKI	15956249	19	46	1486	201	145
33	FAMILY SUPPORT	14892499	27	42	1809	216	156
34	IDI	27657499	37	81	3706	540	320
35	NURUDDEEN	6027916.4	18	21	723	95	68
36	JAURO T/WADA	25529999	29	75	2430	360	259
37	SPECIAL EDUCATION CENTRE	8509999.7	9	22	207	36	26
38	TSANGAYA M/INNA	6382499.8	14	19	372	65	47

Source: Local Government Education Authority Gombe