Enhancing Environmental Performance through Governance: The Case of Skikda Municipality

تحسين الأداء البيئي من خلال الحوكمة: دراسة حالة بلدية سكيكدة

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Abstract:

This study aims to shed light on the role of governance in improving environmental performance, with a particular focus on the Municipality of Skikda. The research adopts a descriptive-analytical approach, with data collected through a questionnaire distributed to a sample of 63 employees of the municipality, determined using Richard Geiger's formula. The data were analyzed using SPSS version 23.

The results revealed a strong positive relationship between the application of the principles of participation, responsibility, and accountability, and the improvement of environmental performance in the Municipality of Skikda, with these principles having the greatest impact. Other governance dimensions (transparency, justice, effectiveness, and efficiency) also showed varying positive effects. Based on these findings, the study recommends intensifying efforts to activate genuine community participation mechanisms and reinforce the principles of responsibility and accountability, given their ability to bring about positive transformations in environmental performance and achieve effective local governance.

Keywords: Governance; Environmental Performance; Sustainable Local Development; Municipality of Skikda.

Jel Classification Codes : H70; Q01; Q50; Q56; Q58.

Abstract in Arabic:

تهدف هذه الدراسة إلى تسليط الضوء على دور الحوكمة في تحسين الأداء البيئي، مع التركيز على بلدية سكيكدة، وقد اعتمدت الدراسة على المنهج الوصفي التحليلي، بجمع البيانات من

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خلال توزيع استبانة على عينة حجمها 63 موظف ببلدية سكيكدة تم تحديدها بواسطة معادلة ريتشارد جيجر، تحليل نتائجها باستخدام برنامج SPSS 23.
أظهرت النتائج وجود علاقة إيجابية وقوية بين تطبيق مبادئ المشاركة والمسؤولية والمساءلة وتحسين الأداء البيئي ببلدية سكيكدة، حيث كان لها التأثير الأكبر. كما كان لبقية أبعاد الحوكمة (الشفافية، العدالة، الفعالية والكفاءة) تأثير إيجابي متفاوت. وبناء على ذلك، أوصت الدراسة بضرورة تكثيف الجهود لتفعيل آليات المشاركة المجتمعية الحقيقية وترسيخ مبدأي المسؤولية والمساءلة، نظراً لقدرتهما على إحداث تحول إيجابي في الأداء البيئي وتحقيق حوكمة محلية فعالة.
الكلمات المفتاحية :حوكمة؛ أداء بيئي؛ تنمية محلية مستدامة؛ بلدية سكيكدة.
تصنيفات Jel: H70; Q01; Q50; Q56; Q58.

1. INTRODUCTION:

Sustainable development and CSR are global trends seeking balance between economic, social, and environmental dimensions. Good governance is vital for transparency, accountability, and trust, especially in developing countries. Public institutions, such as the Municipality of Skikda, exemplify how governance practices can address economic and environmental challenges.

1.1.Statement of the Problem:

Many Algerian municipalities still struggle with weak transparency, low citizen participation, and poor resource use, despite efforts for sustainable development and environmental protection. This study seeks to answer the following main question:

❖ **Does the implementation of governance principles contribute to improving the environmental performance of the municipality of Skikda?**

To answer this question, the study explores the following sub-questions:

- Does the implementation of the principle of disclosure and transparency enhance the environmental performance of the municipality of Skikda?
- Does the implementation of the principle of justice and the rule of law enhance the environmental performance of the municipality of Skikda?
- Does the implementation of the principle of participation enhance the environmental performance of the municipality of Skikda?
- Does the implementation of the principle of responsibility and accountability enhance the environmental performance of the municipality of Skikda?
- Does the implementation of the principle of efficiency and effectiveness enhance the environmental performance of the municipality of Skikda?

1.2.Research Hypotheses:

To answer these questions, the following hypotheses have been formulated. The main hypothesis is:

❖ **The implementation of governance principles has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda..**

The main hypothesis is subdivided into the following sub-hypotheses:

- The implementation of the principle of disclosure and transparency has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda;
- The implementation of the principle of justice and the rule of law has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda;
- The implementation of the principle of participation has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda;
- The implementation of the principle of responsibility and accountability has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda;
- The implementation of the principle of efficiency and effectiveness has a positive and statistically significant role ($\alpha \leq 0.05$) in improving the environmental performance of the municipality of Skikda.

1.3.Research Objectives:

This study aims to achieve a set of objectives summarized as follows:

- To determine the level of implementation of governance principles in the municipality of Skikda;
- To measure the impact of implementing governance principles on improving environmental performance;
- To analyze the relationship between the principle of disclosure and transparency and environmental performance;
- To analyze the relationship between the principle of justice and the rule of law and environmental performance;
- To analyze the relationship between the principle of participation and environmental performance;
- To analyze the relationship between the principle of responsibility and accountability and environmental performance;

- To analyze the relationship between the principle of efficiency and effectiveness and environmental performance.

1.4.Significance of the Study

This study emphasizes the role of governance principles in enhancing municipalities' environmental performance by promoting transparency, justice, participation, accountability, and efficiency, especially amid growing environmental and economic challenges.

1.5.Literature Review:

A study conducted by (Ouaker, et al., 2021) examined the environmental governance system adopted by Saudi Aramco in the oil and gas sector and its role in enhancing environmental performance, while also referring to the state of environmental governance in Algeria and the potential benefits of drawing lessons from the Saudi experience. Relying on an analytical approach through the examination of Aramco's 2019 annual report on environmental governance, in addition to a comparative statistical analysis based on the company's 2018 and 2019 reports, the study demonstrated that Saudi Aramco's environmental governance framework serves as an effective tool for improving its environmental performance. This was achieved through the adoption of numerous policies and strategies that address climate change on the one hand and environmental protection on the other.

In a similar vein, (Ong, et al., 2022) sought to investigate the role of country-level governance in improving environmental performance, drawing on secondary data covering 200 countries over the period 2006–2016, with a sample of 1,110 observations, including 774 from developing countries and 336 from developed countries. The study employed the Worldwide Governance Indicators (WGI), which encompass six key dimensions (voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption), alongside the Environmental Performance Index (EPI) that evaluates both environmental health and ecosystem vitality. Control variables such as population size and primary school enrollment were also considered. Using a panel regression model with robustness tests conducted via STATA, the findings revealed that governance exerts a significant positive impact on environmental performance in developing countries, whereas the effect is weak or insignificant in developed ones. The study concluded that government effectiveness, anti-corruption measures, and regulatory quality are essential drivers of environmental performance, and recommended

reinforcing governance practices by promoting political stability, accountability, and strict adherence to the rule of law, especially in the context of developing countries striving to achieve sustainable development goals.

Furthermore, a study by (Ahmed Al-Tahir Al-Dhawi Mohamed, et al., 2024) explored the role of governance and environmental leadership in enhancing environmental performance and reducing industrial pollution in manufacturing enterprises. Employing a descriptive-analytical approach and using a questionnaire survey administered to a sample of industrial institutions, the study found that environmental governance and leadership have a strong positive impact on improving environmental outcomes and mitigating industrial pollution. The findings also highlighted that environmental innovation and the adoption of sustainable environmental practices reinforce compliance with environmental laws and regulations and encourage companies to develop effective strategies to reduce their negative environmental impacts.

2. THEORETICAL UNDERPINNING:

2.1.The Concept of Corporate Governance:

Corporate governance encompasses the frameworks, principles, and systems that direct and regulate companies. It involves the relationships and interactions among management, the board of directors, shareholders, and stakeholders. Its main goal is to ensure transparency, accountability, and protect shareholders' rights. (Gao & Others, 2023)

Corporate governance is defined as a framework comprising structures, mechanisms, and processes designed to manage and regulate companies effectively. It establishes an integrated system of regulatory controls and policies that guide decision-making processes while ensuring adherence to legal and regulatory requirements. The concept of governance extends beyond state-owned enterprises to include active participation from private sector representatives and various governmental institutions. (Owalo, 2025)

we can be defined it as a system or framework for managing organizations effectively and transparently, ensuring accountability, fairness, the prevention of corruption, and the protection of the rights of all stakeholders.

2.2.Corporate Governance Principles:

Corporate Governance Principles can be summarized as follows**:** (Kheroufi, 2012, p. 43)

2.2.1. Disclosure and Transparency: In decision-making, mutual trust between superiors and subordinates is built by ensuring accessible and understandable information on policies, programs, budgets, and contracts. Key features are: access, relevance, and accuracy of information.

2.2.2. Justice and Rule of Law: Promoting equality and fairness by guaranteeing equal opportunities, protecting human rights, reducing disparities, and upholding the rule of law.

2.2.3. Participation: Involvement in decision-making emphasizes citizen awareness, participation in shaping policies, freedom of expression, and active civil society engagement..

2.2.4. Responsibility and Accountability: Establishing monitoring mechanisms to evaluate institutional performance, ensure accountability, and protect public resources from misuse.

2.2.5. Efficiency and Effectiveness: The technical dimension of public management reflects institutions' capacity to convert resources into programs and projects that address citizens' needs, deliver better outcomes, and optimize resource use. (Kidouan & maamri, 2017, p. 57)

2.3.Environmental performance in municipalities:

Environmental performance in municipalities reflects their commitment to sustainability by reducing pollution, conserving resources, managing waste, creating green spaces, and integrating sustainability into urban planning.

3. METHODOLOGY:

Following the establishment of the general framework of the study, this section addresses the methodological procedures, detailing the steps and approaches adopted in conducting the research.

3.1.Study Population and Sample

In this section, the study population and sample are identified as essential components of the research methodology.

3.1.1. Study Population

Skikda Municipality was selected due to its economic and social significance, its potential management challenges, and its major role in achieving sustainable local development. This provides an opportunity to

examine the impact of governance and to offer practical recommendations for improving efficiency in a relevant local context.

Considering the nature of this research, all municipal departments were included in the study. Thus, the study population consisted of 983 employees, including executives and administrative staff of the municipality. No specific selection criteria (such as gender, age, education level, or experience) were imposed when determining the population.

3.1.2. Study Sample

A random sample was selected from the study population, calculated using the **Richard Geiger method**:

$$n = \frac{\left(\frac{z}{d}\right)^2 \times p\left(1-p\right)}{1+\frac{1}{N}\left[\left(\frac{z}{d}\right)^2 \times p\left(1-p\right)-1\right]}$$

Where: **n** = required sample size/ **N** = population size/ **z** = 1.64 (at a confidence level of 0.90)/ **d** = margin of error (0.1)/ **p** = probability (0.5)

By applying the formula:

$$n = \frac{\left(\frac{1,64}{0,1}\right)^2 \times 0,5(1-0,5)}{1+\frac{1}{983}\left[\left(\frac{1,64}{0,1}\right)^2 \times 0,5(1-0,5)-1\right]} = \frac{67,24}{1,0673855} \cong 63$$

The final sample consisted of **63 executives and administrative employees** of Skikda Municipality, These participants were drawn from various offices and sub-departments, and their responses serve as a reliable basis for answering the research questions. The sample targeted decision-makers, executives, and officers to explore the role of governance in improving the efficiency of public management within Skikda Municipality.

A total of 63 questionnaires were distributed, all of which were retrieved (100% response rate). None were excluded, as all responses were complete. Thus, **63 valid questionnaires** were retained for statistical analysis, corresponding to a **100% effective response rate**, which is highly acceptable for research purposes. Consequently, the final study sample included **63 respondents**, as summarized in Table (03):

Table (01): Distribution of Questionnaires Valid for Analysis

Statement	Distributed	Retrieved	Excluded	Valid for Analysis	Sample Size
Frequency	63	63	0	63	63
Percentage (%)	100%	100%	0%	100%	100%

Source: Author's own work.

3.2.Normality Test :

The Kolmogorov-Smirnov test was used to check data normality for a sample size over 50. The hypotheses were formulated as follows:

***H_0:** The data follow a normal distribution if the significance value (Sig.) >0.05.

***H_1:** The data do not follow a normal distribution if the significance value (Sig.) ≤ 0.05.

The decision to accept or reject H_0 is based on the Kolmogorov-Smirnov results generated using SPSS v.23.

Table (02): Normality Test Results for the Study Dimensions

Study Dimensions	Sig
Transparency	0.000
Justice and Rule of Law	0.000
Participation	0.000
Responsibility & Accountability	0.038
Effectiveness & Efficiency	0.000
Environmental Performance	0.001

Source: SPSS_v23-Generated Output.

Kolmogorov-Smirnov test results show all significance values (**0.000, 0.038, 0.001 < 0.05**), leading to rejection of H_0 and acceptance of H_1, indicating that the data are not normally distributed.

Accordingly, the study data (Transparency, Justice & Rule of Law, Participation, Responsibility & Accountability, Effectiveness & Efficiency,

Environmental Performance) are not normally distributed; hence, non-parametric tests are appropriate for analysis and hypothesis testing.

3.3.Construct Validity and Reliability of the Study Instrument

Construct validity of the study instrument was evaluated using Spearman's rank correlation, while reliability was assessed through Cronbach's Alpha.

Table (03): Summary of Construct Validity and Reliability Results

Dimension	No. of Items	Spearman Correlation Range	Sig.	Cronbach's Alpha
Transparency	4	0.677 – 0.794(**)	0.000	0.867
Justice and Rule of Law	3	0.635 – 0.739(**)	0.000	0.867
Participation	4	0.777 – 0.815(**)	0.000	0.869
Responsibility & Accountability	5	0.730 – 0.840(**)	0.000	0.868
Effectiveness & Efficiency	4	0.736 – 0.775(**)	0.000	0.866
Environmental Performance	10	0.389 – 0.818(**)	0.000	0.852
**: Correlation is statistically significant at the 0.01 level.				

Source: SPSS_v23-Generated Output.

Table 03 shows high and significant Spearman correlations (**0.389–0.840**, $\alpha < 0.01$), with only one moderate value (0.389). Cronbach's Alpha values (**0.79–0.85**) exceed 0.70, confirming the instrument's validity and reliability for assessing governance principles and environmental performance in Skikda.

4. FINDINGS AND DISCUSSION:

4.1.Testing the First Sub-Hypothesis:

The first sub-hypothesis states that: *"The implementation of the principle of disclosure and transparency has a positive and statistically significant role ($\alpha \leq 0.05$) in improving environmental performance in the Municipality of Skikda."*

The relationship between the two variables was examined using the

Wilcoxon one-sample test, as well as Spearman's correlation coefficient with the calculation of the effect size (d).

4.1.1. Testing the Relationship Between the Variables:

A null hypothesis (H_0) was formulated to negate the relationship, and an alternative hypothesis (H_1) was established to confirm its existence:

***H_0:** There is no statistically significant relationship ($\alpha \leq 0.05$) between transparency and the improvement of environmental performance.

***H_1**: There is a statistically significant relationship ($\alpha \leq 0.05$) between transparency and the improvement of environmental performance.

Table (04): Wilcoxon Test on Transparency and Environmental Performance in Skikda.

Partial Axis	Sample Size (n)	W-value	Standard Error (SE)	Z-value	Significance Level (α)
First Sub-Hypothesis	63	400.50	118.69	-3.113	0.002

Source: SPSS_v23-Generated Output.

Table 04 shows the Wilcoxon test results with **$Z = -3.113$** and **$p = 0.002 < 0.05$**, leading to rejection of H_0 and acceptance of H_1. This indicates a significant relationship between transparency and improved environmental performance. The negative Z reflects that transparency helped reduce performance constraints, improving related indicators.

4.1.2. Testing the Strength and Direction of the Relationship:

The strength and direction of the relationship were tested using Spearman's correlation coefficient and the effect size (d) calculated as $Z/\sqrt{n}$, using SPSS.

Table (05): Results of Spearman's Correlation for the First Hypothesis

Partial Axis	Sample Size (n)	Spearman's R	Significance Level (p)	Effect Size (d)
First Sub-Hypothesis	63	0.269*	0.033	-0.39
*: Significant at $\alpha \leq 0.05$.				

Source: SPSS_v23-Generated Output.

The Spearman correlation coefficient (Table 05) shows R = 0.269 at a significance level of p = 0.033, indicating a positive but relatively weak relationship between transparency and environmental performance. The absolute value of the effect size |d| = 0.39 reflects a weak-to-moderate effect according to Cohen's criterion. This suggests that while transparency has a tangible impact, it is not the primary factor driving improvements in environmental performance.

The results **confirm the acceptance of the first sub-hypothesis**, meaning that the transparency positively affects environmental performance in Skikda, though the impact is moderate, indicating a need to strengthen and integrate transparency mechanisms..

4.2.Testing the Second Sub-Hypothesis:

The second sub-hypothesis states that: *"The implementation of the principle of justice and rule of law has a positive and statistically significant role ($\alpha \leq 0.05$) in improving environmental performance in the Municipality of Skikda."*
The relationship between the two variables was tested using the Wilcoxon one-sample test, Spearman's correlation coefficient, and the effect size (d).

4.2.1. Testing the Relationship Between the Variables:

The following hypotheses were formulated:

***H_0:** There is no statistically significant relationship ($\alpha \leq 0.05$) between justice and rule of law and the improvement of environmental performance.

***H_1:** There is a statistically significant relationship ($\alpha \leq 0.05$) between justice and rule of law and the improvement of environmental performance.

Table (06): Wilcoxon Test on Rule of Law and Environmental Performance in the Skikda Municipality.

Partial Axis	Sample Size (n)	W-value	Standard Error (SE)	Z-value	Significance Level (α)
Second Sub-Hypothesis	63	1200.5	125.15	2.988	0.003

Source: SPSS_v23-Generated Output.

The results of the Wilcoxon test (Table 06) indicate that the Z-value reached 2.988 at a significance level of p = 0.003, which is below 0.05. This leads to rejecting H_0 and accepting H_1, confirming that the implementation of justice

and the rule of law has contributed to reducing environmental performance constraints, reflecting improved performance indicators.

4.2.2. Testing the Strength and Direction of the Relationship:

Table (07): Results of Spearman's Correlation for the Second Sub-Hypothesis.

Partial Axis	Sample Size (n)	Spearman's R	Significance Level (p)	Effect Size (d)
Second Sub-Hypothesis	63	0.551**	0.000	0.37
**: Significant at $\alpha \leq 0.01$.				

Source: SPSS_v23-Generated Output.

The Spearman correlation coefficient (Table 07) shows R = 0.551 at p = 0.000, indicating a positive, moderately strong relationship between justice and rule of law and environmental performance. The effect size d = 0.37 represents a weak-to-moderate effect according to Cohen's criterion, meaning that justice and rule of law play a tangible role but are insufficient on their own for major improvements in environmental performance.

The results **confirm the acceptance of the second sub-hypothesis**, as the implementation of justice and rule of law positively and significantly enhances environmental performance. However, additional supportive policies and mechanisms are required to strengthen its impact.

4.3.Testing the Third Sub-Hypothesis

The third sub-hypothesis states that: *"The implementation of the principle of participation has a positive and statistically significant role ($\alpha \leq 0.05$) in improving environmental performance in the Municipality of Skikda."* The relationship was tested using the Wilcoxon one-sample test, Spearman's correlation coefficient, and the effect size (d).

4.3.1. Testing the Relationship Between the Variables:

***H_0:** There is no statistically significant relationship ($\alpha \leq 0.05$) between participation and the improvement of environmental performance.

***H_1:** There is a statistically significant relationship ($\alpha \leq 0.05$) between participation and the improvement of environmental performance.

Table (08): Wilcoxon Test on Participation and Environmental Performance in the Skikda Municipality.

Partial Axis	Sample Size (n)	W-value	Standard Error (SE)	Z-value	Significance Level (α)
Third Sub-Hypothesis	63	18.500	60.917	-4.867	0.000

Source: SPSS_v23-Generated Output.

The Wilcoxon test results (Table 08) show that the Z-value reached -4.867 at p = 0.000, which is less than 0.05, leading to the rejection of H_0 and acceptance of H_1. This indicates that the implementation of participation helped to reduce environmental performance barriers, reflecting a clear improvement in performance indicators.

4.3.2. Testing the Strength and Direction of the Relationship:

Table (09): Results of Spearman's Correlation for the Third Sub-Hypothesis.

Partial Axis	Sample Size (n)	Spearman's R	Significance Level (p)	Effect Size (d)
Third Sub-Hypothesis	63	0.556**	0.000	-0.61
**: Significant at $\alpha \leq 0.01$.				

Source: SPSS_v23-Generated Output.

The Spearman correlation coefficient (Table 09) shows R = 0.556 at p = 0.000, indicating a moderately strong positive relationship between participation and environmental performance. The effect size |d| = 0.61 reflects a medium-to-strong effect according to Cohen's criterion, with the negative sign indicating a reduction in inverse indicators, i.e., actual improvement in environmental performance.

The results strongly **support the acceptance of the third sub-hypothesis**, confirming that participation is among the factors with a relatively stronger positive effect on environmental performance compared to other principles in the Municipality of Skikda.

4.4.Testing the Fourth Sub-Hypothesis:

The fourth sub-hypothesis states that: *"The implementation of the principle of responsibility and accountability has a positive and statistically*

significant role (α ≤ 0.05) in improving public administration effectiveness in the Municipality of Skikda".

The relationship between the two variables was examined using the Wilcoxon one-sample test, Spearman's correlation, and effect size (d).

4.4.1. Testing the Relationship Between the Variables:

The hypotheses were formulated as follows:

***H_0:** There is no significant relationship (α ≤ 0.05) between responsibility and accountability and the improvement of environmental performance.

***H_1:** There is a significant relationship (α ≤ 0.05) between responsibility and accountability and the improvement of environmental performance.

Table (10): Wilcoxon Test on Responsibility and Accountability in Environmental Performance in the Skikda Municipality.

Partial Axis	Sample Size (n)	W-value	Standard Error (SE)	Z-value	Significance Level (α)
Fourth Sub-Hypothesis	63	81.400	118.963	-5.788	0.002

Source: SPSS_v23-Generated Output.

The Wilcoxon test results (Table 10) show that the Z-value reached -5.788 with a p-value of 0.002, which is less than 0.05. This leads to the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_1), confirming that the implementation of responsibility and accountability helped reduce environmental obstacles, improving performance indicators.

4.4.2. Testing the Strength and Direction of the Relationship

Table (11): Results of Spearman's Correlation for the Fourth Sub-Hypothesis

Partial Axis	Sample Size (n)	Spearman's R	Significance Level (p)	Effect Size (d)
Fourth Sub-Hypothesis	63	0.538**	0.000	-0.73
**: Significant at α ≤ 0.01.				

Source: SPSS_v23-Generated Output.

The Spearman correlation coefficient (Table 11) shows R = 0.538 at p = 0.000, indicating a moderately strong positive relationship between responsibility and accountability and environmental performance improvement. The effect size d = -0.73 represents a medium-to-strong effect according to Cohen's standard, where the negative sign indicates a reduction in inverse performance indicators, i.e., tangible improvements in environmental performance.

The results **confirm the acceptance of the fourth sub-hypothesis**, demonstrating that responsibility and accountability are among the key principles with a relatively stronger and positive impact on enhancing environmental performance in the Municipality of Skikda.

4.5.Testing the Fifth Sub-Hypothesis

The fifth sub-hypothesis states that: *"The implementation of the principle of efficiency and effectiveness has a positive and statistically significant role ($\alpha \leq 0.05$) in improving environmental performance in the Municipality of Skikda."*
The relationship between the two variables was assessed using the Wilcoxon one-sample test, Spearman's correlation coefficient, and the effect size (d).

4.5.1. Testing the Relationship Between the Variables:

The hypotheses were formulated as follows:

***H_0:** There is no significant relationship ($\alpha \leq 0.05$) between efficiency and effectiveness and the improvement of environmental performance.

***H_1:** There is a significant relationship ($\alpha \leq 0.05$) between efficiency and effectiveness and the improvement of environmental performance.

Table (12): Wilcoxon Test on Efficiency and Effectiveness and Environmental Performance in the Skikda Municipality.

Main Axis	Sample Size (n)	W-value	Standard Error (SE)	Z-value	Significance Level (α)
Fifth Sub-Hypothesis	63	40.500	115.570	-6.074	0.000

Source: SPSS_v23-Generated Output.

The Wilcoxon test results (Table 12) show that the Z-value reached -6.074 at p = 0.000, which is less than 0.05. This leads to rejecting H_0 and

accepting H_1, indicating that the implementation of efficiency and effectiveness contributed to reducing environmental performance constraints, resulting in noticeable improvements in performance indicators.

4.5.2. Testing the Strength and Direction of the Relationship:

Table (13): Spearman's Correlation Results: Fifth Sub-Hypothesis

Main Axis	Sample Size (n)	Spearman's R	Significance Level (p)	Effect Size (d)
Fifth Sub-Hypothesis	63	0.613**	0.000	-0.76
**: Significant at $\alpha \leq 0.01$.				

Source: SPSS_v23-Generated Output.

The Spearman correlation coefficient (Table 13) shows R = 0.613 at p = 0.000, which indicates a moderately strong positive relationship between efficiency and effectiveness and environmental performance. The effect size d = -0.76 represents a near-large effect according to Cohen's scale, with the negative sign reflecting a decline in inverse performance indicators, i.e., an actual and tangible improvement in environmental performance.

The results **confirm the acceptance of the fifth sub-hypothesis**, demonstrating that the implementation of efficiency and effectiveness has a strong and significant impact and is among the most influential factors in enhancing environmental performance in the Municipality of Skikda compared to other principles.

4.6.Testing the Main Hypothesis:

The main hypothesis states: *"The implementation of governance principles has a positive and statistically significant impact at the significance level ($\alpha \leq 0.05$) on improving environmental performance in the Municipality of Skikda."* The relationship between the variables is examined using the Wilcoxon signed-rank test for a single sample, along with the Spearman correlation coefficient to assess the strength and direction of the relationship.

4.6.1. Testing the Relationship Between the Variables:

The null hypothesis H_0 assumes no relationship, while the alternative hypothesis H_1 assumes the existence of a relationship, as follows:

***H₀:** There is no statistically significant relationship at the level ($\alpha \leq 0.05$) between governance principles and improved environmental performance.

***H₁:** There is a statistically significant relationship at the level ($\alpha \leq 0.05$) between governance principles and improved environmental performance.

Table (14): Wilcoxon Test Results for Governance and Environmental Performance

Partial Axis	Sample Size (n)	W Value	SE	Z Value	α Level
Sub-hypothesis 1	63	400.50	118.69	-3.113	0.002
Sub-hypothesis 2	63	1200.50	125.15	2.988	0.003
Sub-hypothesis 3	63	18.500	60.917	-4.867	0.000
Sub-hypothesis 4	63	81.400	118.963	-5.788	0.002
Sub-hypothesis 5	63	40.500	115.570	-6.074	0.000
Main Hypothesis	63	348.28	107.858	-4.566	0.001

Source: SPSS_v23-Generated Output.

Table 14 illustrates the Wilcoxon signed-rank test results for a single sample, assessing the impact of governance principles on environmental performance in the Municipality of Skikda. The test produced a value of W = 348.28, with a standard error (SE) of 107.858 and a Z statistic of -4.566 ($p = 0.001 < 0.05$). These results indicate a statistically significant improvement in environmental performance due to the application of governance principles

4.6.2. Testing the Strength and Direction of the Relationship:

At this stage, the strength and direction of the relationship are assessed using the Spearman correlation coefficient, as shown in the following table.

Table (15): Spearman Correlation Results for the Main Hypothesis

Axis	Sample Size (n)	Spearman's R	R^2	Significance Level	Effect Size (d)
Main Hypothesis	63	0.587**	0.344	0.000	-0.57
**: Significant at $\alpha \leq 0.01$.					

Source: SPSS_v23-Generated Output.

Table 15 shows a Spearman correlation coefficient of **0.587**, indicating a moderate positive relationship between governance principles and environmental performance. The significance level (**0.000 < 0.05**) confirms the statistical validity of this relationship. The effect size (**d = -0.57**) falls between medium and large according to Cohen's standard, with the negative sign reflecting a reduction in inverse indicators of environmental performance, thus evidencing a clear improvement.

Consequently, **these results confirm the acceptance of the main hypothesis** stating that: *"The implementation of governance principles has a positive and statistically significant impact at the significance level ($\alpha \leq 0.05$) on improving environmental performance in the Municipality of Skikda."*

5. CONCLUSION:

This study revealed that the adoption of governance principles significantly contributes to improving the environmental performance of the Municipality of Skikda. The statistical tests (Wilcoxon and Spearman) demonstrated positive and statistically significant relationships between various governance principles and environmental performance indicators. This highlights the role of governance in enhancing the efficiency of public management, reducing environmental obstacles, and developing more effective resource management mechanisms.

5.1.Key Findings:

The study reached several key findings, which can be summarized as follows:

- A positive and statistically significant relationship was found between transparency and improved environmental performance;
- Responsibility and accountability contributed to reducing ineffective practices and enhancing oversight;
- Community participation had a positive impact on strengthening compliance with environmental measures;
- The rule of law played a critical role in controlling environmental performance and enforcing standards;
- Efficiency and effectiveness were reflected in improved utilization of natural resources;
- The main hypothesis confirmed that the application of governance principles leads to a noticeable improvement in environmental performance.

5.2.Comparison of Findings with Previous Studies

When comparing the findings of this study with previous research, the following observations can be made:

- **Consistency with the study of Waker Mariam et al. (2021):** Their Aramco's governance system improved environmental performance through policies on climate change and protection. This aligns with the current study, highlighting efficiency in resource use and accountability in oversight.
- **Partial alignment with the study of Tze San Ong et al. (2022):** Governance indicators significantly influence environmental performance, especially in developing countries. While Ong et al. examined this at the national level, the current study confirms similar results at the municipal level, highlighting the roles of rule of law and transparency.
- **Agreement with the study of Nadia Ahmed Al-Tahir et al. (2024):** Environmental governance and leadership reduce pollution and improve performance. This is consistent with the current study, which emphasized community participation, transparency, and accountability in reinforcing compliance.

Accordingly, the present study contributes to the existing literature by providing new empirical evidence at the municipal level, confirming that the comprehensive application of governance principles leads to a significant improvement in environmental performance. This represents a valuable addition compared to previous studies that primarily addressed governance at the national or sectoral levels.

5.3.Recommendations:

Based on the findings, the following recommendations are proposed:

- Promote a culture of transparency and disclosure in all aspects of environmental management;
- Establish strong accountability and oversight mechanisms to ensure quality environmental governance;
- Engage citizens and civil society in environmental decision-making;
- Enforce the rule of law by strictly applying environmental standards.

5.4.Future Research Directions:

These findings open avenues for future research, including:

- Assessing the impact of digital transformation on the application of environmental governance principles in public institutions;

- Statistical modeling to determine the direct and indirect impact of governance principles on environmental performance (using SEM);
- The impact of environmental governance on achieving sustainable development goals: An applied study in the municipal services sector.

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