
Effect of Dynamic Environmental Scanning Approaches on Economic Efficiency of Water Service Providers in Kenya

Esther Kaboo Ngugi¹, Dr. Anita Wanjugu Wachira², Dr. Lilian Karimi Mugambi Mwenda³

¹MBA Student, School of Business Management and Economics ,Dedan Kimathi University of Technology, Kenya

²Senior Lecturer, School of Business Management and Economics ,Dedan Kimathi University of Technology, Kenya

³ Senior Lecturer, School of Business Management and Economics ,Dedan Kimathi University of Technology, Kenya

doi.org/10.51505/IJEBMR.2026.10702 URL: <https://doi.org/10.51505/IJEBMR.2026.10702>

Received: May 11, 2026

Accepted: Jun 16, 2026

Online Published: July 03, 2026

Abstract

Access to safe sanitation and water services for all is a human right that is anticipated under the UN Sustainable Development Goals (SDGs). Despite extensive government interventions to improve the water and sanitation sector efficiency, a very large portion of the population still lacks adequate access to these services. This study aimed to evaluate the dynamic environmental scanning approaches and economic efficiency of water service providers (WSPs) in Kenya. Specifically, it explored the effect of dynamic environmental scanning on economic efficiency of WSPs. It was anchored on Lewin's Change Management theory and Systems theory. A descriptive research design was employed, focusing on a census of all the 88 regulated WSPs in Kenya. Collection of data was carried out using closed ended questionnaires, supplemented with secondary data. It focused on data for five financial years from 2019/20 to 2023/24. It obtained a response rate of 89.9%. Descriptive statistics was used to give an outline of the dataset. Hypothesis testing was conducted through inferential statistics to generate conclusions that addressed the objective of the study. Microsoft Excel, python libraries and SPSS version 29 were used in the creation of insightful diagrams, charts, graphs and tables. The findings provided valuable insights for WSPs management, regulatory bodies and policymakers in enhancing water and sanitation services. By addressing this objective, the study strived to facilitate positive change management and advancement in the sanitation and water sector, ultimately benefiting communities within Kenya.

Keywords: dynamic environmental scanning, economic efficiency, change management, water service providers, sustainable development goals (SDGs)

1. Introduction

1.1 Background of the study

Ensuring access to clean drinking water and basic sanitation remains a critical global endeavour, yet it presents significant challenges on a widespread scale (Reader, 2022). According to Andres, Thibert, Cordoba, Danilenko, Joseph and Vega, (2019), achieving targeted access to these essential services necessitates the need to check on the economic efficiency of WSPs. These institutions function within regulatory frameworks, yet they come across a lot of challenges as well as pressures while operating. To thrive and achieve economic efficiency, these institutions need to develop and leverage dynamic environmental scanning approaches that enable them to seize market opportunities as well as transform their resource base effectively (Andres et al., 2019). The study sought to explore whether dynamic environmental scanning approaches contributed to the economic efficiency of WSPs in Kenya.

Access to water for all will not be arrived at without availing safe water to all consumers. Even listed among the main goals of the UN 2030 agenda for sustainable global development (UN, 2015), the shortage of water currently, is growing rapidly while creating impact on the increasing commercial, residential, industrial and agricultural consumers of water in the world (Vollmer & Harrison, 2021). The demand is expected to increase by 55% by 2030 with 25% of cities that are large experiencing water stress (Lund & Becker, 2021). The severe droughts, change in climate, demand increase, growth in population and mismanagement in the past few decades stressed the limited supplies of freshwater further in the globe and led to severe water shortage for about 4 billion people, one month annually (Orimoloye, I. R., Belle, J. A., Olusola, A. O., Busayo, E. T., & Oloade, O. 2021). Close to 2.2 billion individuals globally, have no access to safe drinking water (United Nations World Health Organization 2024).

Water resource constraints experienced by WSPs in areas that water is scarce have been progressed to the Intermittent Water Supply (IWS) (Simukonda, Farmani & Butler, 2022). Over 309 million individuals, mostly in the developing countries within South America, Asia and Africa, are experiencing the IWS (Loubser, 2023). In an IWS, that may occur once a day, once a week, or seasonally, the potable water is supplied for less than twenty- four hours daily to the customers within the water network (Farmani, Dalton, Charalambous, Lawson, Bunney & Cotterill, 2021).

Ogohi (2019) asserts that managers worldwide are confronted with the inevitability of change in response to evolving dynamics in the market. This necessitates the development of proactive managerial systems to effectively address emerging challenges, rather than relying on reactive approaches. Many institutions have embraced change and applied change management approaches which have enabled them to align with the changes in the business environment assuring them of success (Kimaku, 2021). However, even with adoption and implementation of the change management approaches, several institutions have failed. Ogohi (2019) in Nigeria emphasized the inevitability of change and its impact on people and organizational processes, advocating for proactive managerial systems. In Kenya, Kiprotich, Kahuhia and Kinyua, (2019)

asserts that organizations are embracing change management strategy foreseeing that this will lead to an improved achievement in economic performance of the organizations. The economic performance of the organization is established on suitability between them and the environment surrounding them, therefore any change within the environment of operation requires organizations to quickly adjust to the environment.

1.2 Statement of the Problem

Safe and clean water access in Kenya remains a significant problem for many citizens. WSPs have been established by the government to offer sanitation services and water to the population. The ideal situation as portrayed in the SDG 6 is that by the year 2030 water should be accessible to all (Cai, Zhao & Varis, 2021). Contrary to this, Non-Revenue Water (NRW), water coverage, technological, environmental and climate changes cause decline of water resource across WSPs within the country. These challenges have resulted in poor economic efficiency of WSPs, leading to limited access to water, low-quality services and high costs (Farouk, Rahman & Romali, 2023). This situation prompted the necessity for dynamic environmental scanning approaches to resolve these obstacles and improve the economic efficiency of WSPs in Kenya. The poor economic efficiency of WSPs in Kenya leads to inadequate access to water services which has effects that are adverse on the population's health, social wellbeing and economic development. Despite numerous efforts to address these challenges, the situation persists.

In Kenya, many studies have been conducted, Ombachi & Deya, 2022; Nderitu, Waiganjo & Orwa, 2020; Mwanja & Oyugi, 2020; Kakucha, 2019 on influence of Strategic Implementation on various companies. However, the studies failed to address economic efficiency in WSPs. The studies mentioned therefore did not identify the effect of environmental scanning approaches on economic efficiency of WSPs in Kenya. The study was tackled following the context given so as to comprehend and address the gaps in the research through verification of dynamic environmental scanning approaches influence on economic efficiency of WSPs that is empirical.

1.3 Objective of the Study

The specific objective of the study was to explore the effect of dynamic environmental scanning approaches on economic efficiency of WSPs in Kenya.

1.4 Research Hypothesis

This study tested the following specific null hypothesis for the study objective;

H₀: There is no statistically significant effect of dynamic environmental scanning approaches on economic efficiency of WSPs in Kenya.

1.5 Limitations

Although, the study's main objective was to bring about understanding into the; relationship between dynamic environmental scanning and economic efficiency of WSPs in Kenya, a few limitations may have influenced the research and its findings. These limitations were as follows:

The study was limited by the quality of; secondary data sources available; which might have been incomplete or prone to bias. Recognizing this potential limitation, the study prioritized data collection from reputable organizations to enhance the study's validity. Key among these sources, were; WASREB, the Kenyan regulatory authority responsible for overseeing WSPs and Water and Sanitation Providers Association (WASPA); which serves as a collaborative platform for WSPs to share knowledge and best practices. By leveraging data from WASREB, the study ensured access to authoritative regulatory information, including performance benchmarks and KPIs' compliance of the WSPs. This source offered a comprehensive view of the sector's regulatory landscape, which was crucial for a nuanced analysis.

Additionally, engaging with WASPA allowed the study to incorporate industry insights, practical experiences and innovative solutions adopted by different WSPs. This collaboration enhanced the study by integrating diverse perspectives and fostering an understanding that was more holistic of the challenges and successes in water service provision. Therefore, sourcing data from these credible organizations, the study aimed to ensure risk mitigation that was associated with data limitations and biases. This provided a more accurate and insightful analysis of the water services sector.

Despite these constraints, the study held significant value in advancing the current knowledge framework and had the potential to inform and shape change management strategies within Kenyan WSPs. To address these limitations, the study clearly defined the study's scope, focusing on specific, manageable aspects of the sector while it acknowledged the broader, interconnected issues.

The study may not have been able to account for all the complex and interrelated factors that affected the economic efficiency of WSPs in Kenya. The study, in this case identified areas for future research, offering pathways to explore the more extensive concerns that laid beyond its immediate focus. Additionally, the study restricted itself to the effect of dynamic environmental scanning on economic efficiency of WSPs in Kenya. While there is a possibility of reverse causality where efficient firms may have more resources to perform advanced scanning, the study recommends this for further studies.

By doing the research within a well-defined context and suggesting avenues for continued investigation, the study aimed to enhance its general applicability and provided a starting point for additional exploration in the field, thereby promoting deeper insight of the sector's complexities, ultimately supporting more informed and effective change management practices.

1.6 Operational Definition of Terms

Economic Efficiency Is a performance metric focused on achieving sustainable, cost-effective service delivery, primarily measured by a WSP ability to achieve full cost recovery through operational and management cost coverage, (WASREB, 2024).

Dynamic environmental scanning: These are ways to keep up with the outside world by constantly checking for information about events in an organization’s external environment (Yu & Yuan, 2019).

2. Method

2.1 Theoretical Framework

The study was based on Lewin’s Change theory and Systems theory.

2.1.1 Lewin’s Change Theory

The Lewin’s Change Management Theory was developed by Kurt Lewin and published in 1947. The theory is referred to as the Unfreeze-Change-Refreeze Model. The theory focuses on managing and understanding the process of change within organizations (Bartunek, 2023). This theory emphasizes the need to get organizations ready for change, implementation of the change and the new state solidification, to ensure that the change is sustained. It has been widely influential in the organizational development fields and change management fields, with a provision of a foundational framework for subsequent theories and practices.



Figure 1. Kurt Lewin's Change Management stages. Source: Bartunek, 2023

This theory highlights the significance of effectively managing the change process, including the need to unfreeze existing structures, implement the desired changes and establish mechanisms to

solidify the new state. The theory's focus on addressing resistance to change and creating a supportive environment aligns well with the challenges often faced in implementing change initiatives. Kurt Lewin's change management theory which has three steps unfreezing → changing → refreezing is deemed by people as an approach that is classic to manage change (Bridgman, Cummings & Ballard, 2019).

According to Burnes (2020) on the interconnection between Lewin's theory and Dynamic Environmental Scanning, there is ground that is common between the two which can be built upon fruitfully. The study gained insights into the most effective ways to align and adapt dynamic environmental scanning to support economic efficiency initiatives in WSPs in Kenya. The theory can be applied by exploring the link between environmental scanning approaches and economic efficiency (Al-Rahmi, et al., 2019). Lewin's theory highlights the relevance of unfreezing practices that exist, implementing the change and refreezing the new state. This could involve investigating how different environments, such as incremental or radical adoption, impact the effectiveness of dynamic environmental scanning and subsequently influence performance specifically economic efficiency outcomes in WSPs (Saghafian, Laumann & Skogstad, 2021).

The academic contribution of grounding this study in Lewin's Change Management Theory lies in its repositioning of the classical unfreezing, changing and refreezing framework beyond corporate change management into the specialized and underexplored domain of public utility governance in Sub-Saharan Africa. While Lewin's model has been extensively applied in private sector organizational contexts, this study makes an original theoretical contribution by demonstrating that the economic inefficiencies observed across Kenya's WSPs are not merely financial failures but are fundamentally manifestations of organizations frozen in outdated operational structures, having failed to complete the full institutionalized change cycle that Lewin prescribes. Building on Burnes' (2020) identification of common ground between Lewin's theory and dynamic environmental scanning, the study advances the theoretical argument that environmental scanning itself serves as the critical unfreezing mechanism the catalyst that disrupts organizational inertia by surfacing emerging regulatory, socio-economic and operational signals that compel WSPs to initiate meaningful strategic change. By further introducing the moderating role of institutional capacity and adoption type whether incremental or radical the study enriches Lewin's framework with contextual nuance that is largely absent from existing literature, thereby bridging the gap between classical change management theory and the practical realities of economically constrained, publicly regulated water utilities in the developing world.

2.1.2 Systems Theory

The Systems Theory was formulated by Littlejohn in 1983. It is defined as the entities interrelations of objects within a group to form a unified whole. The theory is seen as the foundation for the construction of a view in the new world (Patton & McMahon 2021). This theory enabled the exploration of external influences on WSPs in Kenya, such as regulatory frameworks, political factors and socio-economic dynamics. The theory states that firms which

scan their environment on a continuous basis are likely to adapt faster and allocate resources more rationally. The theory helped in emphasizing the relationship between the environment and the organization. It asserts the importance of scanning the environment for changes so as to align the organizations appropriately in order to ensure economic sustainability in the highly dynamic business environment. By considering the broader environment in which these WSPs operate, insights were provided by the study into how external factors could shape impact economic efficiency. The study investigated the dynamic environmental Scanning approaches among WSPs in Kenya. It evaluated how WSPs continuously monitor and analyze the external environment to identify trends that are emerging, challenges and opportunities. This proactive approach will enable WSPs to align their dynamic environmental scanning initiatives with the evolving demands of the industry (Jain, Swartz, Tonetta, Silver, Johnson, Hill & Paolini, 2021). Theory to the economic efficiency of publicly regulated WSPs in a developing country context, an area that has remained significantly underexplored in existing literature. While Systems Theory has been extensively applied in corporate strategy, information systems, and private sector organizational management, this study breaks new ground by empirically demonstrating its explanatory power within the governance and financial performance of public water utilities in Sub-Saharan Africa, specifically Kenya's WSPs regulated under WASREB. By operationalizing Systems Theory through the lens of dynamic environmental scanning, the study establishes a theoretically grounded and empirically supported linkage between an organization's capacity to monitor and interpret its external environment and its ability to achieve measurable economic outcomes, including personnel expenditure efficiency, O&M cost coverage, and revenue collection efficiency performance. This contribution is further strengthened by the study's revelation that adaptive capacity, a core assumption of Systems Theory is not uniformly distributed across WSPs but is instead conditioned by institutional factors such as the presence of dedicated scanning departments, regulatory compliance culture, and human capital investment, thereby introducing a more nuanced and context-sensitive understanding of how open-systems principles operate in resource-constrained, publicly regulated environments. In doing so, the study not only advances theoretical discourse by contextualizing Systems Theory within Sub-Saharan African public utility governance but also bridges the gap between theory and practice by providing actionable evidence that institutionalized environmental scanning is a critical driver of economic sustainability in the water sector.

2.2 Empirical Literature Review

Dynamic Environmental Scanning gives information on aspects that will affect the company in the future. The information collected from environmental scanning allows the leaders of the organization respond to external environment proactively. Ahmad and Ahmad (2022) conducted a study on the scanning of the environment impact on the local authorities' performance of organizations in Malaysia. It aimed to explore the element of tools in economic efficiency that are linked with the scanning of the environment influence on performance of organizations in the local authorities. It evaluated the relationship above in the public organizations context within Malaysia. The findings showed that the coverage of scanning the environment in general was a necessity for the successful strategies alignment that are competitive as a result of changing the demands and needs of the nature of businesses and society at large. The study implied that there

is a significant relationship between the scanning of the environment and the overall performance of the organization.

A study by Chege and Wang (2020) in Kenya assessed the impact of enterprising innovative strategies in analysis of the environment on the performance of SMEs in the rural areas in developing countries. The study aimed to demonstrate that improvements in SMEs in rural areas through analysis of the environment where strategies that are sustainable can boost the performance of SMEs in the rural areas. The results showed a non-significant influence of instability within the environment on the performance of SMEs in the rural areas. When entrepreneurial innovation strategies were incorporated into scanning of the environment, the results indicated a positive impact on the SMEs performance in the rural areas. This highlights the importance of dynamic environmental scanning, where entrepreneurs continuously monitor and adapt to environmental changes, to enhance resilience and SMEs' growth in the rural areas. The study suggests that policymakers need to craft a business environment that is conducive through incubation of business programs and entrepreneurship training for SMEs in the rural areas. This emphasized the critical role of innovation strategies within the environment in navigating through the changes within the environment.

2.3 Conceptual Framework

The conceptual framework for the study indicates the dynamic environmental scanning relationship with economic efficiency of WSPs in Kenya. This relationship is outlined in figure 2.

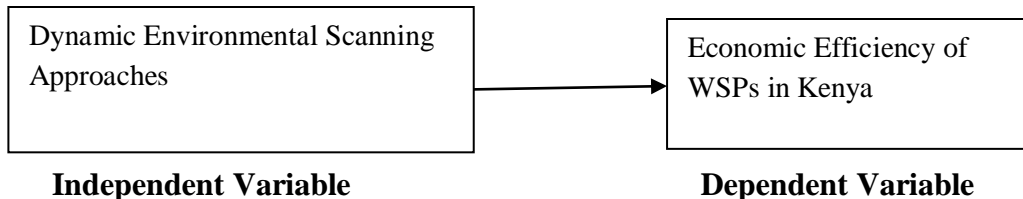


Figure 2. Conceptual framework

2.4 Operational Framework

An operational framework is a structured approach that outlines the processes, procedures and resources needed to achieve specific objectives or carry out a particular project or task. It provides guidance on how tasks will be executed, monitored and evaluated to ensure efficiency and effectiveness in achieving desired outcomes (Roosen, Tonini, Albizzati, Caro, Cristóbal, Lase & Meester, 2023). This framework entails the variables together with the parameters to be used in the study.

The dependent variable entails the parameters that are used to measure the economic efficiency of WSPs. According to WASREB, 2023 Impact Report number 16 there are 11 indicators grouped in 3 subgroups. The first subgroup is quality of service which includes Water Coverage,

Drinking Water Quality, Hours of Supply, Sewered Sanitation and Effluent Quality. The second subgroup is Economic Efficiency which includes Personnel Expenditure / Operations and Maintenance (O+M), O+M Cost Coverage and Revenue Collection Efficiency %. The third subgroup is Operational Sustainability which includes Non-Revenue Water (NRW), Metering Ratio and Staff Productivity. Specifically, the study focused on economic efficiency subgroup which entails; revenue collection efficiency, operations and maintenance (O and M) and personnel expenditure as a percentage of total O and M costs, while other KPIs reported in WASREB impact reports were excluded. These parameters are key indicators for all organizations and provide tangible evidence of the impact of strategic initiatives, demonstrating how changes in management practices influence economic efficiency across WSPs.

The first parameter of the dependent variable is Revenue Collection Efficiency, refers to consistency between amount of revenue collected and the amount billed. This indicator assesses efficiency of revenue management system in a WSP (WASREB, 2024). It is very key because only the revenue that is collected provides funding that is reliable for operations of a WSP. It is generated by Total Collections divided by the Total Billing multiplied by 100%. The ideal sector benchmark is >95%.

The second parameter of the dependent variable is O and M Cost Coverage which is an assessment of a WSP's ability to meet its operational and maintenance costs which is recurrent expenditure. This is by using its own internally generated funds that comes from mostly the sewerage and water billings. This indicator is a measure for the financial sustainability of the WSP as revenues that are own-generated are predictable and reliable in comparison to other utility revenue sources for example grants and subsidies. It is the total sum of billing for sewerage, water and other services divided by sum of BoD expenses, personnel, direct operations, General admin, maintenance, fees and levies multiplied by a 100%. The sector benchmark for this parameter is greater or equal to 150%. With an O and M Cost Coverage of over 150%, a WSP is considered to have a full cost recovery attainment, when it can meet O and M costs, renew its assets and service its debts (WASREB, 2024).

The third parameter which is Personnel expenditures as a percentage of O and M Costs which according to WASREB, is the personnel expenses proportion in relation to total expenses of O and M. It is used to evaluate whether personnel expenses are integrated with the ideal benchmark in the sector. It is calculated by Total personnel expenditures divided by Total O and M multiplied by a 100%. Sum of personnel expenditures incurred include allowances, basic salaries, wages, gratuity, pension and statutory employer contributions, training levy and subscriptions, Incentives/ bonus, leave allowances & other personnel expenditure. Total O and M includes sum of BoD expenses, General admin, personnel, maintenance, direct operations, levies and fees with the ideal sector benchmark being $\leq 25\%$ (WASREB, 2024).

All the parameters under the dependent variable were measured in percentages. Two of these which include revenue collection efficiency and operations and maintenance cost coverage have higher scores being preferred. This means that for these measures the higher the score the better. However, for Personnel Expenditure as a Percentage of O&M Costs, the lower the better. To

align them, the reciprocal of this measure was used in the analysis. The operational framework is as shown in Figure 3.

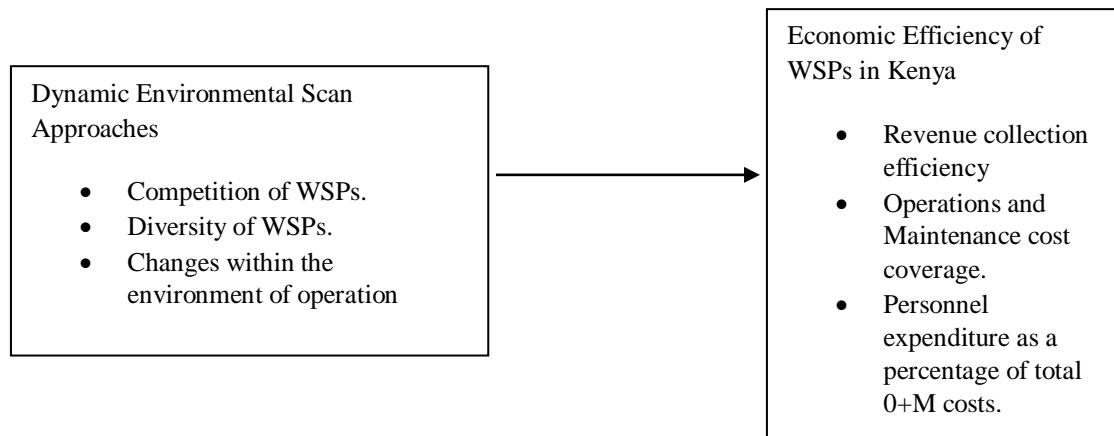


Figure 3. Operational Framework

3. Method

This chapter outlines procedures which were used for collection and analysis of data. It entails research design, sampling size, the target population, data collection techniques, data collection instruments, data collection method, data analysis and presentation.

3.1 Research Design

A correlational research design was adopted in this study since it allows for the examination of relationships between variables without manipulating them, enabling measurement of the strength and direction of associations within a specific context (Siedlecki, 2020). Correlational studies are particularly appropriate for investigating how several variables relate to each other across a population, identifying patterns of association and determining the extent to which a change in one variable causes a change in another (Siedlecki, 2020).

3.2 Target Population

Kenya currently has a total of 88 public regulated WSPs registered by WASREB which comprised the target population. The 88 Managing Directors of the WSPs that are regulated comprised the respondents.

3.3 Sample Size and Sampling Procedure

The study involved a census of all the public WSPs regulated by WASREB. Hence no sampling was conducted since the number of WSPs involved was small and they operate in unique environments. According to WASREB (2024), each of these WSPs operates in a unique environment given the physical location, climatic conditions, local political environment and water sources among others.

3.4 Data Collection

Data collection is the process of measuring and gathering information on variables targeted in an established area, which helps one to answer the stated research questions and assess outcomes. Primary data and secondary data were collected during the study. According to Heidemann, Rommel, Brinks, Claessen, Dreß and Ziese (2019), there are two main types of data which include either primary data or secondary data. Primary data collection refers to the process of gathering information that is firsthand and original directly from the source while secondary data makes use of data that had already been collected. Before commencement of the actual study, questionnaires were tested with respondents who were not participants in the actual study. The purpose of pre-testing was to help in identifying suitability, accuracy and the clarity of the research instruments and to check their reliability and validity. According to Schindler and Cooper (2010), a sample of at least 10 % of the target population is usually accepted in the pilot study. In view of this, respondents were drawn from nine WSPs, with one WSP selected from each region as classified by WASREB using stratified random sampling. The method that was adopted ensured a representation of each category in which 3 WSPs were selected from the very large category and 2 WSPs were selected from the large, medium and small categories. Selection of the WSPs was purposeful to ensure representation of each county in the region (Patton, 2014). This approach ensured that all regions were represented in the pilot study. Therefore, a representation of 10.2% of the total 88 regulated WSPs, was involved in the pilot study. The nine WSPs were not involved in the main study, leaving 79 WSPs to be involved in the main study.

3.5 Data Collection Instruments

In the study, primary data was collected using structured questionnaires. Questionnaires entail questions that are aligned to research questions of a study. The study used questionnaires, since they could be sent to many respondents at the same time as compared to other research tools (Fife-Schaw, 2020). Additionally, questionnaires provide data at a cost advantage over interviews since more people can be able to fill in thus saving time and collecting data from a larger sample (Fife-Schaw, 2020). Questionnaires were selected as they provide an approach that is systematic for gathering data, ensuring consistency and ease of analysis. The questionnaires featured closed ended questions. According to Fife-Schaw (2020), the advantages of closed-ended questions is that they are set to clarify what the researcher is looking for as compared to open-ended questions that sometimes prompt people into diverting from the main issue, thus the preference of using closed ended questions. The questionnaire was crafted carefully to ensure coverage of different aspects, including respondents' background information and economic efficiency of WSPs, all based on the conceptual framework. The primary focus of the data collection was to assess: the influence of dynamic environmental scanning and stakeholder involvement approaches.

To ensure thorough data collection, the questionnaire was organized into sections. The first part concentrated on gathering respondent profiles and providing information on the unit of analysis. Subsequent sections delved into the predictor, probing respondents' perceptions and experiences. For measurement purposes, an interval scale was employed, providing a structured range of

response options. Specifically, a Likert scale was utilized, which allowed respondents to articulate the agreement level, satisfaction or perception on a continuum.

The study also utilized secondary data from WASREB Impact reports spanning five financial years to compute averages and other statistical measures. According to Pattnaik, Sarthak and Pinsky (2025), a complex multi-year dataset can reveal important patterns. Using data across multiple years enhances the reliability and stability of results, as it minimizes the influence of short-term fluctuations and random variations that may occur within a single period. According to Akogun (2022), Improved performance of an organization is evident over a given period of time; where the organizations have learnt and relearned from the efficiency and effectiveness of their processes, effects of policies, systems and strategy and the dynamics in the business environment that sometimes requires strategic realignment and the introduction of updated policies, strategies and systems. According to Saffo, South, Dunne, Vitek and Borkin (2022), likert scales are scales that are used in evaluation of visualizations to generate quantitative estimates of attributes that are subjective. This scale consisted of five points, which were strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. These scales were well designed to capture varying degrees of agreement with statements or propositions, facilitating a comprehensive assessment of perceptions, attitudes, values and behavior. Secondary data was acquired from annual reports published by the regulator, WASREB, for the financial years 2019/20 to 2023/24. The economic efficiency parameters, including revenue collection efficiency, operations and maintenance cost coverage and personnel expenditure as a percentage of total O and M costs were assessed collectively and analyzed separately from the primary data.

3.6 Data Analysis and Presentation

The reason for any research carried out is to offer information so as to assist to give answers to the research questions. Data analysis and presentation refers to the procedures that are set and followed in carrying out the manipulation of data collected so as to present them in a scientific and logical manner, after data collection (Byrne, 2022). It was cleaned to ensure consistency, coded and controlled. Input and analysis was done through the use of Statistical Packages for Social Sciences (SPSS) version 29 and Python Libraries. The independent variable was measured using interval-scaled data. The presentation of data was in form of various graphical formats including charts, tables and graphs to visually portray the relationship between the data sets.

3.6.1 Descriptive Analysis

Data analysis involves the summary and description of the data using descriptive statistics. These included measures of central tendency such as mean, mode and median as well as measures of variability or dispersion which included the range, the standard deviation and the variance (Hahs-Vaughn & Lomax, 2020). Data was presented in diagrams, charts, tables and graphs form.

3.6.2 Test of Assumptions of the Study Variables

The study employed linear regression analysis to determine the relationship between dynamic environmental scanning approaches and economic efficiency of WSPs in Kenya. The assumptions of linear regression were rigorously tested, thereby ensuring the regression analysis validity. Linearity was assessed through scatterplots of the predictor variables against the outcome variable. Independence of errors was evaluated using standardized residual plots. Homoscedasticity was evaluated using scatter plots of standardized residuals against predicted value. Normality of errors was tested through the use of Q-Q plots.

3.6.3 Inferential Analysis

This was done using a linear regression analysis model to assess the effect of dynamic environmental scanning on the economic efficiency of WSPs in Kenya. A step by step analysis of the relationship between dynamic environmental scanning approaches and economic efficiency of WSPs was conducted. The independent variable was regressed against the economic efficiency of WSPs. This was achieved by analyzing a bivariate relationship as follows:

$$Y = b_0 + b_1X + e$$

Where;

b_0 = constant

b_1 = is the coefficient of X which refers to the rate of change of Y with a unit change in X.

X = Dynamic environmental Scanning approaches

e = error term

4. Results and Discussions

This chapter presents the results and findings of the study.

4.1 Response Rate

According to WASREB (2024), there were 88 regulated WSPs in Kenya when the study was being carried out. A pilot study was conducted involving 9 WSPs which were subsequently exempted from the main study. Hence 79 questionnaires were sent out and 71 were received back, thus achieving a response rate of 89.9%. table 1 shows the rate of response of the questionnaires.

Table 1. Response Rate

Level	Frequency
Total Population	88
Pilot (Excluded)	9
Targeted for main study	79
Responses received	71

WASREB categorizes WSPs by size, measured by the number of connections, in terms of: very large, large, medium size and small size WSPs. As at November 2025, the targeted seventy-nine WSPs were distributed by size as shown in table 2. The study distributed one questionnaire to each of the 79 WSPs. Response rate for each of the WSP’s categories are presented in table 2.

Table 2. Distribution of Response Rate by Size of WSP

Serial No.	Category of Water Service Providers by Size	Number of Questionnaires Distributed	Number of Questionnaires Returned	% Response
1.	Very Large	18	16	88.9
2.	Large	29	27	93.1
3.	Medium	13	11	84.6
4.	Small	19	17	89.5
	Total	79	71	89.9

According to Kothari and Garg (2023), the rate of response was appropriate since they argued that 50% rate of response is adequate, 60% good and above 70% referred to as suitable for analysis.

4.2 Tests of Reliability and Validity

Sections 4.2.1 and 4.2.2 show the findings of the tests of reliability and validity respectively.

4.2.1 Tests of Reliability

The study variable of this research was measured using an ordinal scaled semi structured questionnaire. The equivalence’s agreement to each of the statement measuring the variable were to a “not at all”, “small extent”, “moderate extent”, “high extent” and “very high extent”. The study had one variable of interest with a total of eight (8) statements. In order to evaluate the stability of these measures for the variable, the internal consistency coefficient was generated using Cronbach’s alpha and the findings are shown in Table 3.

Table 3. Reliability Test Results for the Study Variable

Scale Item	Number of Items	Cronbach’s alpha	Comments
Dynamic Environment Scanning Approach	8	0.76	Acceptable

The results showed that the variable measurements had a Cronbach alpha coefficient greater (>) than 0.7. Based on this observation, the variable was confirmed to have sufficient level of internal consistency and hence satisfactory accuracy level. According to Blumberg, Cooper and

Schindler (2014), a Cronbach alpha coefficient of 0.7 and above is satisfactory for the variable in a social study.

4.2.2 Validity Test for Study Variables

Informed by the strategic management and broad strategic management drivers, the statements applied in this research composed of statements generated from theoretical and empirical literature. To ascertain validity of content, the research instrument was put through a qualitative test through a review by two experienced professionals from Kenya Institute of Management. The study sought to evaluate the construct validity using principal factor analysis tools (PFA). The findings of the analysis are presented in Table 4.

Table 4. Numerical Construct Validity Results

KMO and Bartlett's Test		Dynamic Environmental Scanning Approach
Number of statements used		8
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.78
Bartlett's Test of Sphericity	Approx. Chi-Square	733.85
	Degrees of freedom	28
	Significance	0.00

Examination of these summary statistics revealed that the independent variable had a KMO of 0.78, an approximate chi square of 733.85 with a degree of freedom of 28. These results of numerical construct validity showed that the study variables KMO's coefficients was greater than a KMO coefficient of 0.50. According to Kaiser (1974) a minimum acceptable KMO coefficient is 0.50. Therefore, the analysis confirmed that the measurement scale possessed a high degree of construct validity and the data was suitable for evaluating both the stimulus and response variables.

4.3 Descriptive Statistics

Descriptive analysis was conducted for the variable. These initial tests were done to summarize the fundamental characteristics of the data and look for potential patterns within the data. The resulting statistical measures, including standard deviations and means, provided a clear data overview distribution for the component. Comprehensive results and detailed interpretations of these findings are demonstrated sequentially in the next sections. Descriptive analysis was conducted using SPSS Version 29 and Python. Specifically, Python Libraries were used for their high quality visual outputs including charts and graphs.

4.3.1 Descriptive Statistics of Economic Efficiency of WSPs in Kenya

The problem of the study was Economic Efficiency of WSPs in Kenya. This variable was examined using three sub-components of economic efficiency; revenue collection efficiency (%), operational and maintenance costs coverage and personal expenditure (%) of total operations and maintenance costs. Data for each of the 71 respondent’s WSP was collected from the regulator and the WSPs reports for the financial years 2019/20 to 2023/24. SPSS Version 29 and Python Libraries were used in the study to extract the descriptive statistics. Findings are presented in Table 5.

Table 5. Descriptive Statistics for Economic Efficiency of WSPs in Kenya

	PE as a (%) of O and M (Inverse)	O and M Cost Coverage %	Revenue Collection Efficiency %
Count	71.0	71.0	71.0
Mean	1.7	96.3	61.9
Standard deviation	0.4	16.0	7.4
Minimum	1.2	58.6	45.3
25%	1.5	86.9	56.4
50%	1.6	97.6	62.1
75%	1.8	104.5	66.8
Max	3.2	134.4	76.6

Table 5 shows the count for the seventy-one WSPs whose data is provided in terms of the mean and the standard deviation. It shows the minimum values obtained for each of the ratio, the 25th percentile value, the median, the 75th percentile and the maximum for each of the measures used in the measurement of economic efficiency of WSPs in Kenya. The results show that the average of PE as a (%) of O and M costs was 1.7 translated as 58.8% and O and M cost coverage average was 96.3%. The revenue collection efficiency had a mean of 61.9%. The results were associated with a standard deviation of 0.4, 16.0 and 7.4 against PE as a (%) of O and M cost coverage and Revenue Collection Efficiency, respectively. This implied a variation in the standard deviations from the mean values of each measure. It showed that the highest reported revenue collection among the WSPs in Kenya was 76.6% and a minimum revenue collection of 45.3%. The maximum and minimum O and M cost % of coverage was 134.4% and 58.6% respectively. Finally, the maximum and minimum values achieved for the respective 71 public WSPs was 3.2% and 1.2% respectively. These statistics mean that there was a spread. The respective violin plots for each of these measures was extracted and the findings are demonstrated in the Figure 6.

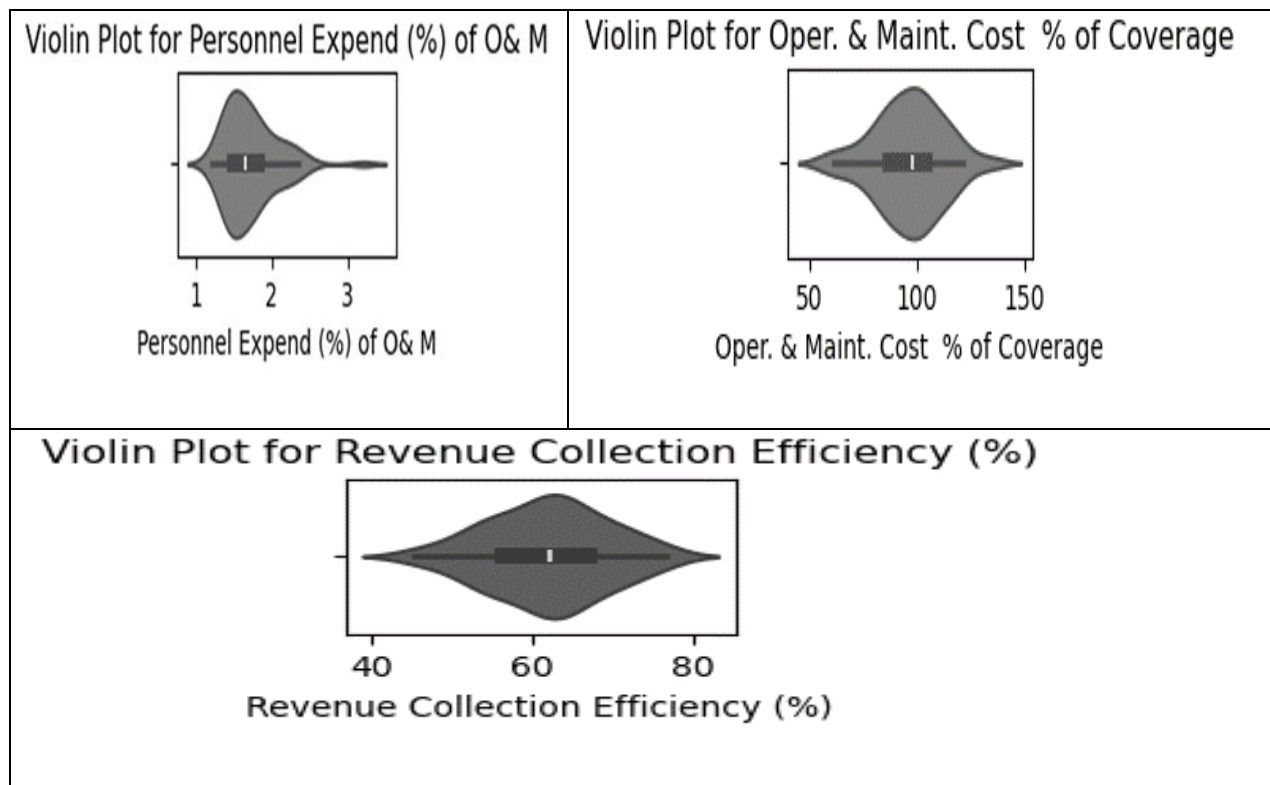


Figure 4. Univariate Violin Plots for WSPs Economic Efficiency Measures

The findings reveal a water sector under significant financial stress, where the majority of Kenya's 71 public WSPs are struggling to sustain themselves. With nearly 59% of operational costs consumed by staff expenditure, most WSPs have very little left to invest in critical maintenance, infrastructure repairs, or service expansion to unserved communities. This is compounded by a revenue collection efficiency of only 61.9%, meaning that close to 4 in every 10 billed shillings never reaches the WSP, a failure driven by weak billing systems, unaffordable tariffs, illegal connections, and poor debt recovery. As a result, the average O&M cost coverage of 96.3% shows that most WSPs cannot fully finance their own operations and likely depend on government subsidies or donor support to remain functional. Most concerning is the wide variation across WSPs, with O&M cost coverage ranging from as low as 58.6% to as high as 134.4% and revenue collection spanning from 45.3% to 76.6%, indicating that while a few providers are financially viable, a large number are deeply vulnerable. Collectively, these figures point to a sector that is ill-equipped to withstand financial shocks such as inflation, drought, or infrastructure failure, ultimately threatening the reliability and affordability of water access for the millions of Kenyan households who depend on these providers daily.

The results in Figure 5 show that the dispersion of the three measures stayed aligned significantly from the normal distribution and the medians of the distributions were largely the same as the respective means of each of the measures. According to Ghasemi and Zahediasl (2012), parametric tests assume the sample data are normally distributed and that if this

assumption is met, these tests are appropriate for drawing conclusions. Therefore, the composite measure of performance did not require any further data treatment for inferential analysis.

4.3.2 Descriptive Statistics for Dynamic Environmental Scanning Approaches

The objective of the study examined the effect of dynamic environmental Scanning approaches on economic efficiency of WSPs in Kenya. To achieve this, the dynamic environmental Scanning approaches as a predictor was examined using, seven (7) statements. The respondents to the questionnaires were requested to tick in a scale of one (1) to five (5), the level that they agreed to the statements of dynamic environmental Scanning approach. The scale used to measure the variable was; Not at all (1), to a small extent (2), to a moderate extent (3), to a high extent (4) and to a very high extent (5). The results of the responses are presented in Table 6.

Table 6. Descriptive Statistics of Dynamic Environmental Scanning Approach and Economic Efficiency of WSPs in Kenya

Statement (s)	To a Very High Extent	To a High Extent	To a Moderate Extent	To a Small Extent	Not at all	Mean	Std. dev
	5	4	3	2	1		
DE_App_1 The WSP carries out an evaluation of employee skills and capacity building areas at least annually	24.9	10.9	24.2	20.9	19.1	3.02	1.16
DE_App_2 The WSP evaluates information technology (IT) infrastructure for efficiency in supporting business processes	14.6	23.6	25.6	28.9	7.3	3.1	1.33
DE_App_3 The WSP updates its internal policies to respond to emerging external needs.	15.8	17	15.1	24.8	27.3	2.7	1.37
DE_App_4 The WSP carries out employee satisfaction survey	17.8	21.7	16.1	22.9	21.6	2.94	1.48
DE_App_5 The WSP carries out an evaluation of the customer profile and changes over time.	15.7	22.8	23.4	34.1	4.1	3.03	1.21
DE_App_6 The WSP carries out monitoring of socio-economic trends that can impact over time.	12.3	12.6	1	46.3	27.8	2.34	1.33
DE_App_7 There is a department charged with the responsibility on reporting on internal and external trends affecting WSPs.	26.9	22.6	12	28.1	10.4	3.29	1.52
Overall						2.92	1.41

The descriptive results in Table 6 indicate that the overall measure for the seven (7) statements measuring dynamic environmental Scanning approach was 2.92 and an associated standard deviation of 1.41. This implies that the WSPs in Kenya could benefit from the dynamic environmental scanning approaches in driving their economic efficiency through provision of the foresight to initiate change. The highest mean achieved was 3.29 and an associated standard deviation of 1.52. This shows that WSPs’ in Kenya place strong emphasis on systematically monitoring and reporting internal and external trends, demonstrating proactive environmental scanning. This supports informed decision-making, strategic planning and timely organizational

responses to sector changes, thus showing how well the water sector is regulated by WASREB who receives the monthly monitoring and evaluation reports from all the WSPs they regulate.

The highest standard deviation recorded was 1.52. This was under DE_App_7 statement which stated that, “there is a department charged with the responsibility on reporting on internal and external trends affecting WSPs”. This shows wide differences in respondents’ views. It also shows that such structures are not consistent across the WSPs, with some having clear departments in place while others lack them or have them poorly defined. The lowest standard deviation recorded was 1.16 under the case of DE_App_1 statement “the WSPs carry out an evaluation of employee skills and capacity building areas at least annually”. This indicates a strong agreement among respondents that WSPs carry out annual evaluations of employee skills and capacity-building needs. This shows that the practice is consistently implemented across WSPs, with little variation in respondents’ views.

The findings reveal a water sector that is partially equipped for strategic foresight but inconsistent in its application across Kenya's WSPs. With an overall mean of 2.92 out of a possible 5, most WSPs acknowledge the value of dynamic environmental scanning but have not yet fully embedded it into their operations, meaning many providers are making critical decisions about water service delivery without a complete or systematic picture of the forces shaping their environment. The strongest area of practice systematically monitoring and reporting internal and external trends (mean 3.29) reflects the positive influence of WASREB's regulatory framework, where monthly monitoring and evaluation reports create a structured feedback loop that supports informed decision-making and timely responses to sector changes. However, the wide variation in whether WSPs have a dedicated department responsible for trend reporting (standard deviation of 1.52) is a serious concern in practice, as it means that some providers are well-positioned to anticipate and respond to emerging challenges such as climate change, population growth, or infrastructure deterioration, while others are essentially operating blind. This structural inconsistency puts vulnerable WSPs at greater risk of being caught off-guard by sector shifts, ultimately compromising their ability to deliver reliable and affordable water services to their communities. The strong consensus around annual employee skills evaluations (standard deviation of 1.16) suggests that human capital development is one area where WSPs are aligned, providing a foundation upon which more systematic and institutionalized environmental scanning practices can be built across the entire sector.

4.4 Diagnostic Tests of Study Variables

This research evaluated the effect of dynamic environmental scanning approaches on economic efficiency of WSPs in Kenya. The dependent variable was economic efficiency of WSPs, measured using revenue collection efficiency, operational and maintenance cost coverage and personnel expenditure as a percentage of total operations and maintenance costs. Miles and Shevlin (2010) advocate for carrying out of the test of linear regression analysis, prior to inferential analysis, to safeguard the accuracy of the hypothesis tests. Based on this, the study carried out the following tests.

4.4.1 Test of Normality for economic efficiency of WSPs in Kenya

Measures of economic efficiency of WSPs were weighted and the resultant composite measure subjected to normality distribution test using Quartile-Quartile (Q-Q) Plot. The output results from Python software are shown in Figure 5

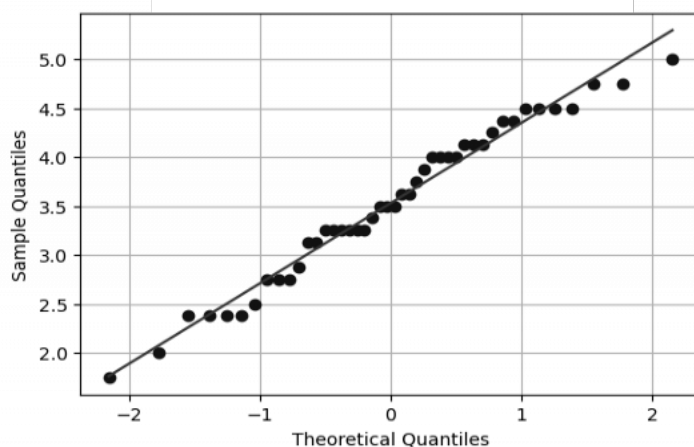


Figure 5. Normal Q-Q Plot for WSPs economic efficiency of WSPs

The figure shows that there were no significant departures from the straight line on both end of the line/ the tails. From these results for the Gaussian distribution of economic efficiency of WSPs, normality of data was confirmed and therefore this data could be used for robust parametric tests to test the study hypothesis.

4.4.2 Test of Autocorrelations - Predictor Variable

The predictor variable evaluated for first order autocorrelation using Durbin-Watson d statistics. The Table shows that first, the d -w (d) statistic for the dynamic environmental scan approaches was 1.68 which is within the threshold range of 1.5 and 2.5. This range confirms that there are no first-order autocorrelation observations among the variable under the test (Garson, 2012). These results show that the tests of hypothesis could be carried out on this variable without further analysis of the data.

4.4.3 Test of Outliers in the Predictor

The study evaluated the data for possibility of outliers. The reason for this test was to point out any data point(s) that deviated to a significant extent, from the general pattern of the measures. Additionally, this test was considered important to ensure reliability and accuracy of data analysis. It was also done to safeguard the linear models from distorted coefficients and eliminate any invalid confidence intervals and also any possible inflated variance. This test was examined out using violin plots for each of the predictors. The output is presented in Figure 6.

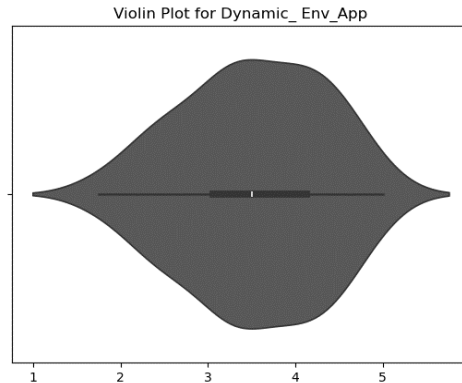


Figure 6. Violin Plots for Predictors

The violin plot displays the median which is the white dot inside the box and interquartile range (IQR), presented by whiskers of the box plot. The kernel shows the probability density of the data that is shown by the shape. The broader sections imply a higher density of data points. The figure also shows that the mutation of the IQR point; showing that the median was also not significantly affected by any extreme values and hence all the values did not require any further analysis. Based on these observations, the predictors were confirmed to be theoretically valid since the test of absence of outliers was satisfied by the data.

4.4.4 Test of Homogeneity of Variance

The test of homogeneity of variance-covariance was carried out using Probability – Probability(P-P) plots. The normal P-P Plots were used to evaluate a null hypothesis that; the given input of study samples is generated from a population with equal variances. This means that this particular test was used to make a comparison between the empirical cumulative distribution function of the predictor variable data set with that of the distribution of the cumulative probability. The output for this test is shown in Figure 7.

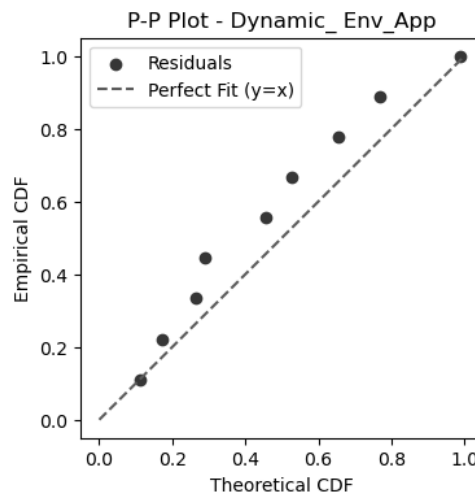


Figure 7. Probability- Probability Plots of Dynamic Environmental Scanning Approaches

The output shown in Figure 7 shows a linear pattern between the two, theoretical and empirical cumulative distribution functions (CDSs). Both distributions appear to be positioned fairly well from the residuals plotted close to the straight line from the origin (0,0) running to the point (1,1). Additionally, the P-P plots do not appear to overly and consistently depart from the unitary line. They are evenly cumulative suggesting a homogeneity of variance-covariance. An overall evaluation of the tests of regression assumptions results, carried out in the study showed that a linear regression model was suitable for testing the hypothesis in the study.

4.5 Inferential Statistics

4.5.1 Influence of Dynamic Environment Scanning Approaches on Economic Efficiency of WSPs in Kenya

The study aimed to assess the effect of dynamic environmental scanning approaches on economic efficiency of WSPs in Kenya. In order to examine the nature of this effect, the study developed the following null hypothesis; H_0 : There is no statistically significant effect of dynamic environmental Scanning approaches on economic efficiency of WSPs in Kenya.

In order to evaluate whether dynamic environmental scanning approaches have a statistically significant effect on economic efficiency of WSPs in Kenya, the weighted scores of dynamic environmental scanning approach measures were regressed on the weighted scores for economic efficiency of WSPs in Kenya in a simple linear regression model using python libraries. The output is presented in Table 7.

Table 7. OLS Regression Summary for Dynamic Environmental Scanning Approaches

Statsmodels Linear Regression Summary:						
OLS Regression Results						
=====						
Dep. Variable:	Economic Efficiency	R-squared:	0.879			
Model:	OLS	Adj. R-squared:	0.877			
Method:	Least Squares	F-statistic:	370.2			
Date:	Thu, 27 Nov 2025	Prob (F-statistic):	4.91e-25			
Time:	11:53:24	Log-Likelihood:	-20.852			
No. Observations:	53	AIC:	45.70			
Df Residuals:	51	BIC:	49.64			
Df Model:	1					
Covariance Type:	nonrobust					
=====						
		coef	std err	t	P> t	[0.025 0.975]

const		3.4379	0.147	23.343	0.000	3.142 3.734
Dynamic_ Env_Scan_App		0.9949	0.052	19.241	0.000	0.891 1.099
=====						

The output in Table 7 presents the overall structure of the ordinary least squares linear regression output, overall model performance metrics and statistical significance of the coefficients of the model. The presented R-squared coefficient of 0.879 imply that 87.9% of the variance in economic efficiency of WSPs in Kenya was explained by dynamic environmental Scanning approach measures. Table 7 additionally shows that the F-statistics of 370.2 and an associated Prob (F-statistic) of $4.91e^{-25}$ was arrived at. These statistics imply that the bivariate linear measures in the restricted model of dynamic environmental Scanning approaches and composite economic efficiency of WSPs in Kenya have a zero probability of occurring by chance. This means that the general model is suitable for evaluating the effect of dynamic environmental Scanning approaches on economic efficiency of WSPs in Kenya.

Based on these findings, the study rejected the null hypothesis that dynamic environmental scanning approaches do not have a statistically significant effect on economic efficiency of WSPs in Kenya and validates that dynamic environmental scanning approaches have a statistically significant effect on economic efficiency of WSPs in Kenya. Table 7 additionally presents the Akaike’s Information Criteria (AIC) of 45.70 and the Bayesian Information Criteria (BIC) were of 49.64. These metrics of model evaluation are low and point a good balance of model complexity and parsimony. The study showed the statistical significance of the bivariate linear regression between dynamic environmental scanning approach measures and economic efficiency of WSPs. The results in Table 7 show that the constant/intercept for the bivariate

model was $\alpha = 3.4379$ and was statistically different from zero (0) as its associated p-value was 0.000, less than a p-value = 0.05.

The findings further show that when the estimated beta coefficient is 0.99, there is 95% confidence that the true value will always be in the confidence interval (0.891, 1.099). Based on these values, the bivariate model for dynamic environmental Scanning approaches and economic efficiency of WSPs in Kenya is;

$$\text{WSP_Economic Efficiency} = 3.4379 + 0.9949 (\text{Dynamic_Env_Scan_App})$$

This model shows that a unit change in dynamic environmental scanning approaches measures cause an increase of 0.9949 on the economic efficiency of WSPs in Kenya. In the absence of dynamic environmental scanning approaches, the economic efficiency of WSPs in Kenya would be 3.4379.

These results agree with a study conducted by Ahmad and Ahmad (2022) on the scanning of the environment impact on the local authorities' performance of organizations in Malaysia. Similarly, it agrees with a study by Chege and Wang (2020) in Kenya which assessed the impact of enterprising innovative strategies in analysis of the environment on the performance of SMEs in the developing countries, specifically in the rural areas. The findings demonstrate the crucial role played by dynamic environmental scanning in support of the systems theory and Lewin's Change management theory which were the anchor theories of this study. This is because, successful application of these theories require a vigilant awareness of the business environment both internal and external. Dynamic environment scanning approaches avail the required information for this purpose on a continuous basis.

5. Conclusion and Recommendations

The study carried out hypothesis testing using linear ordinary least squares (ols) model. The study found that the model had an F-statistic of 370.2 and associated Prob (F-statistic) p-value of 4.91e-25 that is, $\approx 0 <$ than a p-value of 0.05. Based on these findings, the null hypothesis which stated that; dynamic environmental scan approach does not have a statistically significant effect on performance of WSPS in Kenya was rejected, and the study confirmed that dynamic environmental scan approach has a positive and statistically significant effect on performance of WSPS in Kenya at 95 % confidence level.

The study recommends that these practices and policies should be enhanced by management in order to enhance the economic efficiency of Water Service Providers in Kenya. The economic efficiency of these WSPs is not only an important policy issue but one that the regulator; Water Service Regulatory Board (WASREB) should sustain its regulation. The regulator of these firms should sustain the supervisory mechanism of the financial performance for enhanced contribution of these firms towards sustainable development goal of "ensuring the availability and sustainable management of water and sanitation for all". Lewin's change management and Systems theories were used in identification of possible explanations of the drivers of economic

efficiency in the context of WSPs in Kenya. Specifically, the study finds that Lewin's theory is relevant to the extent that unfreezing of the WSPs structure, adoption a responsive structure and refreezing (enforcing) the actualization is key to achievement of economic efficiency of these firms. Adoption, of system-wise dynamic environmental scanning approaches will be productive in line with the system theory, relative to a silo-based approach to addressing financial performance of these firms.

Management of WSPs in Kenya should strengthen the adoption of dynamic environmental scanning management practices to enhance organizational economic efficiency. Managers should place greater emphasis on improving organizational structures and undertaking continuous environmental scanning to enable timely identification of internal and external changes affecting operations. In addition, management of WSPs in Kenya should ensure that their continuous environmental scanning practices are in place and strategic plans are regularly updated and aligned with the prevailing business. By fostering strategic responsiveness, managers can improve operational efficiency, sustainability and overall economic efficiency of WSPs in Kenya.

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