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Effect of Customs Risk Analysis System on Customs Revenue Performance at Jomo Kenyatta International Airport, Kenya

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Abstract

Purpose: Customs revenue performance remains a primary function of customs administration in most developing nations. These nations rely heavily on imports to sustain various aspects of their economies and, to a lesser extent, on the exports of raw and finished goods. Despite its importance, customs revenue performance sometimes falls short of government targets because of under-declaration, smuggling, and delays in cargo clearance. This study aimed to determine the effect of the customs risk analysis system on customs revenue performance at Jomo Kenyatta International Airport, Kenya. The study was grounded in the following theories: the Theory of Customs Union and the Technological Change Theory

Methodology: The study adopted an explanatory research design, and the target population was 208 customs revenue officers and clearing & forwarding agents at Jomo Kenyatta International Airport. The study distributed 208 questionnaires; 183 were completed and returned, representing a response rate of 88%. The study used a census survey, and primary data were collected through questionnaires. The data were analyzed using descriptive statistics, including means, frequency distributions, standard deviations, and percentages. Inferential statistics included regression analysis and correlation analysis.

Results: The study's regression analysis found that the customs risk analysis system affects customs revenue performance positively and significantly ($\beta = 0.262$, $p = 0.000$),

Recommendation: KRA management should invest in training programs that enhance officers' cognitive skills to contextualize risk intelligence, exercise sound judgment in targeting decisions, and adapt selectivity criteria to emerging fraud patterns, ensuring that technological investments translate into tangible revenue gains. Future studies should examine how trade facilitation policies and regulatory frameworks influence customs revenue performance.

Keywords: *Customs Risk Analysis System, Customs Revenue Performance and Jomo Kenyatta International Airport*

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1. Introduction

Customs revenue performance is a fundamental government function that involves taxing international trade to generate revenue and regulate the movement of goods across borders (Richard, 2023). Globally, organizations such as the World Customs Organization promote standardized procedures to enhance efficiency, transparency, and compliance in customs administration (Beverelli, 2022). In developing economies, customs duties remain a significant source of public finance due to limited domestic tax capacity, with agencies' tax collection playing a central role in revenue mobilization (Prichard, 2019).

Revenue performance remains a primary function of customs administrations in most developing nations (Babyenda, & Bale, 2021). These nations rely heavily on imports to sustain various aspects of their economies and, to a lesser extent, on the exports of raw and finished goods. The movement of goods and people across their borders places a significant burden on customs administrations (Gwaindepi, 2019). This responsibility is further amplified by the challenges of the 21st century, which affect current and future development and necessitate a more proactive and action-oriented approach by customs administrations (Pavlenko, & Triakina, 2020). To improve revenue performance and facilitate cross-border trade while protecting society, customs administrations must implement both global and local initiatives and incentives.

A customs risk analysis system is a structured analytical framework customs administrations use to systematically identify, assess, prioritize, and manage risks associated with cross-border trade to protect revenue, safeguard security, and facilitate legitimate trade. Rather than inspecting every shipment manually, these systems use trade data, including declaration details, product classification, trader compliance history, and shipment attributes, to generate risk profiles and risk scores that target high-risk consignments for further scrutiny while expediting low-risk cargo (Hoffman et al., 2019).

Risk management in customs involves a logical process of identifying and analyzing risk factors to improve the efficiency of customs control, minimizing unnecessary interventions, and optimizing resource allocation (Drobot et al., 2017). Empirical research shows that selectivity methods, including automated rule-based profiling and manual selection, significantly affect risk management systems' detection rates, highlighting the importance of robust risk analysis mechanisms (Bawoke Tiruye, 2023).

In Kenya, customs revenue is a key pillar of government financing, administered by the Kenya Revenue Authority (KRA) through its Customs and Border Control Department (KRA, 2023). Trade volumes, clearance efficiency, and the implementation of policy and administrative reforms, alongside regional integration under the East African Community (EAC), shape tariff regimes and cross-border trade dynamics (Ndung'u, 2021). Kenya has increasingly adopted digital customs systems such as the Integrated Customs Management System (iCMS) to improve operational efficiency, enhance transparency, and minimize revenue leakages (KRA, 2022). However, persistent challenges including smuggling, misclassification, and under-valuation of imports continue to constrain optimal revenue performance (Muturi, 2020).

Jomo Kenyatta International Airport is Kenya's largest international airport and the primary gateway for both passenger and cargo traffic in East Africa. Located in Nairobi, about 15 kilometers southeast of the city center, it serves as Kenya Airways' main hub and handles millions of passengers annually. The airport is a critical node for Kenya's trade, particularly

imports and exports, making it a focal point for customs revenue performance managed by the Kenya Revenue Authority. With modern cargo terminals and passenger facilities, JKIA has expanded multiple times to accommodate growing air traffic and meet international standards.

Its strategic location makes it a central hub for transit and freight in East Africa. Beyond aviation, the airport supports economic activities such as logistics, hospitality, and retail, contributing significantly to Kenya's GDP.The Kenya Revenue Authority administers customs operations at JKIA under the Customs and Excise Act, Cap 472. These operations generate significant government revenue through import duties, excise taxes on selected goods, and value-added tax (VAT) on imports, while regulating trade and ensuring compliance with national and international regulations (Owino, 2019).

1.1 Problem Statement

Customs revenue is a major source of government income in Kenya, generated through import duties, excise taxes, VAT on imports, and other trade-related levies. It contributes significantly to national development by financing public services and infrastructure while regulating trade and protecting local industries (OECD, 2022). Despite its importance, customs revenue performance sometimes falls short of government targets due to under-declaration, smuggling, and delays in cargo clearance. Fluctuations in global trade and inefficiencies in manual processing also affect revenue performance. To address these challenges, the Kenya Revenue Authority has implemented reforms including risk-based inspections, post-clearance audits, and the Kenya Electronic Single Window System (KESWS) to improve efficiency.

For instance, during the 2022/2023 financial year, the Customs and Border Control Department collected KSh 707.9 billion against a target of KSh 739.0 billion, reflecting a shortfall in revenue performance (Kenya Revenue Authority, 2023). Similarly, in the 2023/2024 financial year, customs revenue amounted to KSh 791.4 billion compared to a target of KSh 837.1 billion, achieving about 94.6% of the target, which indicates a continued gap between expected and actual performance s. In addition, during the first half of the 2024/2025 financial year (July–December 2024), customs revenue performance s stood at KSh 429.1 billion, which was below the proportional target of KSh 456 billion, showing slower growth compared to revenue expectations. The relatively slow pace was influenced by declines in import values for key goods such as foods, beverages, fuels, and lubricants, which account for over one-third of the import tax base (KRA, 2025).

These recurring gaps between projected and actual customs revenue show declining revenue performance relative to targets, despite reforms aimed at strengthening customs administration and trade facilitation. Despite numerous studies on customs revenue performance in other economies, this research thus sought to establish the effect of the customs risk analysis system on customs revenue performance at Jomo Kenyatta International Airport, Kenya.

2. Literature Review

2.1 Theoretical Review

2.1.1 Theory of Customs Union

Viner (1950) developed the Theory of Customs Union to explain the economic effects of regional trade integration. The theory holds that a customs union involves removing tariffs among member states and adopting a common external tariff on goods imported from non-member countries. It emphasizes trade creation, which occurs when trade shifts toward more

efficient producers within the union, and trade diversion, which occurs when imports shift from more efficient non-member producers to member countries because of preferential tariff treatment. Recent literature continues to apply these concepts in analysing the trade and economic effects of customs unions (Larch & Yotov, 2025).

The theory is relevant to customs revenue performance because regional integration changes the sources and composition of customs revenue. While qualifying goods traded among member states may move without customs duties, imports from non-member countries remain subject to the common external tariff. Consequently, customs revenue performance depends partly on the volume of external imports, applicable tariff rates, accurate classification and valuation of goods, determination of origin, and effective collection of customs duties. In the EAC, the Customs Union provides for free trade among Partner States for qualifying goods and a common external tariff for goods originating outside the region, making effective customs administration important for revenue protection and collection (EAC, 2025).

For the present study, the Theory of Customs Union provides the regional integration framework for explaining customs revenue performance. Effective customs administration is necessary to ensure that applicable duties and taxes are accurately assessed and collected while facilitating legitimate trade. At the Port of Mombasa, practices such as risk identification, risk analysis and risk treatment can support accurate duty assessment and reduce revenue leakage arising from non-compliance. Although Viner's original theory focuses mainly on trade creation, trade diversion and welfare effects, its principles provide a useful foundation for examining how customs administration within a customs union can influence customs revenue performance (Viner, 1950; EAC, 2025).

2.1.2 Technological Change Theory

Technological Change Theory, whose foundations are associated with Joseph Schumpeter (1934), explains how technological innovation transforms organizational processes, improves productivity, and creates new ways of performing economic and administrative activities. Technological Change Theory explains how technological innovation transforms organizational processes, decision-making, and operational performance. In customs administration, technological change has increasingly shifted risk management from manual inspection toward automated, data-driven identification and targeting of potentially risky consignments.

The World Customs Organization (WCO, 2024) reports that customs administrations are increasingly adopting artificial intelligence, machine learning, big data, data analytics and cloud computing to modernize customs operations. Similarly, Vijayakumar (2025) argues that technology-centric, data-driven approaches can strengthen customs risk management by improving analysis of large volumes of trade information and supporting more precise risk targeting.

The theory is particularly relevant to the Customs Risk Analysis System because technology enables customs authorities to integrate and analyse information from declarations, traders, cargo movements and previous compliance records to identify potential risks. According to Vijayakumar (2025), data analytics, artificial intelligence and machine learning can support entity profiling, anomaly detection, import valuation analysis and automated targeting, thereby improving the identification of high-risk consignments. The WCO (2024) further reports that big data and data analytics were among the most widely adopted emerging technologies

reported by customs administrations, demonstrating their growing importance in risk-based customs control.

2.2 Empirical Review

2.2.1 Customs Risk Analysis System

Reynolds (2023) investigated the impact of customs risk analysis and targeting practices implemented by U.S. Customs and Border Protection on customs revenue performance. The study found that introducing risk analysis techniques, including targeted audits, importer profiling, and compliance reviews, led to measurable increases in revenue recovered from duties, taxes, and fees. Revenue statistics indicated that proactive risk-based enforcement contributed hundreds of millions of dollars in recovered revenue compared with prior baseline figures. The findings showed that risk analysis systems enabled customs officers to identify high-risk transactions more accurately, improving detection of undervaluation, misclassification, and non-compliance. Reynolds concluded that integrating advanced risk analysis into customs operations strengthens revenue performance by reducing leakage and prioritizing enforcement resources. The study recommended expanding data analytics capabilities, applying machine learning for risk prediction, and providing continuous training for customs analysts to sustain and improve revenue performance.

Kizito (2025) investigated the relationship between risk management practices, including risk identification, and revenue collection at the Uganda Revenue Authority (URA). The study used survey and interview data from 132 participants to analyse how risk-sharing agreements, performance-based metrics, and localized risk frameworks influence revenue outcomes (Kizito, 2025). Results showed that stronger risk identification and management practices were significantly positively correlated with revenue collection; better identification of risky taxpayers and non-compliant transactions improved overall tax compliance and boosted revenue. The analysis also found that higher compliance rates, aligned performance targets, and adaptable risk strategies contributed to increased revenue generation. Kizito concluded that effective risk identification and tailored risk frameworks are essential for strengthening revenue collection at URA.

Wairimu (2023) examined the effect of risk identification practices on customs service delivery at the Kenya Revenue Authority. The study focused on activities such as identifying high-risk imports, profiling traders, and monitoring compliance to improve customs operational efficiency. Findings showed that effective risk identification significantly improved the quality and timeliness of customs service delivery to traders and other stakeholders. Data analysis indicated that prioritizing high-risk transactions reduced delays, improved cargo clearance times, and enhanced customer satisfaction. The study concluded that systematic risk identification is essential for improving service delivery by enabling proactive management of potential compliance issues. The study recommended strengthening risk profiling systems, providing continuous staff training, and integrating digital tracking tools to sustain and further improve customs service delivery performance in Kenya.

2.2.2 Customs Revenue Performance

Customs revenue performance is the process by which a government mobilizes funds through levies imposed on goods as they enter or leave a country, with most revenue typically coming from import duties, excise taxes, and value-added tax (VAT) on imported products. It is central

to national tax systems and plays a dual role: generating public revenue to support government expenditure and regulating international trade by enforcing tariff schedules and trade policies (World Bank, 2023).

This system requires careful valuation of goods, classification under harmonized tariff codes, and strict monitoring to reduce illicit practices such as smuggling and misclassification (International Monetary Fund [IMF], 2022). Modern customs administrations have increasingly adopted digital platforms, single-window systems, and risk management tools to speed up clearance processes, improve compliance, and minimize revenue loss (Organization for Economic Co-operation and Development [OECD], 2024).

Tax is an enforced fiscal charge imposed by the state on persons to fund civic expenditures (Ondimu, 2021). Tax can also be viewed as a cost to the taxpayer, whether an individual or a corporate body. Taxation creates a conflict: taxpayers want to minimize costs and maximize profit, while the government wants to maximize revenue through improved compliance. To maximize revenue and minimize cost, the government has improved the efficiency of tax administration by employing competent personnel and embracing modern technology in tax performance. These are some of the reforms instituted by the Kenya Revenue Authority to simplify tax performance processes (Nyaga, 2024).

2.3 Conceptual Framework

According to Mugenda (2008), a conceptual framework is a concise description of the phenomenon under study, accompanied by a graphical description of the study's major variables. The independent variable was the customs risk analysis system. The dependent variable was customs revenue collection

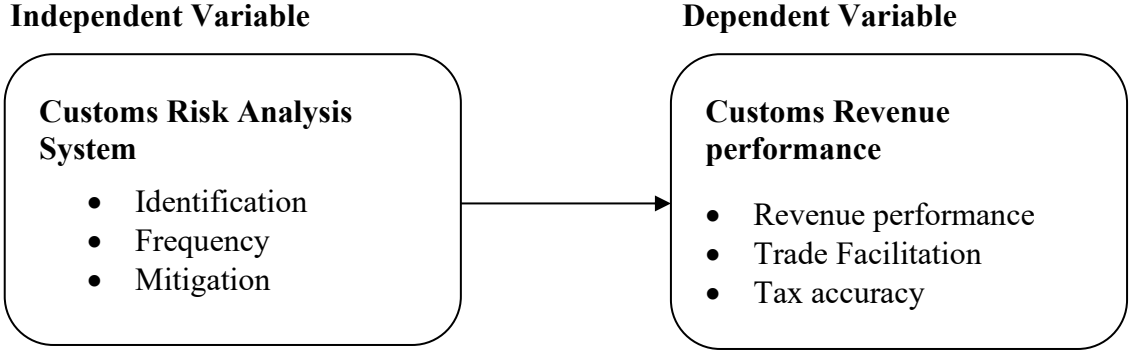


Figure 1: Conceptual Framework

3. Methodology

The study employed an explanatory research design. This helped in understanding the phenomenon by discovering and measuring the causal relationships between variables. Research design as defined by Creswell (2013) is a detailed outline of how an investigation took place. According to Kothari (2011), research design is the structure, strategy, and plan the researcher uses to obtain answers to the research questions. Population refers to an entire group of individuals who are the concern for the study within the area of the study (Mugenda & Mugenda, 1999). The target population was 208 customs revenue officers and clearing & forwarding agents, KRA, (2026). A census survey was used in this study. The study distributed

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208 questionnaires; 183 were completed and returned, representing an 88% response rate. The remaining 25 questionnaires (12% non-response rate) were not completed.

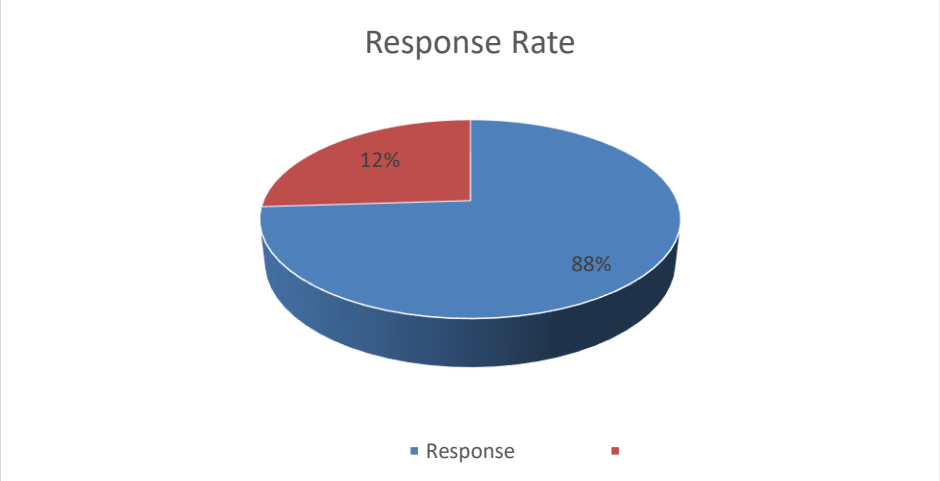


Figure 1: Response Rate

Reliability analysis

The study used Cronbach's Alpha to test reliability and confirm the internal consistency of items. According to Cooper and Schindler (2013), Cronbach's alpha determines a range between 0 and 1; as a result, when the Cronbach's alpha has a score ranging 0-0.6 it is an indication that the reliability of the instrument is low; however, a score of 0.7 and above indicates that the internal consistency and reliability is high and reliable. Table 1 shows that customs revenue performance has a Cronbach's alpha value of 0.732, which is above 0.7; this indicates high internal reliability. Similarly, the customs risk analysis system has an alpha value of 0.850, which is greater than 0.7.

Table 1: Test of Reliability of Questionnaire

Factor	Number of Items	Cronbach Alpha score	Conclusion
Customs revenue performance	5	0.732	Reliable
Customs risk analysis system	5	0.850	Reliable

4. Results and Discussion

4.1 Descriptive Statistics

4.1.1 Descriptive statistics of Customs Risk Analysis System

Table 2: Table 4.6 shows that, on average, respondents agreed with all statements about the Customs Risk Analysis System, with an overall mean of 4.30. Specifically, respondents agreed most strongly with the statement "The system regularly updates risk profiles based on emerging trends," which resulted in the highest mean of 4.42. Because this mean is closest to 5 ("strongly agree") on the Likert scale, it suggests strong consensus that the system stays current with evolving risks. The standard deviation of 0.586 indicates that responses clustered near the

mean, reflecting moderate consistency among participants. Similarly, respondents agreed with the statement "The frequency of risk alerts enhances timely decision-making," with a mean of 4.38, close to 4 on the Likert scale. The standard deviation of 0.531 shows that responses were closely clustered around the mean, indicating strong agreement among participants. Furthermore, respondents agreed with the statement "Frequent risk analysis improves compliance among traders," reflected by a mean of 4.36. This mean, being closer to 4 on the Likert scale, indicates favorable perceptions regarding the system's influence on trader behavior. The standard deviation of 0.564 suggests relatively consistent responses. Respondents also agreed with "Risk identification processes are timely and efficient," which had a mean of 4.22, again closer to 4. The standard deviation of 0.634 reveals moderate variability around the mean. Finally, respondents agreed with the statement "The system integrates multiple data sources for risk identification," with a mean of 4.11, closer to 4 ("agree") on the Likert scale. The standard deviation of 0.665 indicates that responses were somewhat more dispersed compared to other items, yet still relatively close to the mean. Overall, the descriptive statistics reflect consistently positive perceptions across all dimensions of the Customs Risk Analysis System, with the highest agreement on the system's adaptability and alert frequency.

Table 2: Descriptive statistics for Customs Risk Analysis System

	N	Mean	Std. Deviation
Risk identification processes are timely and efficient	183	4.22	.634
The system integrates multiple data sources for risk identification	183	4.11	.665
The system regularly updates risk profiles based on emerging trends	183	4.42	.586
More frequent risk alerts improve timely decision-making.	183	4.38	.531
Frequent risk analysis improves compliance among traders	183	4.36	.564
Overall Mean		**4.30**	

4.1.2 Descriptive Statistics of Customs Revenue Performance

Table 3 presents the descriptive statistics for customs revenue performance indicators. On average, respondents strongly agreed with the statement "There is a reduction in revenue leakages," with a mean of 4.31. Since the mean, when rounded to the nearest whole number, is 4 on the Likert scale, it indicates strong agreement. Additionally, the descriptive summary shows that, on average, respondents agreed with the statement "Duty collection processes are efficient and timely," with a mean of 4.03. The standard deviation of 0.702 suggests that the responses were moderately dispersed around the mean. Furthermore, respondents, on average, agreed with the statement "Automation has increased customs revenue performance," with a mean of 4.10, as the mean rounded to the nearest whole number was closer to 4. The standard deviation of 0.785 indicates a moderate spread of responses around the mean. Furthermore, the

descriptive summary shows that, on average, respondents were neutral to agreeing with the statement "Trade processes are simplified through automation," with a mean of 3.93, closer to 4 on the Likert scale. The standard deviation of 0.676 indicates that responses were moderately close to the mean. In addition, respondents, on average, strongly agreed with the statement "The system enhances accuracy in revenue assessment," with a mean of 4.27, closer to 4 on the Likert scale. The standard deviation of 0.726 indicates moderate dispersion around the mean. The overall mean of 4.13 across all statements indicates that, on average, respondents agreed with the positive statements regarding customs revenue performance, reflecting favorable perceptions of automation's impact on revenue collection.

Table 3: Descriptive Statistics for Customs Revenue Performance

	N	Mean	Std. Deviation
Revenue leakages have decreased.		4.31	.588
Duty collection processes are efficient and timely.		4.03	.702
Automation has increased customs revenue performance.		4.10	.785
Trade processes are simplified through automation.		3.93	.676
The system enhances accuracy in revenue assessment		4.27	.726
Overall Mean		**4.13**	

4.2 Correlation Analysis

Correlation analysis is a statistical technique used to examine and quantify the degree of association between two or more variables, allowing researchers to determine the strength and direction of their relationship (Schober, Boer, & Schwarte, 2018). The customs risk analysis system has a positive and significant correlation with customs revenue performance ($r = 0.780$, $p = 0.014 < 0.05$). This strong positive relationship suggests that effective risk analysis mechanisms play a critical role in optimizing revenue collection by enabling customs authorities to identify high-risk consignments, allocate inspection resources efficiently, and minimize fraudulent declarations that undermine revenue targets.

Table 4: Correlation Statistics

	Customs Revenue performance	**Customs risk analysis system**
Customs revenue performance	1	0.780**
Customs risk analysis system	0.780**	1
Sig	0.014	

. **. Correlation is significant at the 0.05 level (2-tailed).

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4.3 Regression Analysis

Table 5 indicates that the customs risk analysis system had a positive correlation with customs revenue performance of up to 78% (R = 0.780). According to the study findings, the model accounts for 60.8% (R-Square, 0.608) of the variation in customs revenue performance. This implies that the remaining 39.2 % of the change was caused by other factors not included in the model. The results further reveal that even if the study adjusts, the model would still account for 60.3% (Adjusted R Square, 0. 603) of customs revenue performance.

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.780[a]	.0.608	.603	.43234

a. Predictors: (Constant), Customs risk analysis system _mean

Further ANOVA tests were conducted to determine whether the model explains the relationships among variables as postulated in the conceptual model. Table 6 shows an F value of 210.591 with a significance level of 0.000, which is far below the 0.05 significance level, indicating that the model is statistically significant.

Table 6: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	91.186	1	91.186	210.591	0.000
	Residual	78.401	181	0.433		
	Total	169.587	182			

a. Dependent Variable: Customs revenue performance
b. Predictors: (Constant), Customs risk analysis system

Table 7 showed that a one-unit change in customs risk analysis system caused a 0.262 increase in customs revenue performance. The study found that the customs risk analysis system had a positive and significant effect on customs revenue performance $\beta = 0.262$, p-value = 0.000 < 0.05). The hypothesis was rejected.

Table 7: Regression Coefficient Analysis

Variable	Standardized β	Std. Error	t-Statistic	Unstandardized β	Prob.
Constant	1.673	0.146	11.459		0.000
Customs revenue performance	0.262	0.022	11.909	0.262	0.000

4.4 Discussion

The third objective sought to establish the effect of the customs risk analysis system on customs revenue performance at Jomo Kenyatta International Airport, Kenya. The study also found that the customs risk analysis system was positively and significantly correlated with customs revenue performance (r = 0.780, p = 0.014 < 0.05). This strong positive relationship suggests

that effective risk analysis mechanisms play a critical role in optimizing revenue collection by enabling customs authorities to identify high-risk consignments, allocate inspection resources efficiently, and minimize fraudulent declarations that undermine revenue targets. Moreover, the results showed that the effects of the customs risk analysis system on customs revenue performance were positive and significant ($\beta = 0.262$, $p = 0.000$). This highlights that intelligence-driven selectivity enables customs administrations to focus enforcement resources on high-risk consignments, thereby maximizing the efficiency of customs revenue collection. The study findings concurred with. Reynolds (2023) investigated the impact of customs risk analysis and targeting practices implemented by U.S. Customs and Border Protection, finding that the introduction of risk analysis techniques led to measurable increases in revenue recovered from duties, taxes, and fees, with proactive risk-based enforcement contributing hundreds of millions of dollars in recovered revenue compared with prior baseline figures

5. Conclusion

The study objective sought to establish the effect of the customs risk analysis system on customs revenue performance at Jomo Kenyatta International Airport, Kenya. The study also found a positive, significant correlation between the customs risk analysis system and customs revenue performance. This strong positive relationship suggests that effective risk analysis mechanisms play a critical role in optimizing revenue collection by enabling customs authorities to identify high-risk consignments, allocate inspection resources efficiently, and minimize fraudulent declarations that undermine customs revenue targets. Moreover, the hierarchical regression analysis showed that the customs risk analysis system had a positive and significant effect on customs revenue performance.

6. Recommendations

KRA management should invest in training programs that strengthen officers' cognitive skills to contextualize risk intelligence, exercise sound judgment in targeting decisions, and adapt selectivity criteria to emerging fraud patterns, ensuring that technological investments translate into tangible revenue gains.

Future studies should examine how trade facilitation policies and regulatory frameworks affect customs revenue performance.

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