

Leveraging Tanzania's national e-procurement system for sustainable public procurement: An empirical review of environmental and operational outcomes

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ABSTRACT

This research investigated how the National e-Procurement System contributes to sustainable public procurement by analyzing its contribution to sustainable public procurement through four dimensions: reduction of paperwork, carbon emissions reduction, cartridge reduction, and reduction of transportation and communication cost for procuring organizations and suppliers. The study is guided by the natural-resource-based view, transaction cost economics, and the technology-organization-environment framework. An empirical desktop-review design was employed. Data was deliberately selected from Tanzanian laws; Public Procurement Regulatory Authority reports and guidelines; the National e-Procurement System sources; the 2025 Methodology for Assessing Procurement Systems report; and precisely 20 peer-reviewed journal articles published between 2024 and 2026. Thematic analysis was employed to analyze the data. The findings reveal that e-tendering, bidding, evaluation, approval, contract management, and communication minimize the use of paper, copy, bind, and storage processes. Also, the National e-Procurement System saved 617.85 tons of carbon dioxide emissions in one year. Moreover, Tanzania's National e-Procurement System also eliminates the need for travel on behalf of both the suppliers and the purchasing organization, as well as officers of the purchasing organization. In this way, costs of fuel, fare, accommodation, courier services, and opportunity costs are reduced along with expanding geographical reach for tender documents. The study recommends that Public Procurement Regulatory Authority should integrate a sustainability dashboard into Tanzania's National e-Procurement System to monitor resource savings and independently verify avoided carbon dioxide emissions. Also, Tanzania's National e-Procurement System should promote environmentally friendly supplies while the government improves connectivity, training and support to prevent supplier exclusion.

Keywords: Carbon Emissions, National E-Procurement of Tanzania, Paperless Procurement, Printer Cartridges, Sustainable Public Procurement, Transportation and Communication Costs

I. INTRODUCTION

Public procurement is not just about compliance and cost-effectiveness, but about generating economic benefits, being socially inclusive, and reducing environmental impacts throughout the life cycle of goods, works, and services. Therefore, sustainable public procurement involves connecting procurement and purchasing decisions with environmental, social, and economic aspects. The importance of this policy approach is particularly highlighted by Public procurement Regulatory Authority (PPRA) of Tanzania where public procurement comprises a large portion of the government's budget and can affect production methods, markets, and consumption of resources (PPRA, 2025a; Adjei-Bamfo & Maloreh-Nyamekye, 2019; Schooner et al., 2021).

Digitalization is one of the means through which procurement can be made sustainable. A standard tender process might involve multiple copies of solicitation documentation, responses from the bidders, evaluation logs, approval process, contract documents, invoices and letters. The paper process involves use of raw materials such as wood, water, electricity, fuel, toner and ink, as well as creation of solid and hazardous waste through the dumping of paper waste and cartridges. A digital procurement system can reduce some material inputs by replacing them with electronic documents, approvals and communication processes. However, digital platforms use electricity, have infrastructure in the form of data centres and create electronic waste; thus, the environmental value of digital procurement systems must be evaluated (Singh et al., 2022; Croom & Brandon-Jones, 2005, 2007; Boafo, 2020).

The country of Tanzania has also implemented the Tanzania National e-Procurement System (TANePS), and thereafter, the National e-Procurement System of Tanzania (NeST). The services provided by NeST include e-registration, e-tendering, e-contract management, e-payment, e-catalogue and e-auction services (NeST, 2026). Public Procurement Act, 2023 uses the electronic procurement system as a must-use for public procurement, and sustainable procurement is now integrated into the legal and policy regime (United Republic of Tanzania, 2023; PPRA, 2024). PPRA defines NeST as an important tool that contributes to efficiency, minimization of waste and performance on environmental, social and governance aspects (PPRA, 2026; Shatta et al., 2020a; Njunwa, 2023).

The previous studies conducted in Tanzania focused on the adoption, performance of employees, functionality, transparency, cost savings and corruption control of TANePS. Komba et al. (2023) established that TANePS was

commonly used for e-tendering and e-payment. Joseph and Masoud (2025) showed that although NeST automates the process and minimizes the risk of manual errors, it is limited by such factors as downtime, connectivity and lack of full integration with contract management. The above studies show that digital procurement transforms the process of doing business. However, there are very few studies that specifically focus on the environmental impact of less paperwork and use of printing cartridges. In this regard, the research focuses on addressing the empirical gap related to the role of NeST in sustainable procurement (Shatta & Shayo, 2021; Shatta, 2024). The research will be conducted using the empirical desktop review method. This method will involve synthesis of empirical measurements, legislation and policy, as well as empirical studies results. Special attention will be paid to the paperwork, carbon footprint and printer cartridges.

1.1 Statement of the Problem

In the era before the advent of e-procurement, it relied on printed tender documents, several copies of the bids, tender submissions, paper-based evaluation files, paper approval processes and paper-based contract documents. This approach incurred periodic costs for paper, toners, ink, transportation and storage, while at the same time contributing to environmental pollution by the production of papers, movement of vehicles and the dumping of expended cartridges. While NeST was intended to reduce inefficiencies and improve transparency, it is yet to be systematically considered in the scholarly literature as a tool for sustainable procurement (Croom & Brandon-Jones, 2005; Maagi & Mwakalobo, 2023a). However, the evidence available is scattered. PPRA provides plenty of information regarding avoided carbon emissions due to paperless procurement, while empirical studies concentrate on usage and performance of the system rather than direct environmental indicators. Furthermore, no established national baseline is present as to how many reams of papers or printer cartridges government institutions have been using prior to NeST, how this number has shifted since the use of the system started and whether the used cartridges have been remanufactured, recycled or properly disposed. In absence of synthesis and critical analysis, there is a considerable possibility that digitalization will be portrayed as sustainable in the absence of sufficient analysis of measurement limits, rebound printing, energy consumption and electronic waste (Singh et al., 2022; Belal et al., 2025).

1.2 Research Objectives

- i. To examine the contribution of NeST to minimizing paperwork in Tanzania's public procurement process.
- ii. To assess the contribution of NeST to reducing carbon emissions associated with paper-based procurement activities.
- iii. To evaluate the contribution of NeST to reducing the use and environmental burden of printer cartridges in public procurement.
- iv. To examine the contribution of NeST to minimizing transportation and communication costs incurred through procurement officers' follow-up and suppliers' physical submission of tender documents.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Natural-Resource-Based View

The Natural-Resource-Based View (NRBV) by Hart (1995) builds upon the resource-based view of strategy, asserting that competitive and institutional advantages can be gained through capabilities which overcome limitations of the natural environment. The key capabilities in NRBV include pollution prevention, product stewardship and sustainable development. The pollution prevention capabilities involve waste and emission reductions at the source of pollution; product stewardship considers the environmental impact throughout the entire lifecycle of a product; and sustainable development involves integration of economic activities with environmental and social concerns (Hart, 1995; Hart & Dowell, 2011). Electronic tendering is an example of a pollution-prevention capability in the context of NeST. This theory has strengths in the ability to relate operational resource efficiency to strategic public value creation. However, its weaknesses include overlooking some of the mandatory regulations, user behaviors, and technological capabilities in its conceptualization of NeST. As a result, the theory can explain the reasons behind the emergence of sustainability value in paperless procurement processes but fails to fully account for the behaviors of procuring entities and their suppliers regarding NeST.

2.1.2 Transaction Cost Economics

Transaction Cost Economics (TCE), primarily developed by Coase (1937) and Williamson (1985), addresses why organizations adopt governance structures which reduce transaction costs in exchange. Transaction costs relate to such factors as searching for information, preparing and transmitting documents, negotiation, monitoring and enforcement of agreements and addressing uncertainty. The specificity of assets, uncertainty and frequency of transactions determine whether market, hybrid or hierarchical governance are more efficient choices (Williamson, 1985).

In the case of public procurement, the actual collecting and submission of tender documents, officers' inspections, courier delivery, communication, monitoring of contracts are all transaction costs besides the cost of contract. NeST reduces such transaction costs by creating searchable opportunities, using standard electronic documents, remote submission of bids, automated notifications and monitorable contract information (Croom & Brandon-Jones, 2005, 2007; Bosio et al., 2023). Therefore, TCE is the most straightforward theoretical perspective for explaining cost reduction in transportation, communication and administration. The advantages of this perspective include its concentration on exchange costs, whereas its limitations lie in efficiency being an insufficient framework for environmental protection and equality.

2.1.3 Technology-Organization-Environment framework

The Technology-Organization-Environment (TOE) framework has been formulated by Tornatzky and Fleischer (1990) for understanding the adoption of organizational technology in three contexts. The technological context involves compatibility, complexity, relative advantage, security and system reliability. The organizational context consists of leadership support, skills, resources, structure and readiness. The environmental context involves regulation, infrastructure, suppliers and institutional pressure. All the constructs are based on empirical evidence from Tanzanian research. Organizational, technological and environmental factors had a significant impact on e-procurement adoption (Njunwa, 2023). Performance expectancy, effort expectancy and user attitudes impacted usage (Shatta, 2024). Shatta et al. (2020a) have even associated e-procurement adoption with green procurement. The strengths of TOE include its comprehensive understanding of implementation determinants; its weaknesses include its focus on explaining adoption rather than environmental determinants. In this research, TOE helps us understand why the contribution of sustainability by NeST hinges on connectivity, full system integration, management support, user skills, enforceability of electronic records and supplier readiness.

Implication of theory on the research. The three theories complement each other. NRBV determines the sustainable value that results from avoiding paper, cartridge, fuel, and carbon waste. TCE shows how remote electronic transactions lower costs of transactions between suppliers and the procurement agency. TOE describes the circumstances under which NeST is adopted and utilized enough to realize the benefits. NeST is best suited for sustainable procurement when there is no use of paper-based processes at all, when users are trustworthy and skilled to use the system, where legislation approves electronic documentation, and where there is environmental performance measurement (Hart & Dowell, 2011; Njunwa, 2023; Shatta, 2024) under the unified theoretical framework.

2.2 Empirical Review

2.2.1 Paperwork, Printing and Cartridge Consumption

Paper document flows become a result of traditional public tendering processes. Purchasing organizations produce specifications, solicitations, evaluations, approvals, contracts, invoices and letters, while suppliers have to buy, print, bind and submit several bidding papers. Papermaking and printing consume wood, water, electricity, ink and toner resources and generate wastes throughout their life cycles. Electronic documents, signatures, approvals and archives help save on materials, but their effect becomes less efficient if organizations keep duplicate electronic and paper records. The importance of printing consumables should not be underestimated since toners and ink cartridges consist of plastics, metals, packaging and chemical wastes. Good ink management increases efficiency and environmental performance, while circular procurement helps extend the lifecycle of cartridges via refilling, remanufacturing and return by suppliers (Krystosiak et al., 2024; Croom & Brandon-Jones, 2007; Njunwa, 2023).

2.2.2 Carbon Emissions and Digital Procurement

Paperless procurement results in decreased greenhouse gas emissions embedded in paper production, printing, transport and disposal. Paperless procurement could also result in reduced vehicular emissions in the event where tender documents, clarifications, bid documents and contract communications are transmitted electronically. PPRA has national evidence of sustainability with regards to paperless procurement through NeST that shows 617.85 tonnes of carbon dioxide emissions avoidance per year (PPRA, 2025a). However, for a true net impact assessment, one must include electricity consumption in data centers, networks and users' devices, embedded emissions in ICT products and electronic waste. The use of e-procurement helps in green procurement and sustainable supply chain management, according to research by Singh et al. (2022), but digitalization needs to be supplemented by environmental policies and performance measurement. The adoption of e-procurement was seen to help green procurement and sustainability in the supply chain, yet digitalization must go hand-in-hand with environmental practices and performance measurement (Schooner et al., 2021; Singh et al., 2022).

2.2.3 Transportation and Communication Costs

The cost of transportation is one of the most important transaction costs associated with manual procurement in cases where suppliers are found at long distances from the procuring organization. The physical system would entail the suppliers and/or couriers to collect documents, attend clarification sessions, deliver sealed bids before deadline, follow-up on matters of evaluation and payments, and exchange signed documents. Likewise, procurement officers have to make trips to user departments, supplier firms, project sites, or the office in order to deliver documents and get approvals. Costs such as fuel, air/bus fares, depreciation of vehicles, per diem, lodging costs, costs of couriers, and time spent in making the trips could be discouraging for micro, small, and remotely located firms from participating in procurement. E-tendering systems, e-clarification, e-bidding, e-notifications, and electronic communication of contracts reduce the need for all these trips. Bosio et al. (2023) present a convincing investment case for e-government procurement with lower transaction and procurement costs, while Maagi and Mwakalobo (2023a, 2023b) reveal that Tanzanian practitioners perceive e-procurement to involve cost and time saving (Bosio et al., 2023; Croom & Brandon-Jones, 2005).

2.2.4 Sustainable Public Procurement

The concept of sustainable public procurement is defined as the procurement of goods, services, works, and utilities in such a way that it results in good value for money throughout the entire life cycle and brings benefits to both the organization and society/economy without causing any harm to the environment (United Nations Environment Programme [UNEP], 2021; PPRA, 2025a). The sustainable public procurement thus includes more than just the cost efficiency of procurement but also such factors as resource efficiency, emissions, social inclusion, and value to the public sector in the long run. The electronic government procurement is understood as the use of advanced digital technology to plan the process, announce the opportunities, circulate the solicitation documentation, accept and evaluate the offers, conduct the awards and manage the contracts, make payments, and keep the auditable records. NeST involves such modules as the e-registration, e-tendering, e-contract management, e-payment, e-catalogue, and e-auction (NeST, 2026). When these modules replace manual procedures, digitalization becomes an operational capability for sustainable procurement rather than merely an administrative reform (Adjei-Bamfo & Maloreh-Nyamekye, 2019; Da Motta & Da Costa, 2019).

III. METHODOLOGY

3.1 Research Design

The methodology used for the study was empirical review. In contrast to a purely theoretical review, it emphasized sources that contained information about real use, results obtained, statistical data, survey results, or implementation experience. The unit of analysis was information on e-procurement in Tanzania and its connection with paper, printing, carbon, resource efficiency, or sustainable procurement (Snyder, 2019; Page et al., 2021).

3.2 Search Strategy and Review Period

Sources were identified using purposive searches of PPRA, NeST, legal and governmental sources from Tanzania, journal websites, and other academic databases. The main keywords used were 'NeST', 'TANePS', 'Tanzania e-procurement', 'sustainable procurement', 'paperless procurement', 'carbon emissions', 'printing', 'toner' and 'printer cartridge'. The population for empirical review included exactly 20 peer-reviewed journal articles published between January 2024 and July 2026. Earlier sources were selected only for definition of concepts and explanation of theories and methodology and they were not considered as part of 20 reviewed articles. The sources were selected if they: (i) focused on electronic or sustainable public procurement; (ii) had Tanzanian data or empirical findings transferable to Tanzania; and (iii) offered enough methodological and institutional details. Opinion articles with no verifiable evidence and sources confusing Tanzania's NeST with other technologies were excluded (Page et al., 2021; Xiao & Watson, 2019).

3.3 Eligibility and Source Selection

After conducting title, abstract and full-text screening, 20 journal articles fulfilled the inclusion criteria. The final dataset included ten papers published in 2024, eight in 2025 and two in 2026. Preference was given to Tanzanian literature, with more recent international literature being used where it provided relevant empirical or analytic evidence concerning digital procurement, sustainable procurement, transaction cost reduction, circularity, carbon management or user adoption in relation to the NeST research objectives. The data were entered into a matrix including author/institution, publication year, context, methodology, key results and relevance to the three research objectives. The evidence was then categorised through thematic analysis into paperwork reduction, carbon-emission reduction and cartridge reduction. Triangulation involved comparison of statutory legislation, PPRA administrative evidence and independent empirical evidence. Evidence claims were differentiated between directly measured, administratively estimated or logically inferred claims. This ensured validity and prevented cartridge savings, which cannot be measured independently since

their national volume is unknown, from being treated as independently measured claims (Braun & Clarke, 2006; Snyder, 2019).

3.4 Data Extraction and Thematic Analysis

Limitations of this literature review are present. PPRA's carbon number is based on institutional calculations, while the public source lacks a complete life cycle assessment, baseline, emission factor and uncertainty range. Studies from Tanzania do not separate environmental effects from other results, and there were no datasets about procurement of papers and cartridges in the country over time found. This makes it impossible to measure the effect of these policies nationally for all three indicators (Snyder, 2019; Page et al., 2021).

3.5 Reliability, Validity

Reliability was improved through the consistent application of inclusion/extraction criteria across all sources and through the use of an evidence matrix. Validity was improved through triangulation of sources whereby statutory and administrative sources were cross-referenced with independent empirical studies and foreign studies. Peer-reviewed sources and primary sources were prioritized in the review.

3.6 Ethical Considerations

Ethical considerations were observed by using credible and publicly available sources, acknowledging all authors through appropriate citations and references, and respecting intellectual property rights. Since the desktop review did not involve human participants or personal data, informed consent was not required. Academic integrity, objectivity, and transparency were maintained by accurately presenting findings, applying clear study-selection criteria, avoiding plagiarism and data misrepresentation, and using the reviewed information solely for academic purposes

IV. FINDINGS & DISCUSSIONS

4.1 List of peer reviewed journal articles

The Table below shows the peer review journal articles which were used for this study;

Table 1

Summary of the empirical evidence reviewed

Source	Year	Setting/method	Key finding	Relevance
Ragin-Skorecka	2024	Poland; quantitative survey of public e-procurement users	System quality and user experience influence satisfaction and sustained use	Explains conditions for paperless and remote procurement
Shatta & Mabina	2024	Tanzania; cross-sectional survey, n=367; PLS-SEM	Relative advantage, performance expectancy, attitude and law influence adoption	Shows regulatory and perceived-benefit drivers of NeST use
Shatta	2024	Tanzania; buyers and suppliers, n=383; PLS-SEM	Effort expectancy, performance expectancy and attitude predict actual use	Supports buyer-supplier acceptance of remote transactions
Rutatola	2024	Tanzania; supplier survey and structural modelling	Top-management support strengthens social influence on intention to use NeST	Shows organisational support needed for supplier participation
Mwalukasa et al.	2024	Tanzania; public entities; quantitative analysis	E-sourcing, e-evaluation and e-contracting improve public-entity performance	Supports full-cycle automation and reduced manual paperwork
Swai & Musabila	2024	Tanzania Revenue Authority; empirical case study	Staff competence strengthens e-procurement performance	Links skills with effective digital replacement of physical processes



Maagi & Mwakalobo	2024	Tanzania; explanatory sequential mixed methods	Practitioners associate e-procurement with procurement savings	Supports reduced printing, communication and travel costs
Krystosiak et al.	2024	Printing process; material and environmental analysis	Proper management improves efficiency and environmental sustainability	Supports toner/cartridge reduction and circular management
Sun et al.	2024	China; listed firms, 2010–2020; logit models	Public procurement participation increases firms' circular-economy adoption	Demonstrates procurement's market leverage for circularity
Musonda et al.	2024	Zambia Ministry of Health; quantitative survey	E-procurement improves efficiency, transparency and user experience	Regional evidence on streamlined electronic processes
Chawala & Maagi	2025	Tanzania; empirical public-procurement study	E-procurement risk controls reduce errors and corruption opportunities	Supports audit trails and reduced manual intervention
Joseph & Masoud	2025	Kinondoni MC; 100 surveys and 15 interviews	NeST improves automation and transparency; downtime and integration gaps remain	Direct NeST functionality evidence
Komba et al.	2025	PPRA and GPSA; survey, n=200	84% frequently used e-tendering/e-payment; readiness aided adoption	Shows extensive substitution of paper-intensive stages
Mzuguno & Makula	2025	Mbeya City; suppliers and procurement professionals	Technological and user factors influence NeST adoption	Explains variation in realised sustainability gains
Belal et al.	2025	UK healthcare; qualitative case study	Digital procurement enables environmental monitoring and process efficiency	International evidence on digital–environmental pathways
Andhov et al.	2025	Public procurement lifecycle; legal and governance analysis	AI can embed sustainability from needs assessment through contract learning	Supports future NeST sustainability analytics
Kalison et al.	2025	Tanzania construction projects; empirical project study	Tender advertisements and procurement processes use national e-procurement	Confirms digital tendering in project procurement
Wang & Shen	2025	China; listed companies 2015–2023; robustness tests	Green public procurement significantly improves corporate ESG performance	Shows supplier-level sustainability effects
Basile et al.	2026	Construction procurement; systematic review and modelling	Digital procurement and information modelling reduce time and transaction costs	Supports automation, remote exchange and efficiency



Tanzubil Atiga	& 2026	Ghana public procurement; empirical e-procurement study	E-procurement practices improve supply-chain performance	Recent African performance benefits	corroboration of
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The corpus chosen consists of 20 papers, 10 papers published in 2024 (50%), 8 in 2025 (40%) and 2 in 2026 (10%). Out of these papers, 11 present empirical evidence from Tanzania, three papers from other parts of Africa, and six papers offer international data on digital procurement/sustainable procurement. This helps in deriving national-level conclusions based mostly on Tanzanian data, but drawing implications from comparative studies based on recent trends.

4.1.1 NeST and the Minimization of Paperwork

The findings have clearly illustrated that NeST replaces electronic transactions with various paper processes. NeST includes modules for electronic registration, electronic notice of tenders, electronic solicitation, bidding, evaluation, approvals, contracts, cataloguing, auctions, and payment (NeST, 2026). It has made an end-to-end system where the need for entities to prepare physical tender packages, along with the requirement of bidders to print several copies of tender packages, bind them, and send them to tender boxes is eliminated (Croom & Brandon-Jones, 2007; Boafu, 2020). There are evidences that prove the process, but not tons of papers saved using it. In their study, Komba et al. (2023), have found out that 84% of the people have used TANePS to conduct e-tendering and e-payment, which means that the high-level procurements activities have been converted to the digital world. According to Joseph and Masoud (2025), by conducting 100 questionnaires and 15 interviews at Kinondoni Municipal Council, the use of electronic system has brought about automation and reduced errors. From their study, it is clear that the process of partial automation and occasionally the failure of the system could make people revert to manual process. This means that minimization of paper takes place when the NeST becomes reliable, integrated, and used (Njunwa, 2023; Shatta, 2024).

Paperwork reduction also has aspects of economics and governance, which support sustainability. Having fewer paper copies means reduced cost in terms of paper, printing, binding, delivery, and archiving. Being able to retrieve records quickly saves search time and physical space for archiving, while having a standardized electronic process minimizes loss and any unauthorized manipulation of records. In relation to NRBV, NeST increases resource efficiency, while from TOE's perspective, the effectiveness is contingent upon technology, individual capability, and compulsory electronic processing (Masudin et al., 2021; Ndei & Mutuku, 2021).

4.2 NeST and Reduction of Carbon Emissions

The key quantitative outcome is the PPRA's calculation that the paperless procurement system in NeST avoided 617.85 tonnes of carbon dioxide emission within a year. According to PPRA, this amount is equivalent to reducing the use of about 144 passenger cars powered by gasoline over a year, avoiding the consumption of 69,523 gallons of gasoline, or recycling 218 tonnes of waste (PPRA, 2025a). Such administrative calculations directly give Tanzanian empirical evidence that the system is being viewed not only as an efficiency reform but also as a climate change solution (Singh et al., 2022; Schooner et al., 2021). Several reasons could lead to the reduction estimation. Reduction in the use of paper decreases the emissions embodied in pulp, paper manufacture, and paper distribution. Reduction in printing minimizes the consumption of electricity and the production of consumables. The online tender submission and communication process eliminates travel to deliver papers to the relevant parties. Digital records might eliminate the construction and operations of physical records. International empirical studies also indicate that e-procurement can improve green procurement performance in the integration of electronic and environmental processes (Singh et al., 2022; Belal et al., 2025).

Nevertheless, such a conclusion must be properly qualified. Avoided emissions do not equal net emissions. NeST employs data centers, networks, computers and backup facilities, which all use power and have embodied carbon. In addition, users might print electronic papers, producing a rebound effect. Since PPRA source does not provide full boundaries of life cycle and does not provide an independent verification, the 617.85 tons number should be presented as a proper estimate and not as an independently verified net carbon number. The proper future study would take into account ICT electricity consumption, ICT device manufacturing and e-waste emissions.

4.3 NeST and Reduction in Printer-Cartridge Use

Printer cartridges are a somewhat hidden yet vital part of the environmental impact of procurement. Toner cartridges and ink cartridges are made of plastics, metals, residual chemicals and packaging; the production, transportation and disposal of these cartridges have environmental impacts. The printing of procurement documents multiple times results in quicker disposal of printer cartridges. This means that each procurement document which is truly digitized is saving some amount of toner or ink.

In sum, there is therefore a clear causal chain but no Tanzania-focused quantitative evidence. The paperless operation carried out by NeST naturally decreases the amount of print, and as a result, the need for cartridges. The evidence from print management indicates that management of ink and print processes makes operations more efficient and environmentally friendly (Krystosiak et al., 2024). Nonetheless, neither the PPRA literature reviewed nor Tanzanian case studies provide any pre-post analysis regarding cartridge usage and waste. This means that cartridge savings will be considered an expected downstream achievement (Krystosiak et al., 2024; Croom & Brandon-Jones, 2007).

Lack of data can be an opportunity for policymaking too. The consumption of cartridges can be simply measured based on the purchases of toners and ink via the framework contracts and catalogues and correlating these purchases with the printing activity of the entities. NeST could classify the cartridges based on their original, remanufactured or refillable nature and register take back policies from suppliers.

4.4 NeST and Transportation and Communication-Cost Reduction

Through the literature of 20 papers, it is found that NeST lowers transportation and communication costs in the procurement process by using three distinct methods. Firstly, the bidders can view and download tenders from websites and can send their bids online without traveling again and again to the procuring agency. In traditional procurement systems, an enterprise that has its operations in some other district or province has to spend money on tickets, fuel, accommodation, food, courier services and productive time to get documents from the organization or to send documents to it (Bosio et al., 2023; Maagi & Mwakalobo, 2023a).

Secondly, clarifications, notifications, approvals, contract communications and payments in electronic form lessen physical follow-up activities of the supplier and procurement officer. Electronic records facilitate the procurement officer to communicate with several bidders without having to print and send individual letters. Maagi and Mwakalobo (2023b) established that e-procurement saves time in Tanzania, while Maagi and Mwakalobo (2023a) have established the cost savings associated with e-procurement. The rationale is based on transaction cost theory, whereby digital exchange lowers the costs associated with searching, communicating, coordinating, traveling and monitoring (Maagi & Mwakalobo, 2023b; Shatta, 2024).

Thirdly, fewer travels would also result in co-benefits to the environment due to less fuel consumption and reduced congestion and emissions from transportation. However, there is no proof of any financial savings at the national level. NeST and PPRA do not make public data such as kilometres saved, number of journeys by suppliers avoided, officer travel claims, courier costs and fuel savings. It is also true that physical inspections of sites and deliveries as well as contract management of construction projects and goods will still be required.

4.5. Discussion

4.5.1 Reduction of Paper work

These results show that NeST helps sustainable procurement in two interrelated aspects. Firstly, NeST affects the process of procurement because of digitization of documents, approval, communication, and documentation process. Secondly, this change of the process decreases the need for physical inputs and related emissions. This effect occurs best when the digital process substitutes for, not duplicates, the paper process. The requirement for using NeST as stipulated by the Public Procurement Act makes it possible because it does not facilitate the double processing that was done digitally and manually in the previous case (United Republic of Tanzania, 2023; PPRA, 2024; Masudin et al., 2021).

Regarding the first objective, the evidence available is convergent: the system design of NeST is paperless, while Tanzanian user studies show substantial usage of online procurement and advances in automation. However, the continued existence of lack of integration and connectivity, as described by Joseph and Masoud (2025), might ensure that shadow paper files will remain. Therefore, merely relying on technology implementation is not sufficient, and procurement processes, audit, and record keeping practices need to be designed to include electronic records as official and exclude redundant paper-based versions (Croom & Brandon-Jones, 2007; Joseph & Masoud, 2025).

4.5.2 Reduction of Carbon and Carbon dioxide emission

Regarding the second objective, PPRA's estimate of 617.85 tonnes of avoided CO₂ emissions demonstrates NeST's potential contribution to environmental sustainability (PPRA, 2025). The reduction results from decreased paper use, printing, photocopying and physical submission of tender documents. NeST also minimizes travel by suppliers and procurement officers, thereby reducing fuel consumption and transport-related emissions. This finding supports Singh et al. (2022), who established that e-procurement promotes green procurement by reducing resource consumption. However, the estimate requires a transparent carbon-accounting methodology covering the amount of paper saved, journeys avoided, travel distances and applicable emission factors. It should also account for electricity consumed by servers, communication networks and user devices because digital systems generate their own environmental footprint (Lövehagen et al., 2023). Therefore, comparing the life-cycle emissions of paper-based procurement with those of NeST would provide a more reliable estimate of its net carbon savings.

4.5.3 Reduction of Cartridge Reduction

Concerning the third objective, less cartridge usage results directly from less printing but is the least researched impact among the three. This point needs to be addressed since cartridges are procured using the public budget and can be tracked via NeST itself. In fact, tracking cartridges will convert an assumed co-benefit into an auditable result. Procurement criteria may include favoring high yield, refills and remanufactured cartridges, take back and proper disposal, and avoiding printers that force organizations to purchase proprietary and costly consumables (Krystosiak et al., 2024; Da Motta & Da Costa, 2019).

These research findings confirm the NRBV assumption about digital competence that can prevent pollution and raise the efficiency of resource usage. The research results also confirm the theory of organizational and environmental excellence which states that reliability and compatibility of the technology used, readiness of the organization, and regulatory enforcement make the difference between achieving or failing to achieve environmental benefits. Malfunctioning or partial integration of the platform will force users to print additional copies while digitally competent organizations with paperless policies will realize more savings. Sustainable procurement must be embedded into NeST through data fields, evaluation criteria, catalogs and dashboards (Hart & Dowell, 2011; Njunwa, 2023).

4.5.4 Saving on Transportation, Communication and Supplier Participation

The transport implication widens sustainable procurement from mere paper reductions. Electronic access and submission transform the involvement in the process from a physical one dependent on locality to one that is remotely available. This has the potential of reducing transaction costs for the suppliers, enhancing competition and including businesses which are not based in big administrative centers. It also frees the procurement officials from the burden of trips required in delivering and following up the documents and enables them use the saved time in conducting analysis and contract inspections where necessary. But the lack of connectivity and downtimes or the preference for parallel hard copies might push the cost burden to suppliers and might marginalize firms in rural areas (Bosio et al., 2023; Boafu, 2020).

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This empirical literature review shows that the NeST plays an important role in sustainable public procurement in Tanzania. Firstly, NeST reduces the amount of paperwork in the process of tendering, evaluation, approvals, contract-making, payments and document management. In addition, this significant reduction leads to some benefits related to printing, binding, transportation and storage costs. PPRA's estimation of 617.85 tonnes of carbon dioxide avoided annually represents the best result of an environmental benefit, but its calculation should be verified independently. Reduction in the use of printer cartridges can also be seen as a consequence of paperless procurement, but at present it is impossible to make an estimation in numerical terms. Consequently, NeST should be considered as enabling technology of sustainable procurement, but not the proof of its sustainability. Its final contribution will depend on its usage throughout the entire chain, connection quality, exclusion of any duplication of paper processes, criteria of green procurement and accurate environmental estimation.

5.2 Recommendations

The study recommends that PPRA should incorporate a sustainability dashboard into NeST to monitor paper, printing and cartridge savings, avoided trips, fuel consumption and net greenhouse gas emissions. Procuring entities should establish annual benchmarks for paper, toner, courier, travel, fuel and archiving costs. PPRA should publicly disclose and independently verify the methodology used to calculate the reported 617.85 tonnes of avoided CO₂. NeST specifications should prioritize duplex printers, recycled paper, refillable cartridges and supplier take-back arrangements. The government should also improve rural connectivity, mobile access, user training and help-desk support to prevent supplier exclusion. Future studies should compare paper, cartridge, travel and courier costs, supplier participation expenses and emissions before and after NeST implementation.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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