# AI and the Future of Sustainability Disclosures: A Systematic Desk Review Preparedness of Public Universities for Mandatory Non-Financial Reporting by 2028

**Jeremiah Osida Onunga, Jared Okello**

**Turkana University College, Kenya**

**DOI: https://doi.org/10.68050/JAMS.2026.477**

**Received: 14 Sept 2026; Accepted: 15 Sept 2026; Published: 20 September 2026**

## ABSTRACT

The global shift toward sustainability reporting has substantially broadened expectations for organizations to disclose non-financial information pertaining to environmental, social, and governance (ESG) performance. In Kenya, the gradual adoption of international sustainability disclosure standards like the phased application of the IPSASB Sustainability Reporting Standard on Climate-related Disclosures (IPSASB SRS 1) finalized in January 2026 after an October 2024 exposure draft to public sector entities signals a consequential transformation in institutional accountability. Public universities, which operate large campuses and fulfil essential public service roles through teaching, research, and community engagement, will increasingly be required to report sustainability performance in a transparent, structured, and measurable manner. Yet many of these institutions continue to rely on fragmented administrative systems that render sustainability data collection both difficult and inconsistent. This paper examines how Artificial Intelligence (AI) can support the measurement, verification, and reporting of sustainability indicators in Kenyan public universities as the country prepares for mandatory non-financial reporting requirements. Employing a systematic desk review methodology guided by PRISMA principles, the study synthesizes scholarly and policy literature on sustainability reporting frameworks, ESG indicators relevant to higher education, and emerging AI technologies applied to sustainability analytics. The study proposes an AI-enabled sustainability reporting architecture tailored to the institutional and operational realities of Kenyan public universities and identifies critical readiness gaps that must be addressed. Rather than offering empirical proof of impact, the review indicates that AI-driven data systems have the potential to enhance the accuracy, efficiency, and credibility of sustainability disclosures and to strengthen institutional governance and accountability; these are conceptual propositions derived from the literature synthesis and the proposed architecture, and they remain to be empirically tested in the Kenyan public university context. This paper contributes to the growing discourse on responsible AI, digital governance, and sustainability reporting within higher education institutions across Africa.

**Keywords:** Artificial Intelligence; ESG Reporting; Sustainability Disclosures; Non-Financial Reporting; Higher Education; Kenya; Institutional Preparedness

## INTRODUCTION

Over the past two decades, the global conversation on sustainability has undergone a profound and largely irreversible transformation. What began as a primarily environmental movement concerned with pollution, resource depletion, and ecological collapse has evolved into a comprehensive governance imperative touching institutional operations, investor expectations, regulatory design, and public accountability across every sector of society. Organizations are no longer assessed solely on their financial performance; they are expected to give a credible, structured, and independently verifiable account of their environmental stewardship, social impact, and governance integrity. This broader accountability framework, commonly referred to as Environmental, Social, and Governance (ESG) reporting, has become an organizing principle for stakeholder relations, regulatory compliance, and the long-term legitimacy of institutions that aspire to public trust.

Sustainability reporting has emerged as the principal mechanism through which organizations communicate their ESG performance to external audiences. Through structured sustainability disclosures, institutions provide governments, investors, students, communities, and civil society with substantive information about how their activities affect natural systems, human well-being, and institutional governance (Eccles & Krzus, 2010). The theoretical foundations underpinning this accountability demand are well established: stakeholder theory positions organizations as accountable to all parties affected by their activities, not merely to financial shareholders (Freeman, 1984); legitimacy theory suggests that institutions must demonstrate ongoing alignment with societal norms and expectations to maintain their social license to operate (Suchman, 1995); and institutional theory draws attention to the normative and mimetic pressures that drive organizations to adopt similar governance practices as reporting standards proliferate and regulatory expectations converge (DiMaggio & Powell, 1983). Together, these theoretical traditions explain why sustainability reporting has moved from a voluntary gesture to a governance imperative, and why organizations that fail to produce credible disclosures face mounting reputational and regulatory consequences.

Universities occupy a particularly significant and at times distinctly uncomfortable position within this accountability landscape. Higher education institutions are not merely centers of knowledge production and intellectual inquiry; they are also complex organizational entities with extensive physical infrastructures, large employee populations, substantial resource footprints, and deep embeddedness within the communities and ecosystems they inhabit. University campuses function, in many respects, as small urban systems: they encompass residential facilities, administrative offices, research laboratories, libraries, transport networks, and recreational spaces, all of which consume significant quantities of energy and water, generate substantial volumes of waste, and sustain thousands of staff members while simultaneously serving even larger student populations. The aggregate environmental and social impact of a large public university is, by any reasonable measure, significant comparable in scale to a mid-sized municipal authority, but rarely governed with equivalent environmental accountability.

The discomfort arises from the inherent tension between institutional claims and institutional practice. Through research programs on climate change, biodiversity loss, public health, and social equity, universities have long positioned themselves as intellectual authorities on the very sustainability challenges they are now being asked to address within their own operations. Through degree programs in environmental science, sustainable development, governance, and public policy, they shape the knowledge, values, and professional orientations of the decision-makers who will manage these challenges for the next generation. It is, therefore, increasingly difficult to sustain a position of scholarly authority on sustainability without demonstrating commensurate institutional commitment through transparent, robust, and externally verifiable reporting of one's own sustainability performance. The credibility gap between teaching sustainability and practicing it is narrowing, and universities that fail to close it risk not only regulatory exposure but a more fundamental erosion of intellectual authority.

In Kenya, these pressures carry additional weight given the national development frameworks within which public universities operate. Vision 2030, Kenya's long-term development blueprint, identifies knowledge-based economic growth, environmental sustainability, and social equity as central pillars of national progress (Government of Kenya, 2007). The Big Four Agenda and its successor policy frameworks have reinforced commitments to food security, affordable housing, manufacturing, and universal healthcare all of which intersect with sustainability governance in meaningful ways. Public universities, as key instruments of national development, are expected not only to generate the knowledge that informs these agendas but to embody their principles through institutional practice. The gradual alignment of Kenya's regulatory environment with international sustainability reporting standards most notably through the IPSASB Sustainability Reporting Standard on Climate-related Disclosures (IPSASB SRS 1), finalized in January 2026 for public sector entities and the growing influence of IFRS Sustainability Disclosure Standards in the broader East African financial reporting landscape further reinforces the expectation that universities will integrate structured sustainability disclosures into institutional governance by 2028 (IPSASB, 2024, 2026; IFRS Foundation, 2023).

Despite these expectations, sustainability reporting practices within most Kenyan public universities remain rudimentary. Data relevant to sustainability indicators are dispersed across multiple administrative departments

facilities management tracks energy consumption, procurement offices maintain purchasing records, human resource departments hold employment statistics, and academic offices manage student welfare data without any integrating system capable of consolidating them into a coherent, institution-wide picture. Many universities continue to rely on manual data collection and compilation: labor-intensive, error-prone, difficult to audit, and essentially incapable of producing the real-time monitoring that modern sustainability governance requires. The gap between what mandatory reporting will demand and what current institutional systems can deliver is, in most cases, substantial.

Artificial Intelligence (AI) offers a credible and increasingly accessible pathway for addressing these systemic challenges. AI technologies encompassing machine learning, predictive analytics, natural language processing, computer vision, and automated data integration can process large and heterogeneous datasets, detect patterns invisible to manual analysis, generate real-time insights, and automate complex multi-step reporting processes (Brynjolfsson & McAfee, 2017; Rolnick et al., 2019). Within the specific context of sustainability reporting, AI-driven systems have demonstrated, in the settings studied in the literature reviewed below, the potential to streamline data collection, improve analytical depth, reduce the burden of manual compilation, and enhance the credibility and comparability of institutional disclosures; whether comparable gains would materialize in Kenyan public universities is a proposition this paper develops conceptually rather than a finding it demonstrates empirically.

This study examines how Artificial Intelligence can support sustainability reporting in Kenyan public universities as the country prepares for mandatory non-financial reporting requirements. Through a systematic desk review of relevant scholarly and policy literature, the paper identifies applicable sustainability reporting frameworks, maps ESG indicators relevant to the higher education context, analyzes AI technologies with demonstrated potential for sustainability analytics, and proposes an integrated AI-enabled sustainability reporting architecture tailored to the operational realities of Kenyan universities. In doing so, the paper aims to make a substantive contribution to the growing body of scholarship on digital governance, responsible AI, and sustainability accountability within African higher education a field that remains underdeveloped relative to its importance and its urgency.

## Sustainability Reporting in Higher Education

Sustainability reporting within higher education institutions is a governance practice both relatively recent in origin and deeply uneven in its development across institutional and regional contexts. While universities have engaged with sustainability as an academic discipline for several decades, formal institutional reporting of their own sustainability performance has emerged only over the past two decades and even then, its adoption has been scattered, often tokenistic, and driven more by external pressure than internal conviction.

## The Evolution of University Sustainability Reporting

Historically, universities contributed to sustainability primarily through the production and dissemination of knowledge. The parallel expectation that universities should model sustainability through their own operations gained traction gradually, spurred by the emergence of international charters—the Talloires Declaration (1990), the Copernicus Charter (1993), and the subsequent Kyoto Declaration—that called on institutions to demonstrate environmental commitment through institutional practice as well as academic program. Sustainability reporting, as a formalized governance activity, began to emerge as the accountability mechanism through which universities could give an organized account of their environmental and social performance to external stakeholders.

Research by Lozano (2011) provided one of the earliest systematic global assessments of sustainability reporting in universities, finding that many institutions faced structural difficulties integrating sustainability metrics into management systems and governance frameworks. The decentralized nature of university administration where faculties and departments operate with considerable autonomy made institution-wide data collection complex, inconsistent, and politically contested. Subsequent scholarship confirmed and extended these findings: Leal Filho et al. (2019) argued that universities needed to adopt structured reporting frameworks analogous to those used in corporate organizations, while Disterheft, Caeiro, Azeiteiro, and Leal

Filho (2015) identified leadership commitment and internal communication as critical enablers of effective sustainability governance in higher education. More recently, Findler, Schönherr, Lozano, Reider, and Martinuzzi (2019) demonstrated that universities that embed sustainability explicitly within their strategic planning documents are significantly more likely to develop systematic sustainability reporting practices a finding with direct implications for the institutional design of sustainability governance in Kenyan universities.

**The African and Kenyan Situation**

In Africa, sustainability reporting within universities remains comparatively limited in scope and formalization. While sustainability initiatives have proliferated energy conservation programs, tree-planting campaigns, gender equity policies, community development projects these efforts are frequently implemented in an ad hoc manner and rarely integrated into formal sustainability reporting systems that would enable accountability, benchmarking, or learning over time (Nhamo & Mjimba, 2020). The structural constraints are real: limited digital infrastructure, resource-constrained administration, high staff turnover, and the absence of regulatory mandates have historically reduced incentives for universities to invest in sustainability data systems.

Kenyan public universities reflect this regional pattern. Many institutions have developed sustainability-related policies and some have established environmental management units, yet systematic measurement and disclosure of sustainability indicators remains inconsistent and largely voluntary. Sustainability information is typically siloed within individual departments, limiting institutional-level visibility into overall performance and making it difficult for governing bodies to exercise meaningful sustainability oversight. What gets reported, and to whom, depends largely on individual initiative rather than institutional architecture.

The policy environment is shifting in ways that will make this informality increasingly untenable. Kenya's alignment with international sustainability disclosure standards, the finalization of IPSASB SRS 1 (Climate-related Disclosures) for public sector entities, and the strengthening of the national climate governance framework under the Climate Change Act (Cap. 387) collectively create a regulatory trajectory toward mandatory sustainability disclosure that public universities will be unable to avoid.

**Policy and Regulatory in Kenya**

Kenya's commitment to sustainable development is embedded within several foundational policy frameworks. Vision 2030 identifies environmental sustainability, social equity, and responsible governance as central pillars of national development (Government of Kenya, 2007). The National Climate Change Action Plan and the updated Climate Change Act reinforce institutional obligations related to environmental management, emissions monitoring, and climate risk disclosure, establishing a domestic policy architecture broadly consistent with the direction of international sustainability reporting standards.

At the regulatory level, the Capital Markets Authority of Kenya has introduced sustainability disclosure guidelines for listed companies, signaling a broader institutional movement toward mandatory non-financial reporting. The Public Sector Accounting Standards Board is expected to align its guidance for public institutions with the now-finalized IPSASB SRS 1, establishing the specific sustainability disclosure obligations that will apply to public universities. For university administrators and governance boards, the 2028 mandatory reporting timeline represents both a compliance deadline and a strategic planning horizon a fixed point around which institutional infrastructure investments must be organized. The question is no longer whether Kenyan public universities will be required to report their sustainability performance systematically, but whether they will have the systems, the data, and the governance capacity to do so credibly when that requirement arrives.

**The Problem**

The global emphasis on sustainability reporting has created substantial new expectations for organizations to disclose detailed, standardized, and independently verifiable information on their environmental, social, and governance performance. For universities, meeting these expectations is complicated by the dispersed and

heterogeneous nature of sustainability data, which originates across multiple administrative and operational systems that were typically designed for entirely different purposes. Facilities management tracks energy and water consumption using infrastructure management software; procurement offices maintain purchasing and supply chain records in financial systems; human resource departments hold employment, training, and workforce diversity data in personnel systems; and student welfare offices manage support services data in academic administration platforms. In the absence of integrated data infrastructure, aggregating these disparate streams into a coherent, institution-wide sustainability narrative is an exercise in institutional improvisation rather than systematic governance—consuming considerable administrative effort while producing outputs of uncertain quality and comparability.

In Kenyan public universities, this challenge is compounded by the fact that most administrative information systems were procured primarily to support financial management and academic administration. These systems frequently lack the data fields, reporting categories, taxonomies, and analytical functionality required to capture sustainability-related information in ways that align with international reporting frameworks. As a consequence, sustainability reporting in these institutions tends to rely on manual data collection labor-intensive, susceptible to error, impossible to audit with confidence, and incapable of providing the real-time monitoring that modern sustainability governance demands. Reports produced through such processes may fulfill a formal obligation, but they are unlikely to meet the standards of rigor, completeness, and independent verifiability that regulators, funding partners, and civil society increasingly expect.

The widening gap between what mandatory reporting will require and what current institutional systems can deliver poses a genuine governance risk. Institutions that arrive at the 2028 reporting deadline without adequate data infrastructure face not only the immediate cost of non-compliance but the longer-term reputational damage of being identified as institutions unable to account for their own sustainability performance a particularly damaging position for organizations whose academic credibility depends substantially on their authority to speak on sustainability issues.

Artificial Intelligence offers a promising and increasingly demonstrable response to these systemic limitations. AI technologies can automate data collection and integration, analyze complex and heterogeneous datasets, generate real-time sustainability insights, and produce structured reports aligned with international disclosure standards (Brynjolfsson & McAfee, 2017). Despite the rapid proliferation of AI applications across many organizational domains, the potential of AI for sustainability reporting within African universities remains substantially underexplored in academic literature—a gap that represents both a scholarly lacuna and a practical policy challenge that this study seeks to address.

### Research Objectives

This study is guided by four specific objectives

i. To examine sustainability reporting frameworks relevant to higher education institutions

ii. To identify ESG indicators applicable to public universities

iii. To analyze how Artificial Intelligence can support sustainability data collection and reporting in university contexts

iv. To propose an AI-enabled sustainability reporting architecture tailored to the institutional and operational realities of Kenyan public universities.

## LITERATURE REVIEW

### Sustainability Reporting and Institutional Accountability

The emergence of sustainability reporting as a governance instrument reflects a fundamental and still-unfolding shift in how societies understand institutional accountability. For much of the twentieth century,

organizational performance was evaluated almost exclusively through financial reporting: revenues, expenditures, assets, and liabilities provided the dominant vocabulary through which institutions accounted for themselves to their stakeholders. This narrowly economic conception of accountability was always incomplete it could not capture environmental externalities, social impacts, or governance failures that fell outside the reach of the profit-and-loss statement but it was only in the late twentieth and early twenty-first centuries, as evidence of ecological overshoot, social inequality, and high-profile corporate governance failures accumulated, that the limitations of financial reporting alone became politically and institutionally impossible to ignore.

Sustainability reporting addresses this limitation by incorporating environmental, social, and governance indicators into institutional performance assessments (Cho, Magnan, & Patten, 2012). The theoretical foundations underpinning this shift are multiple and mutually reinforcing. Freeman's (1984) stakeholder theory established the philosophical basis for a broader conception of organizational accountability one in which institutions are answerable not only to shareholders but to all parties materially affected by their activities. Suchman's (1995) legitimacy theory explains why organizations that fail to demonstrate alignment with prevailing societal norms around environmental responsibility and social impact face reputational consequences that ultimately threaten institutional survival. DiMaggio and Powell's (1983) institutional theory illuminates the mechanisms through which sustainability reporting practices spread across organizational fields: as leading institutions adopt sustainability disclosure standards and regulatory bodies mandate compliance, mimetic and normative pressures drive wider adoption, creating the self-reinforcing dynamics that have produced the current global sustainability reporting landscape.

Gray, Kouhy, and Lavers (1995) extended this theoretical foundation through their analysis of social and environmental accounting, demonstrating that voluntary sustainability disclosures are often strategically motivated used to manage stakeholder relationships and signal institutional legitimacy rather than to provide comprehensive accountability. This insight remains relevant today and carries particular weight for universities, whose sustainability reports may reflect the desire to project a sustainability-oriented identity as much as a commitment to genuine environmental and social accountability. Understanding this tension between substantive and performative reporting motivations is important for designing institutional frameworks that incentivize the former over the latter.

Eccles and Krzus (2010) made an influential early case for integrated reporting, arguing that combining financial and non-financial information within a single governance narrative provides a more accurate and strategically useful picture of organizational performance than either type of reporting can deliver in isolation. Their work helped establish the intellectual foundations for the Integrated Reporting Framework and contributed to the broader momentum toward mandatory sustainability disclosure that now characterizes the global reporting environment.

**Global Sustainability Reporting Frameworks**

Several international frameworks have been developed to guide sustainability reporting practices and promote comparability across institutions and sectors. Understanding these frameworks is essential not merely as a compliance exercise but because the frameworks embody different theoretical conceptions of what sustainability reporting is for who it serves, what it should measure, and how it should be governed.

The Global Reporting Initiative (GRI) has produced one of the most widely adopted sustainability reporting standards in the world, with more than 10,000 organizations across 100 countries reporting in accordance with GRI guidelines (Global Reporting Initiative, 2021). The GRI framework provides detailed, indicator-based guidelines for reporting environmental, social, and governance performance across a wide range of organizational types and sectors. Its modular structure, comprehensive guidance documentation, and extensive multi-stakeholder development process make it particularly accessible for institutions new to formal sustainability reporting, while its widespread adoption ensures that GRI-aligned reports are recognized and understood by regulators, investors, and civil society organizations globally.

The International Sustainability Standards Board (ISSB), established in 2021 under the IFRS Foundation, has introduced two foundational standards: IFRS S1, which establishes general requirements for the disclosure of sustainability-related financial information, and IFRS S2, which addresses climate-related disclosures specifically (IFRS Foundation, 2023). These standards aim to harmonize the fragmented global landscape of sustainability reporting and improve comparability across organizations and jurisdictions, drawing substantially on the Task Force on Climate-related Financial Disclosures (TCFD) framework in their design. Their adoption is gaining momentum in multiple jurisdictions, like emerging economies in Sub-Saharan Africa, as regulatory bodies recognize that sustainability risks are also financial risks requiring systematic disclosure.

Of particular and direct relevance to this study is the IPSASB Sustainability Reporting Standard on Climate-related Disclosures (IPSASB SRS 1), developed specifically for public sector entities and therefore the most directly applicable framework for Kenyan public universities, at least for the climate-related dimension of sustainability disclosure it currently covers (IPSASB, 2024, 2026). Unlike the GRI and ISSB frameworks, which were developed primarily with private sector organizations in mind, SRS 1 is tailored to the accountability obligations, governance structures, and reporting contexts of public institutions, although its present scope is limited to climate-related disclosures rather than the full ESG spectrum, with IPSASB signaling further sustainability reporting standards to follow. It addresses the specific challenges that public sector entities face in sustainability reporting like the diversity of stakeholder relationships, the absence of commercial profit motivations, and the public interest dimensions of institutional decision-making making it the normatively and practically appropriate starting point for universities preparing for mandatory disclosure.

The Sustainability Accounting Standards Board (SASB) provides industry-specific sustainability metrics, some of which retain material relevance for universities particularly those addressing energy management, water and wastewater management, employee diversity and inclusion, and governance and oversight. The Integrated Reporting Framework, developed by the International Integrated Reporting Council and now administered by the IFRS Foundation, offers a complementary governance architecture that situates sustainability performance within a broader narrative of institutional value creation, connecting financial and non-financial reporting in ways that align naturally with the accountability obligations of public sector institutions.

**Sustainability Reporting in Higher Education**

Universities occupy a distinctive and theoretically interesting position within the sustainability reporting landscape. As institutions simultaneously producing knowledge about sustainability, preparing the future workforce to address sustainability challenges, and managing large operational systems with significant environmental and social impacts, they face accountability demands that are both broader in scope and more complex in character than those facing most other organizational types (Cortese, 2003; Wals, 2014).

Empirical research on sustainability reporting in higher education has grown substantially over the past fifteen years, though it remains geographically skewed toward institutions in the Global North. Lozano (2011) conducted an early and influential systematic assessment of sustainability reporting practices in universities globally, documenting the structural difficulties that most institutions faced in integrating sustainability metrics into management systems and governance frameworks. He identified the decentralized nature of university governance where departments and faculties maintain considerable administrative autonomy as a particularly significant obstacle, noting that this structural feature creates both data collection challenges and political resistance to the kind of cross-departmental data sharing that meaningful sustainability reporting requires.

Disterheft et al. (2015) extended this analysis by examining the role of participatory processes in sustainability governance, finding that institutions that involved a broad range of internal stakeholders in sustainability planning were more likely to develop systematic and credible sustainability reporting practices. Findler et al. (2019) made a significant empirical contribution by demonstrating, through analysis of a large sample of European universities, that explicit integration of sustainability objectives within strategic planning documents is a strong predictor of the development of systematic sustainability reporting infrastructure suggesting that

sustainability reporting capacity is best developed as a product of strategic institutional commitment rather than as a response to ad hoc external pressure. Leal Filho et al. (2019) further argued that universities require structured sustainability reporting frameworks analogous to those used in corporate organizations to achieve meaningful and auditable accountability.

In the African context, Nhamo and Mjimba (2020) documented the limited but growing engagement of African universities with sustainability governance, noting that structural constraints like limited funding, inadequate digital infrastructure, and the absence of regulatory mandates have historically reduced incentives for systematic sustainability reporting. Munasinghe (2010) observed that sustainability governance in developing country institutions tends to be reactive rather than proactive, driven by donor requirements and external reporting obligations rather than internal institutional commitment. These observations resonate with the Kenyan context and underscore the importance of creating regulatory environments and institutional incentives that shift the basis for sustainability reporting from compliance to genuine governance.

**ESG Indicators Applicable to Universities**

Understanding which ESG indicators are most relevant and most practically measurable in a university context is foundational to designing an effective sustainability reporting system. The following synthesis draws on reporting frameworks, empirical studies of university sustainability practice, and higher education governance literature to map the most significant indicators across environmental, social, and governance dimensions.

**Environmental Indicators**

Environmental indicators measure the impact of institutional operations on the natural environment, and for large campus-based organizations like universities, these impacts are both substantial and, increasingly, well-characterized in the literature. Energy consumption encompassing electricity, heating, cooling, and institutional vehicle fleets represents one of the most significant and measurable environmental impacts of university operations, and it has received extensive scholarly attention (Lozano, 2011; Kylili, Fokaides, & Christoforou, 2016). Kylili et al. (2016) demonstrated that energy benchmarking across campus buildings, enabled by digital monitoring infrastructure, could identify energy efficiency improvement opportunities equivalent to 20–30 percent reductions in institutional carbon footprints a finding directly relevant to Kenyan universities navigating both sustainability obligations and energy cost pressures.

Water usage within university buildings and grounds is particularly significant in the East African context, where water scarcity is an increasing and politically sensitive governance concern (UNEP, 2016). Monitoring water consumption patterns across campus facilities provides the foundation for conservation initiatives and for the kind of resource stewardship accounting that IPSASB SRS 1 now requires of public institutions. Solid waste generation and recycling rates, carbon emissions from institutional transport and built infrastructure, the extent of renewable energy adoption, and green procurement practices like the environmental credentials of institutional suppliers complete the core environmental indicator set for universities. Together, these indicators provide a quantified picture of the institution's resource metabolism that financial accounts cannot capture and that manual reporting processes cannot produce with the consistency and frequency that meaningful governance requires (GRI, 2021).

**Social Indicators**

Social indicators evaluate the institution's impact on employees, students, and the surrounding community the human dimensions of sustainability performance that are, in many respects, the dimension most central to a university's core institutional purpose. Gender equality in academic staffing and institutional leadership remains a particularly significant social indicator for Kenyan universities: UNESCO (2019) documented persistent and substantial gender gaps in senior academic and administrative leadership across sub-Saharan Africa, with women occupying fewer than 30 percent of full professorial positions in most national university systems. Progress on this indicator is not merely a sustainability obligation but a dimension of institutional quality with direct implications for research productivity, student mentorship, and organizational culture.

Student welfare programs encompassing mental health support, financial assistance, disability accommodation, and the adequacy of campus safety infrastructure reflect the institution's commitment to the well-being of its primary service population. The importance of student welfare as a sustainability indicator has been underscored by growing evidence of mental health challenges among university student populations globally, like in Kenya, where a study by Ndetei et al. (2016) identified significant rates of depression and anxiety among university students. Staff training and professional development opportunities, community outreach and engagement activities, and policies promoting inclusive and equitable access to education complete the core social indicator picture. Higher-order social impact metrics such as the proportion of graduates employed in sustainability-related fields, or the economic multiplier effects of university activity on surrounding communities represent an emerging but as yet insufficiently standardized dimension of university social reporting (Wals, 2014).

**Governance Indicators**

Governance indicators address institutional leadership, accountability structures, and the integrity of decision-making processes the foundational conditions that determine whether sustainability commitments are translated into outcomes or remain aspirational. For public universities, which are publicly funded and governed under legislative frameworks, governance accountability is not merely a sustainability aspiration but a constitutional and legal obligation.

Procurement transparency is a particularly significant governance indicator for Kenyan public institutions. The Ethics and Anti-Corruption Commission (EACC, 2019) has consistently identified procurement irregularities as one of the most significant integrity risks in Kenyan public institutions, and university procurement processes which involve substantial discretionary authority over large public resource flows are among the areas most exposed to this risk. AI-enabled procurement analytics, which can flag anomalous procurement patterns and monitor compliance with sustainability procurement policies, therefore serve dual governance functions: enhancing sustainability accountability and strengthening anti-corruption controls simultaneously. Anti-corruption mechanisms, ethical leadership and conflict-of-interest policies, institutional governance frameworks and stakeholder participation processes, and adherence to public sector accountability standards round out the governance indicator set most relevant to Kenyan public universities. The inclusion of governance indicators in sustainability reporting reflects a broader recognition in the literature that environmental and social sustainability outcomes are themselves products of governance quality: institutions with transparent, participatory, and accountable governance structures are more likely to make decisions that promote sustainability across all dimensions of institutional life (Freeman, 1984; Suchman, 1995).

**Artificial Intelligence and Sustainability Monitoring**

Artificial Intelligence refers to computational systems capable of performing tasks that typically require human cognitive capabilities: learning from data, recognizing complex patterns, generating predictions, making sequential decisions under uncertainty, and producing coherent natural language outputs (Agrawal, Gans, & Goldfarb, 2018). Over the past decade, AI technologies have moved from research environments into mainstream organizational deployment with a speed and breadth that has few historical parallels, transforming fields as diverse as medical diagnosis, financial risk management, supply chain optimization, and environmental monitoring. The relevance of AI to sustainability governance is correspondingly broad.

For sustainability monitoring specifically, AI technologies address capabilities that are directly responsive to the core data management challenges that universities face. Machine learning algorithms can analyze historical records of energy consumption, water usage, and waste generation to identify seasonal patterns, detect anomalies that may indicate equipment malfunction or behavioral changes, quantify the relationship between campus activity levels and resource consumption, and generate rolling consumption forecasts that support proactive resource planning (Rolnick et al., 2019; Deb, Zhang, Yang, Lee, & Shah, 2017). Deb et al. (2017) demonstrated, in a study of energy consumption forecasting for institutional buildings, that machine learning models consistently outperformed conventional statistical methods in prediction accuracy a finding with practical significance for universities seeking to establish credible energy consumption baselines for sustainibi-

lity reporting.

Predictive analytics models extend this analytical capacity to the future, enabling institutions to simulate the likely sustainability impacts of proposed policy or infrastructure interventions before committing to their implementation. This forward-looking analytical capability is particularly valuable for university strategic planning, where decisions about capital investment new building construction, renewable energy installations, fleet electrification have sustainability implications that play out over decades and that are poorly captured by retrospective reporting alone. Zeng, Chen, and Zhang (2021) demonstrated the effectiveness of predictive analytics in modeling carbon reduction trajectories for institutional campuses, providing a methodological template directly applicable to university sustainability planning in Kenya.

Natural language processing (NLP) techniques address a different but equally important dimension of the sustainability data challenge: the extraction of relevant ESG information from the unstructured textual sources procurement descriptions, policy documents, committee minutes, tender notices, and institutional reports that contain much of the governance indicator data relevant to sustainability reporting. Tsai and Wang (2017) demonstrated that NLP-based information extraction systems could identify and categorize sustainability-relevant content from large corporate document archives with accuracy comparable to expert human annotators, while requiring only a fraction of the time. For universities, where governance indicator data is frequently embedded in administrative text records rather than structured databases, NLP offers a pathway to systematic governance reporting that manual processes cannot replicate.

Automated data integration tools—like application programming interfaces, extract-transform-load pipelines, and cloud-based data orchestration platforms—provide the technical infrastructure that makes it possible to consolidate sustainability data from multiple institutional systems into a unified, analytically accessible repository (Brynjolfsson & McAfee, 2017). Without this integration capability, AI analytics cannot function effectively: machine learning models trained on incomplete or inconsistent datasets produce unreliable outputs, and the governance value of the entire system depends ultimately on the quality of the underlying data foundation.

It is equally important, however, to acknowledge that AI is not a neutral or risk-free technology. The deployment of AI systems in institutional governance raises substantive questions about algorithmic accountability whether AI-generated sustainability reports can be independently audited and verified data privacy in the handling of sensitive institutional and personal data, and the concentration of analytical capacity in systems that may be opaque to the people responsible for institutional governance. Jobin, Ienca, and Vayena (2019), in their comprehensive survey of AI ethics guidelines across fifty-one countries and international organizations, identified transparency, accountability, fairness, and human oversight as the most widely shared principles for responsible AI deployment. For public universities deploying AI in sustainability governance, these principles must inform not only the technical design of AI systems but the governance frameworks within which those systems operate establishing clear lines of human accountability for AI-generated outputs, mechanisms for error detection and correction, and protections against the misuse of sustainability data for purposes other than those for which it was collected.

## METHODOLOGY: A SYSTEMATIC DESK REVIEW GUIDED BY PRISMA

### Philosophical and Epistemological Orientation

This study adopts a systematic desk review methodology guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The methodological choice is not arbitrary: it reflects both the epistemological orientation of the study and the practical constraints imposed by the current state of the research field. Sustainability reporting within Kenyan public universities is a governance domain in early and uneven development. Institutional practices are nascent, standardized primary empirical data are scarce, and the phenomena of interest the intersection of AI capabilities, sustainability reporting requirements, and African higher education governance are sufficiently novel that conceptual framework development is a

more productive scholarly contribution at this stage than premature empirical testing of hypotheses that have not yet been theorized.

The epistemological orientation of this study is broadly interpretivist. It is concerned not primarily with measuring a phenomenon at a single moment in time but with understanding how different bodies of knowledge sustainability accounting scholarship, AI research, African higher education governance studies, and international policy frameworks can be integrated into a coherent conceptual architecture for thinking about a problem that spans all of them. This orientation does not imply methodological permissiveness; on the contrary, it demands a particularly rigorous and transparent approach to literature selection and analysis precisely because the study's conclusions rest not on statistical inference from observed data but on the synthesis and interpretation of existing scholarly and policy knowledge. The PRISMA framework, originally developed for systematic reviews in health sciences and subsequently adapted for use across a wide range of disciplines (Moher, Liberati, Tetzlaff, & Altman, 2009), provides the structured transparency that this epistemological approach requires.

The study is positioned within the tradition of critical-constructive scholarship in sustainability governance: it takes seriously the structural constraints that limit institutional sustainability practice in lower-income country contexts, while refusing the fatalism that can accompany deficit-oriented analyses of institutional capacity in the Global South. The proposed AI architecture and conceptual framework are intended as practical contributions to an achievable governance improvement agenda, grounded in existing technological capabilities and adapted to the institutional realities of Kenyan public universities rather than imported wholesale from high-resource settings where the enabling conditions are very different.

**Positionality Statement**

Reflexivity about researcher positionality is an important dimension of interpretive research methodology, particularly in studies that draw on literature from multiple disciplinary traditions and that make normative arguments about institutional reform (Braun & Clarke, 2006; Creswell & Poth, 2018). The authors of this study bring perspectives shaped by academic and professional experience in higher education governance, sustainability management, and digital technology policy in the East African context. This positional grounding provides contextual knowledge that enriches the analysis particularly in interpreting the policy environment and institutional realities of Kenyan public universities but it also creates the potential for interpretive bias toward solutions that are consistent with existing governance reform agendas in the region. We have sought to mitigate this bias through the systematic and transparent literature screening process described below, which imposes procedural constraints on the selection of evidence, and through explicit acknowledgment of alternative interpretations and counterarguments in the discussion section. The normative argument of this paper that AI-enabled sustainability reporting systems represent a valuable and achievable governance investment for Kenyan public universities is based on the evidence synthesized through the review process, but readers should be aware that this argument is made from a position of general support for digital governance reform in African higher education, and should evaluate it accordingly.

**Rationale for a Systematic Desk Review**

The decision to conduct a systematic desk review rather than a primary empirical study was driven by several substantive considerations that go beyond the practical constraints of data availability. Tranfield, Denyer, and Smart (2003) make a compelling case for systematic reviews as a methodology for developing evidence-informed management knowledge, arguing that the systematic review approach when properly conducted can generate conceptual contributions of comparable rigor and practical relevance to those produced by primary empirical studies, while synthesizing a breadth of disciplinary knowledge that no individual primary study can encompass.

In the context of this study, a systematic desk review is the appropriate methodology for three substantive reasons. First, the 2028 mandatory reporting deadline means that the institutional sustainability reporting systems that will ultimately need to be studied empirically do not yet exist in developed form in most Kenyan

public universities. Conducting surveys or interviews about systems that institutions have not yet built would produce data of uncertain validity and limited analytical purchase. Second, the research question is inherently interdisciplinary, spanning sustainability accounting, AI research, higher education management, and African governance studies in ways that require synthesis across bodies of literature that rarely communicate with one another. No single primary study, however well designed, could adequately bridge these disciplines. Third, the conceptual contribution of the study—an AI-enabled sustainability reporting architecture tailored to the Kenyan higher education context—is precisely the kind of output that a systematic desk review is best positioned to generate: a structured synthesis of existing knowledge, organized into a framework that can guide subsequent empirical testing and practical implementation.

**Literature Search Strategy**

The literature search was conducted across multiple academic databases selected for their complementary disciplinary coverage and geographic scope. Google Scholar provided broad, interdisciplinary coverage and access to grey literature like institutional reports, policy documents, and working papers not captured in subscription databases. Scopus and Web of Science provided rigorous peer-reviewed coverage with strong representation of natural science, information systems, and accounting scholarship, and enabled citation analysis to identify highly influential works in each of the study's thematic areas. JSTOR provided access to longer-established social science and humanities literature, particularly relevant for the theoretical foundations sections of the review. The search covered publications, standards, and policy documents published between January 2000 and August 2026, capturing the period during which formal international sustainability reporting frameworks emerged and matured; foundational theoretical works predating this window (e.g., Freeman, 1984; DiMaggio & Powell, 1983) were retained where they underpin the study's conceptual framework rather than its empirical evidence base.

The search extended to publications and technical documents produced by key international organizations directly engaged in sustainability reporting standard-setting and governance: the Global Reporting Initiative, the International Sustainability Standards Board, the International Public Sector Accounting Standards Board, the United Nations Environment Programme, the United Nations Educational, Scientific and Cultural Organization, the World Bank, and relevant Kenyan regulatory bodies like the Public Sector Accounting Standards Board, the National Environment Management Authority, and the Capital Markets Authority of Kenya. These institutional sources were essential for capturing the regulatory and policy dimensions of sustainability reporting that academic literature, with its typical publication lag and disciplinary focus, does not fully address in real time.

The search strategy employed four sets of carefully constructed keyword combinations, each designed to capture literature relevant to a distinct dimension of the research question, linked through Boolean AND and OR operators to maximize systematic coverage. The first set addressed sustainability reporting foundations: sustainability reporting, ESG disclosure, non-financial reporting, integrated reporting, sustainability accounting, and corporate social responsibility disclosure. The second set was specifically oriented toward higher education: sustainability reporting in universities, ESG higher education, campus sustainability governance, university sustainability management, higher education sustainability, and campus environmental reporting. The third set addressed AI and digital technology applications: artificial intelligence sustainability, machine learning environmental monitoring, predictive analytics sustainability, natural language processing governance, AI governance, and digital sustainability analytics. The fourth set situated the inquiry geographically and developmentally: sustainability reporting Africa, sustainability reporting Kenya, sustainability reporting developing countries, non-financial disclosure public sector Africa, and sustainability governance Sub-Saharan Africa. These keyword combinations were systematically iterated across all searched databases, and citation tracing from highly relevant publications was used to identify additional sources not captured by keyword searches.

**Inclusion and Exclusion Criteria**

The inclusion criteria for this study were defined prospectively before the screening process began and applied

consistently throughout. This prospective definition is a methodological requirement of systematic review methodology: post-hoc adjustment of inclusion criteria in response to the content of retrieved literature introduces selection bias that undermines the transparency and replicability of the review (Moher et al., 2009). Studies were included if they substantively addressed at least one of four thematic domains: sustainability reporting frameworks or ESG disclosure standards applicable to organizational or institutional contexts; sustainability governance practices within higher education institutions; AI or other advanced digital technology applications in sustainability monitoring, analytics, environmental governance, or institutional data management; or policy and regulatory frameworks relevant to sustainability reporting in developing countries or the African context, like Kenya specifically.

Studies were excluded on five grounds: exclusive focus on financial reporting without any sustainability or ESG dimension, reflecting an absence of relevance to the study's subject matter; absence of substantive engagement with organizational sustainability governance or practice, excluding theoretical or philosophical work that did not connect to practical governance implications; lack of peer review or credible institutional authorship, applied to exclude sources of uncertain methodological quality and evidentiary standing; publication before the year 2000, reflecting the judgment that the field of formal international sustainability reporting frameworks did not exist in its current institutional form prior to the early 2000s and that earlier literature would not adequately reflect the governance environment this study addresses; and geographic restriction to contexts so different from the Kenyan higher education system such as highly digitized, well-resourced institutional environments with mature sustainability reporting cultures that their findings could not reasonably be expected to translate to the study context.

**The PRISMA Four-Stage Screening Process**

The literature screening process followed the four sequential stages established by the PRISMA framework identification, screening, eligibility assessment, and inclusion applied in a structured and documented manner designed to ensure that the final literature corpus is both comprehensive and methodologically defensible.

In the identification stage, systematic database searches using the keyword combinations described above returned approximately sixty-five publications as potentially relevant to the study's research questions. This initial number reflects the inherently broad character of keyword-based database searches, which prioritize recall capturing all potentially relevant items over precision at this early stage. The identification stage also incorporated forward and backward citation tracing from a set of six anchor publications identified a priori as particularly central to the study's thematic focus: Lozano (2011) on university sustainability reporting, Leal Filho et al. (2019) on higher education sustainability, Rolnick et al. (2019) on AI and climate change, the GRI Universal Standards (2021), the IPSASB SRS ED 1 exposure draft (IPSASB, 2024), and Tranfield et al. (2003) on systematic review methodology. Citation tracing from these anchor publications identified an additional seven publications not returned by keyword searches, bringing the initial corpus to seventy-two items before deduplication.

Before screening began, the seventy-two records identified in the previous stage were checked for duplication using reference-management software (Zotero) supplemented by manual review; three duplicate records were removed, leaving sixty-nine unique records for title-and-abstract screening. The screening stage then involved a systematic review of titles and abstracts for all sixty-nine unique publications. Two reviewers independently assessed each publication against the inclusion and exclusion criteria on the basis of title and abstract information alone, with disagreements resolved through discussion and reference to the prospectively defined criteria. Publications were excluded at this stage if their titles and abstracts clearly indicated irrelevance to the study's thematic scope. Fourteen publications were excluded at this stage for clear thematic irrelevance, reducing the corpus to fifty-five publications.

The eligibility assessment stage involved a full-text review of all fifty-five remaining publications. This more detailed examination allowed for a precise and well-grounded application of the inclusion and exclusion criteria to publication content rather than abstract descriptions. Twenty-three publications were excluded at this stage: twelve because full-text review revealed that their relevance to the study's thematic domains had been

overstated by their abstracts, seven because they did not meet the methodological quality threshold operationalized through the quality-appraisal criteria described below (see Quality Appraisal), and four because their contextual specificity to institutional environments incomparable to Kenyan public universities limited their analytical transferability. This left a final corpus of thirty-two publications for detailed thematic analysis—a corpus size consistent with the norms of systematic literature reviews in management and governance research (Tranfield et al., 2003).

The inclusion stage involved the organization and thematic mapping of the thirty-two retained publications. Each publication was assigned to one or more thematic categories based on its primary analytical contribution, using a coding scheme developed inductively through iterative reading of the corpus. This thematic categorization informed both the structure of the literature review and the organization of the results section.

**Quality Appraisal**

To operationalize the methodological quality threshold applied at the eligibility stage, each publication surviving title-and-abstract screening was appraised against five criteria adapted from the mixed-methods quality assessment tool developed by Kmet, Lee, and Cook (2004): clarity of the research aim or purpose; appropriateness of the methodology or evidentiary basis to that aim; transparency of the data, evidence, or reasoning presented; relevance and specificity to the study's higher-education, AI, sustainability-reporting, or Kenyan/African thematic scope; and the credibility of the source and its authorship (Table M1). Two reviewers independently scored each criterion 0 (not met), 1 (partially met), or 2 (fully met), for a maximum possible score of 10; disagreements exceeding one point were resolved through discussion. Publications scoring below 6 out of 10, or scoring 0 on the relevance and specificity criterion, were treated as not meeting the quality threshold. This appraisal accounts for seven of the twenty-three exclusions at the eligibility stage reported above.

| Criterion | Guiding Question | Score Range |
|---|---|---|
| Clarity of aim | Is the purpose of the study, report, or standard clearly stated? | 0-2 |
| Methodological/evidentiary appropriateness | Is the method (empirical, conceptual, or policy) suited to the stated aim? | 0-2 |
| Transparency of evidence | Are data sources, evidence, or reasoning clearly described and traceable? | 0-2 |
| Relevance and specificity | Does the work substantively engage with higher education, sustainability reporting, AI, or the Kenyan/African context? | 0-2 |
| Credibility of source | Is the work peer-reviewed, or produced by a recognized institution or standard-setting body? | 0-2 |

*Table M1: Quality Appraisal Criteria (adapted from Kmet, Lee, & Cook, 2004)*

**PRISMA Flow Diagram**

Figure M1 summarizes the flow of records through the identification, screening, eligibility, and inclusion stages described above, following PRISMA reporting conventions (Moher et al., 2009).

| Stage | n |
|---|---|
| Identification - records via database searching (Google Scholar, Scopus, Web of Science, JSTOR, institutional/policy sources) | 65 |
| Identification - additional records via citation tracing from anchor publications | 7 |
| Identification - total records identified | 72 |
| Duplicates removed | 3 |

| | |
|---|---|
| Records screened (title/abstract) | 69 |
| Records excluded at screening (thematic irrelevance) | 14 |
| Full-text articles assessed for eligibility | 55 |
| Full-text articles excluded: overstated relevance (12); quality-appraisal threshold not met (7); limited contextual transferability (4) | 23 |
| Studies included in thematic synthesis | 32 |

*Figure M1: PRISMA-style flow diagram of the identification, screening, eligibility, and inclusion stages*

**Thematic Content Analysis**

The thirty-two publications in the final literature corpus were analyzed using thematic content analysis, a well-established qualitative methodology for identifying recurring concepts, interpretive patterns, and analytical themes across a body of literature (Braun & Clarke, 2006). The application of thematic content analysis to systematic literature reviews has been endorsed by multiple methodological authorities as a rigorous approach for generating conceptual contributions from synthesized literature (Tranfield et al., 2003; Nowell, Norris, White, & Moules, 2017).

The analysis proceeded through six phases, following the process described by Braun and Clarke (2006). In the familiarization phase, the researchers read each of the thirty-two publications in its entirety, making detailed notes on key arguments, empirical findings, theoretical frameworks, and conceptual contributions. In the initial coding phase, passages, claims, and arguments across the corpus were coded using a developing scheme of descriptive labels. Codes were assigned inductively—emerging from the content of the literature rather than from a predetermined theoretical framework—to ensure that the resulting themes reflected the actual content and character of the reviewed scholarship rather than the researchers' prior expectations. In the theme search phase, codes were organized into candidate themes by identifying patterns of conceptual similarity and relational connection across the coding scheme. In the theme review phase, candidate themes were refined and consolidated through iterative reading of the coded material, ensuring that each theme was internally coherent, clearly distinguishable from other themes, and sufficiently grounded in the literature to support substantive analytical claims. In the theme definition phase, each theme was named, defined, and characterized through a summary of the key claims and evidence it encompassed. In the write-up phase, the themes were developed into the structured literature synthesis and results analysis presented in Sections 5 and 7 of this paper.

Three major themes emerged from the analysis: sustainability reporting frameworks and governance structures; ESG indicators applicable to higher education institutions; and AI technologies with potential application in sustainability monitoring and reporting. These themes are directly reflected in the organization of the literature review (Section 5), the results tables and interpretive commentary (Section 7), and the proposed architecture (Section 8). The thematic analysis process was reflexive throughout: as themes were refined, earlier coding decisions were revisited to ensure consistency, and the researchers actively sought disconfirming evidence and alternative interpretations to guard against the confirmation bias that can affect qualitative synthesis.

**Overview of the Reviewed Literature and Policy Documents**

Table M2 lists representative works from the retained corpus, organized by the four thematic categories used throughout this review, together with the type of source and its principal contribution to the analysis. The table is illustrative rather than exhaustive: the complete set of works consulted, including additional sources supporting the theoretical framework and methodology, appears in the reference list.

| Author(s) & Year | Type | Thematic Category | Contribution to This Review |
|---|---|---|---|
| Eccles & Krzus (2010) | Conceptual/book | Reporting frameworks & governance | Foundational case for integrated non-financial reporting |

| | | | |
|---|---|---|---|
| Gray, Kouhy, & Lavers (1995) | Empirical/theoretical | Reporting frameworks & governance | Longitudinal analysis of corporate social/environmental disclosure |
| Global Reporting Initiative (2021) | Standard-setting document | Reporting frameworks & governance | GRI Universal Standards indicator structure |
| IPSASB (2024, 2026) | Standard-setting document | Reporting frameworks & governance | Public-sector climate-related disclosure standard (SRS 1) |
| IFRS Foundation (2023) | Standard-setting document | Reporting frameworks & governance | IFRS S1 general sustainability disclosure requirements |
| Government of Kenya (2007) | Policy document | Reporting frameworks & governance | Vision 2030 national development priorities |
| Cortese (2003) | Conceptual | ESG indicators in higher education | Role of higher education in sustainable development |
| Lozano (2011) | Empirical | ESG indicators in higher education | State of sustainability reporting in universities |
| Leal Filho et al. (2019) | Empirical | ESG indicators in higher education | HEI contributions to local sustainability initiatives |
| Disterheft et al. (2015) | Empirical | ESG indicators in higher education | Success factors for participatory sustainability approaches |
| Findler et al. (2019) | Empirical | ESG indicators in higher education | Impacts of HEIs on sustainable development |
| UNESCO (2019) | Policy/statistical report | ESG indicators in higher education | Gender equity data in higher education |
| Rolnick et al. (2019) | Empirical/technical | AI applications in sustainability monitoring | Survey of machine learning for climate action |
| Deb et al. (2017) | Empirical/technical | AI applications in sustainability monitoring | Time-series forecasting for building energy consumption |
| Zeng, Chen, & Zhang (2021) | Empirical/technical | AI applications in sustainability monitoring | Predictive analytics for carbon-reduction pathways |
| Tsai & Wang (2017) | Empirical/technical | AI applications in sustainability monitoring | NLP methods for ESG scoring |
| Jobin, Ienca, & Vayena (2019) | Empirical/review | AI applications in sustainability monitoring | Critical landscape of AI ethics guidelines |
| Kylili, Fokaides, & Christoforou (2016) | Empirical/review | AI applications in sustainability monitoring | KPI approaches in building sustainability |
| Ethics and Anti-Corruption Commission (2019) | Policy/survey report | Kenya/Africa policy & digital governance | Governance-integrity risks in Kenyan public institutions |
| Munasinghe (2010) | Conceptual | Kenya/Africa policy & digital governance | Sustainomics framework for development practice |
| Nhamo & Mjimba (2020) | Edited volume | Kenya/Africa policy & digital governance | SDGs and higher education institutions in Africa |

*Table M2: Representative Overview of the Reviewed Literature and Policy Documents by Thematic Category*

### Methodological Limitations

A systematic desk review, however rigorously conducted, is subject to limitations that must be acknowledged if its conclusions are to be appropriately contextualized. The most significant limitation of this study is its reliance on published and grey literature, which introduces the well-documented publication bias problem: studies with positive or confirmatory findings are more likely to be published than those with null or negative results, meaning that the literature corpus may overrepresent evidence in favor of AI's potential for sustainability monitoring while underrepresenting evidence of implementation failures, unintended consequences, or contexts in which AI deployment has not delivered expected benefits. We have sought to mitigate this bias by explicitly searching for critical and skeptical perspectives on AI in governance contexts like Jobin et al.'s (2019) analysis of AI ethics challenges and by acknowledging implementation limitations explicitly in the discussion section.

A second limitation is that the literature on AI for sustainability reporting in African higher education specifically is sparse, requiring the study to draw substantially on evidence from other organizational contexts and geographic settings and to reason about the applicability of that evidence to the Kenyan university context. This inferential step from other contexts to the study context is necessary but imperfect: the enabling conditions for AI deployment in well-resourced European or North American university systems are meaningfully different from those obtaining in most Kenyan public universities, and conclusions drawn from one context may not translate straightforwardly to the other. We have sought to address this limitation by grounding the proposed architecture explicitly in the institutional realities identified in the Kenya-specific and Africa-specific literature, and by advocating a phased implementation approach that begins with the least technically demanding components of the architecture.

A third limitation is the temporal boundedness of the literature corpus: as a field that is developing rapidly in both its AI and sustainability reporting dimensions, some findings reviewed in this study may be superseded by subsequent developments within a relatively short period. This limitation is inherent to all review-based research and underscores the importance of treating the proposed architecture as a framework to be updated and refined as both AI capabilities and regulatory requirements evolve, rather than as a fixed prescription for institutional design.

A fourth and critical limitation concerns the proposed AI-enabled sustainability reporting architecture itself: it is a conceptual synthesis derived from the reviewed literature, not a system that has been implemented, piloted, or empirically evaluated in a Kenyan public university or comparable public-sector context. Claims made elsewhere in this paper about the architecture's potential to improve reporting accuracy, efficiency, or credibility are therefore framed as plausible, literature-grounded propositions rather than demonstrated outcomes, and should be treated as hypotheses for future empirical and pilot testing rather than as established findings.

## RESULTS

This section presents the findings of the systematic desk review, organized around the four thematic areas identified through the PRISMA screening and thematic content analysis. Results are presented in tabular form to facilitate synthesis and comparative analysis, followed by interpretive commentary grounded in the reviewed literature.

### Distribution of Literature by Thematic Focus

Table 1 presents the thematic distribution of the 32 studies retained in the final review corpus.

*Table 1: Distribution of Reviewed Studies by Thematic Area*

| Thematic Area | Studies (n) | Share (%) |
|---|---|---|
| Sustainability reporting frameworks and governance | 10 | 31 |

| | | |
|---|---|---|
| ESG indicators in higher education | 9 | 28 |
| AI applications in sustainability monitoring | 8 | 25 |
| Digital governance and sustainability reporting | 5 | 16 |
| Total | 32 | 100 |

The distribution of literature reveals that sustainability reporting frameworks represent the most extensively studied theme within the corpus, accounting for 31 percent of reviewed studies. Studies on ESG indicators in higher education constitute 28 percent of the corpus. AI applications in sustainability monitoring account for 25 percent substantial, but signal an emerging rather than mature field, particularly at the intersection of AI and African higher education governance. Digital governance studies account for the remaining 16 percent, underscoring the relevance of broader digital transformation processes to sustainability accountability.

**Sustainability Reporting Frameworks**

Table 2 summarizes the major sustainability reporting frameworks identified and assessed in the reviewed literature.

*Table 2: Major Sustainability Reporting Frameworks Identified in the Literature*

| Framework | Primary Focus | Applicability to Universities |
|---|---|---|
| GRI Standards | Comprehensive ESG performance reporting | Widely applicable; most commonly referenced in HEI literature |
| IPSASB SRS 1 | Public sector climate-related disclosures | Most directly applicable for Kenyan public universities on climate indicators; narrower scope than GRI |
| IFRS S1 / S2 (ISSB) | Sustainability-related financial disclosures | Increasing relevance as East African regulators align with ISSB |
| SASB Standards | Industry-specific sustainability metrics | Selective indicators relevant to energy, workforce, governance |
| Integrated Reporting Framework | Combined financial and non-financial governance | Applicable for embedding sustainability in institutional narratives |

The GRI Standards emerge as the most widely referenced framework for universities, valued for their comprehensive indicator structure and institutional adaptability. IPSASB SRS 1 (Climate-related Disclosures) represents the most directly applicable and legally significant framework for Kenyan public universities on its covered climate-related indicators, given its design for public sector entities and alignment with public sector accounting obligations; it does not yet, however, cover the full range of social and governance indicators that GRI addresses. An integrated approach drawing on GRI indicator depth while complying with IPSASB SRS 1's governance structure for climate-related disclosures is both technically feasible and institutionally appropriate, and represents the framework combination most likely to satisfy both regulatory requirements and stakeholder expectations.

**ESG Indicators for Universities**

Table 3 maps the ESG indicators most relevant to public universities, synthesized from reporting frameworks and empirical studies in the reviewed literature.

*Table 3: Key ESG Indicators for Public Universities*

| ESG Category | Key Indicators |
|---|---|
| Environmental | Energy consumption (electricity, heating, cooling, transport); water usage and intensity; solid waste and recycling rates; GHG emissions (Scopes 1, 2, and 3); renewable energy adoption; green procurement practices; biodiversity impacts of campus development |
| Social | Gender equity in staffing and academic leadership; student welfare and mental health programs; staff training and professional development; community outreach and impact; inclusive education policies; disability accommodation; graduate employment outcomes |
| Governance | Procurement transparency and integrity; anti-corruption mechanisms; ethical leadership and conflict of interest policies; stakeholder participation in governance; institutional accountability frameworks; compliance with public sector standards; board diversity and composition |

Environmental indicators are the most extensively measured within existing university sustainability reporting systems, in part because energy and water consumption can be quantified through metering infrastructure without requiring complex social assessments (Lozano, 2011; Kylili et al., 2016). The inclusion of Scope 3 greenhouse gas emissions indirect emissions from supply chains, student and staff commuting, and academic travel represents an important frontier for university environmental reporting that most institutions have not yet systematically addressed (GRI, 2021). Social indicators are central to universities' core institutional purpose and are increasingly subject to regulatory and stakeholder scrutiny, yet measurement remains less systematic and more contested than for environmental metrics (UNESCO, 2019; Wals, 2014). Governance indicators are critical for Kenyan public universities navigating the intersection of sustainability accountability and public sector integrity obligations (EACC, 2019; Freeman, 1984).

**AI Technologies for Sustainability Reporting**

Table 4 identifies the AI technologies most relevant to sustainability monitoring and reporting in university contexts.

*Table 4: AI Technologies for Sustainability Reporting in Universities*

| AI Technology | Application in University Sustainability Reporting |
|---|---|
| Machine Learning | Pattern analysis in energy and water consumption; anomaly detection; consumption forecasting; efficiency opportunity identification |
| Predictive Analytics | Forecasting environmental impacts; simulating outcomes of sustainability interventions; carbon reduction pathway modelling |
| Natural Language Processing | Extracting ESG-relevant content from procurement records, policy documents, and institutional reports |
| Data Mining and Integration | Consolidating sustainability data from disparate institutional systems into unified analytical datasets |
| Automated Reporting | Generating structured disclosures aligned with GRI, IPSASB SRS 1 (climate-related disclosures), and ISSB reporting standards |
| Computer Vision / IoT Sensing | Real-time monitoring of campus energy use, occupancy, and waste via sensor networks and visual analytics |

Machine learning and predictive analytics emerge as the most extensively validated AI capabilities for sustainability monitoring (Rolnick et al., 2019; Deb et al., 2017; Zeng et al., 2021). NLP tools offer a largely untapped potential for governance indicator reporting in universities, where relevant information is frequently embedded in administrative text sources (Tsai & Wang, 2017). The addition of computer vision and IoT sensing capabilities to the framework reflects developments in campus monitoring infrastructure that, while less common in African universities currently, represent an achievable medium-term component of sustainability data systems as sensor technology costs continue to decline.

**Institutional Preparedness Challenges**

Table 5 summarizes the key challenges affecting institutional preparedness for sustainability reporting, as identified in the reviewed literature.

*Table 5: Key Challenges Affecting Institutional Preparedness for Sustainability Reporting*

| Challenge | Description and Implications |
|---|---|
| Fragmented data systems | Sustainability data held in disconnected departmental systems without integration, preventing institution-wide visibility and consistent reporting |
| Limited digital infrastructure | Inadequate hardware, connectivity, and software platforms for data analytics, integration, and real-time monitoring |
| Absence of standardized metrics | Inconsistent indicator definitions and reporting formats across and within institutions, undermining comparability and external credibility |
| Insufficient staff expertise | Limited institutional capacity in sustainability data governance, analytics, and AI system management |
| Governance and policy gaps | Absence of institutional policies for data stewardship, ownership, quality assurance, and AI ethics governance |
| Resource and funding constraints | Inadequate budgetary provision for sustainability data infrastructure investment, particularly in smaller and less-resourced institutions |

Fragmented data systems represent the most pervasive and consequential barrier identified in the literature a structural problem that AI technologies can help to solve but cannot solve alone (Lozano, 2011; Leal Filho et al., 2019). Limited digital infrastructure compounds this challenge at a more fundamental level, reflecting capital investment deficits that must be addressed through policy and funding mechanisms rather than through technology choices alone (Nhamo & Mjimba, 2020). The addition of resource and funding constraints as a distinct challenge category reflects the explicit recognition in the African higher education literature that technology-enabled governance reforms require sustainable financial models, not just institutional will (Munasinghe, 2010).

**Proposed AI-Enabled Sustainability Reporting Architecture**

Drawing on the synthesis of findings from the systematic desk review, this study proposes an AI-enabled sustainability reporting architecture designed for the operational and institutional context of Kenyan public universities. The architecture is structured around five interconnected functional layers, organized in a logical sequence from data origination to governance output. Each layer addresses a distinct but mutually reinforcing challenge in the sustainability reporting chain, and the architecture as a whole is designed to be modular and scalable capable of being implemented incrementally as institutional capacity and financial resources allow, rather than requiring simultaneous deployment of all components. This design philosophy is deliberate: the African higher education governance literature consistently demonstrates that reform initiatives imposed at a scale and pace that outstrips institutional absorptive capacity are more likely to fail than those that build iteratively on existing systems and competencies (Munasinghe, 2010; Nhamo & Mjimba, 2020).

Before presenting the architecture, it is important to state its evidentiary status clearly. The general categories of AI capability associated with each layer below, and their applicability to sustainability monitoring, are grounded in the peer-reviewed and standard-setting literature reviewed above (e.g., Deb et al., 2017; Rolnick et al., 2019; Tsai & Wang, 2017; Zeng et al., 2021; GRI, 2021; IPSASB, 2024, 2026). The specific configuration of these capabilities into a single five-layer architecture, and its tailoring to the institutional realities of Kenyan public universities, is the authors' own conceptual synthesis. It has not been built, piloted, or empirically evaluated in this or any comparable setting, and is presented as a proposal for institutional planning and subsequent empirical testing rather than as a validated model of what AI-enabled sustainability reporting yields in practice.

**Data Collection Layer**

The data collection layer constitutes the foundational infrastructure of the sustainability reporting system, and the quality of everything that follows is directly determined by the quality of what is captured here. This layer is responsible for systematically gathering sustainability-relevant data generated by the diverse operational and administrative systems that universities maintain in the course of their normal institutional functioning.

The primary institutional data sources are well-established administrative systems that already exist in most Kenyan public universities in some form. Energy management systems ranging from basic utility billing records to sophisticated building management systems with sub-metering capabilities provide the foundation for energy consumption reporting. Even institutions without dedicated energy management software can begin with utility meter data, provided that recording is systematic and consistent. Water monitoring infrastructure, similarly, can range from aggregated billing data to granular sub-metering systems that record consumption patterns at the building or zone level, enabling the kind of site-specific analysis that effective water conservation management requires. Procurement databases provide the institutional purchasing records from which supply chain sustainability indicators like supplier environmental credentials, procurement policy compliance, and the sustainability characteristics of purchased goods and services can be derived. Human resource information systems contain the employment composition, training, compensation equity, and workforce diversity data essential for social indicator reporting. Financial management systems, while not sustainability data sources in themselves, provide expenditure disaggregation that can reveal sustainability-relevant spending patterns, like investments in renewable energy, energy efficiency, and sustainability capacity building.

In addition to these established administrative systems, the architecture incorporates environmental sensor networks as an increasingly accessible and cost-effective data collection technology. Internet of Things (IoT) sensor devices capable of monitoring temperature, air quality, occupancy, energy utilization, water flow, and waste volume across physical campus spaces provide a granularity and timeliness of environmental data that administrative records alone cannot deliver (Brynjolfsson & McAfee, 2017). The cost of IoT sensor technology has declined dramatically over the past decade, making sensor network deployment increasingly feasible for institutions with constrained capital budgets. For Kenyan public universities where established administrative data collection is limited, sensor infrastructure may in some cases provide a faster route to reliable environmental data than the retrofitting of legacy administrative systems.

A critical design principle at the data collection layer is the standardization of data capture protocols across all source systems. Without agreed definitions for measurement units, reporting periods, system boundaries, and data quality standards, data collected from different institutional sources cannot be reliably integrated or compared undermining the entire downstream architecture. The development of a standardized sustainability data taxonomy, aligned with the indicator definitions specified in GRI Standards and IPSASB SRS 1, should therefore be one of the first governance activities undertaken in implementing this architecture.

**Data Integration Layer**

The data integration layer addresses the central operational challenge of university sustainability reporting identified consistently throughout the literature: the consolidation of sustainability data dispersed across multiple departments and information systems into a unified, analytically accessible, and institutionally

governed data repository. This is not merely a technical challenge but an organizational and political one: departments that have historically owned their own data may resist integration mandates that reduce their data autonomy, and building the inter-departmental trust and cooperation required for sustainable data sharing requires sustained leadership commitment and diplomatic institutional process management.

The technical components of the data integration layer include data warehousing infrastructure whether on-premise servers or cloud-based storage platforms, depending on institutional connectivity and cost considerations and enterprise data integration middleware capable of establishing reliable, automated data flows from source systems into the central repository. Extract-Transform-Load (ETL) pipelines provide the standard technical mechanism for this integration work, extracting data from source systems on defined schedules, transforming it into the standardized formats specified in the sustainability data taxonomy, and loading it into the centralized data warehouse. The design of ETL pipelines must accommodate the diverse technical architectures of source systems, which in Kenyan universities may range from modern cloud-based platforms to legacy desktop databases, and must include robust error handling and exception logging to ensure that data quality issues are identified and addressed before they propagate into the analytics layer.

Data standardization and quality assurance processes are applied as part of the integration workflow to address the quality issues missing values, inconsistent recording practices, unit conversion errors, and definitional ambiguities that are inevitable when sustainability data is extracted from systems not originally designed for sustainability monitoring. Automated data quality checks, like range validation, cross-system consistency verification, and completeness monitoring, provide systematic early warning of quality problems. A data stewardship governance structure—defining institutional roles and responsibilities for data quality, access control, and dispute resolution—must accompany the technical infrastructure to ensure that quality issues are not merely detected but corrected, and that accountability for data quality is clearly assigned.

**AI Analytics Layer**

The AI analytics layer is the intellectual engine of the sustainability reporting system the point at which integrated data is transformed into the understanding and foresight that sustainability governance requires. The specific AI tools deployed at this layer correspond to the distinct analytical tasks that comprehensive sustainability reporting demands, and their deployment must be sequenced and prioritized in accordance with data availability and institutional analytical capacity.

Machine learning models represent the first and most foundational analytical capability to be deployed. Supervised learning algorithms like gradient boosting models, random forests, and neural networks can analyze historical patterns in energy consumption, water usage, and waste generation to identify drivers of consumption variation, detect anomalies indicative of equipment malfunction or behavioral change, and generate consumption forecasts with demonstrably higher accuracy than conventional statistical methods (Deb et al., 2017). The value of accurate consumption forecasting extends beyond sustainability reporting: it directly supports institutional resource planning and budget management, providing a governance dividend that helps build internal institutional support for the broader AI sustainability reporting infrastructure.

Predictive analytics models extend the machine learning capability from historical pattern analysis to forward-looking scenario modeling. Carbon reduction pathway models, for example, can simulate the cumulative emissions impacts of a portfolio of sustainability interventions renewable energy procurement, building retrofitting, fleet electrification, travel policy reform over ten- to thirty-year planning horizons, enabling institutional governing bodies to make evidence-based decisions about which combination of interventions offers the most cost-effective path to declared sustainability targets (Zeng et al., 2021). This predictive capability is directly relevant to the mandatory reporting context: under GRI Standards and IPSASB SRS 1, organizations are expected to disclose not only their current sustainability performance but their targets and the credibility of their pathways to achieving them.

Natural language processing models are applied to the large volume of unstructured textual data—procurement descriptions and justification documents, policy papers, committee minutes, sustainability narrative sections of annual reports that contains information relevant to governance indicators but is not captured in structured

databases (Tsai & Wang, 2017). NLP-based information extraction systems can identify, categorize, and quantify sustainability-relevant content from these textual sources, making governance indicator reporting more comprehensive and less dependent on manual document review. For institutions with limited analytical staff capacity, NLP automation of governance indicator extraction has the potential to substantially reduce the time required to compile sustainability reports, although the magnitude of this benefit has not been empirically demonstrated in a Kenyan university setting and should be treated as a plausible, literature-informed expectation rather than a proven outcome.

Anomaly detection systems operate continuously across the integrated dataset, monitoring sustainability metrics for patterns that deviate significantly from expected ranges or historical trends. These systems serve a dual function: they identify data quality issues such as missing meter readings, unit conversion errors, or system integration failures that may distort reported sustainability performance, and they flag genuine operational anomalies such as unusual energy consumption spikes, procurement pattern irregularities, or sudden changes in workforce composition that may warrant management attention. The governance value of real-time anomaly detection extends well beyond sustainability reporting: it provides an early warning system for a range of institutional risk categories, like energy infrastructure failures, procurement integrity concerns, and workforce management issues.

**Sustainability Dashboard Layer**

The sustainability dashboard layer performs a translation function that is as critical as any of the analytical capabilities that precede it: it converts the complex, multi-dimensional outputs of the AI analytics layer into visual representations that are accessible, interpretable, and actionable for the range of institutional stakeholders who need to use sustainability information for governance and operational decision-making. The most analytically sophisticated AI system delivers limited governance value if its outputs are accessible only to technical specialists and cannot be used by the university administrators, governing board members, departmental managers, and sustainability officers who make the decisions that actually determine sustainability outcomes.

Well-designed sustainability dashboards present key ESG indicators in near-real-time, enabling continuous monitoring of institutional performance across environmental, social, and governance dimensions replacing the periodic, retrospective snapshot that annual sustainability reports provide with an ongoing, dynamic governance instrument. Hierarchical dashboard architecture allows users to navigate between institution-wide aggregate views and granular departmental or facility-level detail: a vice-chancellor can monitor overall energy consumption trends against institutional targets at a glance, while a campus services director can drill into building-level data to identify specific facilities driving energy over-consumption and prioritize maintenance interventions accordingly. This multi-level visibility is essential for connecting strategic sustainability governance with operational sustainability management, ensuring that institutional sustainability commitments translate into the day-to-day operational decisions that actually determine sustainability outcomes.

Dashboard design must be governed by human-centered design principles that prioritize clarity, interpretability, and actionability for non-technical users. Raw data outputs and model predictions must be translated into governance-relevant indicators presented in formats trend lines, traffic light indicators, benchmark comparisons, and plain-language interpretive summaries that communicate their significance clearly to administrators with no technical background in data analytics or AI. The selection of dashboard metrics should be governed by the institution's sustainability strategy and reporting framework obligations, ensuring that what is measured and monitored is what is strategically important rather than what is technically easiest to display.

**Reporting and Compliance Layer**

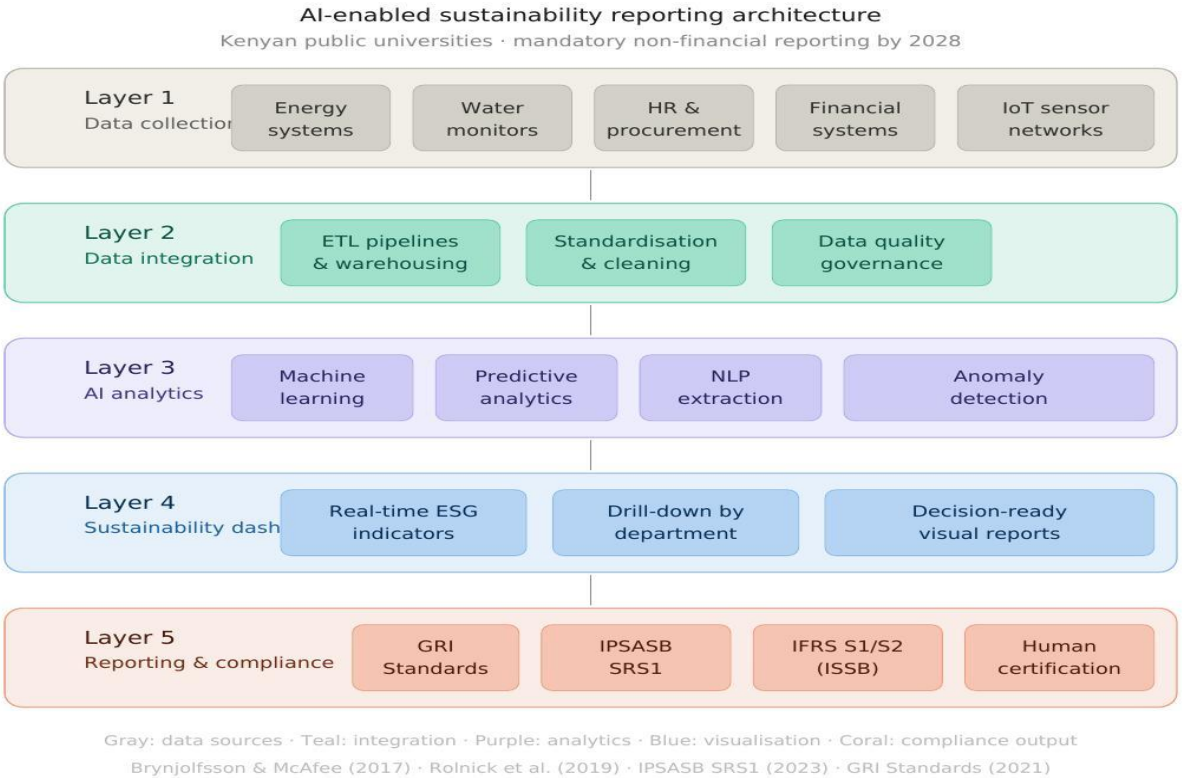
The reporting and compliance layer completes the data-to-disclosure pipeline, translating analyzed and visualized sustainability data into the structured, framework-aligned, and externally auditable disclosures that mandatory reporting requires. This is where the institutional governance value of the entire architecture is

realized in its most tangible form: in the production of sustainability reports that regulators will accept, that funding partners will trust, and that the public will find credible.

AI-driven automation can address the most labor-intensive components of the report generation process. Relevance mapping systems extract indicator values from the integrated database and map them automatically onto the disclosure requirements of applicable reporting frameworks—GRI Standards, IPSASB SRS 1, and ISSB guidance, with the potential to reduce the manual effort of compliance mapping considerably, although the specific time savings will depend on institutional data readiness and have not been empirically measured in this study. Report generation algorithms format extracted indicator values, trend analyses, and narrative summaries into report structures that conform to framework-specified disclosure formats and are ready for human review and certification before submission. Natural language generation systems can draft narrative sustainability disclosures describing institutional sustainability context, performance trends, and strategic commitments from structured data inputs, providing first-draft narrative content that sustainability officers can review and refine rather than compose from scratch.

It is essential, however, that automation not replace human judgment in the governance certification process. Sustainability reports produced by AI-assisted generation systems must be reviewed, validated, and formally certified by appropriately qualified institutional officers before submission to regulatory bodies or publication for public stakeholders. The institutional governance responsibility for the accuracy, completeness, and integrity of sustainability disclosures cannot be delegated to automated systems: it must be clearly vested in named human officers with the authority and accountability to ensure that disclosures are trustworthy. AI automation enhances the efficiency and consistency of report production; it does not and should not substitute for the human governance accountability that gives sustainability disclosures their legitimacy.

The architecture diagram below presents the five-layer data-to-disclosure pipeline proposed for Kenyan public universities. Layer 1 captures raw sustainability data from institutional systems and IoT sensors. Layer 2 integrates these datasets through ETL pipelines, standardization, and data quality governance. Layer 3 applies AI analytics including machine learning, predictive modelling, NLP extraction, and anomaly detection. Layer 4 translates analytical outputs into real-time dashboards accessible to institutional decision-makers. Layer 5 generates framework-aligned sustainability disclosures and requires human certification before submission.



**Mapping Architecture Layers to Indicators, Data Sources, Standards, and Governance Responsibility**

Table 6 consolidates the proposed architecture by mapping each layer to the ESG indicators it primarily serves, its institutional data source(s), the reporting standard(s) it supports, and the institutional governance or verification responsibility required to keep AI outputs accountable. As noted above, this mapping is the authors' conceptual proposal, synthesized from the reviewed literature and standards; it has not been empirically validated through implementation in a Kenyan public university and should be treated as a framework for pilot testing rather than a validated operational model.

*Table 6: Mapping of Proposed Architecture Layers to ESG Indicators, Data Sources, Reporting Standards, and Governance Responsibility*

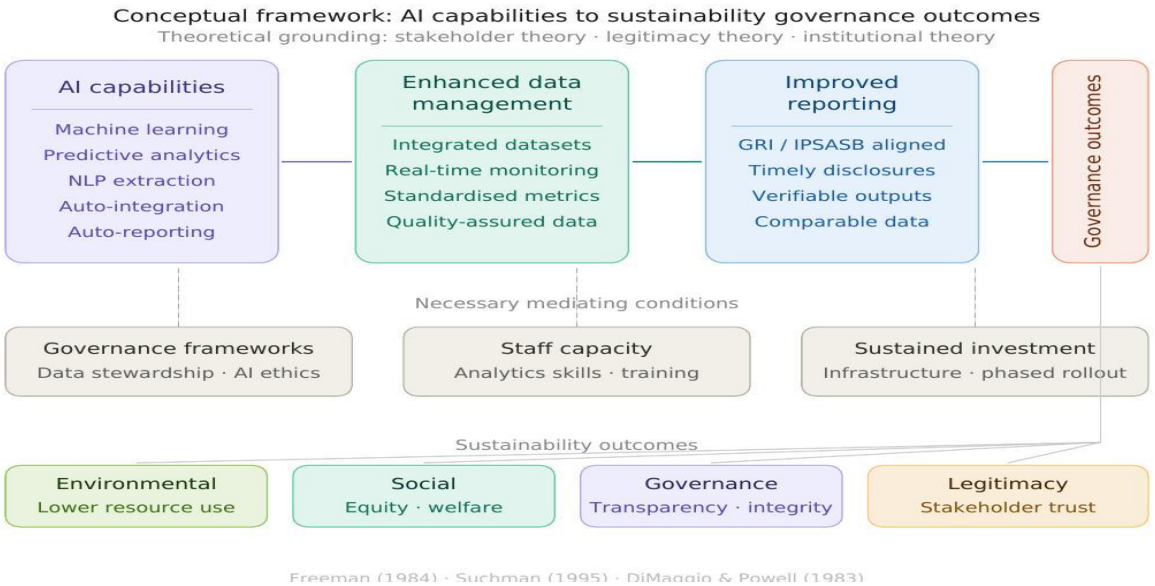
| Layer | Primary AI/Technical Component | ESG Indicators Addressed | Institutional Data Source(s) | Relevant Reporting Standard(s) | Governance/Verification Responsibility |
|---|---|---|---|---|---|
| Data Collection | Utility metering, IoT sensors, administrative records | Energy & water consumption; waste volumes; procurement spend; workforce composition | Facilities, procurement, HR, and finance systems | GRI 302/303/306; IPSASB SRS 1 (climate-related metrics) | Facilities/sustainability office; data owners in source departments |
| Data Integration | ETL pipelines, data warehouse, standardized data taxonomy | Cross-cutting; enables comparability across all E/S/G indicators | Consolidated institutional data repository | GRI data-quality principles; IPSASB SRS 1 | Data governance/IT office; designated data steward |
| AI Analytics | Machine learning, predictive analytics, NLP extraction, anomaly detection | Environmental forecasts & anomalies; governance-text indicators; cross-cutting trend indicators | Integrated repository; unstructured text (minutes, procurement documents) | GRI target/trend disclosures; IPSASB SRS 1 climate targets/pathways | Sustainability analytics unit; independent review of model outputs |
| Sustainability Dashboard | Business-intelligence dashboards, visualization | All ESG indicators, for internal monitoring | Outputs of the AI analytics layer | Internal management reporting (supports, but is not itself, an external disclosure standard) | Sustainability officer; departmental/unit managers |
| Reporting & Compliance | Automated relevance mapping, report generation, NLG drafting | Final structured E/S/G disclosures mapped to framework | Dashboard/analytics outputs | GRI Standards; IPSASB SRS 1 (climate-related disclosures); IFRS S1/S2 (ISSB) where | Named institutional officer(s) with certification authority (e.g., Council-designated signatory); external assurance where required |

| | | | | | |
|---|---|---|---|---|---|
| | | requirements | | applicable | |

**Conceptual Framework**

The conceptual framework underlying this study integrates insights from stakeholder theory (Freeman, 1984), legitimacy theory (Suchman, 1995), and institutional theory (DiMaggio & Powell, 1983) with an evidence-based analysis of AI capabilities to propose a governance change pathway for Kenyan public universities. The framework posits that AI capabilities encompassing data integration, machine learning analytics, predictive modelling, NLP-based information extraction, and automated reporting function as enabling infrastructure for improved sustainability governance, operating through a causal chain that connects technological investment to governance outcomes. AI capabilities enhance institutional capacity for sustainability data management, which in turn improves the quality, comprehensiveness, timeliness, and credibility of sustainability reporting. More robust reporting strengthens institutional governance accountability by providing decision-makers and external stakeholders with the evidence base needed to hold institutions to their sustainability commitments and to evaluate progress over time. This improvement in governance accountability creates the conditions under which genuine sustainability improvements reduced energy consumption, more equitable institutional cultures, more transparent procurement processes become both more likely and more demonstrable.

The framework below illustrates the causal pathway through which AI capabilities drive improved sustainability governance in Kenyan public universities. The chain runs from AI capabilities through enhanced data management and improved reporting to strengthened governance outcomes. Three necessary mediating conditions governance frameworks, staff capacity, and sustained investment support the main pathway. Four sustainability outcome categories fan out from the governance improvement node.




## DISCUSSION

The findings of this study illuminate both the urgency and the genuine complexity of the sustainability reporting challenge facing Kenyan public universities. The 2028 deadline for mandatory non-financial reporting is not a distant abstraction; it falls well within the planning horizon of current institutional leadership, and the gap between what it will require and what most universities can currently deliver is, by any honest assessment, substantial. Universities that treat this deadline as a future concern rather than a present imperative risk arriving at it without the data systems, governance frameworks, or analytical capacity to produce disclosures of the quality and credibility that regulators and stakeholders will expect.

The theoretical framework developed through this review drawing on stakeholder theory (Freeman, 1984), legitimacy theory (Suchman, 1995), and institutional theory (DiMaggio & Powell, 1983) provides a useful

analytical lens for understanding why sustainability reporting has become institutionally mandatory rather than merely strategically desirable. The isomorphic pressures identified by DiMaggio and Powell (1983) are clearly visible in the Kenyan context: as global sustainability reporting norms solidify and regional regulatory frameworks align with international standards, the coercive pressure on public universities to adopt structured sustainability disclosure practices intensifies. The question, from a legitimacy theory perspective, is whether universities will be able to produce disclosures that demonstrate genuine sustainability performance or whether they will be confined to the kind of ceremonial compliance reporting that satisfies formal requirements while failing to reflect substantive governance that Suchman (1995) identifies as a common organizational response when accountability demands outpace institutional capacity.

The case for AI as an enabling technology in this context is well-grounded in the literature reviewed but requires careful qualification. The data management challenges facing Kenyan universities fragmented systems, manual processes, limited staff capacity, and inconsistent metrics are precisely the categories of problem that AI technologies are designed to address. Machine learning can identify patterns in datasets too large and complex for manual analysis (Rolnick et al., 2019). Predictive analytics can support evidence-based planning by modelling the likely impacts of sustainability interventions with a granularity and forward-looking horizon that retrospective reporting cannot provide (Zeng et al., 2021). NLP can reduce the burden of governance indicator extraction from administrative text sources (Tsai & Wang, 2017). Automated reporting can generate consistent, framework-aligned disclosures more efficiently and with lower error rates than manual compilation (Brynjolfsson & McAfee, 2017). These capabilities are real, empirically demonstrated, and directly relevant to the university sustainability reporting context. They are not speculative.

However, the literature also consistently demonstrates that technological capability does not automatically translate into governance improvement. Findler et al. (2019) found that sustainability reporting capacity in universities depended critically on leadership commitment and strategic integration of sustainability objectives factors that are organizational and political rather than technological in character. Disterheft et al. (2015) demonstrated the importance of participatory governance processes in building the internal institutional trust and cooperation that effective sustainability data sharing requires. Munasinghe (2010) observed that technology-enabled governance reforms in developing country institutions fail at disproportionate rates when they are implemented without adequate attention to absorptive capacity the organizational, human, and financial resources needed to operate and sustain new systems effectively. These findings collectively suggest that the primary constraints on AI-enabled sustainability reporting in Kenyan universities are not technological but organizational and institutional: the quality of leadership commitment, the strength of data governance frameworks, the depth of staff capacity, and the adequacy of sustained financial investment.

The equity dimension of this transition demands explicit attention in the policy discourse surrounding mandatory sustainability reporting. The financial and technical demands of implementing AI-enabled sustainability systems are likely to be more readily manageable for large, well-resourced flagship universities which have larger administrative budgets, more technically qualified staff, and better digital infrastructure than for smaller, more resource-constrained regional universities that serve disproportionately large proportions of students from disadvantaged backgrounds. If AI-enabled sustainability governance becomes a marker of institutional quality achievable only by well-resourced institutions, the result will be a stratification of sustainability accountability that contradicts the equity principles that sustainability governance is supposed to advance. This is not a hypothetical risk; it is a pattern documented in the literature on technology adoption in higher education globally (Wals, 2014). Addressing it will require proactive policy interventions shared digital infrastructure platforms, collaborative procurement arrangements, targeted capacity-building funding, and proportionate regulatory expectations calibrated to institutional resources rather than the assumption that market forces or institutional initiative will produce equitable outcomes.

The AI ethics dimensions of this governance transition also merit sustained attention. Jobin et al.'s (2019) documentation of the global convergence around principles of AI transparency, accountability, fairness, and human oversight provides a normative framework for responsible AI deployment in sustainability governance that Kenyan universities should adopt and adapt to their specific institutional contexts. Algorithmic accountability ensuring that AI-generated sustainability analytics can be independently verified and that errors

can be identified and corrected is particularly important in a context where institutional credibility is at stake. Data privacy governance establishing clear policies on the collection, storage, access, and use of the sensitive institutional and personal data that sustainability reporting systems will process is both an ethical imperative and an increasingly explicit regulatory requirement. Human oversight mechanisms ensuring that AI-generated disclosures are reviewed and certified by accountable human officers before submission are non-negotiable: the governance responsibility for sustainability reporting cannot be delegated to automated systems, however sophisticated.

A final observation concerns the relationship between sustainability reporting and sustainability outcomes a relationship that the academic literature on organizational sustainability governance suggests is real but conditional. Gray et al. (1995) observed that sustainability disclosure can be performative rather than substantive a legitimacy management exercise rather than a genuine accountability mechanism. The design of AI-enabled sustainability reporting systems must therefore attend not only to the efficiency of disclosure production but to the governance conditions that make disclosures credible and improvement-oriented: independent data verification, meaningful stakeholder engagement in indicator selection, transparent reporting of negative as well as positive performance, and institutional cultures that treat sustainability data as a learning resource rather than a reputation management instrument.

## POLICY IMPLICATIONS

The findings of this study carry substantive implications for three distinct but interconnected audiences: university administrators and governing boards, national regulatory bodies and government agencies, and development partners and funding institutions operating in the Kenyan higher education space.

For university administrators and governing boards, the most urgent priority is the initiation of integrated data management infrastructure capable of capturing and consolidating sustainability indicators across administrative departments. This is a prerequisite for any meaningful sustainability reporting AI-enabled or otherwise and it requires an institutional commitment at the level of senior leadership, expressed not merely in policy declarations but in budget allocations and organizational accountability structures. Governing boards should establish sustainability reporting as a standing agenda item and require regular reporting from management on the progress of data infrastructure development. Sustainability data stewardship policies defining institutional standards for data quality, access control, retention, and privacy should be developed and adopted as a matter of priority, providing the governance framework within which data collection and integration systems will operate.

Investment in AI-driven analytics platforms should be treated as a medium-term strategic priority, approached through a phased implementation logic that begins with the analytical capabilities most directly supported by existing institutional data and builds incrementally as data quality and staff capacity improve. Universities should resist the temptation to procure comprehensive, off-the-shelf AI sustainability platforms without first assessing their compatibility with existing institutional data systems and their fit with the specific indicator requirements of GRI Standards and IPSASB SRS 1. Platform selection decisions should be made in consultation with sustainability reporting specialists and data governance experts, and should include requirements for independent auditability of AI-generated outputs—a non-negotiable condition for the external credibility of sustainability disclosures.

For national regulatory bodies, the most consequential contribution to institutional preparedness would be the early development of clear, operationally specific, and adequately resourced guidance on mandatory sustainability reporting requirements. The current ambiguity about precisely what will be required of public universities by 2028, and in what disclosure format, creates significant and inefficient uncertainty for institutions seeking to invest in compliance infrastructure. Detailed, phased regulatory guidance specifying minimum disclosure requirements, acceptable reporting frameworks, data quality standards, and compliance assessment procedures would enable institutions to make informed investment decisions and would reduce the risk of costly, late-stage redesign. Regulatory bodies should also consider establishing national sustainability

reporting capacity-building programs, providing technical assistance, training resources, and standardized data collection tools that smaller institutions can access without developing their own from scratch.

At the national and development partner level, the establishment of shared digital infrastructure platforms providing cloud-based data integration, analytics, and reporting capabilities accessible to all Kenyan public universities on a shared-cost basis represents the most potentially impactful single intervention for accelerating sector-wide sustainability reporting readiness. Such platforms would allow institutions that cannot individually afford sophisticated AI analytics infrastructure to access comparable capabilities through pooled resources, dramatically lowering the effective barrier to compliance and creating a more equitable distribution of sustainability reporting capacity across the sector.

## CONCLUSION

Sustainability reporting is rapidly becoming a defining expectation of institutional governance, and Kenya's public universities find themselves at a critical juncture. The approaching 2028 deadline for mandatory non-financial reporting is both a governance challenge and a genuine institutional opportunity. It is a challenge because most universities currently lack the data infrastructure, analytical capacity, and governance frameworks required for robust, credible, and independently verifiable sustainability disclosure. It is an opportunity because building these capabilities if approached with genuine institutional commitment, regulatory clarity, and appropriate financial investment can generate governance improvements that extend well beyond compliance: improvements in operational efficiency, institutional transparency, resource stewardship, and the quality of evidence available for institutional decision-making.

The theoretical framework developed in this study grounding the analysis in stakeholder theory (Freeman, 1984), legitimacy theory (Suchman, 1995), and institutional theory (DiMaggio & Powell, 1983) provides a coherent explanation for why sustainability reporting has become an institutional imperative for Kenyan public universities, not merely a regulatory nicety. The proposed AI-enabled sustainability reporting architecture, built from five interconnected functional layers, provides a structured and evidence-based roadmap for how institutions can develop the data systems, analytical capabilities, and governance processes needed to meet this imperative. The architecture is designed to be modular, scalable, and incrementally implementable, reflecting the realistic constraints of Kenyan higher education institutions rather than the idealized conditions of well-resourced university systems in the Global North.

Artificial Intelligence is not a panacea, and this paper has been careful not to present it as one. The structural constraints on sustainability reporting in Kenyan universities limited budgets, fragmented data systems, inadequate digital infrastructure, thin staff capacity, and governance gaps are real and will not be resolved by technology alone. Leadership commitment, regulatory clarity, inter-institutional cooperation, and sustained financial investment are equally necessary conditions for success. AI amplifies institutional sustainability governance capacity; it does not substitute for it.

Several important questions remain beyond the scope of this desk review and merit attention in subsequent empirical research. How do specific organizational and leadership characteristics of Kenyan public universities affect their readiness to implement AI-enabled sustainability systems? What are the most effective models for inter-institutional collaboration on shared sustainability data infrastructure in the East African context? What governance mechanisms most effectively ensure that AI-generated sustainability disclosures are not only accurate but improvement-oriented that they drive genuine sustainability progress rather than merely satisfying reporting obligations? These questions call for primary empirical investigation, like institutional case studies, participatory action research with university sustainability officers, and longitudinal analysis of reporting quality and sustainability outcomes as mandatory disclosure regimes take effect.

Universities that engage seriously with these questions—that begin building sustainability data infrastructure now, that develop AI governance frameworks in advance of deployment, and that treat sustainability reporting as a strategic governance investment rather than a compliance burden—will be better positioned not only to satisfy the 2028 regulatory requirements but to demonstrate the kind of institutional sustainability leadership

that their academic missions, their public funding obligations, and the students and communities they serve increasingly, and rightly, demand. The time to begin is not 2027. It is now.

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