

Sustainability performance evaluation of higher education institutions: Development of a preliminary set of indicators

Iyeke Omagbemi Aimuanmwosa¹, Kuan Yew Wong^{2*},

Mohd Firdaus Mohd Taib³, Ayodeji Sulaiman Olawore⁴

^{1,2,3}Universiti Teknologi Malaysia, Faculty of Mechanical Engineering, 81310 Johor Bahru, Johor, MALAYSIA

⁴Department of Mechanical Engineering, Kwara State University, 241103 Malete, NIGERIA

ARTICLE INFO

Article history:

Received 30 November 2025

Revised 12 January 2026

Accepted 31 January 2026

Online first 04 July 2026

Published 31 August 2026

Keywords:

Higher education institutions

Sustainability

Sustainable development

Sustainability assessment tools reporting

DOI:

10.24191/myse.v13i2.9710

ABSTRACT

Higher Education Institutions (HEIs) have increasingly pursued sustainability in alignment with global declarations such as the 1977 Tbilisi Declaration, the 1990 Talloires Declaration, and the 2005 UN Decade of Education for Sustainable Development. Despite these initiatives, many campuses remain far from being sustainable, as challenges of global warming and climate change persist. Various studies have developed sustainability indicators tailored to international and regional contexts to assess institutional performance. This paper seeks to establish a preliminary set of sustainability performance indicators (PIs) specific to Nigerian HEIs. Using a systematic desk research approach, existing sustainability assessment tools (SATs) were reviewed, resulting in the selection of 12 SATs encompassing 320 indicators. From these, 43 indicators relevant to the Nigerian context were identified. Also, "sewage disposal" was included as a critical local factor, bringing the total to 44 preliminary PIs. The findings demonstrate that contextual factors, including purpose, developmental stage, institutional background, and focus, significantly shape PIs. Nigerian HEIs are in the preliminary stages of sustainability application, hence the contextualised indicators proposed in this study aim to strengthen localised sustainability actions. Understanding the current phase of sustainability development and strategically applying these indicators can enhance the capacity of Nigeria's HEIs, particularly in the context of early adopters such as those in Nigeria.

^{2*}Corresponding author. E-mail address: m-wongky@utm.my

Co-authors. E-mail address : iyekeoma@gmail.com

1. INTRODUCTION

Sustainable development (SD) has become a dominant paradigm across policy and research agendas at global, national, and municipal scales (Schoenaker et al., 2015). Within this landscape, higher education institutions (HEIs) hold a contested yet vital role, serving not only as producers of knowledge but also as institutional exemplars expected to model sustainability in practice. Their evolving contribution to national development is well noted (Gunasekara, 2006), and their expanding sustainability commitments are widely documented (Lozano et al., 2013, 2015). HEIs bear a dual mandate: to equip future generations with sustainability competencies while also operating sustainably. Through teaching, research, and collaborations, universities shape ethical frameworks, influence policy discourse, and co-produce innovations that advance broader sustainability transitions (Dyer & Dyer, 2017; Leal Filho et al., 2020; Sady et al., 2019). By embedding sustainability across core functions, HEIs can catalyse change at multiple societal levels.

Global momentum to embed SD in education gained traction following the United Nations Educational, Scientific, and Cultural Organisation's (UNESCO) 1997 call for the systemic integration of sustainability into curricula (UNESCO, 1997). The UNESCO initiative was later reinforced by other initiatives such as Education for Environment, Population, and Sustainable Development, which promoted environmental integrity and social equity through education (Tan et al., 2014). The rise of a sustainable campus reflects this institutional shift, with universities increasingly cast as microcosms of sustainable urbanism. Scholars argue that HEIs must fully leverage their teaching, research, and operational capacities to advance sustainability, serving as strategic nodes for broader societal change (Caeiro et al., 2020; Mora et al., 2020; Shawe et al., 2019). Yet this aspirational role stands in stark contrast to material realities because HEIs operate as energy-intensive, high-consumption entities whose footprints often mirror those of cities functioning as agents of carbonisation and drivers of climate change (Roos et al., 2020; Ryan-Fogarty et al., 2016). From a mitigation framework perspective, low-carbon city (LCC) approaches are a prevalent methodology for tackling climate change in urban areas and HEIs (Azhar et al., 2025). They also participate in unsustainable production, consumption, and construction patterns, with construction activities identified as significant sources of air, water, and noise pollution (Halimi & Ismail, 2017). Although many HEIs are revising curricula, governance, and operations to align with SD principles, scholars caution that current practices remain largely unsustainable without deeper systemic reform (Beynaghi et al., 2016; Salvia et al., 2020; Yarime & Tanaka, 2012).

Nowhere is this tension more acute than in the Global South, where rapid HEI expansion outpaces the capacity for sustainability. In Nigeria, the higher education sector has grown explosively, from 284 institutions in 2019, as reported by the National University Commission (NUC) (NUC, 2019), to 307 by 2023, comprising 72 federal, 67 state, and 168 private universities (NUC, 2023), amidst inadequate infrastructure, unplanned urbanisation, and mounting environmental stress. With a projected population of 237.5 million by 2025 (UNFPA, 2025), Nigerian HEIs function as *de facto* "mini-cities" in a context where economic growth and urbanisation are strongly correlated with rising CO₂ emissions (Mohd Zulkifli et al., 2021). While urban planning offers a potential pathway for aligning development with ecological systems, Yuting et al. (2024) note that implementation remains limited. Recognising these pressures, the Association of African Universities (AAU) issued the 2009 Abuja Declaration, urging institutions to review curricula,

policies, and operations and to implement comprehensive sustainability assessments (AAU, 2009). Yet over a decade later, empirical progress remains minimal.

Critically, Nigeria lacks context-sensitive frameworks to assess sustainability performance (SP). While resources have flowed into institutional expansion, there is virtually no official reporting or scholarly documentation of campus sustainability. To date, only Adenle et al. (2020) have proposed sustainability indicators for HEIs in Nigeria. Still, it focuses exclusively on environmental metrics, neglecting the Triple Bottom Line (TBL) framework that integrates social equity, economic viability, and environmental stewardship. This omission reflects a broader pattern: dominant sustainability assessment tools (SATs) originating in the Global North that prioritise technical, environmental data while marginalising social justice, local knowledge, and the institutional realities of the Global South (Velasco et al., 2018).

This paper addresses this critical gap. Hence, we ask: What preliminary PIs are appropriate for assessing HEIs in Nigeria, grounded in the four core institutional functions of academics, engagement, operations, and governance, and also fully aligned with the TBL? The research objective, therefore, is to develop a preliminary set of indicators for the assessment of HEIs in Nigeria, grounded in the four core institutional functions of academics, engagement, operations, and governance, while also fully aligned with the TBL. Through a systematic desk-based analysis of established SATs, we propose the first TBL-integrated indicator set explicitly designed for Nigeria's early-stage sustainability context. Our contribution is threefold: (1) a practical, adaptable framework for Nigeria's HEIs to initiate evidence-based sustainability planning; (2) a transferable model for sub-Saharan institutions navigating similar developmental constraints of rapid growth and limited resources; and (3) a challenge to the epistemic dominance of Northern evaluative frameworks, informed by decoloniality, which prioritises local context, equity, and the practicality of institutional implementation. While some indicators map clearly to single TBL pillars, for example, electricity consumption, renewable energy adoption, and carbon emissions to the environmental dimension, others, such as staff involved in sustainability research, publications related to sustainability, and sustainability training for staff development, span social and economic dimensions, enabling flexible yet coherent application.

The extant literature reviewed identified two significant research gaps related to this study. Dominant SATs originating in the Global North prioritise technical, environmental data while marginalising social justice, local knowledge, and the institutional realities of the Global South (Velasco et al., 2018). Also, Nigeria specifically lacks context-sensitive SAT to assess HEIs' SP. Although Adenle et al. (2020) have proposed sustainability indicators for HEIs in Nigeria, these indicators are still exclusively environmental metrics, neglecting the Triple Bottom Line (TBL) framework that integrates social equity, economic viability, and environmental stewardship. Hence, this study aims to fill this gap. Although designed for Nigeria, the framework holds broader relevance for HEIs across the Global South facing analogous pressures of growth, under-resourcing, and sustainability imperatives.

2. METHODOLOGY

Given the absence of nationally recognised sustainability assessment frameworks and empirical reporting in Nigerian HEIs, this study employs a systematic desk-based review to develop contextually relevant PIs for evaluating SP. While primary data collection would be ideal, the lack of institutional reporting and

standardised metrics in Nigeria, as noted by Adenle et al. (2020), renders a secondary data approach both necessary and methodologically justified. This approach synthesises globally validated SATs while allowing for adaptation to Nigeria's unique infrastructural, social, and governance contexts.

The research follows a three-phase protocol designed to ensure systematic, transparent, and context-sensitive indicator development. We commenced with a rigorous, systematic review of the literature to identify peer-reviewed publications that critically assess or operationalise SATs in higher education institutions. Second, functional, available online SATs that address the four core activities of HEIs were given focus. Third, based on these insights, indicators were selected across the four core activities of HEIs: academic, engagement, operations, and governance, while ensuring adherence to the TBL principle, encompassing social, economic, and environmental dimensions as articulated by Elkington (1998, 2004). This threefold process provided a systematic and holistic approach to indicator development.

2.1 Selection of Sustainability Assessment Tools (SATs)

To ensure rigour and reproducibility, we searched in June 2025, Scopus and Web of Science Core Collections, applying the query below:

TITLE-ABS-KEY (sustainability OR "sustainable development") AND ("higher education institution" OR university OR campus) AND (assessment OR benchmarking OR reporting).

The study limited results to English-language, peer-reviewed articles published between 1993 and 2024 to capture the evolution of SATs while maintaining a manageable scope. The initial search yielded 7,053 records, which were filtered using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) structure designed to improve transparency and reduce selection bias.

Inclusion criteria required that studies: (1) focus explicitly on whole-institution HEIs; (2) the article compares and analyses at least three SATs; and (3) discuss the four core HEI functions in an integrated manner. Exclusion criteria removed studies centred on non-HEI contexts, those lacking TBL integration, and works that discussed sustainability only at the departmental or programmatic level. After removing duplicates and screening titles and abstracts, including full-text assessment, 32 articles met all criteria (see Figure 1). These include comparative evaluations, conceptual frameworks, and empirical applications of SATs across Global North and South contexts (e.g., De Filippo et al. (2019); Drahein et al. (2019); Sepasi et al. (2018)), providing a balanced evidence base for indicator extraction. Notably, only one article published in 2023 met the inclusion criteria, while none from 2024 were eligible.

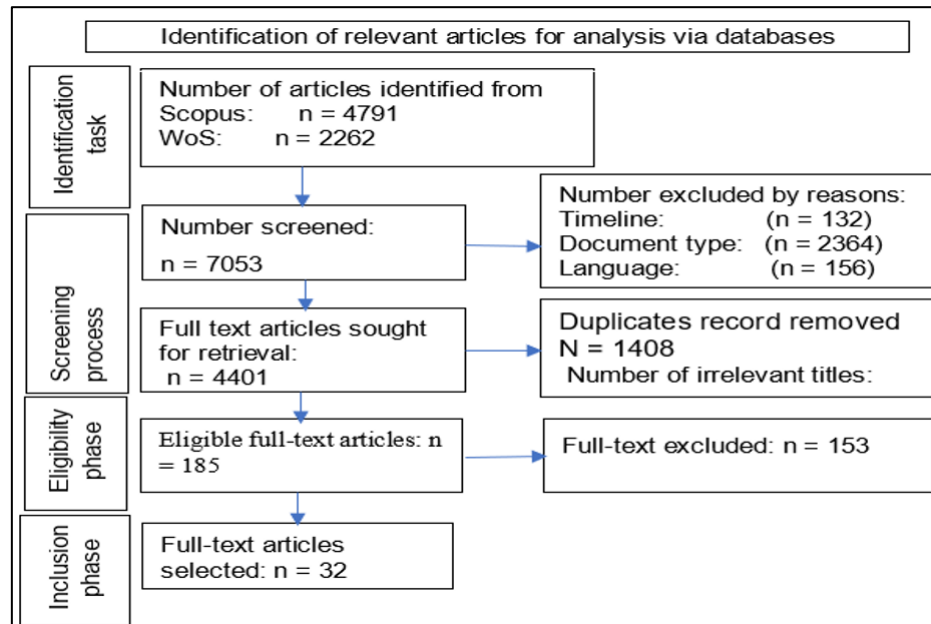


Fig. 1. Article filtering procedure using PRISMA

Source: Author

From these 32 articles (Table 1), we identified 76 distinct SATs for further analysis. Applying predefined selection criteria (detailed in Appendix I), and supported by a rigorous screening process presented in Appendix II, we narrowed this to 12 widely referenced and contextually relevant tools, including STARS, AASHE (2019), GASU, Lozano (2006) and AISHE, Roorda et al. (2009) as shown in Table 2; abbreviations are explained in Appendix II. These tools were selected for their global reach, methodological transparency, and documented application in diverse institutional settings.

Table 1. The 32 articles selected in ascending year

Reference	Number of SATs	Perspective of the Reviewed Article
Shriberg (2002)	11	Global
Lozano (2006)	11	Global
Fonseca <i>et al.</i> (2011)	7	Global
Saadatian <i>et al.</i> (2011)	17	Global
Yarime & Tanaka (2012)	16	Regional
Kamal & Asmuss (2013)	4	Regional
Maragakis & van den Dobbelsteen (2015)	8	Global
Shi & Lai (2013)	3	Global
Lopatta & Jaeschke (2014)	5	Regional
Amaral <i>et al.</i> (2015)	6	Global
Fischer <i>et al.</i> (2015)	12	Global
Góes & Magrini (2016)	8	Regional
Gómez <i>et al.</i> (2015)	8	Regional
Lauder <i>et al.</i> (2015)	4	Global
Bullock & Wilder (2016)	9	Global
Gustavo De Lima <i>et al.</i> (2016)	3	Regional
Larrán Jorge <i>et al.</i> (2016)	7	Regional

Sonetti et al., (2016)	16	Global
Alghamdi et al. (2017)	12	Global
Berzosa et al. (2017)	16	Regional
Gamage & Sciulli (2017)	13	Regional
Kapitulčinová et al. (2018)	12	Global
Sepasi et al. (2018)	33	Regional
De Filippo et al. (2019)	12	Regional
Drahein et al. (2019)	8	Regional
Findler et al. (2019)	19	Global
Parvez & Agrawal (2019)	10	Regional
Caeiro et al. (2020)	25	Global
Du et al. (2020)	15	Regional
Zahid et al. (2021)	13	Regional
Veideman (2022)	4	Global
Du et al. (2023)	11	Regional

Source: Author

Table 2. Details of the selected sustainability assessment tools (SATs)

SATs	Origin	Version Date	Number of Indicators	Rating Benchmark	Reference
AISHE	Netherlands	2009 V2.0	30	A 5-point ordinal scale	Roorda et al. (2009)
AMAS	Chile	2014	25	Likert scale	Gómez et al. (2015)
ASSC/SCAS	Japan	2013	48	Less than 45, Bronze; (45-65), Silver (66-84), Gold; Greater than 84, Platinum	Alghamdi, et al., (2017)
CSAF (core)	Canada	2005	172	Percentage evaluation	Cole (2005)
GASU	UK	2006	59	Likert scale	Lozano (2006)
P & P	UK	2019	61	1 st class, 2 nd class upper, 2 nd class lower, 3 rd class, and failed universities	People & Planet (2024/2025)
SAQ	International	2009	35	Likert scale: 0- No idea; 1-Not any; 2- know little; 3- know quite a bit; 4- know a lot	ULSF (2001)
STARS	North-America	2019	64	Reporter designation: Not available; Bronze, 25; Silver, 45; Gold, 65; Platinum, 85.	AASHE (2019)
SusHEI	Portugal	2011	44	-	Madeira et al. (2011)
GU (toolkit)	UN/International	2013	134	Likert scale	Dave et al. (2014)
UniSAF	Netherlands	2017	78	-	rootAbility Green Office Model, Maastricht University (2017)
USAT	Swedish/Africa Program	2009	75	Likert scale: x- do not know; 0-none; 1- know little; 2- sufficient; 3- considerable; 4- greatly	Togo & Lotz-Sisitka (2009)

Source: Author

2.2 Selection of Indicators

From the 12 selected SATs, we extracted 320 unique indicators, which were then aggregated and analysed for frequency of appearance. Indicators appearing in three or more SATs were retained to ensure cross-contextual validity; a threshold chosen to reflect robustness rather than arbitrary benchmarking. Furthermore, the threshold aligns with the United Kingdom's higher education standards, which classify a 30% score (less than three appearances) as a failure grade in the accreditation of engineering programs (Engineering Council, 2023). For conciseness, only the frequency matrix for the first academic category is presented in Appendix III. The summary of the overall frequency analysis is given in Table 3. This process yielded 57 candidate indicators. These were then refined through consolidation and contextual adaptation as presented in Appendix IV.

Table 3. Categorisation of the degree of appearance of the indicators

Categories	Below 30%	(30-49) %	(50-69) %	70% and above	Total
Academic	55	02	04	04	65
Engagement	27	04	04	02	37
Operations	85	03	07	06	101
Governance	96	11	09	01	117
Total	263	20	24	13	320

Source: Author

To enhance applicability to the Nigerian context, we introduced one context-specific indicator: sewage disposal. This addition was informed by Adenle et al. (2020), who identified inadequate waste-management infrastructure as a critical sustainability challenge on Nigerian campuses. We also consolidated overlapping indicators, for example, merging "offering academic courses with sustainability content" and "enrolling students in sustainability courses" into a single measure: "sustainability-focused academic courses offered by an HEI." Similarly, we split broader indicators, such as "staff and students involved in sustainability research," into discrete measures for staff and student involvement to improve precision and measurability.

The final set comprises 44 indicators, categorised under the four core HEI functions (Academic, Engagement, Operations, Governance) and mapped to the TBL dimensions. To ensure balance, we included both science-centric indicators, quantitative measures tied to environmental impact (e.g., electricity consumption, carbon emissions) (Aljerf & Choukaife, 2016), and policy-centric indicators, qualitative or normative measures reflecting institutional commitments to equity and justice (e.g., employees' rights and diversity coordination) (Rametsteiner et al., 2011). This method acknowledges its limitations: the dominance of Northern epistemologies in the SAT literature and the lack of direct input from Nigerian stakeholders. Nevertheless, by grounding indicator selection in cross-contextual patterns and supplementing with Nigeria-specific insights (Adenle et al., 2020), this approach offers a robust starting point for developing a locally relevant, TBL-integrated assessment framework, which is a critical first step in contexts where sustainability measurement remains nascent.

3. RESULTS

This study identifies a preliminary set of 44 PIs for evaluating SP in Nigerian HEIs, developed through a systematic review of SATs published between 1993 and 2024. While existing SAT frameworks predominantly reflect contexts in Europe, North America, and Asia, the African context remains

underrepresented. To address this gap, our approach extracts, refines, and contextually adapts indicators to align with Nigeria's institutional, infrastructural, and socio-economic realities. The complete indicator set is presented in Table 4, organised across four functional domains: academics (curriculum, education, research), engagement (campus and community activities), operations (resource use), and governance (strategy, policy, and accountability).

Table 4. Preliminary selected performance indicators

Indicators	Code	Description	Assessment Unit
Sustainability-focused academic courses offered by an HEI.	A1	The number of academic courses that focused on sustainability in an HEI.	Number
Academic programs with sustainability specialisations.	A2	The number of academic programs with sustainability specialisations in an HEI.	Number
Sustainability training for staff development.	A3	The number of sustainability trainings for staff development in an HEI.	Number
Staff involved in sustainability research.	A4	The number of staff involved in sustainability-focused research in an HEI.	Number
Students involved in sustainability research.	A5	The number of students involved in sustainability-focused research in an HEI.	Number
Intellectual property rights from sustainability-focused research.	A6	The number of intellectual property rights from sustainability-focused research in an HEI.	Number
Commercialised sustainability research outputs.	A7	The number of commercialised sustainability research outputs in an HEI.	Number
Publications related to sustainability.	A8	The number of publications (Books, book chapters, Journal Articles, Conference Papers, Policy Papers, etc.) related to sustainability in an HEI.	Number
Centres on campus providing sustainability-related research or services.	A9	The number of centres on campus providing sustainability-related research or services.	Number
Sustainable careers and recruitment.	A10	The number of sustainable careers and recruitment for sustainability-focused careers after studies.	Number
Sustainability culture.	E1	The extent to which sustainability culture is practised in an HEI.	Likert scale
Outreach materials and publications on sustainability.	E2	The extent of the availability of sustainability outreach information materials (website, bulletins, newsletters, etc.) in an HEI.	Likert scale
Orientation programs on sustainability for staff and students.	E3	The extent to which sustainability is incorporated into the orientation program for staff and students in an HEI.	Likert scale
Registered societies, clubs, and associations related to sustainability.	E4	The number of registered sustainability-related societies, clubs, and associations for staff and students in an HEI	Number
Inter-campus collaboration.	E5	The number of sustainability functions and projects carried out in collaboration with other campuses in an HEI.	Number
Community service engagement by staff and students.	E6	The number of community service engagements undertaken by staff and students through stakeholders' collaboration in an HEI.	Number
Electricity consumption.	O1	The amount of electricity consumed annually by an HEI.	kWh
Indicators	Code	Description	Assessment
Renewable energy.	O2	The amount of renewable energy consumed annually by an HEI.	kWh
Carbon emissions.	O3	The amount of direct and indirect carbon emitted annually by an HEI.	tCO ₂ e
Water consumption.	O4	The volume of water consumed annually by an HEI.	L

Solid waste generated.	O5	The quantity of solid waste generated annually by an HEI.	kg
Toxic and hazardous waste generated.	O6	The extent of safe disposal and treatment of toxic and hazardous wastes in an HEI.	Likert scale
Rainwater used.	O7	The annual volume of untreated rainwater used in an HEI.	L
Campus fleet.	O8	The number of registered eco-friendly. transportation (electric vehicles, electric motorcycles, etc.) in an HEI.	Number
Pedestrians and cycling.	O9	The extent to which pedestrians and cycling are promoted and encouraged in an HEI.	Likert scale
Eco-friendly buildings and facilities.	O10	The number of buildings and facilities with eco-friendly designs and construction in an HEI.	Number
Sustainable landscape management.	O11	The extent of the use of toxic and hazardous chemicals (inorganic fertilisers and chemical pesticides) to control pests and maintain campus grounds in an HEI.	Likert scale
Biodiversity and ecosystem services.	O12	The extent of care for the sustainable coexistence of man and other living things in an HEI.	Likert scale
Water efficiency measures.	O13	The extent to which Water minimisation and efficiency measures are put in place in an HEI.	Likert scale
Recycling of solid waste.	O14	The amount of solid waste recycled in an HEI.	kg
Public space.	O15	The extent to which public space is utilised for recreational and sporting activities in an HEI.	Likert scale
Green space and forest land.	O16	The extent to which green space and forest land are provided for and protected in an HEI.	
Sewage disposal.	O17	The extent to which sewage is efficiently and safely disposed of in an HEI.	Likert scale
Sustainability-dedicated employees.	G1	The extent to which relevant employees are dedicated to planning and managing initiatives in an HEI.	Likert scale
Procurements from sustainable suppliers.	G2	The number of procurements per annum from sustainable suppliers (machines, equipment, materials, furniture, food, etc.) in an HEI.	Number
Sustainability budget.	G3	The annual budget allocated to sustainability projects and initiatives in an HEI.	Amount in Naira
Non-financial incentives and support for staff.	G4	The extent to which non-financial incentives and support are given to employees to enhance sustainability-related teaching, research, and other initiatives in an HEI.	Likert scale
Employees' rights.	G5	The extent to which the rights of employees (including outsourced contract staff) are protected in line with the applicable laws and regulations.	Likert scale
Occupational health and safety of employees.	G6	The extent to which the health and safety of employees are protected in an HEI.	Likert scale
Total grants and funds for sustainability-related research.	G7	The amount of grants and funds received by an HEI for sustainability-related research.	Amount in Naira
Sustainability targets and strategies.	G8	The number and type of sustainability targets and strategies in an HEI.	Number
Sustainable/ethical investment and banking	G9	The amount of sustainable investment and banking in an HEI.	Amount in Naira
Diversity and equity coordination.	G10	The extent to which discrimination and inequality (including ethnicity, religious bias, gender bias, societal status, etc.) are prevalent in an HEI.	Likert scale
Sustainability reporting for stakeholders.	G11	The number of sustainability reports published annually by an HEI for Number stakeholders.	Number

KEY: A (Academic); E (Engagement); O (Operations); and G (Governance).

Likert scale: (1= very low, 2 = low, 3 = average, 4 = high, 5 = very high)

Source: Author

The framework integrates the TBL principle, encompassing environmental, social, and economic dimensions in accordance with prevailing SAT literature. Each indicator includes a clear description, code,

and standardised assessment unit (e.g., number, kWh, Likert scale, or amount in Naira), enabling consistent measurement and cross-institutional comparison. Notably, the study's main findings produced a set of PIs that balances globally recognised metrics, such as carbon emissions (O3), renewable energy use (O2), and sustainability publications (A8), with context-specific indicators, including sewage disposal (O17) and diversity and equity coordination (the discrimination and inequality, including ethnicity, religious bias, gender bias, societal status, etc. prevalent in an HEI) (G10), which reflect Nigeria's unique challenges. This dual orientation ensures both alignment with international standards and responsiveness to local priorities, offering a foundation for SP assessment that is both globally legible and locally meaningful.

4. DISCUSSIONS

The proposed indicator set reflects the multidimensional nature of sustainability. While specific indicators, such as electricity consumption (O1), renewable energy use (O2), water consumption (O4), and carbon emissions (O3), map clearly to the environmental pillar of the TBL, many others cut across social and economic domains. For example, staff and students' involvement in sustainability research (A4, A5), Publications related to sustainability (A8), and sustainability training for staff development (A3) simultaneously foster social capacity-building and drive economic innovation through knowledge production and commercialisation. This integrative character aligns with the holistic conception of SD emphasised in comparative SAT literature and underscores the limitations of rigid, siloed categorisation. As Elkington (1998, 2004) observed, the TBL framework is not a checklist but an interdependent system for addressing ecological crises alongside their socio-economic dimensions. Our methodology, therefore, covers indicators that collectively span all three TBL pillars and map equally to HEIs' core functions: academics, engagement, operations, and governance.

This study presents the first comprehensive, context-sensitive PI framework for sustainability performance assessment (SPA) in Nigerian HEIs. It bridges global SAT insights with local realities, including infrastructural deficits, limited data systems, and governance constraints. Furthermore, it challenges the uncritical transplantation of Northern-hemisphere models. The inclusion of precise, standardised assessment units (e.g., kWh, number of programs, Likert scales, Naira amounts) is a deliberate response to the vagueness that often plagues self-reported sustainability claims. Systematic reporting against these units would enable meaningful tracking of progress, particularly for operational indicators where quantitative improvements are most verifiable.

The academic domain moves beyond superficial curricular add-ons toward systemic integration of sustainability in teaching, research, and degree programs. Indicator (A1), sustainability-focused courses offered, was designed to accommodate institutions at early stages of adoption by prioritising course availability over enrolment figures. This pragmatic choice supports incremental institutional change while aligning with global trends in curriculum renewal. Similarly, A2 (academic programs with sustainability specialisations) and A9 (sustainability research centres) signal institutional commitment to producing skilled professionals and fostering innovation. Indicators A6, A7, and A8 further link research to real-world impact, reflecting growing expectations that HEIs contribute not only to knowledge but to scalable solutions for SD.

Engagement indicators position HEIs as civic actors. Initiatives such as sustainability orientation (E3), students' clubs (E4), and community service (E6) are vital for cultivating a "sustainability culture"; a

concept of particular relevance in contexts where, as Adenle et al. (2020) note, African HEIs remain in the introductory phase of sustainability adoption. Inter-campus collaboration (E5) and public outreach (E2) extend this role beyond institutional boundaries, reinforcing HEIs as nodes of knowledge exchange and societal transformation.

Operations encompass 17 indicators that capture HEIs' material footprint. Quantitative metrics (e.g., O1, O3, O5) enable benchmarking, while qualitative assessments (e.g., O11 on chemical use, O12 on biodiversity) address ecological integrity, often neglected in conventional audits. Nevertheless, as Teh (2025) indicates, insufficient public awareness of biodiversity conservation remains the leading driver of biodiversity decline. Notably, O17 (sewage disposal) directly responds to Nigeria's limited municipal sanitation infrastructure. This context-specific factor is absent in most global SATs but critical to local environmental health.

Governance indicators institutionalise sustainability through dedicated staffing (G1), budgeting (G3), ethical procurement (G2), and reporting (G11). Several reflect Nigeria's socio-political fabric, such as G10 (diversity and equity coordination), which interrogates discrimination along ethnic, religious, and gender lines in a pluralistic society, while G5 and G6 (employee rights and safety) anchor sustainability in labour justice. Procurement and investment indicators (G2, G9) echo global shifts toward using institutional leverage to promote responsible supply chains and divest from unsustainable industries.

In sum, the framework balances global comparability with contextual fidelity. By integrating conventional metrics, such as carbon emissions, with locally salient indicators, such as sewage management and religious inclusivity, it affirms that sustainability in HEIs cannot be decoupled from place-based realities. While the PIs remain preliminary and require empirical validation, they offer a critical foundation for SPA in Nigeria and similar settings. Achieving this enhances moving beyond generic templates toward situated, actionable sustainability governance.

5. RESEARCH IMPLICATIONS

This study offers several practical and strategic implications. The proposed set of preliminary PIs equips academic administrators in Nigeria with a structured means to communicate their institutions' sustainability practices and achievements transparently. Such transparency is essential for building social legitimacy and ensuring institutional resilience in an increasingly competitive higher education landscape. For policymakers, the framework provides a timely and actionable reference for guiding the SD of Nigerian HEIs with potential applicability to other regional institutions at similar early stages of sustainability integration.

Beyond national use, the indicators facilitate international benchmarking. Nigerian HEIs can systematically compare their sustainability performance, particularly in operations (e.g., renewable energy use, carbon emissions) and engagement (e.g., student societies, community outreach) with institutions in more advanced contexts such as Europe and North America. This comparative capacity supports institutional learning, identifies performance gaps, and informs strategic planning. Although tailored to Nigeria, the framework's structure allows for adaptation across comparable national settings in Africa. By enabling monitoring across TBL dimensions while permitting contextual flexibility in indicator classification, the framework positions Nigerian HEIs to strengthen domestic sustainability practice and actively contribute to regional and global dialogues on higher education sustainability performance.

6. CONCLUSION

The HEIs in Nigeria remain at an introductory phase of their sustainability journey and require PIs that reflect local social, economic, and infrastructural realities. Unlike institutions in Europe or North America, where SATs have evolved over decades, Nigerian and sub-Saharan African HEIs operate in contexts that demand context-specific approaches. Addressing this gap, this study proposes a preliminary set of 44 PIs derived from a systematic review of global SAT literature and adapted to the Nigerian setting, with potential relevance for similarly situated institutions across sub-Saharan Africa. The framework aligns with the four core functions of HEIs (academics, engagement, operations, and governance), ensuring that sustainability assessment encompasses knowledge creation, societal outreach, campus management, and institutional leadership. It also integrates TBL dimensions (environmental, social, and economic), offering a holistic lens that is particularly vital in regions where ecological challenges are deeply intertwined with socio-economic constraints.

Sustainability PIs provide measurable benchmarks that enable HEIs to evaluate progress, identify gaps, inform policy, and report transparently to stakeholders, thereby enhancing institutional credibility. To the authors' knowledge, this is the most recent systematic effort to develop a comprehensive, context-sensitive PI framework for assessing sustainability performance of HEIs in Nigeria, filling a documented gap in the literature and offering a potentially replicable model for the broader region. A key limitation is the scarcity and fragmentation of reliable sustainability data in Nigeria and much of sub-Saharan Africa, which hampers accurate measurement and longitudinal tracking. Nonetheless, this study establishes a foundational framework for advancing sustainability assessment and practice in a context that is critically underrepresented.

7. FUTURE RESEARCH DIRECTIONS

Future studies should refine and prioritise the 44 preliminary PIs by assigning weights to reflect their relative importance. The Delphi technique, a structured expert consensus method, offers a robust approach for this prioritisation, enhancing methodological rigour and enabling policymakers and university leaders to focus resources on the most impactful sustainability dimensions. Furthermore, innovative data collection strategies warrant exploration. Social media platforms, given their reach, accessibility, and capacity to capture diverse stakeholder perspectives, could supplement traditional top-down reporting with inclusive, bottom-up insights. Such participatory methods may strengthen accountability, raise awareness, and foster cultural change, embedding sustainability more deeply within institutional practices.

While data limitations persist, this indicator set provides a critical foundation for context-sensitive SPA of HEIs in Nigeria. Building on it through weighting, validation, and novel data approaches can advance sustainability outcomes across Nigeria and the wider sub-Saharan African region.

8. ACKNOWLEDGEMENTS/FUNDING

The authors extend their gratitude to the Universiti Teknologi Malaysia for the good research infrastructure that facilitated this study. No grant or organisation supports this work. This research is part of a thesis to be submitted as partial fulfilment of the requirements for the degree of Doctor of Philosophy at Universiti Teknologi Malaysia.

9. CONFLICT OF INTEREST STATEMENT

The authors declare no financial interests, personal relationships, or proprietary interests in any material discussed in this article.

10. AUTHORS' CONTRIBUTIONS

All authors collaboratively formulated the research design and the manuscript. The submitting author was primarily responsible for data cleansing and tabulation. Each author meticulously reviewed and endorsed the final manuscript, reflecting their unified concurrence.

11. DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

AI tools like ChatGPT, Grammarly) were used for drafting, assistance, paraphrasing and grammar checking. All content was critically reviewed and edited by researcher.

12. DATA AVAILABILITY/SUPPLEMENTARY MATERIALS

The datasets used and/or analysed during this study are available from the corresponding author upon reasonable request.

13. ETHICS STATEMENT

The authors declare that this research did not involve human or animal subjects.

14. REFERENCES

- AASHE. (2019). *STARS Technical Manual Version 2.2*. 1–322. <https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf>
- Adenle, Y. A., Chan, E. H. W., Sun, Y., & Chau, C. K. (2020). Modifiable campus-wide appraisal model (MOCAM) for sustainability in higher education institutions. *Sustainability*, 12(17) <https://doi.org/10.3390/su12176821>
- Alba-Hidalgo, D., Benayas del Álamo, J., & Gutiérrez-Pérez, J. (2018). Towards a Definition of Environmental Sustainability Evaluation in Higher Education. *Higher Education Policy*, 31(4), 447–470. Retrieved from

^{2*}Corresponding author. E-mail address: m-wongky@utm.my
Co-authors. E-mail address : iyekeoma@gmail.com

<https://doi.org/10.1057/s41307-018-0106-8>

- Alghamdi, N., Heijer, A. Den, & Jonge, H. De. (2017). Assessment tools' indicators for sustainability in universities: an analytical overview. *International Journal of Sustainability in Higher Education*, 18(1), 84–115. <https://doi.org/10.1108/IJSHE-04-2015-0071>
- Aljerf, L., & Choukaife, A. E. (2016). Sustainable development in Damascus University: A survey of internal stakeholder views. *J Environ Stud*, 2(2), 1–12. <https://pdfs.semanticscholar.org/7b99/c7e450c725f081660741492762e138fd976a.pdf>
- Amaral, L. P., Martins, N., & Gouveia, J. B. (2015). Quest for a sustainable university: A review. *International Journal of Sustainability in Higher Education*, 16(2), 155–172. <https://doi.org/10.1108/IJSHE-02-2013-0017>
- AAU. (2009). *Abuja Declaration on sustainable development in Africa: the role of higher education*. In 12th General Conference of Association of African Universities (p. 2). https://www.aau.org/wp-content/uploads/sites/9/2018/04/abuja_declaration_on_sustainable_development.pdf
- Azhar, F. N., Zain, Z. M., & Ayob, N. A. (2025). Exploring Shah Alam City Council's Commitment Towards a Low-Carbon City. *Malaysian Journal of Sustainable Environment*, 12(1), 265–284. <https://doi.org/10.24191/myse.v12i1.1646>
- Berzosa, A., Bernaldo, M. O., & Fern, G. (2017). *Sustainability assessment tools for higher education : An empirical comparative analysis*. 161, 812–820. Retrieved from doi:10.1016/j.jclepro.2017.05.194
- Beynaghi, A., Trencher, G., Moztarzadeh, F., Mozafari, M., Maknoon, R., & Leal Filho, W. (2016). Future sustainability scenarios for universities: Moving beyond the United Nations Decade of Education for Sustainable Development. *Journal of Cleaner Production*, 112, 3464–3478. <https://doi.org/10.1016/j.jclepro.2015.10.117>
- Bullock, G., & Wilder, N. (2016). The comprehensiveness of competing higher education sustainability assessments. *International Journal of Sustainability in Higher Education*, 17(3), 282–304. <https://doi.org/10.1108/IJSHE-05-2014-0078>
- Caeiro, S., Hamón, L. A. S., Martins, R., & Aldaz, C. E. B. (2020). Sustainability assessment and benchmarking in higher education institutions: a critical reflection. *Sustainability*, 543(12). <https://doi.org/10.3390/su12020543>
- Cole, L. (2005). *Assessing Sustainability on Canadian University Campuses: Development of a Campus Assessment Framework*. In Handbook of Sustainability Research. Frankfurt (GE). B.Sc. University of Victoria, 2000. <https://scispace.com/pdf/assessing-sustainability-on-canadian-university-campuses-ta5bbs3hx5.pdf>
- Dave, M., Gou, Z., Prasad, D., & Li, F. (2014). *Greening Universities Toolkit V2.0: Transforming Universities into Green and Sustainable Campuses : A Toolkit for Implementers* (M. Pradhan & P. Fuentenebro (eds.)). United Nations Environment Programme (UNEP). <https://wedocs.unep.org/20.500.11822/11964>
- De Filippo, D., Sandoval-Hamón, L. A., Casani, F., & Sanz-Casado, E. (2019). Spanish Universities' sustainability performance and sustainability-related R & D+I. *Sustainability*, 5570(11). https://doi.org/10.3390/su11205570?urlappend=%3Futm_source%3Dresearchgate.net%26utm_medium%3Darticle
- Drahein, A. D., De Lima, E. P., & Da Costa, S. E. G. (2019). Sustainability assessment of the service operations at seven higher education institutions in Brazil. *Journal of Cleaner Production*, 212, 527–536. <https://doi.org/10.1016/j.jclepro.2018.11.293>
- Du, Y., Arkesteijn, M. H., & Heijer, A. C. Den. (2020). Sustainable Assessment Tools for Higher Education Institutions: Guidelines for Developing a Tool for China. *Sustainability (Switzerland)*, 6501(12). <https://doi.org/10.3390/su12166501>

- Du, Y., Ye, Q., Liu, H., Wu, Y., & Wang, F. (2023). Sustainable Assessment Tools for Higher Education Institutions: Developing Two-Hierarchy Tools for China. *Sustainability (Switzerland)*, 15(15), 11551. <https://doi.org/10.3390/su151511551>
- Dyer, G., & Dyer, M. (2017). Strategic leadership for sustainability by higher education: The American college & university presidents' climate commitment. *Journal of Cleaner Production*, 140, 111–116. <https://doi.org/10.1016/j.jclepro.2015.08.077>
- Elkington, J. (1998). Accounting for the Triple Bottom Line. *Measuring Business Excellence*, 2(3), 18–22. <https://doi.org/10.1108/eb025539>
- Elkington, J. (2004). *Enter the Triple Bottom Line*. In A. Henriques & J. Richardson (Eds.), *The Triple Bottom Line: Does It All Add Up* (pp. 1–16). Routledge. <https://doi.org/10.1108/13598540910941948>
- Engineering Council. (2023). *Accreditation of Higher Education Programs (AHEP)*. Engineering Council. <https://oldwww.engc.org.uk/education-skills/accreditation-of-higher-education-programmes/>
- Findler, F., Schönherr, N., & Lozano, R. (2019). Assessing the Impacts of Higher Education Institutions on Sustainable Development — An Analysis of Tools and Indicators. *Sustainability*, 59(11). <https://doi.org/10.3390/su11010059>
- Fischer, D., Jenssen, S., & Tappeser, V. (2015). Getting an empirical hold of the sustainable university: a comparative analysis of evaluation frameworks across 12 contemporary sustainability assessment tools. *Assessment and Evaluation in Higher Education*, 40(6), 785–800. <https://doi.org/10.1080/02602938.2015.1043234>
- Fonseca, A., Macdonald, A., Dandy, E., & Valenti, P. (2011). The state of sustainability reporting at Canadian universities. *International Journal of Sustainability in Higher Education*, 12(1), 22–40. <https://doi.org/10.1108/14676371111098285>
- Gamage, P., & Sciulli, N. (2017). Sustainability Reporting by Australian Universities. *Australian Journal of Public Administration*, 76(2), 187–203. Retrieved from doi:10.1111/1467-8500.12215
- Góes, H. C. de A., & Magrini, A. (2016). Higher education institution sustainability assessment tools: Considerations on their use in Brazil. *International Journal of Sustainability in Higher Education*, 17(3), 322–341. <https://doi.org/10.1111/1467-8500.12215>
- Gómez, F. U., Sáez-Navarrete, C., Lioi, S. R., & Marzuca, V. I. (2015). Adaptable model for assessing sustainability in higher education. *Journal of Cleaner Production*, 107, 475–485. <http://dx.doi.org/10.1016/j.jclepro.2014.07.047>
- Gunasekara, C. (2006). Reframing the role of universities in the development of regional innovation systems. *The Journal of Technology Transfer*, 31(1), 101–113. <https://eprints.qut.edu.au/10427/1/10427.pdf>
- Gustavo De Lima, R., Lins, H. N., Pfitscher, E. D., Garcia, J., Suni, A., Salgueirinho Osório De Andrade Guerra, J. B., & Caroline Renata Delle, F. (2016). A sustainability evaluation framework for Science and Technology Institutes: An international comparative analysis. *Journal of Cleaner Production*, 125, 145–158. <https://doi.org/10.1016/j.jclepro.2016.03.028>
- Halmi, N. Q. A., & Ismail, Z. (2017). Environmental pollution and existing regulations: A review analysis. *Malaysian Journal of Sustainable Environment*, 2(1), 73–86. <https://ir.uitm.edu.my/id/eprint/29797/1/29797.pdf>
- Kamal, A. S. M., & Asmuss, M. (2013). Benchmarking tools for assessing and tracking sustainability in higher educational institutions: Identifying an effective tool for the University of Saskatchewan. *International Journal of Sustainability in Higher Education*, 14(4), 449–465. <https://doi.org/10.1108/IJSHE-08-2011-0052>
- Kapitulčinová, D., AtKisson, A., Perdue, J., & Will, M. (2018). Towards integrated sustainability in higher education

- Mapping the use of the Accelerator toolset in all dimensions of university practice. *Journal of Cleaner Production*, 172, 4367–4382. <https://doi.org/10.1016/j.jclepro.2017.05.050>
- Larrán Jorge, M., Herrera Madueño, J., Calzado, Y., & Andrades, J. (2016). A proposal for measuring sustainability in universities: a case study of Spain. *International Journal of Sustainability in Higher Education*, 17(5), 671–697. <https://doi.org/10.1108/IJSHE-03-2015-0055>
- Lauder, A., Sari, R. F., Suwartha, N., & Tjahjono, G. (2015). Critical review of a global campus sustainability ranking: GreenMetric. *Journal of Cleaner Production*, 108, 852–863. <https://doi.org/10.1016/j.jclepro.2015.02.080>
- Leal Filho, W., Eustachio, J. H. P. P., Caldana, A. C. F., Will, M., Salvia, A. L., Rampasso, I. S., Anholon, R., Platje, J., & Kovaleva, M. (2020). Sustainability leadership in higher education institutions: An overview of challenges. *Sustainability*, 12(9). <https://doi.org/10.3390/su12093761>
- Lopatta, K., & Jaeschke, R. (2014). Sustainability reporting at German and Austrian universities. *Int. J. Education Economics and Development*, 5(1), 66–90. <https://doi.org/10.1504/IJEED.2014.059868>
- Lozano, R. (2006). A tool for a Graphical Assessment of Sustainability in Universities (GASU). *Journal of Cleaner Production*, 14(9–11), 963–972. <https://doi.org/10.1016/j.jclepro.2005.11.041>
- Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, F. J., Waas, T., Lambrechts, W., Lukman, R., & Hugé, J. (2015). A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. *Journal of Cleaner Production*, 108, 1–18. <https://doi.org/10.1016/j.jclepro.2014.09.048>
- Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D., & Lambrechts, W. (2013). Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *Journal of Cleaner Production*, 48, 10–19. <https://doi.org/10.1016/j.jclepro.2011.10.006>
- Lukman, R., Krajnc, D., & Glavič, P. (2010). University ranking using research, educational and environmental indicators. *Journal of Cleaner Production*, 18, 619–628. <https://doi.org/10.1016/j.jclepro.2009.09.015>
- Madeira, A. C., Carravilla, M. A., Oliveira, J. F., & Costa, C. A. V. (2011). A methodology for sustainability evaluation and reporting in higher education institutions. *Higher Education Policy*, 24(4), 459–479. <https://doi.org/10.1057/hep.2011.18>
- Maragakakis, A., & van den Dobbelsteen, A. (2015). Sustainability in higher education: Analysis and selection of assessment systems. *Journal of Sustainable Development*, 8(3). <https://doi.org/10.5539/jsd.v8n3p1>
- Mohd Zulkifli, S. A., Noorazlan Ong, N. D., & Sheikh Zain, R. (2021). The Impact of Malaysian Economic Development on Co2 Emission. *Malaysian Journal of Sustainable Environment*, 8(1), 105–118. <https://doi.org/10.24191/myse.v8i2.13241>
- Mora, H., Pujol-López, F. A., Mendoza-Tello, J. C., & Morales-Morales, M. R. (2020). An education-based approach for enabling the sustainable development gear. *Computers in Human Behavior*, 107. <https://doi.org/10.1016/j.chb.2018.11.004>
- National Universities Commission (2023). *Nigerian University System Statistical Digest Data Collection for Universities* (Reports for Universities). https://www.nuc.edu.ng/wp-content/uploads/2021/07/2019-nigerian-university-system-statistical-digest-condensed-version-final-2_compressed.pdf
- National Universities Commission (2019). *Nigerian University System Statistical Digest*. <https://nigeriareposit.nln.gov.ng/handle/20.500.14186/727>
- Parvez, N., & Agrawal, A. (2019). Assessment of sustainable development in technical higher education institutes of

- India. *Journal of Cleaner Production*, 214, 975–994. <https://doi.org/10.1016/j.jclepro.2018.12.305>
- People & Planet (2024/2025). *People & Planet University League*. <https://www.reading.ac.uk/news/2024/University-News/Reading-University-People-and-Planet-ranking-2024-2025>
- Rametsteiner, E., Alkan-olsson, J., Frederiksen, P., & Pulzl, H. (2011). Sustainability indicator development — Science or political negotiation? *Ecological Indicators*, 11(1), 61–70. <https://doi.org/10.1016/j.ecolind.2009.06.009>
- Roorda, N., Rammel, C., Waara, S., & Paleo, U. F. (2009). *AISHE 2.0 Manual - English Edition*. https://www.researchgate.net/publication/327551379_AISHE_20_Manual_-_English_Edition
- Roos, N., Heinicke, X., Guenther, E., & Guenther, T. W. (2020). The role of environmental management performance in higher education institutions. *Sustainability*, 12(2). <https://doi.org/10.3390/su12020655>
- rootAbility Green Office Model, Maastricht University. (2017). *University Sustainability Assessment Framework (UniSAF)*. <https://www.greenofficemovement.org/sustainability-assessment/>
- Ryan-Fogarty, Y., O'Carroll, D., O'Mahony, M. J., & O'Regan, B. (2016). *Development of the green-campus programme in Ireland: Ensuring continuity of environmental education and action for sustainable development throughout the Irish education system*. In W. Leal Filho & P. Pace (Eds.), *In Teaching Education for Sustainable Development at University Level* (pp. 269–284). Cham, Switzerland: Springer. https://doi.org/10.1007/978-3-319-32928-4_19
- Saadatian, O., Salleh, E. I., Dola, K. B., & Tahir, O. M. (2011). Identifying Strength and Weakness of Sustainable Higher Educational Assessment Approaches. *International Journal of Business and Social Science*, 2(3), 137–147
- Sady, M., Żak, A., & Rzepka, K. (2019). The role of universities in sustainability-oriented competencies development: Insights from an empirical study on Polish universities. *Administrative Sciences*, 9(3). Retrieved from doi:10.3390/admsci9030062
- Salvia, A. L., Brandli, L. L., Leal Filho, W., Rebelatto, B. G., & Reginatto, G. (2020). Energy sustainability in teaching and outreach initiatives and the contribution to the 2030 Agenda. *International Journal of Sustainability in Higher Education*, 21, 1607–1624. Retrieved from doi:10.1108/IJSHE-05-2020-0180
- Schoenaker, N., Hoekstra, R., & Smits, J. P. (2015). Comparison of measurement systems for sustainable development at the national level. *Sustainable Development*, 23(5), 285–300. <https://doi.org/10.1002/sd.1585>
- Sepasi, S., Rahdari, A., & Rexhepi, G. (2018). *Developing a sustainability reporting assessment tool for higher education institutions: The University of California*. *Sustainable Development*, 1–11. Retrieved from doi:10.1002/sd.1736
- Shawe, R., Horan, W., Moles, R., & O'Regan, B. (2019). Mapping of sustainability policies and initiatives in higher education institutes. *Environmental Science and Policy*, 99(4), 80–88. <https://doi.org/10.1016/j.envsci.2019.04.015>
- Shi, H., & Lai, E. (2013). An alternative university sustainability rating framework with a structured criteria tree. *Journal of Cleaner Production*, 61, 59–69. <https://doi.org/10.1016/j.jclepro.2013.09.006>
- Shriberg, M. (2002). Institutional assessment tools for sustainability in higher education: Strengths, weaknesses, and implications for practice and theory. *Higher Education Policy*, 15(2), 153–167. [https://doi.org/10.1016/S0952-8733\(02\)00006-5](https://doi.org/10.1016/S0952-8733(02)00006-5)
- Sonetti, G., Lombardi, P., & Chelleri, L. (2016). True green and sustainable university campuses? Toward a clusters approach. *Sustainability*, 8. <https://doi.org/10.3390/su8010083>

- Tan, H., Chen, S., Shi, Q., & Wang, L. (2014). Development of green campus in China. *Journal of Cleaner Production*, 64, 646–653. <https://doi.org/10.1016/j.jclepro.2013.10.019>
- Teh, K. Y. (2025). Factors Affecting Local Communities' Support for Environmental Sustainability in Taman Negara Pahang, Kuala Tahan, Malaysia. *Malaysian Journal of Sustainable Environment*, 12(1), 241–264. <https://doi.org/10.24191/myse.v12i1.2540>
- Togo, M., & Lotz-Sisitka, H. (2009). *Unit-Based Sustainability Assessment Tool*. www.unep.org/unit-based-sustainability-assessment-tool
- ULSF. (2001). *Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities* (pp. 1–12). <https://ulsf.org/sustainability-assessment-questionnaire/>
- UNESCO. (1997). *Educating for a Sustainable Future: A Transdisciplinary Vision for Concerted Action*. <https://unesdoc.unesco.org/ark:/48223/pf0000110686>
- UNFPA. (2025). *World population dashboard*. www.unfpa.org/data/world-population
- Veidemann, A. (2022). Education for sustainable development in higher education rankings: Challenges and opportunities for developing internationally comparable indicators. *Sustainability*, 14(9), Article 5102. <https://doi.org/10.3390/su14095102>
- Velasco, A., Valencia, M., Morrow, S., & Ochoa-Herrera, V. (2018). Understanding the limits of assessing sustainability at Universidad San Francisco de Quito USFQ, Ecuador, while reporting for a North American system. *International Journal of Sustainability in Higher Education*, 19(4), 721–738. <https://doi.org/10.1108/IJSHE-04-2017-0054>
- Yarime, M., & Tanaka, Y. (2012). The Issues and Methodologies in Sustainability Assessment Tools for Higher Education Institutions: A Review of Recent Trends and Future Challenges. *Journal of Education for Sustainable Development*, 6(1), 63–77. <https://doi.org/10.1177/097340821100600113>
- Yuting, W., Athira, Rahinah, Sarah, & Azmiah. (2024). Dynamics in Harmonious Human-Nature Urban Ecosystem Model for Environmental Sustainability: A Review. *Malaysian Journal of Sustainable Environment*, 11(2), 45–74. <https://doi.org/10.24191/myse.v12i1.1566>
- Zahid, M., Ur Rahman, H., Ali, W., Habib, M. N., & Shad, F. (2021). Integration, implementation, and reporting outlooks for sustainability in higher education institutions (HEIs): index and case-based validation. *International Journal of Sustainability in Higher Education*, 22(1), 120–137. <https://doi.org/10.1108/IJSHE-10-2019-0308>



© 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY-NC-ND) license (<http://creativecommons.org/licenses/by/4.0/>).

15. APPENDIX

A. Screening criteria of sustainability assessment tools for HEIs

Measures used	Explanation
Ease of access	E1- Primary information accessible in published literature or digital platforms E2- Obtainable in the English language
Usage status	S1- The SAT is functioning S2- User response or usage example is obtainable
Theme of SAT	T1- Crafted for HEIs T2- Comprehensive framework for evaluating SD that encompasses academic (education, research, and curriculum), institutional operations, governance, and community engagement.

Source: Modified and adapted from Du et al. (2020)

B. Screening process of sustainability assessment tools (SATs) for HEIs

S/N	Campus Sustainability Assessment Tools (SATs)	Origin	E1	E2	S1	S2	T1	T2	Revision number	Decision	Reference
1	Accelerator	A set of change-agency tools and methods based on SD principles.	✓	✓	✓	×	–	×	1	EX	Kapitulčinová et al. (2018)
2	ACUPCC	American colleges and universities' presidents' climate commitment.	✓	✓	✓	–	✓	×	3	EX	Fonseca et al. (2011)
3	AISHE	Auditing instrument for sustainability in HEIs.	✓	✓	✓	✓	✓	✓	20	IN	Shriberg (2002)
4	AMAS	Adaptable model for sustainability in HEIs.	✓	✓	✓	✓	✓	✓	6	IN	De Filippo et al. (2019)
5	AMPR	Alternative missing pieces reports I, II, & III approach.	✓	✓	×	–	–	–	2	EX	Saadatian et al. (2011)
6	ARWU	Academic ranking of world universities.	✓	✓	✓	✓	✓	×	–	EX	Lukman et al. (2010)
7	ASGC	Assessment standard for green campus.	✓	✓	✓	✓	✓	×	1	EX	Du et al. (2020)
8	ASSC	Assessment system for a sustainable campus.	✓	✓	✓	✓	✓	✓	3	IN	Alghamdi et al. (2017)
9	AUSP	Assessment of university sustainability Policies.	✓	×	–	–	–	–	1	EX	Gómez et al. (2015)
10	A3P	Public Administration Environmental Agenda Guidelines for Brazil.	×	✓	✓	✓	✓	×	2	EX	Gustavo De Lima et al. (2016)
11	BIQ-AUA	Benchmarking indicators. Alternative university appraisal (AUA).	×	–	–	–	✓	×	8	EX	Kapitulčinová et al. (2018)
12	BGP	Beyond grey pinstripes.	✓	✓	✓	✓	×	×	2	EX	Bullock & Wilder (2016)
13	BSIS	Business school impact system.	✓	✓	✓	✓	×	×	1	EX	Findler et al. (2019)
14	CE	Campus ecology.	✓	✓	×	–	✓	✓	6	EX	Draheim et al. (2019)
15	CITEAMB	Red de Ciencia, Tecnología, Innovación y Educación Ambiental en Iberoamérica.	✓	×	–	–	–	–	1	EX	Fischer et al. (2015)
16	CRC	Campus report card.	×	–	–	–	✓	✓	1	EX	Parvez & Agrawal (2019)
17	CRUE	Conference of rectors of Spanish Universities.	✓	×	–	–	–	–	1	EX	Fischer et al. (2015)
18	CS	Cool schools.	✓	✓	✓	✓	✓	×	3	EX	Fonseca et al. (2011)
19	CSAF	Campus sustainability assessment framework.	✓	✓	✓	×	✓	✓	10	EX	Lopatta & Jaeschke (2014)
20	CSAF (core)	Campus sustainability assessment framework core.	✓	✓	✓	✓	✓	×	5	EX	Gamage & Scullin (2017)
21	CSAF (refined)	Campus sustainability assessment framework refined.	✓	✓	✓	✓	✓	×	1	EX	Parvez & Agrawal (2019)
22	CSAR	Campus sustainability assessment review project.	✓	✓	×	–	–	–	5	EX	Findler et al. (2019)
23	CSRC	College sustainability report card.	✓	✓	×	✓	✓	✓	11	EX	Draheim et al. (2019)
24	CSISG	Campus Sustainability Selected Indicators Snapshot and Guide.	✓	✓	–	–	–	×	6	EX	Shriberg (2002)
25	DUK	German Commission for UNESCO.	✓	✓	–	–	–	–	2	EX	Fischer et al. (2015)
26	DLEPI	Draft list of environmental performance indicators.	×	–	–	–	–	–	1	EX	Saadatian et al. (2011)
27	ERW	Environmental report and workbook.	×	–	–	–	–	–	6	EX	Yarime & Tanaka (2012)
28	EAMC	Environmental assessment method for the community.	×	–	–	–	–	–	1	EX	Saadatian et al. (2011)
29	EMAS	Eco-management and audit scheme.	✓	✓	✓	–	×	×	1	EX	Sepassi et al. (2019)

S/N		Campus Sustainability Assessment Tools (SATs)	Origin	E1	E2	S1	S2	T1	T2	Revision number	Decision	Reference
30	EMS (self assessment)	Environmental management system self-assessment checklist.	USA	✓	✓	✓	✓	×	×	5	EX	Lozano (2006)
31	EPS	Environmental performance survey.	Canada; USA	✓	✓	×	×	—	×	3	EX	Shriberg (2002)
32	ESD (toolkit)	Education for Sustainable Development Toolkit.	Canada	✓	✓	✓	✓	✓	×	1	EX	Sepasi et al. (2019)
33	ESET	Environmental sustainability evaluation tool for Spanish Universities.	Spain	✓	×	✓	—	✓	✓	1	EX	Alba-Hidalgo et al. (2018)
34	ESDGC	Education for Sustainable Development and Global Citizenship.	UK	✓	✓	—	×	✓	×	1	EX	Kapitučínová et al. (2018)
35	FLA	Framework level actors	International	✓	✓	✓	✓	✓	×	1	EX	Alba-Hidalgo et al. (2018)
36	GASU	Graphical assessment of sustainability in universities.	UK	✓	✓	✓	✓	✓	✓	12	IN	Findler et al. (2019)
37	GCUR	Greenopia college and university ranking.	USA	×	—	—	—	—	—	1	EX	Parvez & Agrawal (2019)
38	GM	UIGreen metric world university ranking.	Indonesia	✓	✓	✓	✓	✓	×	13	EX	Draheim et al. (2019)
39	GMD	Graze model for integrated development.	Australia	✓	✓	✓	✓	✓	×	3	EX	Findler et al. (2019)
40	GP	Green plan.	France	×	—	—	—	✓	—	7	EX	Alghamdi et al. (2017)
41	GRI	Global Reporting Initiative.	International	✓	✓	✓	✓	✓	×	3	EX	Ganage & Sculli (2017)
42	GPGT	Grey pinstripes with green ties.	USA	✓	✓	—	—	×	×	4	EX	Sepasi et al. (2019)
43	GC	Greening campuses.	Canada	×	—	—	—	✓	—	3	EX	Lozano (2006)
44	GU (toolkit)	Greening University Toolkit.	International	✓	✓	✓	✓	✓	✓	2	IN	Ganage & Sculli (2017)
45	GS	Greening.	Indonesia	✓	✓	—	—	✓	×	1	EX	Lauder et al. (2015)
46	GTGCU	Grist's top 15 green colleges and universities.	USA	✓	✓	×	—	✓	×	1	EX	Fonseca et al. (2011)
47	HE21	Higher education 21's sustainability indicators.	UK	×	—	—	—	✓	—	3	EX	Shriberg (2002)
48	HEPSRT	Higher education partnership for a sustainability reporting tool.	UK	×	—	—	—	✓	—	2	EX	Yarime & Tanaka (2012)
49	INDICARE	Indicator-based model to assist in assessing participatory processes.	International	✓	✓	✓	×	—	—	2	EX	Kapitučínová et al. (2018)
50	KSD	Knowledge for sustainable development assessment in McGill.	Canada	✓	✓	×	—	—	—	1	EX	Saadatian et al. (2011)
51	KSGSE	Knight school guide to sustainable education.	Canada	✓	✓	✓	✓	✓	×	1	EX	Fonseca et al. (2011)
52	LIFE	Learning in a future environment.	UK; Australia	×	—	—	—	✓	✓	1	EX	Ganage & Sculli (2017)
53	MCA	Multi-criteria analysis: a tool for a sustainability approach.	—	×	—	—	—	—	—	1	EX	Saadatian et al. (2011)
54	MMAG	Maclean's magazine's annual guide to Canadian universities.	Canada	✓	✓	✓	✓	✓	×	2	EX	Saadatian et al. (2011)
55	PENN	Penn State indicators report.	USA	✓	✓	✓	✓	—	—	4	EX	Findler et al. (2019)
56	P & P	Green League (People & Planet).	UK	✓	✓	✓	✓	✓	✓	6	IN	Findler et al. (2019)
57	PSI	Pacific sustainability index.	USA	✓	✓	✓	✓	✓	×	5	EX	Bullock & Wilder (2016)
58	PRGR	Princeton Review's Green Ratings.	USA	✓	✓	✓	✓	✓	×	2	EX	Amaral et al. (2015)
59	SAHTE	Sustainability assessment for higher technological education.	Brazil	✓	×	—	—	✓	—	1	EX	Draheim et al. (2019)
60	SAF	Sustainable assessment framework for Waterloo University.	Canada	×	—	—	—	—	—	1	EX	Saadatian

S/N		Campus Sustainability Assessment Tools (SATs)	Origin	E1	E2	S1	S2	T1	T2	Revision number	Decision	Reference
61	SAQ	Sustainability assessment questionnaire.	International	✓	✓	✓	✓	✓	✓	15	IN	et al. (2011)
62	SCE	National Wildlife Federation State of the Campus Environment.	USA	✓	✓	×	–	✓	×	11	EX	Findler et al. (2019)
63	SLS	Sustainability leadership scorecard.	UK; Ireland	✓	✓	–	–	✓	×	5	EX	Findler et al. (2019)
64	Sus (HEI)	Sustainability in HEIs model.	Portugal	✓	✓	✓	✓	✓	✓	5	IN	Caciro et al. (2020)
65	SPT	Good company's sustainable pathways toolkit.	USA	✓	✓	×	✓	✓	×	5	EX	Larrán Jorge et al. (2016)
66	STARS	Sustainability tracking, assessment & ranking system.	North America	✓	✓	✓	✓	✓	✓	23	IN	Sepasi et al. (2019)
67	STAUNCH	Sustainability tool for assessing university curriculum in higher education.	UK	✓	✓	✓	✓	✓	×	4	EX	Kapulućinová et al. (2018)
68	Sustainabl	Sustainable assessment tool driven by Dutch students.	Netherlands	✓	✓	✓	✓	×	×	2	EX	Findler et al. (2019)
69	Sustain-Tool	Sustainable assessment tool program.	North America	✓	✓	✓	✓	✓	×	5	EX	Veidemann (2022)
70	SUM	Sustainable university model.	Mexico	✓	✓	✓	✓	✓	×	2	EX	Veidemann (2022)
71	TUR	Three-dimensional university ranking.	Slovenia	✓	✓	✓	✓	✓	×	3	EX	De Filippo et al. (2019)
72	UCLA	University of California, Los Angeles, environmental audit approach.	North America	✓	✓	×	–	–	×	1	EX	Alba-Hidalgo et al. (2018)
73	UEMS	University Environmental Management System.	Saudi Arabia	✓	✓	–	×	✓	×	3	EX	Saadatian et al. (2011)
74	UNIMETRICS	Value metrics and policies for a sustainable university campus.	European Union (EU)	×	✓	–	–	✓	–	1	EX	Parvez & Agrawal (2019)
75	UNISAF	University sustainability assessment framework.	–	✓	✓	✓	✓	✓	✓	5	IN	Sonetti et al. (2016)
76	USAT	Unit-based sustainability assessment tool.	Sweden; Africa	✓	✓	✓	✓	✓	✓	10	IN	Veidemann (2022)
				✓	✓	✓	✓	✓	✓			Findler et al. (2019)

C. Indicators screening process for the academic category

Indicator Type	Code	AISHE	AMAS	ASSC	CSAF-core	GAST	P & P	SAQ	STARS	SusHEI	GU (Toolkit)	UnisAF	USAT	%
Access to research.	A1								X					08
Administrative support for sustainability research, education, and curriculum.	A2					X					X	X		23
Application of sustainability research to inform the sustainability transition of an HEI.	A3										X		X	15
Assessing sustainability aspects during projects.	A4												X	08
Availability of sustainability-focused courses to students from other faculties.	A5						X			X		X		23
Collaborating between faculties, institutions, and stakeholders.	A6					X							X	23
Collaborating in teaching sustainability courses at the faculty level.	A7					X					X		X	23
Committing some of the department's resources to sustainability projects in the community.	A8											X	X	08
Contributions to research for profit.	A9				X									08
Courses to educate the educators in SD.	A10					X					X			23
Critical thinking skills development in students.	A11								X		X		X	15
Deep immersion in a sustainability experience.	A12				X				X		X			15
Development of courses for profit.	A13				X									08
Educational offerings/teaching for the general public.	A14										X	X		15
Encouraging and supporting students' educational and research activities.	A15			X										15
Engaging sustainability in traditional disciplines such as Mathematics, Literature, and History.	A16							X			X			15
Enrolling students in courses with sustainability concerns	A17				X	X	X				X	X	X	69
Estimating the amount of research done by staff and students related to sustainability.	A18							X			X			15
Examining sustainability aspects during courses.	A19				X				X				X	23
Inhibiting the act of respect for other opinions in students	A20										X		X	15
Institution as "Living Lab".	A21			X					X		X			23
Integrating operations practices into the educational and scholarly activities of an HEI.	A22							X					X	15
Integrating problem-solving skills in the curriculum.	A23												X	08
Learning outcomes and sustainability literacy assessment.	A24			X					X					23
Level of research output through publications, conferences, and seminars.	A25		X	X	X	X	X				X	X	X	62
List of issues addressed in curriculum (renewable energy, ecological economics, urban planning, etc.).	A26					X					X			15
Looking at global sustainability issues and challenges in research.	A27										X		X	15
Looking at local sustainability issues and challenges in research.	A28												X	08
Making informed decisions in the teaching approach.	A29												X	08
Management procedure to monitor the incorporation of SD themes into curricula.	A30					X	X				X			23
Management structure and incorporation follow-up procedures, continuous improvement methods, and related topics adaptation to the curricula.	A31					X	X				X			23
The multidisciplinary and interdisciplinary nature of research.	A32	X		X	X	X	X				X	X		77
National and international partnership and collaboration in research.	A33			X	X								X	15
Number and functions of centers on campus providing sustainability-related research or services.	A34					X	X				X			31
Number and percentage of departments and colleges offering sustainability courses.	A35				X	X								23
The number of research projects focused on sustainability conducted by sustainability researchers in research institutes.	A36											X		23
Offering academic topics/courses with sustainability concerns.	A37													
Patents and research commercialization.	A38	X		X	X	X	X	X	X	X	X	X	X	92
Percentage of faculty doing research in sustainability.	A39	X			X	X				X	X	X		46
Research collaboration with non-profit-making enterprises.	A40			X	X						X			23
Research collaboration with profit-making enterprises.	A41				X									08
Selecting and executing sustainability research.	A42										X		X	08
														15

Indicator Type	Code	AISHE	AMIAS	ASSC	CSAF-core	GASU	P & P	SAQ	STARS	SusHEI	GU (ToolKit)	UnisAF	USAT	%
Service-learning and/or internship programs.	A43				x			x					x	23
Societal learning outcomes enhanced by sustainability research results.	A44								x		x	x		23
Staff and students involved in sustainability research.	A45	x	x	x		x	x	x		x			x	77
Staff and students' sustainability educators' program.	A46								x		x			15
Staff expertise in sustainability.	A47			x									x	23
Staff willingness in teaching topics.	A48									x	x		x	23
Staff willingness to carry out sustainability research.	A49									x	x		x	23
Students' involvement in shaping their learning experience.	A50											x		08
Study programs and the number of students whose tuition fees exceed the standard tuition fees of public institutions.	A51										x	x		15
Suggesting important courses to be taught.	A52							x						08
Support for research and pledges.	A53				x				x					15
Sustainability course structure, goals, and duration.	A54					x			x					15
Sustainability research outputs inform the teaching content and practice of courses.	A55									x		x		15
Sustainability specialisation in faculty programs.	A56	x		x		x	x		x	x	x	x		69
Sustainability training and staff professional development.	A57	x		x	x	x	x	x	x	x	x	x	x	92
Sustainable careers and recruitment to enable sustainability-focused careers after studies.	A58					x	x	x		x	x	x	x	54
Teaching approach to make responsible students.	A59													08
The design and delivery of courses by external partners.	A60				x					x		x	x	23
The number of Start-ups and types created from sustainability research.	A61										x	x		15
Thinking critically about the role of the campus in its social and ecological system.	A62							x			x			15
Total number of resource-intensive research activities.	A63										x		x	15
Total number of students and by type.	A64											x		08
Training and professional development for sustainability researchers	A65								x	x		x		23

D. The selection process of performance indicators

Selected indicator	Code	Identified indicator
Sustainability-focused academic courses offered by an HEI	A1	Offering academic courses with sustainability concerns.
Academic programs with sustainability specialisations.	A2	Enrolling students in sustainability courses.
Sustainability training and staff development.	A3	Academic programs with sustainability specialisations.
Staff involved in sustainability research, including multidisciplinary and interdisciplinary research.	A4	Sustainability training and staff development.
Students involved in sustainability research, including multidisciplinary and interdisciplinary research.	A5	Staff and students involved in sustainability research.
Intellectual property rights from sustainability-focused research.	A6	The multidisciplinary and interdisciplinary nature of sustainability research.
Commercialized sustainability research outputs.	A7	Patents and research commercialization.
Publications related to sustainability.	A8	Level of research output through publications, conferences, seminars, etc.
Number and functions of centres on campus providing sustainability-related research or services.	A9	Number and functions of centres on campus providing sustainability-related research or services.
Sustainable careers and recruitment.	A10	Sustainable careers and recruitment to enable sustainability-focused careers after studies.
Sustainability culture.	E1	Outreach campaigns.
Outreach materials and publications.	E2	Creating and raising awareness in sustainability.
Staff and students' orientation on sustainability.	E3	Sustainability awareness program for students.
Registered societies, clubs, and associations related to sustainability.	E4	Outreach materials and publications.
Inter-campus collaboration.	E5	Staff and students' orientation on sustainability.
Community service engagement by staff and students.	E6	Involving students in groups across campus.
Electricity consumption.	O1	Inter-campus collaboration.
Renewable energy.	O2	Campus/community partnership.
Carbon emissions.	O3	Collaborating with stakeholders in addressing community challenges.
Water consumption.	O4	Community service engagement by staff and students.
Solid waste generated.	O5	Energy consumption by sources.
Toxic and hazardous waste generated.	O6	Renewable energy.
Rainwater used.	O7	GHG/Carbon emissions.
Campus fleet.	O8	Water consumption/usage.
Pedestrians and cycling.	O9	Waste generated.
Eco-friendly buildings and facilities.	O10	Toxic and hazardous waste management.
Sustainable landscape management	O11	Rainwater management.
Biodiversity and ecosystem services.	O12	Transportation programmed.
Water efficiency measures.	O13	Sustainable contract buildings, designs, construction, and maintenance.
Recycling of solid waste.	O14	Sustainable landscaping and management.
Public space.	O15	Biodiversity and ecosystem services.
Green space and forest land.	O16	Water efficiency measures.
Sewage disposal.	O17	Recycling of solid waste.
Sustainability-dedicated employees.	G1	Public space.
		Green space managed.
		Forest land.
		Sewage disposal.
		A sustainability office with dedicated staff.
		Sustainable Development Centre.
		Sustainability planning.
		Sustainability policy, mission, and vision.
		Creating a sustainability sub-committee (energy officer, purchasing coordinator, etc.).

Selected indicator	Code	Identified indicator
Procurements from sustainable suppliers.	G2	Sustainable food program. Sustainability suppliers. Sustainable electrical/electronic equipment purchasing.
Sustainability budget.	G3	Sustainable procurement from environmentally friendly and socially responsible companies.
Non-financial incentives and support for staff on sustainability-related teaching, research, and other initiatives in an HEI.	G4	Sustainability budget and financial allocation to SD. Incentive to staff for sustainability teaching and research. Employees' compensation/ reward for SD.
Employees' rights.	G5	Workers' and indigenous rights.
Occupational health and safety of employees.	G6	Green hiring (employment of direct staff with a low number of contract staff, fair wages, etc.). Workplace health and safety.
Total grant and funds for sustainability-related research.	G7	Total revenue from grants and allocations specifying sustainability-related research.
Sustainability targets and strategies.	G8	Sustainability targets and strategies. Sustainable/ethical investment.
Sustainable/ethical investment and banking.	G9	Sustainable/ethical banking.
Diversity and equity coordination.	G10	Diversity and equity coordination.
Sustainability reporting for stakeholders.	G11	Sustainability reporting.

KEY: A (Academic); E (Engagement); O (Operations); and G (Governance)