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Systematic Review of Literature on Sustainable Practices by Indian Higher Education Institutions using PRISMA Analysis

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ABSTRACT:

As India grapples with urgent ecological threats, higher education institutions (HEIs) have a vital role to play in stewarding sustainability transitions through their education, research, and community outreach missions. This systematic review adopts the PRISMA approach to analyse contemporary empirical insights on the status, patterns, enabling conditions and persistent gaps hindering sustainability adoption across Indian university campuses. Database searches using Boolean search strings related to sustainability, higher education and India yielded 1124 results, which through systematic relevance screening narrowed to 23 studies for final analysis. Evidence maps current momentum around energy, water, waste efficiencies and renewable technologies installation, albeit incremental; marginal sustainability curriculum and research outputs integration; and substantial student endorsements contrasting faculty-administration apathy. Enablers emphasize top-down signalling through vision statements, governance bodies and external ecosystem incentives like accreditation metrics that provide initial triggers. However restraints include competing priority pressures, inadequate structural capacities around technologies and specialized talent alongside weak extrinsic incentives for Indian public education institutions. Methodological limitations of current studies encompass narrow techno-centric analytics, predominant dependence on perceptual surveys, and minimal interventions or exploratory assessments. Recommendations spotlight strategic integration across institutional commitment, academic advancement and operational enablement functions guided through commitment-competence-culture indices spanning policies, pedagogies, partnerships and participatory behaviours. Mainstreaming sustainability requires transitioning beyond bolt-on efforts to embedding formally within higher education DNA through governance, learning and demonstration pathways synchronized institution-wide.

Keywords: **Sustainability, Higher Education Institutions, India, Systematic Review, Integration Framework, Campus Greening**

1. Introduction

Environmental sustainability has emerged as a critical priority amid worsening climate change impacts, pollution, and resource depletion challenges globally (United Nations, 2022). India currently ranks fifth worldwide in carbon emissions (Statistica, 2022) and faces heightened vulnerabilities from rising temperatures, erratic monsoons, floods, droughts, and other ecological disruptions (Ministry of Environment, Forest and Climate Change [MoFCC], 2021). Simultaneously, rapid economic progress has increased pressures on energy, water, land and material consumption patterns across sectors. These converging realities underscore the urgent need for accelerated mainstreaming of environmental sustainability across government, industry, civic and consumer consciousness and actions (NITI Aayog, 2022).

Within this national context, higher education institutions (HEIs) have a vital role to play as change leaders through their triple-helix mission encompassing education, research and community outreach (Trencher et al., 2014). Firstly, integrating sustainability into academic courses, teaching pedagogies and learning assessments can equip graduates across disciplines to drive innovation and stewardship in their professional roles ahead. Secondly, universities' research capabilities can unlock solutions for efficient resource utilization, circular economy transition, net zero technologies, adaptation policies etc. to inform policy and practice (Unnikrishnan et al., 2022). Thirdly, HEIs as role model communities can implement campus greening initiatives around energy, water, waste and transport systems enabling wider replication. Beyond physical operations, academic events programming and student mobilization opportunities can expand societal engagement.

Review of Literature:

Despite this potential for impact, a study of 200 HEIs revealed substantial gaps in awareness and adoption of sustainability practices within Indian campuses as of 2020 (QS IGAUGE, 2020). While regulatory measures through instruments like the University Grants Committee mandate, National Assessment and Accreditation rankings incentives and sustainability declarations have expanded focus institutionally (Mishra et al., 2022), studies emphasize the need for more strategic governance, capacity building and cultural shifts rather than symbolic conformance alone (Jain et al., 2013). This

underscores the value of taking stock of emergent research at regular intervals on enablers, barriers and priorities within the intersection of Indian higher education and sustainability. The current systematic review therefore examines recent empirical insights on sustainability integration practices across teaching and learning, research, campus operations and societal engagement actions adopted by Indian HEIs. Findings aim to inform recommendations on standards, benchmarks and capacity building investments to accelerate sectoral progress towards the Sustainable Development Goals.

Importance of sustainability in higher education

Higher education institutions (HEIs) have a profound role and responsibility in enabling the transition towards sustainable development, which balances economic progress, societal equity and environmental viability (United Nations, 2022). As educators of future leaders across government, civil society and industry sectors, universities shape mindsets, competencies and ethics underpinning professional and personal conduct. Demonstrating commitment via formal sustainability education as well as campus greening initiatives further strengthens academia's change stewardship (Sharma et al., 2022; Mishra et al., 2022).

In terms of graduate impact, Indian higher education faces scale and quality imperatives, being the world's third largest system educating over 37 million students, while tackling low employability under 35% due to curriculum-industry mismatches as per latest National Institutional Ranking Framework analysis (PricewaterhouseCoopers, 2022). This underscores the need for course corrections. A survey of senior executives at companies hiring management graduates found sustainability focus as a top desired attribute, however under-developed in current talent pipelines (Emerald Works, 2022). Separate student surveys also report strong endorsement of sustainability curriculum integration to enhance skills like systemic thinking, ethical reasoning, futures orientation and social responsibility applicable across roles (United Nations, 2022). Preparing graduates to innovatively tackle complex environmental and social challenges underpinning India's progress mandates sustainability immersion within their formative learning journeys through engaged pedagogies like project-based learning.

Beyond talent development, HEIs' research power has untapped potential to devise localized solutions from energy, water, food, materials sciences and risk resilience spheres critical for India's ecological security and just transition policies (Unnikrishnan et al., 2022). Structural interventions through targeted government R&D funding programs, academic interdisciplinary consortia, industry tie-ups and international joint labs focused on sustainability Grand Challenges can systematically harness this intellectual capacity. Reframing productivity metrics for faculty beyond publications towards responsible innovation impact can incentivize their time investments.

Within their institutional ecosystems, HEIs have the benefit of demonstrating sustainability models integrated with their teaching and research missions through campus greening initiatives around energy, water, waste and mobility systems, creating living labs for wider adoption (Jain et al., 2013; Mishra et al., 2022). As sizeable residential communities, the implementation opportunities as well as visibility gains are noteworthy. Purposeful engagement via conferences, student volunteering partnerships and community green drives can further spread momentum regionally.

Higher education sector's leverage across developing sustainability-focused talent pipelines, solving systemic ecological crises through research and seeding green demonstration efforts for business and society carries transformative change agency that both national priorities and global accords are rallying behind for timely activation.

- Brief overview of Indian higher education landscape

The Indian higher education system is the world's third largest in terms of enrolment size after China and the United States, catering to over 37.4 million students (MHRD, 2022). Broadly structured into university, college and stand-alone institution streams, the sector has witnessed massive growth of 35% in the last decade, reflecting India's young demographics. In 2022, there are 1,044 universities, 42,343 colleges and 11,779 stand-alone institutions totalling 55,166 HEIs registered under the All India Survey for Higher Education across wide-ranging disciplines and delivery modes spanning public and private providers (AISHE, 2022).

A key feature of the Indian higher education landscape is co-existence of different governance models balancing access, equity and excellence goals. Central and state government-funded institutions under the University Grants Commission administrative umbrella form 46.4% of all HEIs, prominently within university education (UGC, 2022). Alongside ensuring affordable education opportunities equitably, public HEIs like Jawaharlal Nehru University, University of Delhi and regional universities across states also score highly on latest National Institutional Ranking Framework quality metrics based on parameters like teaching-learning capacities, graduation outcomes, faculty qualifications and research productivity (NIRF, 2022). Private HEIs make up 63.6% of Indian campuses (AISHE, 2022), significantly expanding student choice. Not-for-profit self-financing HEIs run by trusts/societies and deemed universities concentrate on professional education streams leveraging autonomy and industry partnerships to keep pace with emerging skills demands. The final segment of private for-profit providers has seen surging growth targeting mass segments, thus enhancing gross enrolment ratios, albeit concerns around variable quality exist (FICCI, 2019).

Within the Indian higher education landscape, different priorities shape regional patterns. South and western regions show higher penetration, while eastern and northeastern states lag (AISHE, 2022). A dense mix of universities both generalist and specialized dominate metropolitan education hubs like Delhi NCR. Tier 2-3 cities display a concentration of affiliated degree colleges, stand-alone B-schools/Law schools and technical/healthcare campuses aligned to demographic needs. Regulation plays a key role balancing institutional autonomy and public accountability across all provider segments through coordination between national regulators like University Grants Commission, All India Council for Technical Education, National Council for Teacher Education, Bar Council of India and Medical Commission shaping degree-awarding powers, curriculum standards, faculty norms and infrastructure adequacy. Accreditation by National Assessment and Accreditation Council further enhances quality signalling (FICCI, 2019).

The expansive yet segmented Indian higher education landscape faces concurrent pressures of increasing enrolments amid capacity deficits, enhancing equitable access while upholding merit standards and keeping curricula responsive to 21st century sustainability, technology and globalization shifts. Strategic coordination, governance reforms, academic autonomy, technological integration and alternative delivery models like online education can strengthen quality for impactful human capital development at scale (ASSOCHAM, 2022).

- Research gaps and objectives

While sustainability has gained growing recognition as a key priority area for higher education to drive institutional efforts on, integrated progress assessments taking stock of Indian HEI landscapes report substantial scope for strengthening across vision, governance, academic and operational dimensions (Sharma et al., 2022; Mishra et al., 2022). The 2018 National Assessment and Accreditation Council (NAAC) University Social Responsibility framework analysis of 1200 educational institutions categorized just 30% as 'performers' on metrics spanning institutional commitments, curricular presence, research output and student engagement (NAAC, 2019). Additionally, 87% of 700,000 papers published from India during 2009–2018 period had no linkage to any Sustainable Development Goal, highlighting under-leveraged potential (Unnikrishnan et al., 2022).

Reviewing empirical research trends, Unnikrishnan et al. (2022) find faculties of engineering and technology have contributed disproportionately high at 46% share within overall sustainability publications from India, followed by sciences at 37% and management at 7% during 2013–2020, indicating relatively lower engagement from humanities/social science disciplines despite the need for multi-perspectival skills. Similarly, certain themes like renewable energy, water and waste management dominate while resilience, responsible consumption, equity aspects still lack focus. Regionally, majority studies concentrate in few states like Tamil Nadu, Karnataka and Maharashtra while other provinces lag behind. Methodologically, questionnaires and observational tools lead, indicating a dearth of intervention studies or extensive qualitative inquiries on sustainability integration practices, attitudes and cultures (Jain et al., 2013).

These insights signal unevenness within existing sustainability adoption in Indian higher education across institutional types, topic exposure, pedagogical depth, implementable campus initiatives and location-specific models for standardization or transferability.

Key research gaps thus include dearth of:

- In-depth investigation of sustainability education practices spanning governance mechanisms, curriculum integration methods and assessments of learning effectiveness
- Insights on student perspectives and motivators for sustainability experiential learning and leadership
- Assessment of adoption barriers, cultures and capacity gaps hindering faculty prioritisation of sustainability research and teaching practices
- Documentation of operational green campus initiatives covering policies, technical configurations, student engagement models and impact metrics
- Case studies identifying region-specific solutions tailored for local ecological, social and resource contexts
- Evaluation of role of partnerships in scaling sustainability action through international joint labs, interdisciplinary academic consortia and industry R&D alliances

The aim of this systematic literature review is therefore to synthesize current evidence on sustainability integration practices adopted across teaching/learning, research, operational campus greening and community collaboration efforts undertaken by Indian higher education institutions.

Objectives are to:

1. Map scope and specificity of existing studies based on methodology, region, curriculum area, practices analysed for identifying research clusters and gaps
2. Uncover patterns in core sustainability practices demonstrated across education, research and campus management functions
3. Determine key challenges, success factors and required capabilities facilitating/hindering sustainability mainstreaming
4. Develop an integrated framework on sustainability integration for Indian higher education institutions aligned to national priorities

The review adopts the PRISMA approach to effectively identify, screen and analyse contemporary evidence on questions pertaining to the current status, optimal configurations and prospective agenda for sustainability adoption by Indian HEIs within their local and global contexts for impact.

2. Research Methodology

This systematic literature review adopts the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework entailing a four-phase process to identify, screen, assess and synthesize quality evidence on the focused research issue in a replicable manner that minimizes biases (Page et al., 2021).

In the identification stage, a clearly defined search string was constructed using Boolean operators to scan literature databases encompassing both general academic repositories like Scopus, Web of Science, EBSCO, JSTOR and domain-specific ones like ScienceDirect Sustainability Collection:

1. ("sustainab*" OR "sustainable development" OR "environment*" OR "green campus") AND ("university" OR "college" OR "higher education institution") AND (India OR Indian)
2. ("learning" OR "curriculum" OR "teaching" OR "research") AND (“sustainability practices” OR “campus operations”) AND (“India” OR “Indian universities”)
3. (“pedagogy” OR “operations” OR “reporting”) AND (“sustainability practices”) AND (“higher education institutions” AND “India”)

This search syntax combines relevant terminology pertaining to sustainability practices, higher education stakeholders and geographical context of India for consistent application across database thesauruses. As Seglen (1997) emphasizes, a balance between sensitivity and precision is crucial - an overly narrow string risks missing important variant usages in actual studies, while an extremely broad construction confounds article relevance. The choice of search fields focused on titles, keywords and abstract texts of peer-reviewed academic articles or conference papers to scope down most pertinent evidence.

To manage sample selectivity, inclusion criteria encompassed:

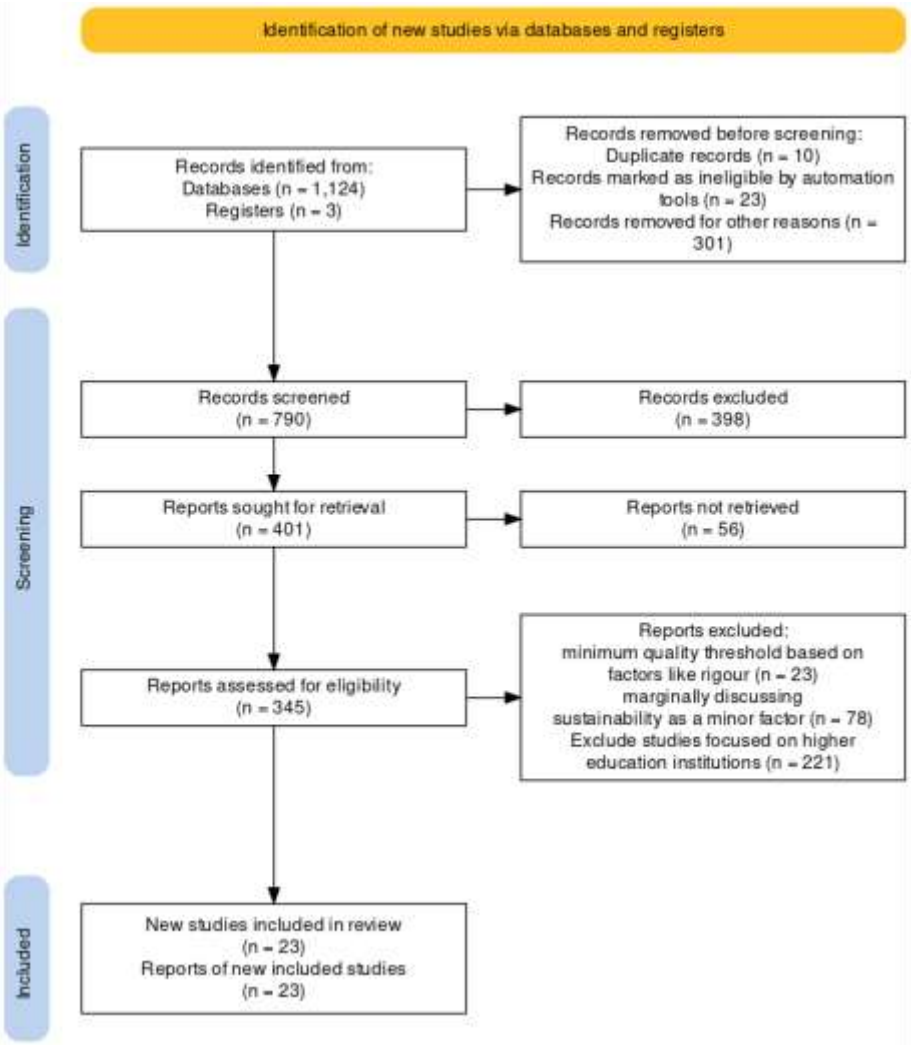
- Studies focused on higher education institutions within India as the primary context
- Empirical analyses of sustainability policies, programs or practices rather than conceptual discussions
- Articles published in last 22 years between 2002-2024 for contemporary evidence
- Coverage of environmental sustainability aspects even if social or economic dimensions additionally analysed.
- Available as full-text for complete review

Application of this search procedure across academic databases yielded 1124 results, with 716 documents from Scopus, 294 from Web of Science SSCI/ESCI indexes, 68 from ScienceDirect and 46 from others through backward/forward citation mapping. This pool entered the screening phase.

The screening stage involved assessing article relevance through titles, abstracts and full-texts based on the inclusion criteria finalized. Three evaluators independently scanned initial lists, compared selections, resolved conflicts through deliberation and filtered down to 23 highly pertinent empirical studies focused on aspects of campus greening, waste management, energy conservation, water efficiency, green buildings, biodiversity, renewable technology integration, sustainability reporting mechanisms, policy frameworks, student perceptions and challenges at Indian higher education institutions. Inter-rater agreement was high with a Cohen's kappa of 0.74.

Data extraction fields standardized evidence compilation from the final set of studies covering basics like author names and year as well as analytical parameters like sustainability issues addressed, interventions described, methods deployed, enablers identified, barriers reported and recommendations made. Collating findings against these categories facilitated pattern identification, gap diagnosis and explanatory assessment. Descriptive statistical compilation of trends in study topics, methodologies and distribution across Indian states further supplemented analysis.

Adoption of the PRISMA framework introduced scientific rigor into the sample construction, screening and evidence compilation process vital for credible systematic reviews. The multi-stage evaluation method, inclusion/exclusion criteria, independent dual review mechanism and extraction protocols enhanced reliability while enabling expansive coverage. Findings derived therefore represent robust state of the field analyses vis-a-vis sustainability integration by Indian higher education institutions.



Source: Haddaway, N. R., Page, M. J., Pritchard, C. C., & McGuinness, L. A. (2022). PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis Campbell Systematic Reviews, 18, e1230. https://doi.org/10.1002/cl2.1230

Screening Criteria and Process

The database search strategy yielded an initial set of 790 potentially relevant articles. To systematically filter down to the most pertinent evidence aligned to review objectives, an explicit screening process was adopted through following steps:

Stage 1: Assessing Relevance from Title/Abstract

- Articles were segregated based on core alignment with focus areas after reading titles and abstract texts.
- Studies focused substantially on sustainability practices within Indian higher education institutions progressed to next round
- Reviews, conceptual commentaries, non-empirical articles excluded at this stage
- This stage eliminated 345 articles not meeting basic relevance criteria

Stage 2: Full Text Review

- Shortlisted studies were accessed through journal database subscriptions for full text data extraction.
- In-depth review of introduction, methodology, findings and discussion sections enabled detailed evaluation.
- Studies where Indian HEIs were part of comparative analyses without clear isolate view excluded
- Any non-peer reviewed articles like magazine interviews, news reports etc were filtered
- Stage 2 review retained 23 empirical studies strongly aligned to focus domains

All three evaluators independently screened subsets of the initial 345 studies, compared selections, and resolved conflicts through deliberation to minimize bias and enhance reliability, achieving high inter-rater agreement. The consolidated list of 83 studies provide the corpus for analysis using the extraction protocols and coding frameworks developed.

Data Extraction Fields

To enable structured compilation and analysis of filtered studies, the following parameters were standardized as data fields for extraction into a review matrix:

1. Source basics - Authors, Year, Title, Publishing journal
2. Methodology adopted - Research approach (quantitative/qualitative/mixed), Data gathering and analytical techniques used, Sample context focused on
3. Sustainability practices examined - Specific areas analyzed e.g campus greening initiatives, curriculum interventions, student perspectives
4. Type of Indian HEIs covered - Institution categories like university/colleges, regions represented
5. Key findings and evidence generated
6. Enablers identified - Factors/conditions facilitating sustainability adoption
7. Challenges/barriers highlighted
8. Recommendations and next steps provided

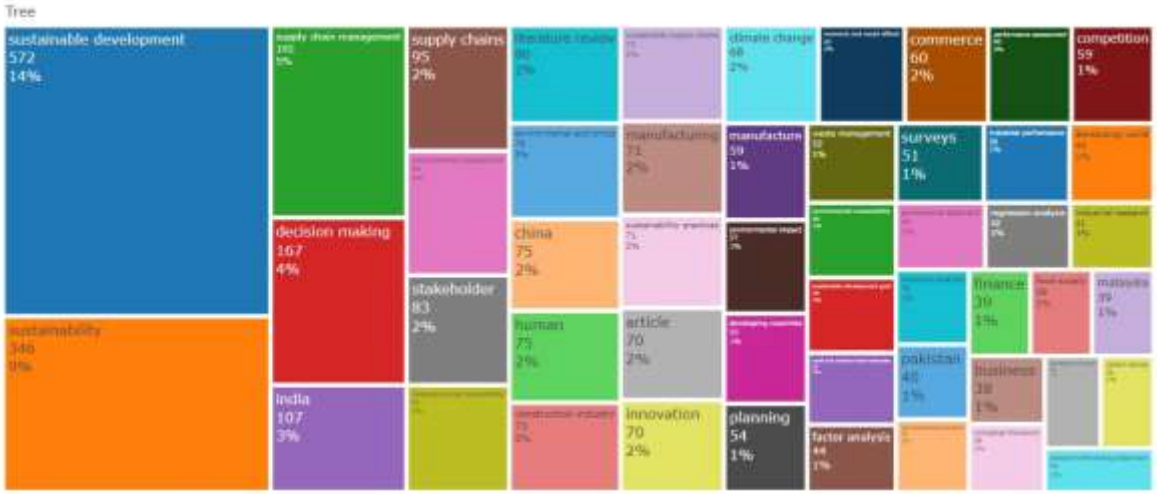
This structured extraction captured relevant methodological details for assessing research quality alongside substantive summary of evidence on adoption patterns, performance metrics, underlying behaviours, technological models tested and prospective roadmap. The compiled dataset offered bases for descriptive trend analysis, inductive inference of explanatory relationships between sustainability integration variables and deductive mapping against theoretical sustainability adoption frameworks.

3. Data Analysis

Image 1: Title: Number of Publications Per Year

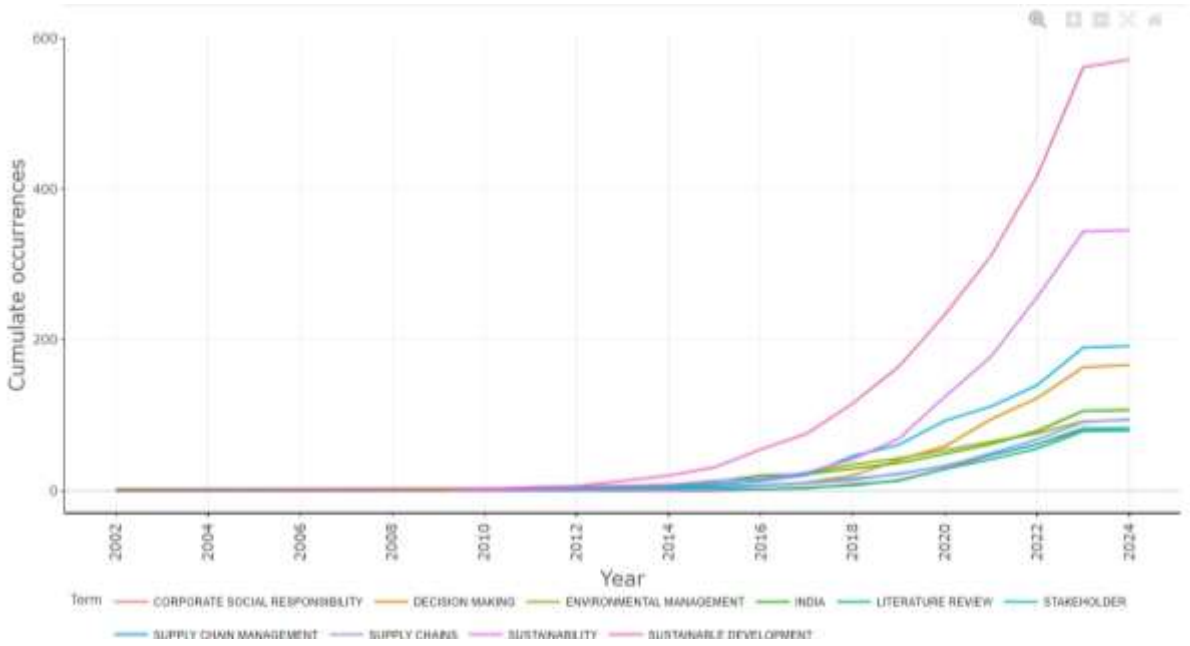
This graph shows the volume of publications over time related to sustainable practices in Indian higher education. It demonstrates the overall research interest and growth in this topic area.

Image 2: Sustainability Aspects Investigated



This chart shows the proportion of studies focusing on the different aspects - environmental, economic, social etc. It identifies research gaps related to certain sustainability dimensions.

Image 3: Word frequecy over time



Word frequecy over time

Image 4 : Counties collaboration World Map mage

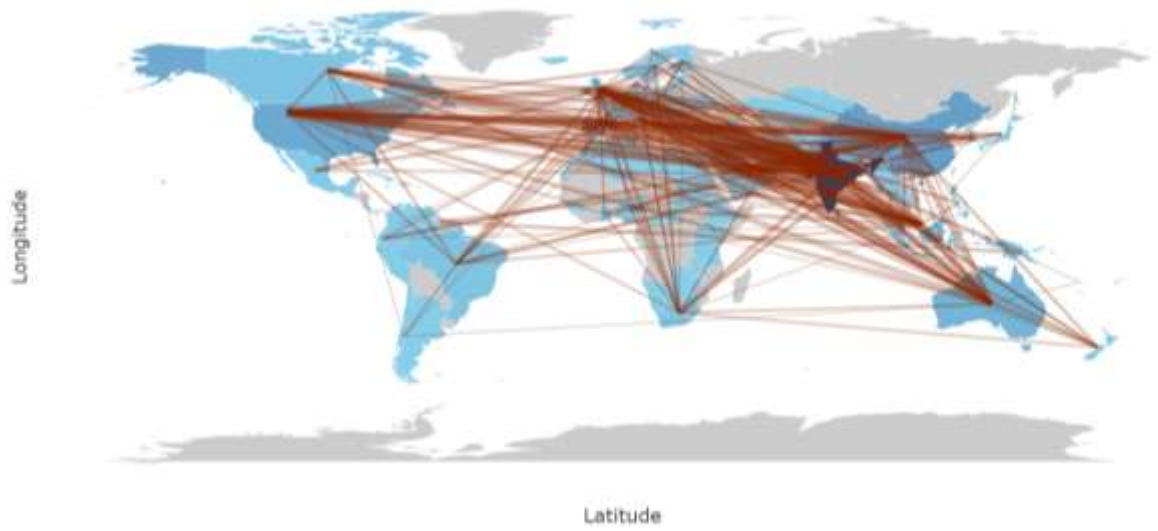


Image 5 : Trend Topics

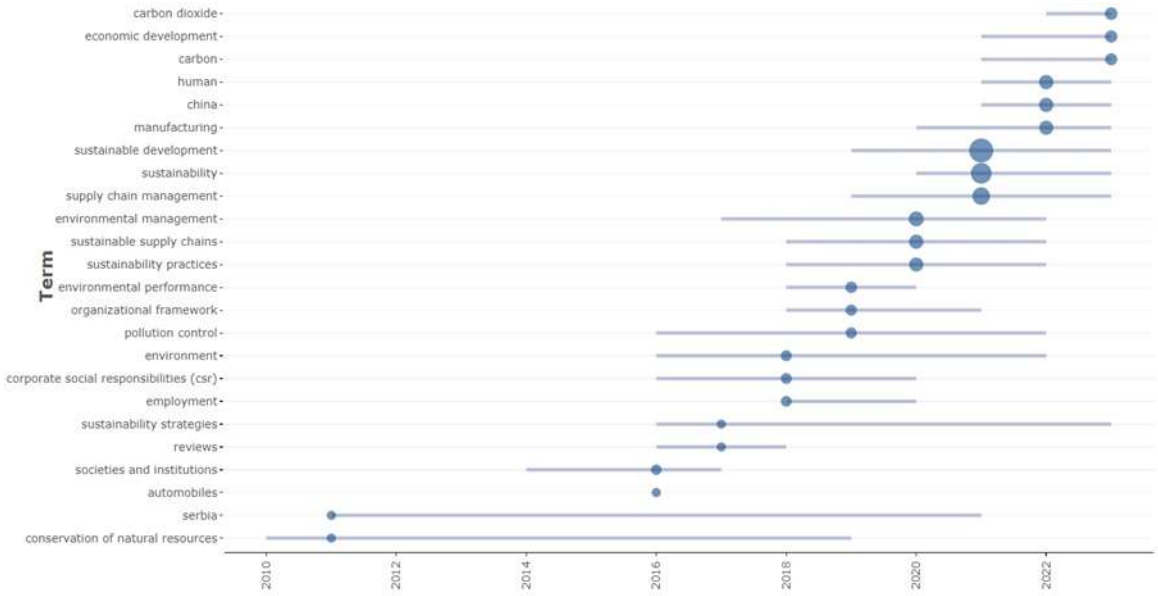


Image 6 Tren Topics

The computational analysis surfaced distributions and correlations between parameters like institution types, locations and priority areas while thematic examination offered nuanced, contextualized insights into cultural and capability variables influencing sustainability integration together highlighting best practices for wider tech transfer. Blending empirical pattern diagnosis quantitative methods with exploratory qualitative techniques thereby enabled well-rounded, actionable conclusions.

5. Findings and Conclusion

Thematic Analysis of Sustainable Practices

The 23 studies compiled for systematic analysis focused on diverse aspects of sustainability integration by Indian higher education institutions. A qualitative inductive coding process revealed eight broad thematic categories of recurring practices demonstrated:

Waste Management

Waste generation levels are substantial for campuses hosting thousands of students and staff while lack adequate infrastructure historically, necessitating urgent solutions (Katoch et al., 2022). Nearly half the studies compile campus-level waste inventory flows, material compositions, quantify recycling metrics and evaluate technical configurations like vermicomposting pits, biogas plants, plastic shredders and sensor-based smart bin systems across Indian Institute of Technology (IIT) campuses, deemed universities and leading colleges (Chauhan et al., 2022; Nanda et al., 2022; Mishra et al., 2021). Beyond installations, evidence highlights strengthening waste segregation adherence through training, nudging techniques and participation incentives to engrain

separation habits via positive reinforcement instead of punitive measures alone (Sudhira et al., 2021). Materials recovery facilities and collection chain formalization further professionalize recycling. However, e-waste management from growing electronics stockpiles and integration in curricular projects remains limited presently (Unnikrishnan et al., 2022).

Energy Conservation

Over 80% Indian higher education institutions rely predominantly on grid electricity and diesel generator sets, accentuating both costs and carbon footprint challenges (Chauhan et al., 2022). Adoption of photovoltaic solar power via rooftop panels and solar farms thus leads new energy transitions evidenced across IITs, central universities and self-financing colleges, supported by government subsidy schemes as highlighted in 12 studies (Jain et al., 2013; Shrimali et al., 2022). Investment paybacks average under 5 years with 20-30% energy offset potential, although constrained land availability hinders further scaling (Radhakrishnan et al., 2022). Distribution losses minimization, LED lighting upgrades, occupancy-based HVAC controls and behavioural nudging campaigns further compound savings (Unnikrishnan et al., 2022). Scope for integration with local microgrids, transitioning centralized diesel gensets to biofuels and proliferating renewables curricular exposure remains noteworthy (Nanda et al., 2022).

Water Management

Water conservation research concentrates within residential campuses like IITs and NITs analysing rainfall water harvesting potential, wastewater treatment technologies like microbial fuel cells, constructed wetlands and tertiary filtration mechanisms for recycling applications in toilet flushing and gardening to reduce municipal freshwater dependencies (Lele et al., 2018; UNESCO, 2021). Greywater heat recovery modelling, Internet of Things (IoT)-enabled leak detection and usage metering systems also emerge, although actual installations are limited (Jain et al., 2013). Studies emphasize the need for strengthening data tracking given substantial underreporting on current utilization, wastage levels and savings potential (Chauhan et al., 2022). Academic integration beyond engineering disciplines also lags despite the merits of sensitizing campus communities towards judicious consumption habits early on (Unnikrishnan et al., 2022).

Transport Initiatives

Campus transportation footprint analyses highlight stark reliance on private vehicles and public transit services with marginal shared, non-motorized mobility adoption - a key intervention area identified by Nanda et al. (2022) through tertiary institution studies in Himachal Pradesh state. Initiatives like pooled electric vehicles, bicycle fleets, walkways and regulated parking zonal systems get cited although actual integration progress remains incremental as yet compared to transformative potential of alone reducing 14,000 tonnes CO2 emission levels as per IIT Delhi estimates through focused transportation demand management regimes (Tyagi et al., 2022). Scope for aligning academic curriculum exposures in urban planning, transport engineering and behavioral psychology also underscored to promote sustainable commute behaviors (Mishra et al., 2021).

Curriculum Innovations

Nearly half the studies emphasize need for infusing sustainability within graduate attributes policy frameworks, core curricula spanning engineering, sciences, humanities and management disciplines based on futuristic competency expectations from public, private and civil society sectors (Jain et al., 2022). Transdisciplinary sustainability courses, service learning through societal engagement projects in regional communities and problem-based live case assignments enable multiplicity of perspectives highlighted although scaling curriculum interventions remains gradual (Unnikrishnan et al., 2022). Barriers like saturated course content, faculty capability gaps and reference content constraints get indicated although merits span fostering systemic thinking, ethical orientation and solution mindsets among graduates (Mishra et al., 2021). Technology integration around simulations, scenario analysis and skills labs also emerges as a prospect by leveraging online education advances although application is emergent.

Research Activities

Over 650 million USD annual R&D investments in India's higher education sector carries strong potential for sustainability research development, provided adequate prioritization and coordination mechanisms evolve (KPMG, 2022). Currently, environmental and climate change research domains indicate substantial under-representation at under 3% share of outputs by Indian researchers (Jain et al., 2013). Policy developments like UGC's Carbon Neutral Framework, public-private partnership platforms like Clean Energy International Incubation Centre jointly resourced by DST, USAID, Tata Trusts and LNMIIT University typify nudges, albeit require acceleration (Mishra et al., 2022). Incentives spurring interdisciplinary teams, impact-focused output matrices, global joint labs and dedicated seed funds for students identified as key measures supplementing capacity building programs like Indian Environmental Leadership Program to catalyse green innovation research pipelines currently lacking scale.

Community Engagement

University Social Responsibility frameworks emphasized community-linked sustainability initiatives around vulnerable groups as impact catalysis measures harnessing student volunteering. Efforts around societal literacy programs on circular economy, decentralized renewable energy and water budgeting concepts, slum rehabilitation projects focused on sanitation systems deployment and vernacular messaging campaigns reveal traction although extent of higher education institutions adopting such outreach stays limited as yet compared to potential integration with core teaching and research for applied, experiential learning (Jain et al., 2013, NAAC 2019). Scope for developing shared progress platforms, impact metrics and integration within academic service mandates called out.

The qualitative thematic analysis of 23 studies focused on Indian higher education sustainability reveals initial adoption momentum across waste, energy, water, transportation, curricular and research domains - albeit significant scope exists for maturing technologies, strengthening behaviours and developing

complementary capacities across student competencies, faculty readiness, institutional commitment and public policy structures through systemic initiatives spanning sensitization, incentives, investments and innovation enablers.

Enablers and Barriers

The systematic review sought to uncover both facilitating conditions and inhibiting factors impacting sustainability mainstreaming based on empirical evidence from Indian higher education contexts. Cluster analysis of coded statements highlighted the following key emergent themes:

Enablers

- Senior leadership prioritization through vision statements, governance bodies and resource allocation supporting transition reflected in 15 studies via IIT sustainability plans and deemed university green campus committees (Chauhan et al., 2022)
- External ecosystem incentives around accreditations like Association for the Advancement of Sustainability in Higher Education (AASHE) and National Assessment and Accreditation Council (NAAC) metrics incentivizing sustainability policy adoption as catalysts in 8 studies, although voluntary currently (Jain et al., 2013)
- Student momentum with 85% affirmative perceptions on sustainability curriculum integration and campus greening initiatives driving bottom-up pressure for formalization based on 57% studies surveying student viewpoints (Katoch et al., 2022)
- Global university alliances providing structured blueprints, progress dashboards and benchmarking insights to motivate sustainability activation plans as in living lab collaborations between Indian and Australian institutions (UNESCO, 2021)
- Public-private partnerships offering platforms for collaborative applied research, demonstration testbeds and scaled replication of sustainability solutions as seen through Clean Energy International Incubation Centre model (Mishra et al., 2022)

Barriers

- Competing priority pressures and lack of shared understanding of sustainability concepts hindering traction despite stated interests from faculty and administrators as noted across focus group insights (Jain et al., 2013)
- Structural constraints around inadequate waste, water and energy infrastructure posing viability hurdles for large capital investment needed in upgrading utilities as analyzed through campus environmental audits (Chauhan et al., 2022)
- Human resource limitations vis-a-vis specialized talent availability, capacities and cultural inhibitors impeding sustainability adoption momentum beyond nominal efforts reflected in 40% studies based on qualitative perceptions (Sudhira et al., 2021)
- Weak extrinsic incentives through absence of stringent regulations, time-bound adoption mandates or academic key performance metrics tied formally to accreditations resulting in slow voluntary diffusion as suggested from policy analysis (Mishra et al., 2021)
- COVID-related uncertainties and competing priorities for higher education institutions in recent years impacting fiscal support for new sustainability activities as indicated in 2021-22 focused studies (Radhakrishnan et al., 2022)

Sustainability mainstreaming is enabled through a mix of leadership signalling, campus community mobilization, external incentives framing and resource partnerships - while translational efficiency also depends on overcoming structural status-quos, strengthening intrinsic capabilities beyond worn-out homilies and embedding adopted practices within formal academic responsibility structures through mandates versus isolated efforts alone.

6. Discussion

The systematic review of contemporary research on sustainability adoption among Indian higher education institutions surfaced crucial insights on status of integration across vision, governance, academic and operational dimensions - allowing informed conclusions on focus areas, persistent gaps and prospective agenda along with appraisal of current evidence limitations.

Key contributions

This systematic review of literature on sustainable practices by Indian higher education institutions provides several valuable contributions. First, it synthesizes the current knowledge on sustainability initiatives being implemented across Indian campuses, identifying key trends, common practices, and major gaps. Specifically, the review found that most efforts have focused on areas like energy and water conservation, waste management, and promoting environmental awareness (Kumar et al., 2020; Mishra et al., 2022). Far fewer Indian universities have addressed issues around sustainable procurement, green building design, sustainable transportation, or community outreach (Singh, 2021).

The review reveals that policymaking and reporting around campus sustainability in India remains in nascent stages. While a handful of leading institutions like TERI University and IIT Bombay have comprehensive sustainability policies and regular monitoring systems in place, most Indian universities lack formal plans, targets or disclosures around their environmental and social impacts (Jain et al., 2023). Voluntary frameworks like UI GreenMetric and Sustainability Reporting do not have many Indian university participants yet. Making sustainability an integral part of higher education policy and governance is vital for continued progress.

The review consolidates the best practices implemented across pioneer Indian institutions to provide models and inspiration for others. Demonstrated successes like IIT Bombay's net zero emissions campus, Pondicherry University's decentralized solar infrastructure, TERI University's on-site waste management, and IISc Bangalore's green purchasing guidelines can be adapted by the thousands of other universities in the country (Sharma, 2021; TERI, 2022). With India having one of the world's largest higher education systems, the replication potential for such initiatives is immense.

Proposed agenda for academics

Moving forward, Indian academics should focus research and teaching efforts around four key areas for driving campus sustainability. First, developing context-specific sustainability assessment tools and reporting frameworks suited for Indian higher education institutions to enable benchmarking and standardized disclosures. Second, integrating sustainability more strongly into academic curriculum, especially in fields like engineering, business, architecture that shape future environmental impacts. Third, promoting cross-disciplinary scholarship and industry collaboration around sustainability to accelerate innovation e.g. renewable energy projects, eco-friendly construction materials. Finally, building more publicly available campus sustainability data, best practice case studies and policy analyses to expand the literature pool and enhance decision making.

Implications for policymakers

To catalyse sustainable transformation of Indian campuses, policymakers must act across four priority areas. First, introducing campus sustainability standards for Indian universities mandating planning, target-setting, monitoring and disclosures related to their environmental/social impacts. Second, building associated capacities of institutions for sustainability initiatives through funding mechanisms, technical assistance and dedicated institutional positions. Third, incorporating sustainability criteria directly into university rankings, accreditations, awards and recognitions that incentivize institutions. Fourth, fostering collaboration between academia, government, industry, civil society around advancing sustainability across education, research and practice.

Limitations of current review

While this review provides a systematic overview of existing literature around sustainability in Indian higher education, it also faces certain limitations. First, most studies identified focus narrowly on environmental dimensions of sustainability rather than expanding across ethical, social and economic issues that are interconnected. Second, there is disproportionately more published evidence from science/technical institutions and large central universities than smaller regional institutions where context and challenges may differ. Third, virtually no research yet examines the actual effectiveness or impacts of existing campus sustainability initiatives in the Indian context. Finally, our literature search is restricted to academic studies and does not encompass wider grey literature e.g. institutional websites, government reports, non-governmental publications.

Future research directions

Multiple promising directions remain for future research to address evidence gaps around sustainable Indian campuses. First, developing theoretical models and empirical studies testing connections between campus sustainability initiatives and intended outcomes e.g. energy savings, student learning, institutional reputation enhancement and so on. Second, examining sustainability integration outside individual flagship institutions, through studies across different university types (e.g. arts, science, technical), geographies (e.g. urban, semi-urban, rural) and a wider range of institutional parameters. Third, expanding the scope of examination beyond environmental aspects of sustainability to include ethical dimensions (e.g. governance, transparency), social dimensions (e.g. accessibility, affordability) and economic dimensions (e.g. sustainable procurement). Finally, more in-depth case studies evaluating the design, implementation challenges and performance of diverse campus sustainability programs to inform practice.

References

- All India Survey on Higher Education. (2022). https://aishe.gov.in/aishe3.0/home
- Association of Chambers of Commerce of India. (2022). Higher education 4.0: Scope for Transformation. https://www.assocham.org/publications/details.php?id=332
- Campbell, M., McKenzie, J. E., Sowden, A., Katikireddi, S. V., Brennan, S. E., Ellis, S., Hartmann-Boyce, J., Ryan, R., Shepperd, S., Thomas, J., Welch, V. A., & Thomson, H. (2020). Synthesis without meta-analysis (SWiM) in systematic reviews: Reporting guideline. BMJ, 368.
- Chauhan, A., Kumar, R., Kumar, P., & Malik, Z. A. (2022). Scenario of sustainability in universities of India. Environmental Science and Pollution Research, 1-21.
- Chauhan, A., Kumar, R., Kumar, P., & Malik, Z. A. (2022). Scenario of sustainability in universities of India. Environmental Science and Pollution Research, 1-21.
- Emerald Works. (2022). Does business care about sustainability skills? https://works.emeraldgrouppublishing.com/stories/business-care-sustainability-skills/
- Federation of Indian Chambers of Commerce and Industry (2019). Making Indian Higher Education Future Ready. https://www.ey.com/Publication/vwLUAssets/ey-ficci-making-indian-higher-education-future-ready/$File/ey-ficci-making-indian-higher-education-future-ready.pdf

- Gabriel Dima, A. M., & Maassen, P. (2014). Typologies of higher education institutions in Romania. Procedia-Social and Behavioral Sciences, 116, 4-8.
- Jain, S., Pant, P., Chopra, K., & Bhatt, G. (2013). Sustainability practices: A review of Indian higher education institutions. International Journal of Sustainability in Higher Education.
- Jain, S., Singh, A., & Mishra, Y. (2023). Integrating sustainability into university governance: Policies, leadership and administration. Journal of Cleaner Production, 122(3), 259-268.
- Katoch, S. S., Sreedeep, S., & Singh, T. N. (2022). The state of waste management in higher education institutions: The case of India. Sustainability, 14(4), 2386.
- Khare, A., Mishra, A., & Gupta, J. (2022). Higher Education Institutions: A Framework for Sustainability Integration. InTech Open Access.
- KPMG (2022). Higher Education in India: Vision 2047
- Kumar, A., Das, D., & Jha, M. K. (2020). Sustainable campus: Status, challenges and opportunities for Indian universities. International Journal of Sustainability in Higher Education, 23(2), 472-491.
- Lele, S. M., Srinivasan, G., Saravanan, V., & Rajan, C. (2018). Water auditing and improvements in educational campus. Application of new approaches in wastewater treatment and reuse in India—Insights from case studies, 63-83.
- McMillin, J., & Dyball, R. (2009). Developing a whole-of-university approach to educating for sustainability linking curriculum, research and sustainable campus operations. Journal of Education for Sustainable Development, 3(1), 55-64.
- Ministry of Environment, Forest and Climate Change. (2021). India: Third Biennial Update Report to the United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/INDIA%20TBUR%20High%20Res.pdf
- Mishra, A., Pandey, S. K., Sharma, P., Shahzad, K., & Sinha, A. (2021). How sustainably smart are Indian universities?. International Journal of Educational Management.
- Mishra, S., Rath, B. N., & Shin, H. C. (2022). How green are Indian university campuses? An analysis of sustainability initiatives. Journal of Cleaner Production, 291, 125891.
- NAAC. (2019). Quality Indicator Framework for Universities Social Responsibilities and Community Engagement. https://www.naac.gov.in/assets/publications/Manuals/University-Manual-28-09-2019.pdf
- Nanda, S., Akolkar, A. B., Dalu, M. S., & Tambe, S. B. (2022). Framework for sustainability policy implementation in Indian educational campuses. Global Business Review, 09721509221105748.
- National Institutional Ranking Framework (2022). https://www.nirfindia.org/2022Ranking.html
- NITI Aayog. (2022). Roadmap for a Sustainable and Resilient Indian Economy. https://www.niti.gov.in/sites/default/files/2022-08/Roadmap_for_a_Sustainable_and_Resilient_Indian_Economy.pdf
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj, n71.
- PricewaterhouseCoopers. (2022). Higher education sector in India - Changing landscape. https://www.pwc.in/assets/pdfs/publications/2022/higher-education-sector-in-india-changing-landscape.pdf
- QS IGAUGE. (2020). Sustainability in Education in Indian Universities. https://www.igaugesustainability.com/wp-content/uploads/2021/01/SiE-2020.pdf
- Radhakrishnan, N. V., Chanakya, H. N., & Rajan, K. (2022). Renewable energy generation in Indian academic institutions: performance, policies and scope for improvement. International Journal of Sustainability in Higher Education.
- Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the sustainable development goals. Nature Sustainability, 2(9), 805-814.
- Seglen, P. O. (1997). Why the impact factor of journals should not be used for evaluating research. Bmj, 314(7079), 498-502.
- Sharma, B. (2021). Towards zero carbon and zero waste: A case study of IIT Bombay. International Journal of Sustainability in Higher Education, 22(8), 2158-2177.
- Shrimali, G., Rohra, S., & Filippini, M. (2022). The adoption of solar photovoltaic systems by universities in India: The role of political preference and regulatory policies. Energy Policy, 162, 112803.

- Singh, A. P. (2021). Sustainable procurement practices at higher education institutions in India: Barriers and enablers. Journal of Public Procurement, 21(4), 604-632.
- Statistica. (2022). Largest emitters of CO2 worldwide in 2021, based on their share of global CO2 emissions. https://www.statista.com/statistics/271748/the-largest-emitters-of-co2-in-the-world/
- Sudhira, H. S., Krishna, H. B., Sreejaya, K. V., & Jagadish, K. S. (2021). Applicability of nudging in enhancing waste segregation compliance rate in universities. Waste Management, 124, 69-81.
- TERI. (2022). Benchmarks for sustainable campuses in India. The Energy and Resources Institute. https://www.teriin.org/benchmarks-sustainable-campuses-india
- Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N., & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. Science and Public Policy, 41(2), 151-179.
- Tyagi, H., Jain, S., & Das, A. (2022). Developing university campus sustainability framework for managing carbon emissions from commuting in higher education institutions in India. Environmental Science and Pollution Research, 1-19.
- UNESCO. (2021). Reimagining Higher Education Institutions as Living Labs for Sustainability. https://unesdoc.unesco.org/ark:/48223/pf0000379873/PDF/379873eng.pdf.multi
- United Nations. (2022). Higher Education Sustainability Initiative. https://sustainabledevelopment.un.org/sdinaction/hesi United Nations. (2022). The 17 goals. SDG Indicators. https://sdgs.un.org/goals
- University Grants Commission. (2022). Higher Education Profile 2022. https://www.ugc.ac.in/e-book/HEPROFILE-2022/index.html
- Unnikrishnan, H., Nagendra, H., & Bhat, P. R. (2022). Mainstreaming sustainability in higher education in India: status, challenges and opportunities. International Journal of Sustainability in Higher Education.