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Article

Readiness assessment of mountain universities of Pakistan for green campus initiatives

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Abstract: The UN agenda of Sustainable Development Goals (SDGs) 2015–2030 is a holistic approach. Universities play an important role in dissemination of quality knowledge, developing the skills and attitudes of a large number of youth across the world. Though the emphasis on Education for Sustainable Development (ESD) started as early as 1992, yet Universities adopted the concept of Green Campus integrating the environmental, social and economic aspects of sustainability quite recently. In developing countries including Pakistan, the Green Campus Initiatives (GCI) have not been implemented in the majority of the Universities. Northern Pakistan comprising Azad Jammu & Kashmir (AJ&K) and Gilgit Baltistan (GB) faces multiple challenges including Climate Impacts at the top. The fragile ecosystem of the region requires more sustainable initiatives at the University and community levels. In this research, the readiness of the seven universities located in Northern Pakistan have been assessed for GCI on the basis scanning of the websites and questionnaire survey of the relevant stakeholders. The results have shown that there is little commitment of resources for sustainability from senior management, lack of awareness in faculty & staff and less research focus on the related themes of green campus. The co-curricular activities in universities are not linked with sustainability and there are no incentives for faculty, staff and students to this end. It has been recommended that Green Campus Framework may be developed for Pakistani Mountain Universities, with commitment from leaders of the universities and allocation of sufficient resources for development of sustainable campuses. The Higher Education Commission of Pakistan (HEC) needs to allocate special funds for promoting GCI across universities in Pakistan.

Keywords: sustainable development goals; higher education institutes; green campus; climate action; Pakistan

1. Introduction

1.1. Role of universities in society

Universities play a transformative role in shaping societies by transfer of knowledge, creation of new knowledge through research and providing wisdom & direction to societies by serving as a think tank. With modern technologies and innovations, the role of universities is also changing from traditional, static to responsive and dynamic, so as to respond to the radical changes in society (Moscardini, 2022). Universities around the globe play a significant role in developing the youth for the challenges of the contemporary world, from their employment to leadership roles in society. Tertiary education is always considered a catalyst for the change and transformation as the majority of the graduates adopt various careers and progressively

develop to management and leadership roles in both public and private sectors (Akour and Alenezai, 2022; Zeb et al., 2024).

1.2. Sustainable development and role of universities

According to Brundtland Commission, report Sustainable Development is defined as "Development for the present generations without compromising the needs for the coming generations" (Brundtland et al., 1987). At the dawn of the twenty-first century, the UN Millennium Development Goals (MGDs) were conceived, having a set of 8 goals, 18 targets and 48 indicators (UN, 2000). However, the MDGs were found indifferent to established human rights principles and the education targets were narrowly framed in the MGDs (Hoeven, 2014). These MDGs were ineffective to move the global majority out of poverty, inequality and unemployment (Unterhalter, 2014). Thus, soon the UN introduced the Sustainable Development Goals (SDG) agenda of 2015, which aimed at harnessing the three aspects of sustainability i.e. Environment, Social and Economics. The SDGs are important and essential for the development of both the developing and developed nations around the world (Caballero, 2019).

Universities act as seats for social transformation to achieve the sustainability goals (Dorutul, 2020). Education can play an important role in creating awareness about sustainability in the students, faculty & staff and outside the Universities (Badea et al., 2020). To cater with these challenges, universities around the world have been involved in the achievement of sustainability goals both inside and outside. Universities can provide a strong foundation for awareness and attitudinal changes for sustainable development in a society. Sustainable or green campus has been defined in many ways across the world. According to Buana et al. (2018), "Sustainable Campus is an environmentally oriented campus that integrates environmental sciences into its policies, management and scholarly activities". Similarly, a Sustainable Campus also represents the implementation and integration of environmental science into all managerial aspects and the best practices of sustainable development (Puspadi et al., 2016). Luis Velazquez et al. (2006) defined sustainable campus as, "A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles".

Universities have adopted the Sustainable Development Practices (SDP) through education, research, faculty & staff development, governance and operations of universities. For assessment of the GCI, various systems have been developed which are linked to sustainability at different levels. However, the developing countries including Pakistan are still less focused on green campus or Sustainable Campus initiatives. There are both financial and non-financial challenges for implementation of the GCI in Universities. The increased anthropogenic activities have led to enhanced Green House Gases (GHG) emissions, which has created climate impacts across the world. Pakistan is listed as the fifth climate vulnerable country in the world (German Watch, 2020). The mountain areas of Northern Pakistan are faced with a multitude of challenges due to the impacts of Climate Change such as floods, Slides,

Glacial Lake Outburst Floods (GLOFs) etc. In this context, the role of the mountain universities has become more important in promoting sustainability both inside and outside the campus. In this research, the readiness of seven mountain universities for GCI has been assessed through scanning of their websites and questionnaire survey to the major stakeholders. These universities are located in the Northern Pakistan called Azad Jammu & Kashmir (AJ&K) and Gilgit Baltistan (GB),

2. Literature review

2.1. Campus sustainability assessment tools

Various tools have been used for assessment of sustainability in universities during 2006–2019 (Dawodu et al., 2022; Geok et al., 2024). These tools mainly include University of Indonesia Green Metrics (UI-GM), Leadership for Environment and Energy Design (LEED) USA, DAE-Greenmetric, Environmental Management System (EMS), ISO-14001 and the United Nations Environmental Program-UNEP. In the United Kingdom, Building Research Establishment for Environment Management (BREEM) is more commonly used. For schools in the United States, the Sustainability Tracking and Rating System Version 2.2 (STAR 2.2) has been adopted. China has developed their own National green campus Evaluation Standards (GB/T51356-2019). All these ranking and certification systems are based on principles of environmental, economic and social sustainability (Zhu et al., 2022). Hamid Bashir et al. (2023) developed an approach for the analysing the relationship between key performance indicators (KPIs) for creating sustainable campuses. They reported that the three critical KPIs for sustainable campuses include, percentage of purchased green products, the proportion of environmentally collaborative suppliers, and the progress rate towards achieving a LEED certification level. These KPIs must be prioritized for continuous improvement initiatives of green campuses. The students in the green campuses are found more satisfied in terms of their Quality of Life (QoL) as compared to non-green campuses (Tiyarattanachai et al., 2016).

2.2. Sustainability approaches used by various universities

Universities have adopted various approaches for developing the green campuses, which include campus energy utilization and optimization, campus carbon emissions control, campus waste generation and management. Stanford University adopted a three-phase approach for developing green campus. In the first phase, they introduced the faculty with the green and sustainable initiatives in planning and implementation of various operations of university such as procurement of supplies, energy, water, land, food and transportation. In the second phase, they used the STARS tool for comprehensive and sustainable evaluation of these initiatives and lastly, it evaluated the development of relationship between the Stanford and local communities (Sugiarto and Lee, 2022). They emphasized over three dimensions for developing green campus i.e., behavioural, learning tools and physical facility. Accordingly, the curriculum and teaching & learning in other universities were also transformed with focus on ESD. With the revision of curriculum and capacity building of the faculty & staff, the concepts of sustainability have been well grounded theoretically but the transfer of this

knowledge for developing green campuses are still in the early stage. There is a lack of knowledge management to connect science, technology and innovation with sustainability (Sima et al., 2019; Yi et al., 2023). The Green University principles of Tsinghua University China was based on three dimensions i.e. green education, green research and green campus. Under this approach, education was linked with sustainability through teaching, learning and assessment. The research productivity focused on sustainable development. The campus infrastructure, operation and maintenance were made sustainable (Zhao and Zhu, 2019). The Universities in the United States have been leading in theory and practice related to green campuses. They were followed by the UK, China, Japan, Canada, Brazil etc. (Chintan et al., 2022). Universities around the world have been adjusting their vision & missions, program and course outcomes to SDGs. Similarly, the research has been aligned with the SDGs in a variety of ways (Jabeen, 2022). At the same time, the SDGs are changing the dynamics of universities across the world and each university engages with Sustainable Development Goals in its own peculiar way (Mallow et al., 2020). Habib and Ismaila (2008) proposed a campus sustainability model given in **Figure 1**.

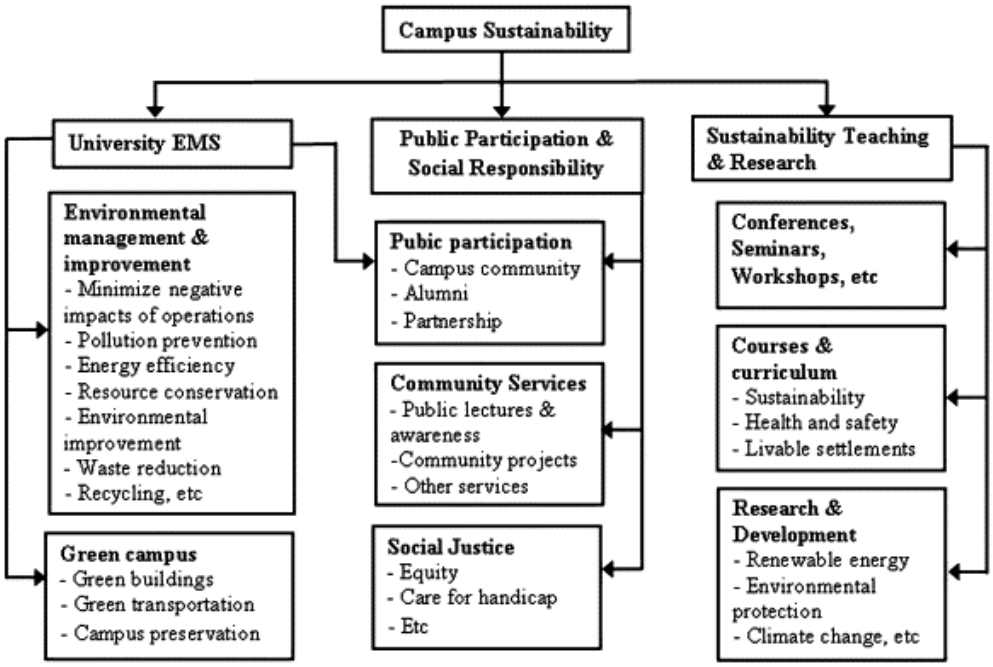

Figure 1. Framework of proposed approach for campus sustainability adopted from Habib and Ismaila (2008).

They proposed an integrated approach incorporating University Environmental Management System (EMS), Public Participation & Social Responsibility and Sustainability Teaching & Research (Habib and Ismaila, 2008). Under EMS, regular environmental management & improvement and GCI was proposed. Public participation can be strengthened through engaging campus community, alumni & other partners from society, creating public awareness and ensuring equity, diversity and inclusiveness. Similarly, teaching and research needs to be focused on sustainable development (SD). With the advent of modern information and communication technologies (ICTs), the use of intelligent technologies in the planning and design of

universities has increased for developing green campuses. The universities are transforming from traditional to technology driven universities for developing sustainable campuses. The concept of NetZero of campus can be achieved with the use of modern technologies such as Artificial Intelligence (AI), Internet of Things (IoT) and data driven techniques (Reihaneh and Marzieh, 2023; Ullah et al., 2024). The use of digital transformation (DT) is becoming an emerging research area for sustainability of campuses. Trevisan et al. (2024), suggested three areas of current research: ensuring sustainability competencies through DT, smart and sustainable campus approaches, and theorisation of sustainability in higher education through DT. Betanti and Ari (2019), assessed the campus sustainability by measuring the carbon footprint of operations related to electricity, transportation and waste generation. Electricity contributed the largest amount (92%) of carbon emission, followed by transportation (7%) and waste generation (1%). Hongwei Tan et al. (2014) analysed the progress of Green Campus development in China and differentiated sustainable campus, green campus and energy & resource saving campus, based on the relevant interventions. Sustainable campus takes a holistic view of sustainability in all its teaching, research, operation, talent cultivation and public engagement. The green campus has more focus on green education, green infrastructure, green operations and green technologies & outreach. Similarly, energy and resource conservation campuses have more focus on demonstration green initiatives as further elaborated in the **Figure 2**.

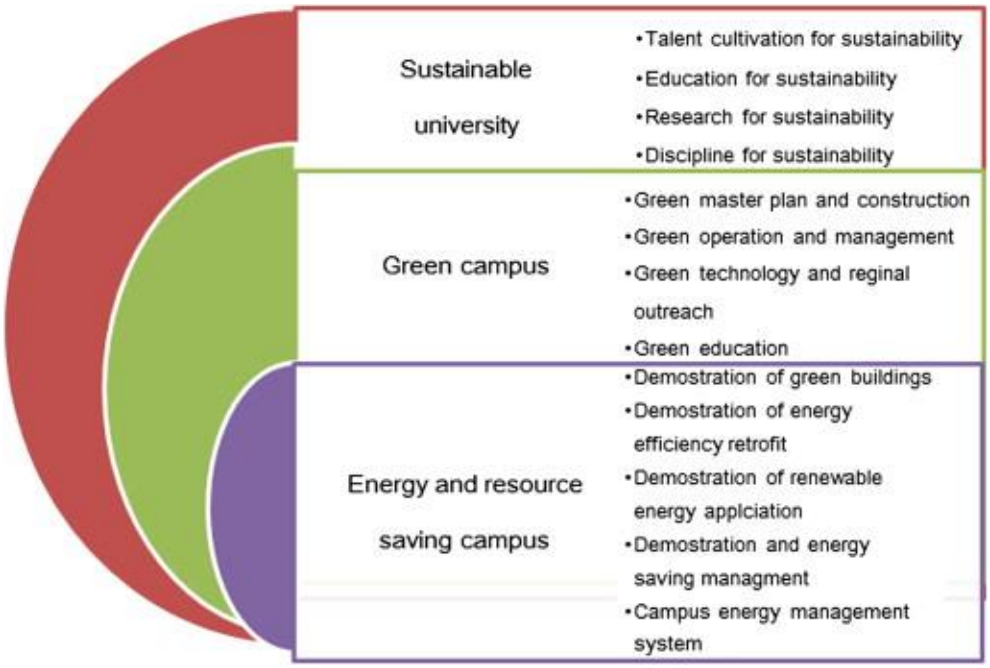

Figure 2. Various connotation of sustainability interventions in campus (Tan et al., 2014).

For green campus, Young Geng et al. (2013) proposed an integrated approach for greening the University campus. This approach is based on use of minimizing water, energy and material and resources, thereby achieving economic benefits and mitigating the ecological impacts of university through teaching, research & other

operations for improving public awareness and involvement. This integrated model is presented in **Figure 3**.

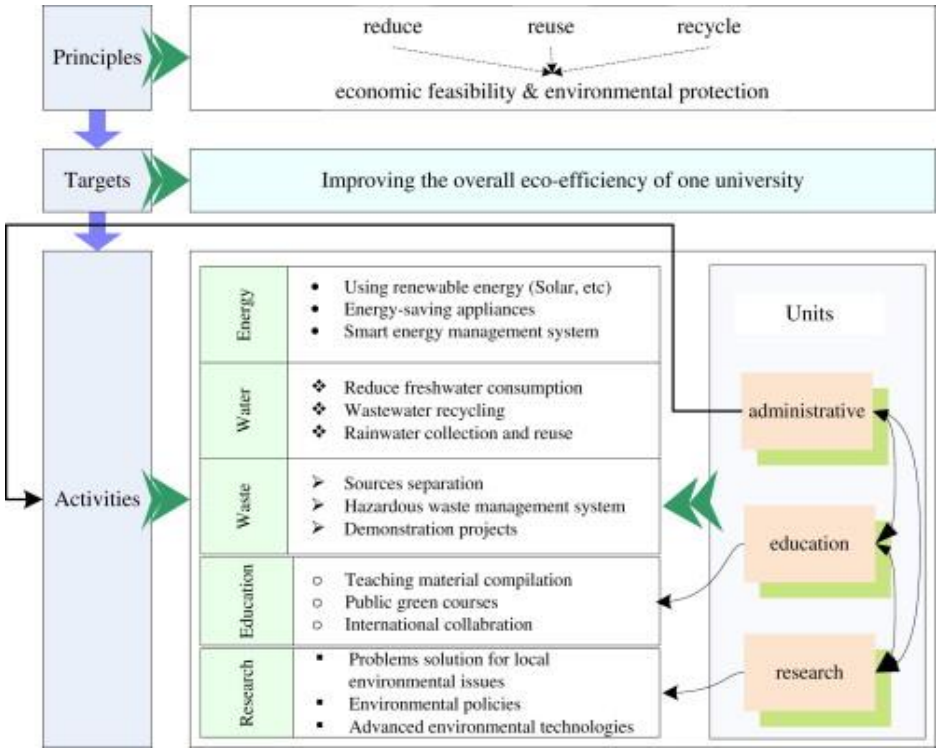

Figure 3. Integrated model for sustainable campus proposed by Young Gen et al. (2013).

Among the various Campus Sustainability Assessment Tools (CSAT), the UI-Green metric system is more comprehensive and more widely used in Asian universities. According to the latest report of UI-Green Metric, 1183 universities from 84 countries are participating in this ranking system (UI-Green metric, 2024). The CSAT are evolving with time and new attributes are being added based on the recent developments. The implementation and review strategies for these tools are also evolving with new approaches, involving diverse stakeholders.

2.3. Barriers to implementation of SD and green campus initiatives

Achieving sustainability at university campuses has become an issue of worldwide interest, particularly given the increasing force of the pro-sustainability movement (Alshuwaikhat and Abubakar, 2008; Velazquez et al., 2006). The assessment of GCI offers many operational and reporting issues as most of the data is provided by the Estate and facility management department and sustainability is not integrated with the University operations, vision & mission and policies (Rachel et al., 2019). The implementation of GCI suffers from various challenges at different levels both in the developed and - developing countries. These barriers have been assessed from various perspectives. Lack of integrated thinking between organizational structure, disciplines, interdisciplinary cooperation and learning, lack of leadership and commitment from senior management and confusion over the concepts and practices of SD are some of the major impediments (Waas et al., 2012). For

sustainability in universities, leadership competencies and change management is required at different levels (Scot et al., 2012). Very few countries and universities in the world have significant staff development initiatives to enhance the ESD in both the teaching and leadership skills of the faculty in universities (UE4SD, 2015). The transformative and leadership skills are deemed necessary for educators, besides teaching skills for real change towards SD in universities and the faculty and senior staff have to lead the process from the front (Barth and Rieckmann, 2012; Zeb et al., 2023). A common barrier, which has been observed in all parts of the world with different intensity, is lack of resources for implementation of the SD initiatives at the Campuses. GCI initially require substantial resources both in terms of human and financial resources, which are rarely available (Gholami et al., 2020). Brandli et al. (2015) highlighted the need for legal regulations, active engagement with the stakeholders, effective planning, proper infrastructure, cultural changes, developing cooperation networks between universities, government policies to encourage the implementation of education for sustainability for promoting SD at campuses.

2.4. Green campus initiatives in developing countries and Pakistan

The emphasis over sustainability in higher education has increased in the developing countries with focus on four main domains i.e. substantial course delivery, research aligned with sustainability, green campuses and engagement with the community & stakeholders (Walter et al., 2021). In Pakistan, the readiness of universities for sustainability was assessed from the perspective of education, research, governance & administration, operations, Outreach & stakeholders' engagements. It was recommended in the earlier research, to incentivise the assessment and faculty for promoting sustainability, encouraging the related thematic research, strengthening partnership for implementation of sustainability related initiatives, strengthening outreach and engagement with the external stakeholders and community (Habib et al., 2021). Issues related to implementation, integration and reporting of sustainability in universities were also highlighted. It was revealed that sustainability has not been integrated with the vision, mission & strategic plans of universities and they mainly exhibit verbal commitments. The implementation, integration, and reporting of sustainable development (SD) in institutions have been observed as limited. Institutions face challenges, particularly in resources and budget constraints, that hinder the implementation of SD-related plans. Moreover, Zahid et al. (2021), SD is not expansively integrated into curricula or research, lacking a structured policy framework. Despite this, Fatima et al. (2021), students in universities show a willingness to participate in SD initiatives when adequately informed. Conversely, limited support from senior management, resistance to change, insufficient stakeholder capacity, and a shortage of financial resources have been identified as significant barriers to SD implementation in public universities in Pakistan (Bukhari et al., 2022; Hinduja et al., 2023). The Islamic University Bahawalpur (IUB) Pakistan adopted various GCI, which included energy conservation strategies, initiatives of waste management, paper management initiatives, fuel management, effective transportation system, teaching and research on sustainable development, community engagement, accountability and reporting (Abid et al., 2023).

2.5. Research gaps in Green Campus Initiatives (GCI)

Universities around the world have increased their emphasis over GCI during the last few decades and particularly after the adoption of Sustainable Development Goals (SDGs) by the United Nations in 2015. According to Mohammad Alizadeh Korde and Weaver (2018), a large number of universities have failed in implementing the sustainable or GCI and still gaps exist in various initiatives i.e. teaching & learning system, governance, operation & maintenance and partnership with the communities (Anthony, 2021). The 5 Ps of engagement of the community in sustainability related initiatives include physical facilities, personal motivations, public perception, price mechanisms and policies (Too and Bajracharya, 2015).

In Pakistan, like most of the developing countries, the Green Campus Initiatives have not been recognized at the levels of executive and senior management. Little or no resources have been allocated for such initiatives and the collaboration with external stakeholders is at its minimal levels. Such initiatives are more related to the development of green landscape or water & energy conservation, hence no integrated approach and framework has been implemented (Zahid et al., 2021). The actions required for promoting sustainability at the campuses have been referred to as Green Campus Initiatives (GCI) and various interventions have been proposed. In this research, the initiatives of education & outreach, establishment of green campus committees, measurement and monitoring of gci, energy conservation & green energy initiatives, water conservation, green transport, sustainable waste management and green procurement have been considered for GCI, with an aim to reduce the Carbon Footprint of University operations. The details are given in **Table 1**.

Table 1. Details of interventions considered for green campus initiatives.

Category of Interventions	Description	References
Establishment of Green Campus Committee	Its establishment, empowerment, frequency of meetings and implementation of recommendations were assessed under this section	Walter et al. (2019); Leith Sharp (2009); Yong Geng (2013).
Measuring and Monitoring of Green Campus Initiatives	The alignment of sustainability with Institutional Vision & Mission, tools for assessment of Green Campus Initiatives, Green Campus Ranking system adopted and availability of action plan for green campus were assessed in this section	Lozano et al. (2013); Anthony Jnr (2021); Ribeiro et al. (2021).
Education Research and outreach	Various initiatives for encouraging sustainable behaviours of students, motivation measures for teaching of sustainability by faculty, community engagement for developing sustainable behaviour both internally and externally were assessed in this section	Tan et al. (2014); Arbuthnott (2009); Karatzogolou (2013); Clifford and Petrescu (2012).
Energy Conservation and Use of Renewable Energy sources	Availability of Energy audits, sharing of energy sources and consumption with students and staff, community awareness programs, use of renewable energy and community engagement for promoting sustainable energy uses were assessed here.	Hasim MS et al. 2019; Ribeiro et al. (2017); Guerra et al. (2018).
Water Quality Assessment and Conservation	The initiatives like water quality testing, encouragement of water conservation through seminars and workshops, availability of rainwater harvesting, installation of efficient water irrigation systems, engagement of internal and external stakeholders were assessed under this section.	Nicole et al. (2020); Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).
Green Transportation	Use of green transport, facilities for biking, use of awareness seminars about green transport, transportation audits and community engagement for green transport were assessed in this section.	Silva Fissi et al. (2021); Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).

Table 1. (*Continued*).

Category of Interventions	Description	References
Sustainable Waste Management	Existing of integrated Solid Waste Management at the campus, Waste audits, and initiatives for zero waste at campus. Initiatives for reduction of paper wastes, existing of waste recycle facilities were assessed here.	Owojori et al. (2022); Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).
Green Procurement	University has established list of green products list, using recycled material, less packing etc. Tracking system for green procurement exists at University level and reuse policy for old material and furniture is deployed at University level.	Homer and Khor (2022); Silva Fissi et al. (2021); Khan SA R et al. (2022).

2.6. Justification and limitation of research

This research was mainly motivated due to limited research on the sustainability initiatives in Pakistani universities with special reference to mountain universities. The earlier studies by Abid et al. (2023) and Zahid et al. (2021) have not addressed the specific challenges of mountain universities, where sustainability initiatives are required with more focus. The research is limited to the universities of Northern Areas of Pakistan called and AJ&K and GB.

3. Material and methods

3.1. Proposed research model

Sustainable University always undertake various initiatives from teaching & learning to research, university operations and internal & external collaboration with the major stakeholders for developing green indicatives. The Green Campus Initiatives (GCI) include a number of interventions. These may include by the existence of Green campus committees and offices (Walter et al., 2019), education and research on sustainability (Tan et al., 2014), measurement and monitoring mechanism for the SDP (Hasim et al., 2019), Water conservation and assessment strategies (Nicole et al, 2020), Green transportation (Silva Fissi et al., 2021), Sustainable Waste Management (Owojori et al., 2022) and Green procurement (Homer and Khor, 2022). In this research, the Green Campus Initiatives (GCI) is treated as dependent variable for assessment of the universities of the Northern Pakistan. The details are shown in **Table 2** and proposed model is shown in **Figure 4**.

Table 2. Summary of dependent and independent variables for the study.

Independents Variable	Dependent Variable	Authors/References
Establishment of Green Committees and Office (GCC)	Green Campus Initiatives (GCI) Education and Outreach (EAO)	Walter et al. (2019); Leith Sharp (2009); Yong Geng (2013).
Measurement and monitoring (MAM)	Green Campus Initiatives (GCI) Education and Outreach (EAO)	Lozano et al. (2013); Anthony Jnr (2021); Ribeiro et al. (2021).
Energy Conservation (ENC)	Green Campus Initiatives (GCI) Education and Outreach (EAO)	Hasim MS et al. (2019); Ribeiro et al. (2017); Guerra et al. (2018).

Table 2. (*Continued*).

Independents Variable	Dependent Variable	Authors/References
Water Conservation (WC)	Green Campus Initiatives (GCI)	Nicole et al. (2020); Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).
	Education and Outreach (EAO)	
Green Transportation (GTR)	Green Campus Initiatives (GCI)	Silva Fissi et al. (2021); Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).
	Education and Outreach (EAO)	
Sustainable Waste Management (SWM)	Green Campus Initiatives (GCI)	Owojori et al. 2022; Ribeiro et al. (2017); Suwartha and Sari (2013); Guerra et al. (2018).
	Education and Outreach (EAO)	

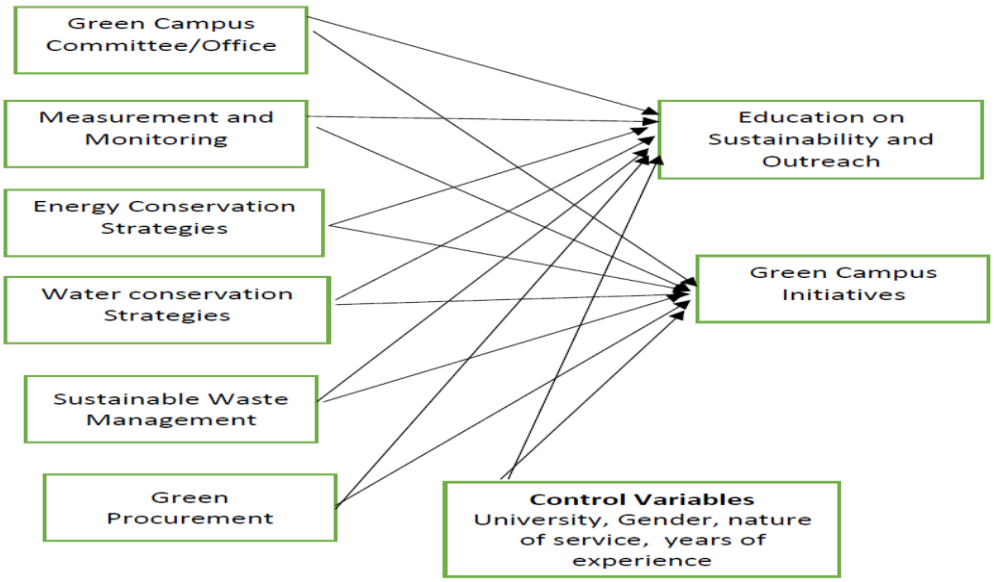

Figure 4. Proposed model for green campus initiatives.

3.2. Study areas

The Northern Areas of Pakistan comprise the administrative region of GB, AJ&K. The GB and AJ&K are part of the Kashmir region (Öztürk et al., 2015). This is a mountainous region and hub of tourism, having the three mighty ranges of Himalaya, Karakoram and Hindukush (HKH). The region is home to the world largest deposit of snow after poles and often called Third pole. These glaciers provide water resources to the 70% of the population in Pakistan (Chetri et al., 2012). The location map of Northern Areas are shown in **Figure 5**. This region is subject to severe ecological challenges including climate impacts, natural disasters, food insecurity and lack of livelihood opportunities. The fragile ecosystem of the region, bring heavy responsibility on the universities to develop sustainability in education, practices and behaviours both inside and outside the campuses. The huge tourism influx dominated by the domestic tourists in the region also create severe challenges for the ecosystem, hence Green Campus Initiatives (GCI) become inevitable for sustainability of the society and their livelihood. In this context, the current research plays a pivotal work, which will open more dimensions of research in future.

Figure 5. Location map of Northern areas (Survey of Pakistan, 2020).

3.3. Population, Samples and Data Collection

3.3.1. Population

There are five public sector Universities in AJ&K i.e. University of Azad Jammu & Kashmir Muzaffarabad, Mirpur University of Science and Technology, University of Poonch Rawlakot, University of Kotli, Women University Bagh and two Universities in GB i.e. Karakoram International University Gilgit and University of Baltistan at Skardu. Further details of these Universities are given in **Table 3**. The universities were established during 1980–2016 with University of AJK as the earliest higher education institute established in 1980, whereas the youngest is University of Baltistan at Skardu was established in 2016. About 52,600 students are enrolled in the seven universities of the region, offering diverse programs in natural sciences, life sciences, social sciences, Arts & Humanities and Engineering & Technology fields. The total academic and administrative staff in these Universities is about 4635. The region has been exposed to climate impacts such as Glacial Lake Outburst Floods (GLOFs), slides, floods, earthquakes etc. The selection of these mountain universities for the study is based on the fact that these universities are located in the climate vulnerable region of Pakistan (Hindukush, Karakoram Himalaya region). For data collection, the websites and previously published data was evaluated based on sustainable development initiatives (SDI) checklist. Questionnaire survey was administered to the major stakeholder of the universities.

3.3.2. Sample size

The questionnaire survey was administered to about 6500 faculty and administrative staff in the mountain universities of the region, to assess their

perspectives on implementation of Green Campus Initiatives. The sample size for infinite population is given by following Statistical formula:

$$n = \frac{Z^2.p.q}{\sigma^2} \quad (1)$$

where:

n; Sample size for infinite population

Z; The score for the confidence level of (1−σ) %. For σ = 0.05, Z = 1.96 (2-tailed test)

p = Population proportion assumed to have the particular attribute being assessed (Here 50% assumed), q = Proportion of remaining population = 1−p, σ; Margin of error = 5% or 0.05 in this case.

Hence the sample size (n) for infinite population = 1.96^2 (0.5) (0.5)/$(0.05)^2$ = 384.16.

For finite population (N = 4635), the adjusted sample size is given as:

$$\text{Adj } n = \frac{n}{1+\frac{N-1}{N}}$$

where N = Population = 4635 in this case, hence the adjusted sample size comes out to:

$$\text{Adj } n = 384$$

Hence, the minimum sample size of 384 responses was required for this study. (For further details of sample size calculation, please visit https://www.cuemath.com/sample-size-formula/

The readiness of seven universities of the region for green campus initiatives has been analysed in this research from seven perspectives i.e. Green Campus Committee and its role, measurement and monitoring system, education and outreach, energy conservation, water conservation, transportation, waste management and finally green procurement.

The questionnaire for Green Campus Initiatives of the Universities was comprised of the following ten sections:

Section 1: Demographic details of the respondents showing name of university, nature of job, length of experience and gender. Section 2: Existence of Green Team at University, their involvement and commitment of the senior management for the implementation of their recommendations (4 questions). Section 3: Measurement and Monitoring (4 questions): Inclusion of Sustainability in the vision & mission, existing monitoring and reporting system and currently adopted green campus certification (if any). Section 4: Education and Outreach (6 questions): The level of involvement of students, faculty and staff in the SD teaching and learning. Efforts for changing the behaviours of students & faculty and engagement with the society are assessed in this section. Section 5: Energy Conservation (9 questions). Important aspects like use of renewable energy, energy audits, involvement of students, faculty and staff in the energy conservation efforts etc. are assessed in this section. Section 6: Water Conservation and Quality Assessment (7 questions). In this section various water conservation initiatives and quality assessment endeavours of the Universities were assessed. Section 7: Transportation (4 questions): The responses about the current

waste management techniques and their sustainability dimensions were assessed. Section 8: (4 questions): The use of green transport initiative was assessed in the selected universities. Section 9: Waste Management (6 questions): The present waste management techniques with focus on suitability were assessed. Section 10: Procurement and Purchasing (5 questions): The selection of environment friendly and energy efficient products was assessed in this section.

The details showing the year of establishment, present students' enrolment, faculty and administrative staff number and website addresses of selected mountain universities are given in **Table 3**.

Table 3. Details of seven mountain universities of HKH region selected for the Green Campus Initiatives (GCI).

No	University	Location	Date of Establishment	No of students	No of employees	Website/ref
1	The University of Azad Jammu and Kashmir	Muzaffarabad (AJ&K)	1980	16,000	1450	www.uajk.edu.pk
2	Mirpur University of Science and Technology	Mipur (AJ&K)	2009	11,600	1250	www.must.edu.pk
3	University of Poonch at Rawalkot	Rawalakot (AJ&K)	2014	4000	350	www.upr.edu.pk
4	University of Kotli	Kotli (AJ&K)	2013	4000	320	www.uokajk.edu.pk
5	Women University Bagh	Bagh (AJ&K)	2014	5000	310	www.wuajk.edu.pk
6	Karakoram International University Gilgit	Gilgit Baltistan (GB)	2002	9500	835	www.kiu.edu.pk
7	University of Baltistan at Skardu	Gilgit Baltistan (GB)	2016	2500	120	www.uobs.edu.pk
			Total	52,600	4635	

The questions asked under each category of attributes used for assessment of the Green Campus Initiatives are given in **Table 4**.

Table 4. Major attributes of questionnaire adopted for the assessment of Green Campus Initiatives. (Adopted from Austin Sustainability Green Campus Checklist 2023).

No	Major attributes of Campus Sustainability	Questions/Contents evaluated
01	Existence of Green Campus Team/Committee and their empowerment (4 questions)	Q1.1 Has University established Green Campus Committee. Q1.2 Which of the following Stakeholders are involved in the Green Campus team? (admin, teachers, students, facility manager, head custodian, cafeteria manager, parents, volunteers) Q1.3 Is Green Campus team empowered to recommend projects for the Campus. Q1.4 Are the projects recommended by Green Campus Team implemented by university.
02	Measuring and Monitoring of Green Campus Initiatives (4 Questions)	Q2.1. Has Environmental Sustainability been included in the Vision and Mission of the University? Q2.2. Have you assessed the Campus Environmental Impact via the following tools? (Eco-audit, Carbon footprint/sq.ft, None, others) Q. 2.3: Have you acquired/applied for International Green Campus Ranking? Q2.4: Has your university developed an action plan for achieving the Environmental goals?

Table 4. (*Continued*).

No	Major attributes of Campus Sustainability	Questions/Contents evaluated
03	Education Research and outreach (6 questions)	Q3.1: Your university encourages Sustainable behaviour via: (Education Campaigns, Incentives, Awards, other) Q.3.2: The teachers are encouraged to teach sustainability concepts, including the relationship between the environment, society, and economics. Q3.3: Staff of University is encouraged to model sustainable behaviour for students, peers and community Q3.4: Students of University model/exhibit sustainable Behaviour for staff, peers and community. Q3.5: University share promotion about sustainable developments learning internally via: (Posters, website, notices, newsletters, workshops, conferences, others) Q3.6: University share promotion about sustainable developments learning externally via: (Green Community events, newsletters, website, parent mailer, participation in green team, Involvement in advisory committee, students/professional organizations.
04	Energy Conservation and Use of Renewable Energy (9 questions)	Q 4.1: University has undertaken energy audit of classrooms, hostels etc. Q4.2: Students know the source of energy to campus and the energy bills are shared with them? Q4.3: Your University offer energy conservation lessons and programs at Campus. Q4.4: Your University encourages responsible energy use via (Incentives, contest, awards, others, and none). Q4.5: The building design of the Campus facilities has harnessed the Natural Lighting and Ventilation Q4.6: Lighting Sensors installed in halls, classrooms and other facilities. Q 4.7: University has employed effective Energy use policy including switching off lights, heaters, computers and other accessories when idle. Q4.8: University arranged Awareness Seminars and workshops for internal and external stakeholders. Q4.9: University employed renewable energy sources such as Solar Geothermal and Hydel etc. to augment the energy demand of the campus?
05	Water Quality Assessment and Conservation (7 Questions)	Q5.1 University regularly checks the quality of water through requisite testing Q5.2 University encourages Water Conservation and responsible behaviour via; (Education Campaigns, incentives, awards, contest, others, None) Q5.3: Has University installed Rainwater Harvesting (RWH) Systems. Q5.4: University has installed efficient irrigation system like drip irrigation, sprinkler irrigation etc. for horticulture. Q5.5: University has deployed Waste Water Reuse projects in the Campus and Hostels. Q 5.6: Water quality assessed periodically for both physical and microbial analysis. Q5.7: University engages internal and external stakeholders/community in water quality and conservation awareness
06	Green Transportation (4 Questions)	Q6.1: University encourages Green Transportation via: (Education campaigns, Contests, incentives, awards, others, none) Q6.2: University conducts regular audit of its transport fleet for green transport. Q6.3: University has ensured Green Transportation's inside the Campus via: (Safe connected and accessible walkways, bike paths, bike racks, green vehicles, others, None) Q6.4: University encourages program administrators and community groups to offer/promote green transportation option in line with University
07	Waste Management (6 questions)	Q7.1: University has done Waste Audit for its segregation. Q7.2: Has University you deployed a system to track the volume and nature of waste generated at the campus. Q7.3: University encourages Zero Waste Culture Via: (Education Campaigns, incentives, awards, contest, zero waste events, others, None) Q. 7.4: University reduces Cafeteria Waste via: (Reusable trays, minimise packaging, students engagement in waste sorting, others, None) Q7.5: University has employed to reduce paper waste via following initiatives (Encouraging digital reading, double sided printing, Reduce margins, multiple pages printing per sheet, minimise paper corresponding, opting out for unwanted mail, none, others) Q 7.6: · University administrators and community groups are engaged and encouraged to reduce, reuse, recycle/compost waste in line with the sustainable practices.

Table 4. (*Continued*).

No	Major attributes of Campus Sustainability	Questions/Contents evaluated
08	Procurement and purchasing (4 Questions)	Q8.1: Has University developed a list of green/clean products such as: (Green Cleaning products, paper products with min 30% recycled material, refillable pins, No to Low Odour markers, No to low odour, plates, cups with recycled material, compostable bags, rechargeable batteries, Energy Star certified computers, Others, None. Q8.2: University tracks its purchasing for Green attributes. Q8.3: University has developed policy for reuse of old material like furniture and factures, accessories and other products Q.8.4 University has provided water cooler at multiple places to refill the water bottle by students and staff.

4. Results and discussions

4.1. Review of the vision, mission and objectives for their relevance to SD

The vision and mission of the seven mountain universities have been given in **Table 5**.

The vision and mission statement of the Universities have been developed and transformed with time to respond to the regional, national and global dynamics. Some of the universities have explicitly shown the words sustainable development as part of their vision and mission, showing their emphasis. The terms sustainable development, Sustainable solutions for economic and environmental issues, socioeconomic development through sustainable R&D have been included in the vision and mission statements. Alternate words like holistic education, historical & cultural values of the region, promote the distinctive cultural and natural heritage also reflect the commitment for sustainability to the extent of their vision and mission statements. Hence, sustainability has been included in the vision and mission statements of the Universities in the region directly or indirectly. This may be mainly attributed to the fact that these universities are located in the mountainous ecologically sensitive region and the leaders of the universities mindful of the challenges sustainability in the region. The vision and mission cannot be static and will always be adjusted to the global and regional dynamics, including the challenges of sustainability in the region.

Table 5. Vision and mission statement of seven mountain universities of the Northern Pakistan.

NO	University	Vision	Mission
1	The University of Azad Jammu and Kashmir (Established 1980)	Transformation to excellence through ***holistic education***	The University is committed to quality education, research and values-driven mentorship through innovations to serve the society and the changing world.
2	Mirpur University of Science and Technology (Established 2009)	To outclass as a leading institution among other institution for research and teaching, driving transformative societal impact and serving as a bridge for knowledge exchange between AJ&K, Pakistan, and the global community.	Mirpur University of Science and Technology is enthusiastic to the holistic development of its students, empowering them to access global knowledge and prepare for future leadership roles. This promise is driven by an ongoing focus on innovation in education, research, creativity, technological progress, and entrepreneurship.
3	University of Poonch at Rawalkot (Established 2014)	The University of Poonch Rawalakot seeks to become a leading centre of superiority by embracing interactive research and teaching method, while encouraging the region's valuable historical and cultural heritage.	The University of Poonch Rawalakot goals to establish a strong foundation for educational opportunities in a compassionate environment, fostering self-reliance, wisdom, values, and human prospective. Its mission is to advance knowledge, develop skills, and cultivate intellectual growth, empowering individuals to contribute positively to civilization and enhance humanity's well-being.

Table 5. (*Continued*).

NO	University	Vision	Mission
4	University of Kotli (Established 2013)	To achieve global recognition as a university, offering high-quality education and research excellence, while maintaining a strong commitment to fostering socio-economic development for a sustainable society.	To establish the University of Kotli AJ&K as a cutting-edge institution focused on generating, advancing, and applying knowledge across diverse academic, research, and professional domains.
5	Women University Bagh (Established 2014)	To be a leading University that provides best teaching-learning environment; promotes critical thinking and entrepreneurship for producing skillful female graduates who can act as agents of change in society.	To provide women with best academic opportunities to transform them into qualified and trained human resource to meet contemporary challenges. To empower women graduates to translate their knowledge, research and technology for giving sustainable solutions of economic and environmental issues. To enhance social and problem solving skills for harmonious social development of local communities in particular and region in general.
6	Karakoram International University Gilgit (Established 2002)	"The Karakoram International University endeavors to become a leading institution of higher learning, meaningfully contributing to sustainable development, promoting knowledge economies and pluralistic societies in the mountainous regions of Pakistan and geographically similar landscapes elsewhere".	1. "Offering Quality academic programs in line with the local, regional & global demands" 2. "Attracting & nurturing high-quality minds to address the contemporary challenges through dissemination & generation of high-quality knowledge & cutting edge research" 3. "Promoting & conserving the indigenous values and creating social & ethical responsibility" 4. "Trying to become financially sustainable; through commercialization of Research and Development"
7	University of Baltistan at Skardu (Established 2017)	A globally engaged, federally chartered public sector university located in the high Himalaya-Karakoram mountains, committed to excellence in higher education. It emphases on synergistic, innovative research and socio-economic development, promoting sustainable research and human resource development to strengthen and empower local communities.	To provide high-quality education and research opportunities for stakeholders, neighbouring regions, and both national and international communities by embracing modern trends in higher education and outreach. This includes implementing innovative and supportable methods to protect, nurture, and promote the unique cultural and natural heritage of GB.

4.2. Results and discussions of questionnaire survey

405 responses were received from the mountain universities, which were comprised of 67% of the academics and 33% of the management and servicing staff. 75% of them were male and 25% were female. The responses under each section are summarised as follows:

4.2.1. Role of green team and office to promote sustainable development at universities

Green offices and green campus committees play instrumental role in promoting sustainability in universities (Walter et al., 2019). In this research majority of the respondents (83%) have reported that green campus team exist and major stakeholders like faculty, administration, students and volunteers are involved. This can be attributed to the efforts of HEC Pakistan, which has been promoting sustainability through education, research and physical facilities. In some of the universities, Green Youth Movement (GYM) under Successful Youth Centre (Prome Minister Youth Development Program) of the Federal Government have been established, where student volunteers have been appointed for green initiatives at the campuses (Islamabad post, 2019). Only 25% of the respondents think that these green campus teams have been empowered to recommend plausible suggestions to the senior

management, however majority opine that Universities implement these recommendations, where the green campus teams are empowered. The responses about involvement of various stakeholders in the green campus initiatives are given in **Figure 6**.

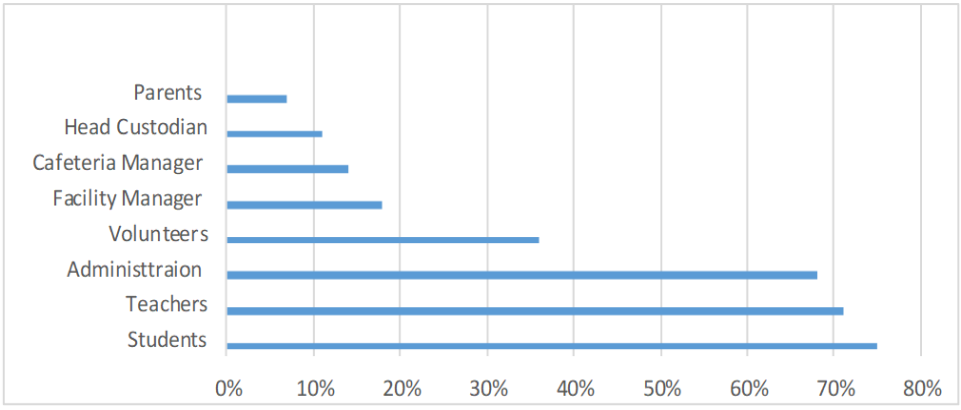

Figure 6. Responses about involvement of stakeholders in green campus initiatives.

4.2.2. Measurement and monitoring of sustainable development

Though green campus committees and teams have been established at the majority of universities but there is no specific measurement and monitoring mechanism to assess the sustainable development initiatives at the campuses (Lozano et al., 2013). Majority of the respondents (83%) have reported that sustainability has been included in the vision and mission of the universities. There is no organized environmental impact assessment and monitoring system in majority of the universities. Most of the respondents (60%) have shared that their universities have not applied for any sustainability ranking. 25% have responded that they are employing University of Indonesia (UI-GM) ranking and 8% use Time Higher Education Impact Ranking (THE-IR). Majority of the respondents (83%) think that their universities have developed the Green Action Plan, which is an encouraging trend, but these plans need implementation in true sense. At times, the authors have observed that without organized regulatory and policy framework at the universities for sustainability, the willingness for sustainability is at minimal level. This is also attributed to excessive teaching and research loads with the faculty and large number of credit hours of teaching and learning for students. To promote sustainability in teaching, assessment and research, some incentives for students and faculty may also be introduced.

4.2.3. Education and outreach

Monitoring of ESD to assess the education outcomes have been found missing in earlier studies (Karatzogolou, 2013). The sustainable behaviour is mainly promoted through education campaigns, followed by incentives like gift cards etc. and competitions & awards. Majority (66%) think that teachers are encouraged to teach sustainability but the role of students and staff for community engagement for sustainability has been reported as weak. For learning about sustainable practices, awareness campaigns & seminars are most effective (67%), followed by posters and e-newsletters from students' societies. Universities also play an effective platform for

engaging external stakeholder and community in the sustainable development through a variety of activities (Clifford and Petrescu, 2012). The survey has shown that for engaging with external stakeholders and society, the professional organizations and green community events have proved more useful, followed by participation of community leaders in University Green initiatives. The responses about various initiatives at Campuses to promote sustainability and sustainable behaviour internally and externally are given in **Figures 7–9** receptively.

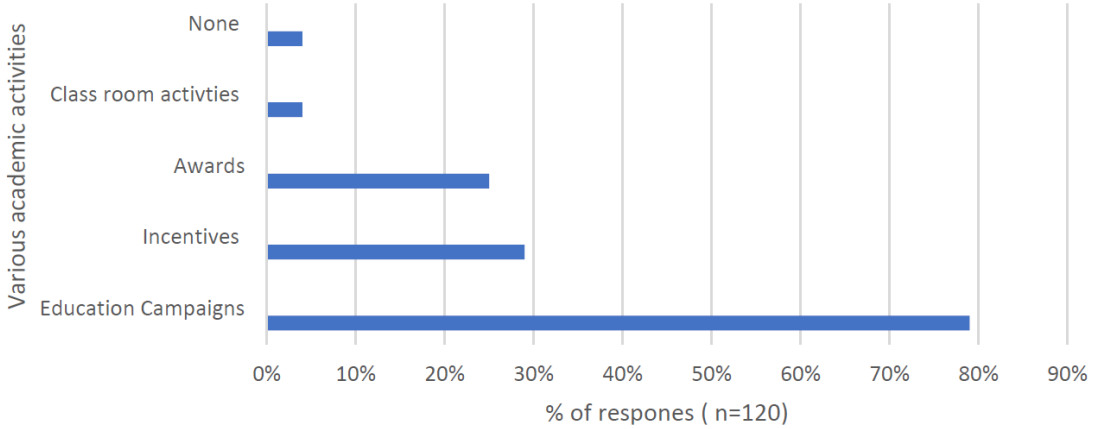

Figure 7. Responses about various initiatives adopted for encouraging sustainable behaviour at campuses.

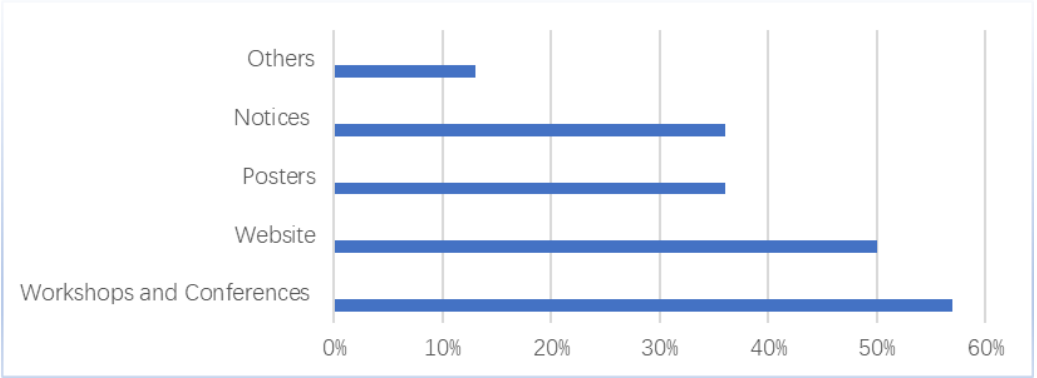

Figure 8. Responses about various activities for promoting sustainable development learning internally.

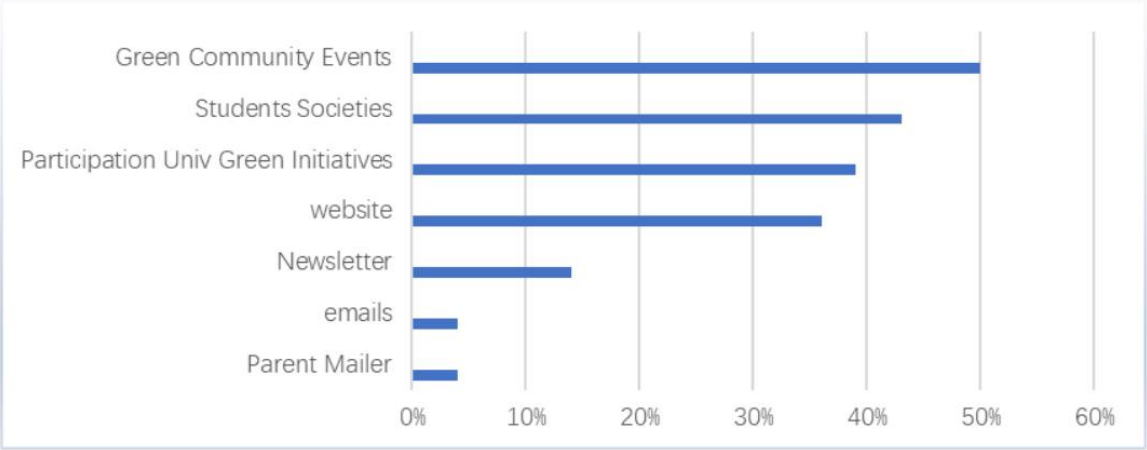

Figure 9. Responses about various activities for promoting sustainable development learning externally.

4.2.4. Energy conservation and renewable energy use strategies

For energy conservation in universities, various strategies have been suggested such as providing energy awareness program, using energy-efficient appliances and equipment, managing activities and academic time scheduling, using the prepaid metering system, and energy management planning (Hasim MS et al., 2019). Majority of the respondents (80%) think that there has not been an organized energy audits at their campuses and nor the energy bill are shared with the staff and students for their awareness. A small number of respondents agree (30%) that specific programs and courses are offered on energy conservation and optimization. For promotion of responsible energy use at the campuses, the majority of the initiatives are restricted to education campaigns only. About 67% of respondents have shared that the concept of passive building design and natural heating & ventilation has been used in design and construction of physical facilities in universities. 85% of the respondents have shared that no light sensors have been used in their universities. Majority (67%) think that Universities have developed energy use policies but these are not practiced holistically. Universities rarely arrange energy conservation seminars. Only 25% of the respondents have reported that their universities have deployed the renewable energy as alternate power sources. The responses on various energy conservation strategies at campuses are given in **Figure 10**.

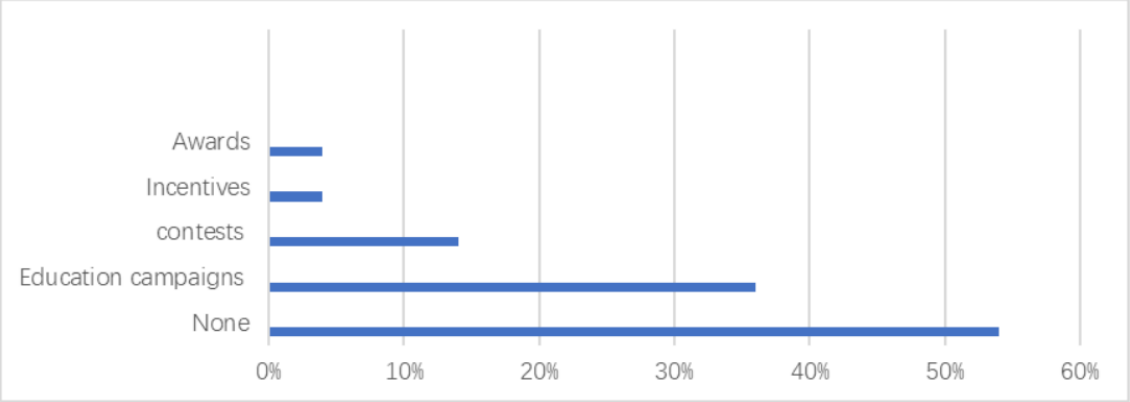

Figure 10. Responses about various initiatives used for energy conservation at campuses.

4.2.5. Water quality and conservation

Implementation of SD curriculum and green campus initiatives, improved the behaviour of students towards water conservation. Similarly, periodic quality testing and sharing reports with the students and staff also improved their stewardship for water (Nicole et al, 2020) Majority of the respondents (75%) have shown that there is no organized water testing system for physical and microbial tests in the campuses. Water conservation is mainly affected through education campaigns with little or no technological interventions. None of the respondents has shared their information about rainwater harvesting in universities. Similarly, very few universities have deployed efficient irrigation systems. Only 16% of the respondents have reported about the reuse of wastewater in their campuses. Very small number of respondents (16%) reveal that community is engaged in the water quality and conservation

interventions. The responses on various initiatives for water conservation are given in **Figure 11**.

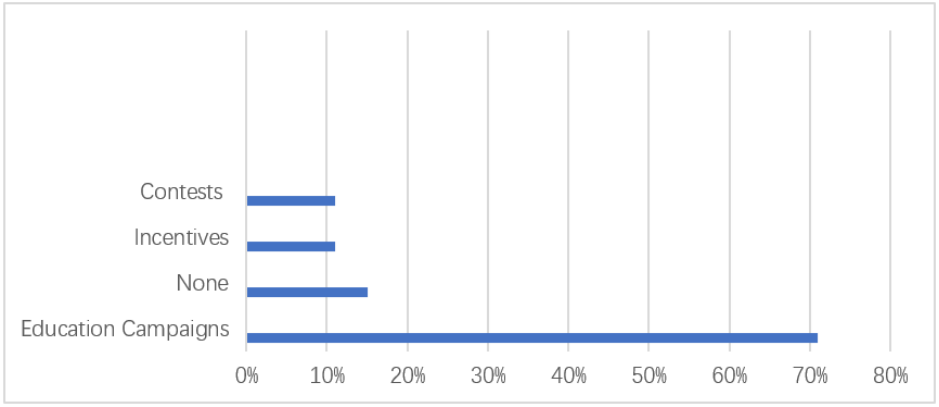

Figure 11. Responses on various initiatives for water conservation at campuses.

4.2.6. Transportation

Use of vehicles in the campuses lead to emissions of detrimental gases and subsequent air pollutions. Hence, for greening the University operations, green transportation is recommended (Silva Fissi et al., 2021). Majority of respondents (58%) have reported that there is no green transports system. Only 25% of the respondents think that education campaigns for use of bikes etc. are being used for promoting green transport at their campuses. Only 16% have reported regular transport audits at their institutes. Where provided, the green transport has been promoted through safe, connected and accessible walkways for bicycles and pedestrians. No engagement with the community for promoting green transport has been reported. The responses on green transportation initiatives and dedicated facilities for promoting green transportation are given in **Figures 12** and **13**.

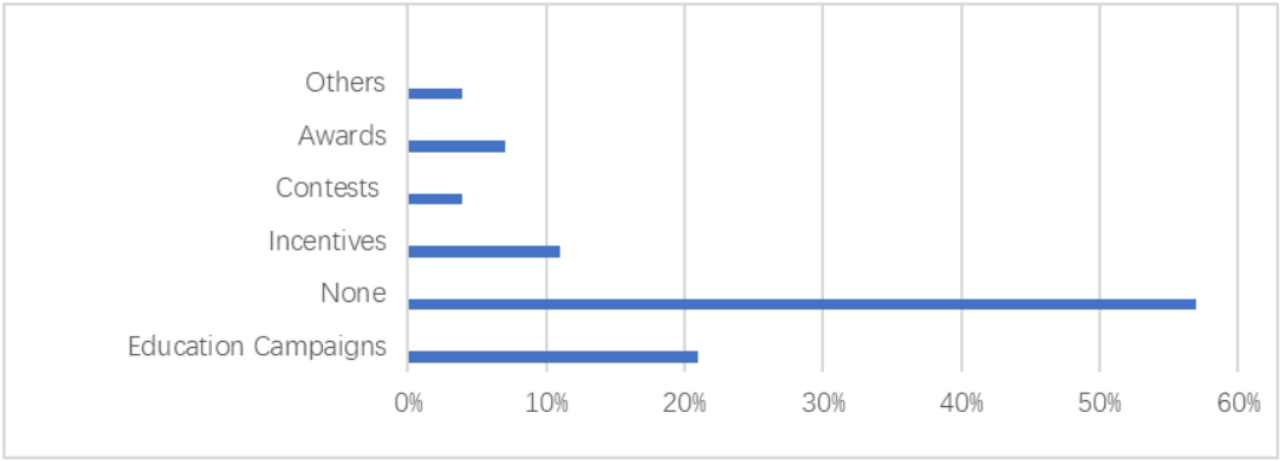

Figure 12. Responses about various initiatives adopted at campus for green transportation.

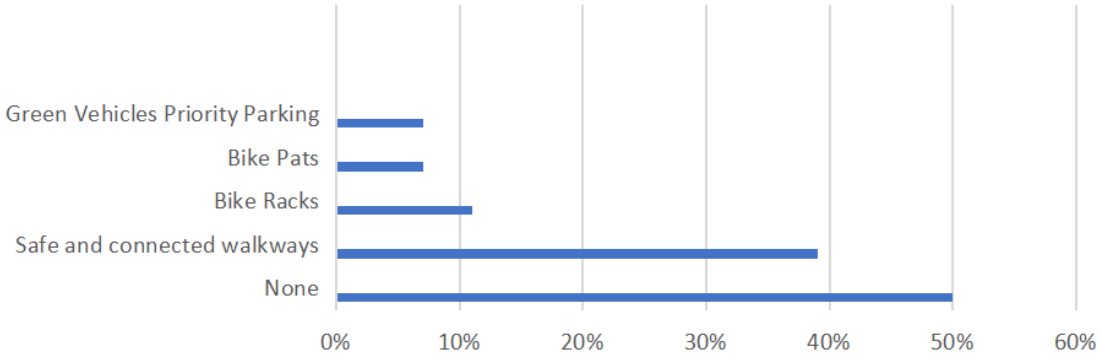

Figure 13. Responses about various facilities at campus for promoting green campus.

4.2.7. Promoting green procurement

Green procurement is becoming a popular way to encourage resource conservation. This also involves the principle of life cycle costing for procurement of goods and services (Homer and Khor, 2022). In current study, about half of the respondents in universities think that there are no green procurement plans, nor the purchase department have identified sustainable products. The products have neither been classified based on their life cycle costing nor their environmental impacts. In this context, hard work and efforts are recommended for creating awareness. No tracking system has been reported in any university for green products. About 42% respondents think that their universities have developed policy for reuse of waste material like furniture & fixtures. Majority of the respondents have reported that water bottles refilling facilities are available at their campuses. The role of universities in promoting sustainable and green products in society has been reported as insignificant. Responses about promoting green product procurement in campuses are given in **Figures 14** and **15**.

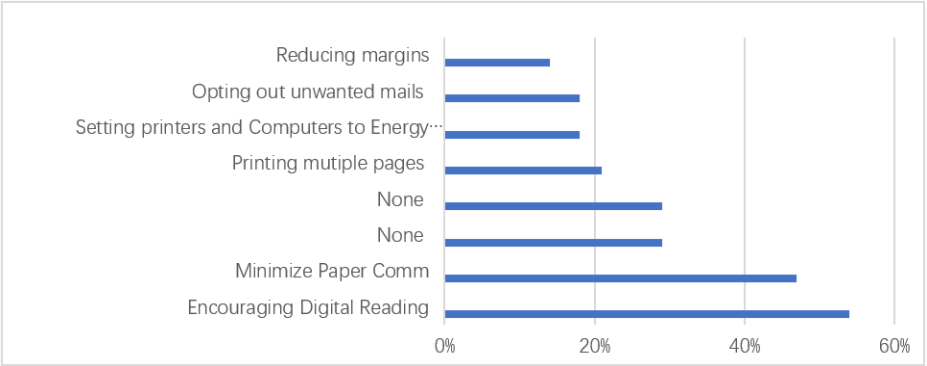

Figure 14. Responses on various initiatives for reducing paper waste at the campuses.

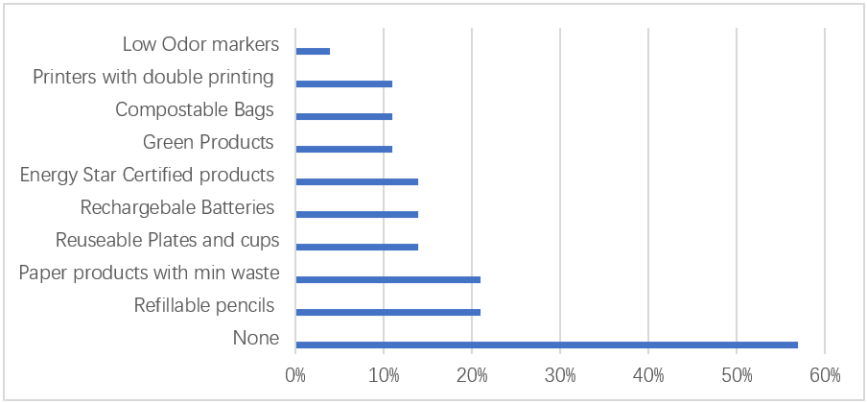

Figure 15. Responses about various green product procurement initiatives at campuses.

5. Conclusion

Universities act as growth engine for socioeconomic development of the country and act as a think tank for development of the youth and societies around the world. The need for sustainable thinking, behaviours and actions inside and outside universities has become more important due to recent deterioration of natural, social and economic environment. Education for sustainability (ESD), has thus laid high emphasis over promoting sustainability at universities both inside and outside. Green Campus Initiatives (GCI) have been adopted in sizeable number of universities and various sustainability ranking systems have been deployed for their assessment but still a large number of challenges are faced by the universities. This research was mainly motivated to assess the readiness, awareness, governance and implementation of Green Campus Initiatives (GCI) in the mountain universities of Northern Pakistan. These universities are located in the fragile ecosystem of AJ&K and GB region which needs special attention for promoting sustainable education and practices at the campuses and outside through community engagements. This region is highly vulnerable to climate impacts, ecological deterioration and environmental degradation due to high influx of tourists, besides natural disasters. Hence, this research will serve as the corner stone for the Education for ESD in the region. Following major conclusions are drawn from the research findings: (a) Majority of the universities have established the Green Campus Committees but they are not empowered enough to take the decisions. (b) Majority of Universities have developed Green Action Plans, but these universities have not applied for global sustainability ranking yet. Only one fourth of universities have applied for UI-Green Metric and other sustainability rankings. (c) Collaboration with professional organization and green community movements have proved more useful for engaging the external stakeholders. (d) Majority of the respondents think that neither regular energy audits have been administered, nor specific energy conservation strategies have been employed at universities. (e) No organized water testing and monitoring system has been installed at universities, as revealed by majority of the respondents. (f) No initiatives for green and environment friendly transport system has been deployed in the universities. Similarly, no organized plan for green procurement has been introduced in the mountain universities. The courses and curriculum of the universities have been

aligned with sustainability principles but the practice side of implementing the green initiatives at campuses and engagement with the community are missing. (g) The teaching, learning and research for sustainability has not been incentivised for both faculty and students, which make the researchers indifferent to these initiatives. The non-allocation of separate and dedicated budgets for promoting SD at the universities in Pakistan is another major impediment to the GCI in universities. The Higher Education Commissions and Provincial Governments need to provide premium for the green initiatives in the universities to develop the required culture and ecosystem.

6. Recommendations for implementation and future research

The leadership of mountain universities in Northern Pakistan needs to address the sustainable campus initiatives more seriously through establishing Green Campus Task Force (GCTF). They also need to allocate sufficient financial and non-financial resources for implementation of the GCI. Universities in Pakistan must be geared to participate the World Sustainability Ranking Systems, preferably UI-GreenMetric system. The HEC of Pakistan may take the lead to allocate special funds for development of Green Campuses. For future research, it is recommended that use of digital technologies and modern Information and Communication Technologies (ICTs) in development of sustainable and smart campuses. Further research on green transport and green procurement is also recommended with special reference to Pakistani Universities.

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References

Abid R.G., Areeba K., Kashif A., S.Asif I.R. (2023), " The way towards a sustainable and Green University: A case study of Islmia University Bahawalpur (IUB) Pakistan", Pakistan Journal of Social Science (PJSS), 43(2), 305-321

Akour, M., & Alenezi, M. (2022). Higher Education Future in the Era of Digital Transformation. Education Sciences, 12(11), 784. MDPI AG. Retrieved from http://dx.doi.org/10.3390/educsci12110784.

Ana Rita Amaral, Eugénio Rodrigues, Adélio Rodrigues Gaspar, Álvaro Gomes (2020), A review of empirical data of sustainability initiatives in university campus operations, Journal of Cleaner Production, 250,119558, https://doi.org/10.1016/j.jclepro.2019.119558.

Anthony Jnr, B. (2021), "Green campus paradigms for sustainability attainment in higher education institutions – a comparative study", Journal of Science and Technology Policy Management, 12(1), 117-148. https://doi.org/10.1108/JSTPM-02-2019-0008

Austin Sustainability Checklist (2023) retrieved from www.austinisd.org/sites/default/files/dept/sustainability/docs/AISD_GreenCampusChecklist_073015.pdf.

Badea,L., Serban,O.G.L., Dedu,S., Perosca,G.I (2020). The impact of education for sustainable development on Romanian Economics and Business Students' Behaviour- Sustainability (MDPI), 12(19), 8169

Barth, M., Rieckmann, M. (2012), Academic staff development as a catalyst for curriculum change towards education for sustainable development: an output perspective. Journal of Cleaner Production, 26, 28–36.

Bifeng Zhu, Gebing Liu and Jing Feng (2022). A comparison on the evaluation standards of sustainable campus between China and America. International Journal of Sustainability in Higher Education 23(6), 1294-1314.

Brandli,L.L., Leal Fillho, W., Frandoloso, M.A.L., Korf .E.P and Daris.D (2015). "The environmental sustainability of Brazilian Universities: Barriers and pre-conditions" in Leal Filho. W. et al, Integrating Sustainability Thinking in Science and Engineering Curricula, Springer International Publishing London, pp.63-74.

Brundtland,G,H., Khalid .M., Agnelli,S., Al-Athel.S., Chidzero .B. (1987), Our Common Future, Oxford Press New York NY, USA 1987.

Buana, R.P.; Wimala, M.; Evelina, R. Pengembangan Indikator Peran Serta Pihak Manajemen Perguruan Tinggi Dalam Penerapan Konsep Green Campus. (Hal. 82-93). RekaRacana J. Tek. Sipil 2018, 4, 82–93.

Bukhari, S. S., Said, H., & Mohamad Nor F. (2020). Conceptual Understanding of Sustainability Among Academic Administrators of Pakistan Public Universities. The Qualitative Report. 25(1), 28-59. https://doi.org/10.46743/2160-3715/2020.3235

Caballero P (2019) The SDGs: changing how development is understood. Global Policy 10(1): 138–140 https://doi.org/10.1111/1758-5899.12629.

Chettri, N., Shrestha, A.B., Zhaoli, Y., Bajracharya, B., Sharma, E., Ouyang, H. (2012). Real World Protection for the "Third Pole" and Its People. In: Huettmann, F. (eds) Protection of the Three Poles. Springer, Tokyo. https://doi.org/10.1007/978-4-431-54006-9_5

Clifford, D and Petrescu,C.(2012), "The keys to university-community engagement sustainability", Non-profit Management and Leadership, .23(1),77-91, doi:10.1002/nml.21051.

Dawodu, Ayotunde et al. (2022) Campus sustainability research: indicators and dimensions to consider for the design and assessment of a sustainable campus. Heliyon, 8 (12), 11864

Durotul Y (2020), "Implementation of Psychomotor Assessment of Life Skills Learning program package. Humanities & Social Sciences Reviews 8(1),171-176 https://doi.org/10.18510/hssr.2020.8124.

Fatima.T., Muhammad A., Muhammad U (2021). Green Initiatives of Higher Education Institutes (Universities) and Students' Willingness to participate in green activities: A study in Pakistan" International Journal of Business Reflections. 2(2).

Fiksel,J., Livingston,R., Martin,J. and Rissing, S.W. (2013). Sustainability at the Ohio State University: beyond the physical campus" Journal of Environmental Studies and Sciences. 3(1), 74-82.

Geok, T. K., Shah, A., Goh, G. G. G., & Zeb, A. (2024). The links between sustainability dimensions and green campus initiatives in mountain universities. Journal of Infrastructure, Policy and Development, 8(9), 7653.

Gholami, H., Bachok, M. F., Saman, M. Z. M., Streimikiene, D., Sharif, S., & Zakuan, N. (2020). An ISM Approach for the Barrier Analysis in Implementing Green Campus Operations: Towards Higher Education.

Guerra-Santin, O., Bosch, H., Budde, P. et al. Considering user profiles and occupants' behaviour on a zero energy renovation strategy for multi-family housing in the Netherlands. Energy Efficiency 11, 1847–1870 (2018). https://doi.org/10.1007/s12053-018-9626-8.

Habib M. Alshuwaikhat, Ismaila Abubakar (2008) An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices, Journal of Cleaner Production, 16(16), 777-1785, https://doi.org/10.1016/j.jclepro.2007.12.002.

Habib, M.N., Khalil, U., Khan, Z. and Zahid, M. (2021), "Sustainability in higher education: what is happening in Pakistan?", International Journal of Sustainability in Higher Education. 22(3), 681-706. https://doi.org/10.1108/IJSHE-06-2020-0207

Hamdi Bashir, Zehra Canan Araci, Khaled Obaideen, Imad Alsyouf (2023),An approach for analyzing and visualizing the relationships among key performance indicators for creating sustainable campuses in higher education institutions, Environmental and Sustainability Indicators.19, 100267. https://doi.org/10.1016/j.indic.2023.100267.

Hasim M.S, Azam W F H Wan, Hashim A E, Ariff, N R M (2019). The Implementation of Sustainable Energy Initiatives in Campus Buildings. Asian Journal of Quality of Life (AjQoL), 4(17), 63-77

Hoeven Rolph Van Der (2014) Full Employment Target: What Lessons for a Post-2015 Development Agenda?, Journal of Human Development and Capabilities, 15(2), 161-175, DOI: 10.1080/19452829.2014.883370.

Hongwei Tan, Shuqin Chen, Qian Shi, Lingling Wang (2014), Development of green campus in China, Journal of Cleaner Production, 64,646-653, https://doi.org/10.1016/j.jclepro.2013.10.019.

Islamabad post (0219) Prime Minister's Kamyab Jawan Programme to Collaborate with HE, available at https://islamabadpost.com.pk/prime-ministers-kamyab-jawan-programme-to-collaborate-with-hec/.

Jabeen F. (2022) "The Alignment of Universities With Sustainable Development Goals: How Do Academics Perceive the Progress (Not) Made?," in IEEE Transactions on Engineering Management.

Karatzoglou, B. (2013) "An in-depth literature review of the evolving roles and contributions of universities to education for sustainable development". Journal of Cleaner Production., 49, 44–53.

Khan, S. A. R., Yu, Z., & Farooq, K.(2023). Green capabilities, green purchasing, and triple bottom line performance: Leading toward environmental sustainability, Business Strategy and the Environment,32(4), 2022–2034.https://doi.org/10.1002/bse.32342034KHANET AL.

Leith Sharp (2009) Higher education: the quest for the sustainable campus, Sustainability: Science, Practice and Policy, 5:1, 1-8, DOI: 10.1080/15487733.2009.11908023

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 . Clean. Production, 108, 1–18.

Luis Velazquez, Nora Munguia, Alberto Platt, Jorge Taddei (2006), Sustainable University: what can be the matter? Journal of Cleaner Production, 14(9), 810-819, https://doi.org/10.1016/j.jclepro.2005.12.008.

Mohammad alizadehkorde, M., & Weaver, R. (2018). Universities as models of sustainable energy-consuming communities? review of selected liter-ture. Sustainability, 10(9), 3250.

Moscardini A. O. , Strachan R. & Vlasova T. (2022) The role of universities in modern society. Studies in Higher Education, 47:4, 812-830, DOI: 10.1080/03075079.2020.1807493.

Nicole M. A, Alison W. Bowers, Estelle G (2020) Environmental education outcomes for conservation: A systematic review. Biological Conservation, 241 https://doi.org/10.1016/j.biocon.2019.108224.

Owojori, O. M., Mulaudzi, R., & Edokpayi, J. N. (2022). Student's Knowledge, Attitude, and Perception (KAP) to Solid Waste Management: A Survey towards a More Circular Economy from a Rural-Based Tertiary Institution in South Africa. Sustainability, 14(3), 1310. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su14031310.

Öztürk, Münir; Hakeem, Khalid Rehman; Faridah-Hanum, I.; Efe, Recep (2015). Climate Change Impacts on High-Altitude Ecosystems. Springer. p. 455. ISBN 978-3-319-12859-7.

P Hinduja, P., Mohammad, R. F., Siddiqui, S., Noor, S., & Hussain, A. (2023). Sustainability in Higher Education Institutions in Pakistan: A Systematic Review of Progress and Challenges. Sustainability, 15(4), 3406. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su15043406.

Puspadi, N.A.; Wimala, M.I.A.; Sururi, M.R.; Sipil, J.T.; Nasional, I.T. Comparison of Obstacles and Challenges in Implementing Green Campus Concepts at Itenas and Unpar. J. Reka Racana 2016, 2, 1–13.

Rachel S., William H., Richard M and Bernadette O' Regan (2019), "Mapping of Sustainability policies and initiatives in Higher Education Institutes" Environmental Science and Policy. 99, 80-88.

Reihaneh Aghamolaei, Marzieh Fallahpour (2023), Strategies towards reducing carbon emission in university campuses: A comprehensive review of both global and local scales, Journal of Building Engineering,76,107183, https://doi.org/10.1016/j.jobe.2023.107183

Ribeiro, J.M.P. et al. (2017). Promotion of Sustainable Development at Universities: The Adoption of Green Campus Strategies at the University of Southern Santa Catarina, Brazil. In: Leal Filho, W., Brandli, L., Castro, P., Newman, J. (eds) Handbook of Theory and Practice of Sustainable Development in Higher Education. World Sustainability Series. Springer, Cham. https://doi.org/10.1007/978-3-319-47868-5_29.

Scott, G., Tilbury, D., Sharp, L. and Deane, E. (2012), Turnaround Leadership for Sustainability in Higher Education, Australian Office of Learning and Teaching, Sydney available at https://www.uws.edu.au/__data/assets/pdf_file/0018/411075/TLSHE_Final_Exec_Summary_HA_12_Nov_12_pdf_version.pdf.

SDSN Australia/Pacific (2017) Getting started with the SDGs in Universities: A guide for Universities Higher Education Institutes and the Academic Sector, Australia, New Zealand and Pacific Education. Sustainable Development Solutions Network-Australia/Pacific, Melbourne.

Silvia Fissi, Alberto Romolini, Elena Gori, Marco Contri (2021), The path toward a sustainable green university: The case of the University of Florence, Journal of Cleaner Production, 279, https://doi.org/10.1016/j.jclepro.2020.123655.

Sima.M., Ines G., Dan B (2019) "An overview of campus greening initiatives at universities in Romania" International Journal of Sustainability in Higher Education. 20(3), 410-422.

Sugiarto, A.; Lee, C.-W.Huruta, A.D. A Systematic Review of the Sustainable Campus Concept. Behav. Sci. 12, 130. https:// doi.org/10.3390/bs12050130.

Survey of Pakistan (2020), Political Map of Pakistan- available at http://www.surveyofpakistan.gov.pk/Detail/MTUzYWU5ZGItNTA4NS00MDlkLWFlODctNTRkY2JmNWI0Mjg2.

Sustainability. Sustainability, 12(1),363. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su12010363.

Suwartha N, Sari R F (2013), Evaluating UI GreenMetric as a tool to support green universities development: assessment of the year 2011 ranking, Journal of Cleaner Production, 61, 46-53, https://doi.org/10.1016/j.jclepro.2013.02.034.

Tiyarattanachai, R., Hollmann, N.M. (2016). Green Campus initiative and its impacts on quality of life of stakeholders in Green and Non-Green Campus universities. SpringerPlus 5, 84 https://doi.org/10.1186/s40064-016-1697-4

Too, L. and Bajracharya, B. (2015), "Sustainable campus: engaging the community in sustainability", International Journal of Sustainability in Higher Education, Vol. 16 No. 1, pp. 57-71. https://doi.org/10.1108/IJSHE-07-2013-0080.

Trevisan, L.V., Eustachio, J.H.P.P., Dias, B.G. et al. Digital transformation towards sustainability in higher education: state-of-the-art and future research insights. Environ Dev Sustain 26, 2789–2810 (2024). https://doi.org/10.1007/s10668-022-02874-7.

UE4SD (2015), 2014 Innovation Report, UE4SD, Cheltenham, available at http://ue4sd.eu/images/2014/InnRep2014.pdf.

Ullah, R., Ismail, H. B., Khan, M. T. I., & Zeb, A. (2024). Nexus between Chat GPT usage dimensions and investment decisions making in Pakistan: Moderating role of financial literacy. Technology in Society, 76, 102454.

United Nations (2000)-The Millennium Declaration. United Nations General Assembly, New York USA.

Unterhalter E (2019) The many meanings of quality education: politics of targets and indicators in SDG4.Global Politics, 10(1):39–51. https://doi.org/10.1111/1758-5899.12628.

Waas,T., Huge,J., Ceulemans,K., Lambrechts,W., Vadebabeele,J., Lozano,R., and Wright,T., (2012), " Sustainable Higher Education-Understanding and Moving Forward, Flemish Government Environment, Nature and Energy Department Brussels.

Walter L. F., Markus W, Amanda L S, Maik A, Anselm Gr Felix S (2019), "The role of green and Sustainability Offices in fostering sustainability efforts at higher education institutions" Journal of Cleaner Production, 232, 1394-1401, https://doi.org/10.1016/j.jclepro.2019.05.273.

Walter L.F., Maria.A.P.D., Subrana.S., Halima.B., Theam F.N., A Qayum A.A., Gazi M.A., Ayyoob S., Amanda L.S., Qudsia.K., Mustafa.S and Samara.N (2022). Sustainability practices at higher education institutions in Asia. International Journal of Sustainability in Higher Education, 23(6), pp 1250-1276.

Yong Geng, Kebin Liu, Bing Xue, Tsuyoshi Fujita (2013) "Creating a "green university" in China: a case of Shenyang University", Journal of Cleaner Production, 61 (2013), 13-19, https://doi.org/10.1016/j.jclepro.2012.07.013.

Zahid, M., Ur Rahman, H., Ali, W., Habib, M.N. and Shad, F. (2021). Integration, implementation and reporting outlooks of sustainability in higher education institutions (Universities): index and case base validation. International Journal of Sustainability in Higher Education, 22(1), 120-137. https://doi.org/10.1108/IJSHE-10-2019-0308.

Zhao. W and Zou. Y (2020) Green university initiatives in China: a case of Tsinghua University. International Journal of Sustainability in Higher Education. 16(4), 491-506.