

Appraisal of Sustainability Concerns of Guru Nanak Dev University Campus, Amritsar

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ABSTRACT

The higher education institutions act as role models for incorporating sustainable practices by adopting various development strategies and actions in the core activities such as teaching, research and community outreach as well as in other activities like spatial planning, management of physical growth and development, maintenance of buildings and open spaces, supply of electricity, water and other utilities, etc. These institutions play an important part in taking different sustainable initiatives. This paper attempts to benchmark and appraise the sustainability concerns based on the guidelines issued by the Ministry of Housing and Urban Affairs. The indicators of sustainability under physical and social pillars have been localised for the Guru Nanak Dev University Campus and the campus has been assessed based on the identified parameters.

Keywords: *Sustainability, Higher Education Institutions, Livability, Campus Sustainability*

INTRODUCTION

Sustainable development is a big challenge to improve the development both qualitatively and quantitatively. The planning of campuses in the light of sustainable goals acts as demonstration projects for the society as well as for the city governing bodies. Through such initiatives, these institutions can demonstrate innovative ideas, methods, practices and even technologies that can be beneficial for the

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masses. Such an initiative also provides hands-on learning experience for the students as well. While addressing the sustainability concerns of campus, it is important that it follows eco-friendly practices which promote sustainability, minimise waste, bring efficiencies, use renewable resources and promote recycling to build the water, solid waste, energy and landscaping sectors.

Based on the global Sustainable Development Goals (SDGs), every nation is seeking sustainable solutions various for environmental concerns for overall welfare, health and economy of the regional, city and local environs. India has devised 'livability standards' to match the spirit of SDGs. The Indian government has asked the higher education institutions, for the attainment of the SDGs, to reduce their carbon footprints of the national and global environment. Hence, sustainability concerns, a livable environment and pragmatic solutions have become major topics in academic discourse in Universities and colleges. Inter-disciplinary research has grown to a point where the four key pillars of sustainability, i.e., governance, economic, social and physical are being integrated to create a livable environment for the students, workers and residents within the institutions.

Guru Nanak Dev University has also taken various initiatives to improve the livability as well as the sustainability of the campus. Established in 1969, Guru Nanak Dev University, Amritsar is amongst the prestigious higher education institutions of the country to impart education and promote research in the Humanities, learned professions, Science, especially in applied nature and technology. The University presented many models in achieving these objectives to create a sustainable living environment in the campus. The present article benchmarks the initiative taken up by the campus-based on Sustainable Development Goals and livability standards.

International and National Toolkits and Guidelines focusing on sustainability concerns

Sustainability has become a topic of concern at the National and International level since 1972, with the first United Nations Conference on the Environment, held in Stockholm followed by the Brundtland Report of 1987 and various other summits such as Earth Summit, Millennium Summit, World Summit on sustainable development, to name a few. In 2015, Sustainable Development Goals were formed that were set to be achieved by 2030, representing 17 goals that were to be achieved by various set targets. At the institutional level, the United Nations Educational, Scientific and Cultural Organization (UNESCO)

has taken the responsibility of Education for Sustainable Development which is to be monitored through policy initiatives and their collaboration with relevant stakeholders to be implemented by 2030. It focuses on enhancing the educational system in light of sustainable development goals for which it has identified a toolbox that highlights the capacity building of educators, empowering young contributors and actors, enhancing local level actions and implementation of the same. Other than the incorporation of sustainable development in education, a number of guidelines, sustainable plans, toolkits have been prepared at the international level. Sustainable development parameters, identified by guidelines, for appraisal of Guru Nanak Dev University are summarised as follows:

- The University of Victoria Campus has proposed Sustainability Guidelines, 2006 focusing on campus planning & site design, sustainable transportation, energy efficiency & renewable energy, water efficiency & stormwater management, waste management, conserving materials & resources and indoor environment quality.
- The University of Wisconsin Oshkosh Campus Sustainability Plan, 2008 -2012 lays stress on electrical energy management and conservation, freshwater conservation, storm water management, facilities planning, renovations and construction, transportation, purchasing, recycling, food services and grounds operations.
- The International Alliance of Research Universities (IARU)-Green Guide for Universities, 2009 identified energy management, water management, landscape management, biodiversity protection, dining services, waste management, building energy and emissions, life cycle cost (LCC) analysis, laboratory, green purchasing, transport & communication and employee & student engagement.
- Greening Universities Toolkit, 2011 highlights sustainability in research, education for sustainability, governance and administration, community outreach, energy, carbon & climate change, water use, land use and material flows.
- Environmental Sustainability of University Campuses, 2014 talks about resource efficiency, renewable energy production, water efficiency, sustainable campus landscape, material/waste conservation, sustainable transportation, green building initiative and grey water recycling.

- Sustainable Development Goals has been set as global goals to be achieved by 2030 with specific targets and benchmarks. These focus on outcomes that are based on physical, social, economic and environmental development. A total of 17 global goals have been identified. In the light of SDGs, Times Higher Education Impact Rankings, 2020 ranks the campuses at the international level delimiting the goals and targets to higher education level solely based on the sustainable development goals. The SDG goals and sub-targets under the TIME's ranking focus on Research, Education and Publication. In addition to research and education, it also emphasises on taking different measures at the campus level that can make the campus sustainable. The details of the same have been summarised in Table 1.

TABLE 1: SDG GOALS AND INDICATORS AS PER THE TIMES HIGHER EDUCATION IMPACT RANKINGS, 2020

SDG 1 - No Poverty	<ul style="list-style-type: none"> • Proportion of students receiving financial aid • University anti-poverty programmes • Community anti-poverty programmes
SDG 2 - Zero Hunger	<ul style="list-style-type: none"> • Student hunger • Proportion of graduates in food sustainability • National hunger
SDG 3 - Good Health and well being	<ul style="list-style-type: none"> • Proportion of health graduates • Collaborations and health services
SDG 4 - Quality Education	<ul style="list-style-type: none"> • Proportion of graduates with teaching qualification • Lifelong learning measures • Proportion of first-generation students
SDG 5 - Gender Equality	<ul style="list-style-type: none"> • Proportion of first-generation female students • Student access measures • Proportion of senior female academics • Proportion of women receiving degrees • Women's progress measures
SDG 6 - Clean Water and Sanitation	<ul style="list-style-type: none"> • Water usage; Water care • Proportion of reused or recycled water in the community
SDG 7 - Affordable and Clean Energy	<ul style="list-style-type: none"> • Clean energy measures • Energy use • Energy and the community

(contd. Table 1)

SDG 8 – Decent work and Economic growth	<ul style="list-style-type: none"> • Employment practices • Expenditure per employee • Proportion of students taking work placements • Proportion of employees on secure contracts
SDG 9 – Industry, Innovation and Infrastructure	<ul style="list-style-type: none"> • Patents • Number of university spin-offs • Research income from industry
SDG 10 – Reduced Inequalities	<ul style="list-style-type: none"> • First-generation students • Students from developing countries • Students and staff with disabilities • Measures against discrimination
SDG 11 – Sustainable cities and Communities	<ul style="list-style-type: none"> • Support of arts and heritage • Expenditure on arts and heritage • Sustainable practices
SDG 12 – Responsible Consumption and Production	<ul style="list-style-type: none"> • Operational measures • Proportion of recycled waste
SDG 13 – Climate Action	<ul style="list-style-type: none"> • Low-carbon energy use • Carbon neutrality
SDG 14 – Life below Water	<ul style="list-style-type: none"> • Supporting aquatic ecosystems • Water-sensitive waste disposal • Maintaining a local ecosystem
SDG 15 – Life on Land	<ul style="list-style-type: none"> • Supporting land ecosystems • Land-sensitive waste disposal
SDG 16 – Peace, Justice and strong Institutions	<ul style="list-style-type: none"> • University governance measures • Working with government • Proportion of graduates in law and civil enforcement
SDG 17 – Partnerships for the goals	<ul style="list-style-type: none"> • Relationships to support the goals

- Green-Campus Guidebook 2016-2017, Ireland focuses on litter and wastes energy, water conservation and protection, transport and travel, biodiversity, green information and communications technology, procurement, air quality and climate change.
- Guide to Campus Living, 2019-2020 gives weightage to campus living services, study and computer centres, safety in the residence halls and apartments, health and wellness and standards for living in campus.

At the national level Livability Standards and Ease of Living has been proposed by the Ministry of Urban Development to match the spirit

of sustainable development goals. To improve the Livability standards of cities 79 indicators (57 Core Indicators and 22 Supporting Indicators) has been identified. While the Core indicators are considered an essential measure of the livability of cities, the supporting indicators supplement the Core indicators by adding value to them. The four pillars of livability standards are Physical, Social, Economic and Institutional. Similarly to improve the quality of life of the residents', Ease of Living Index has been proposed in 2018 to examine the liveability of Indian cities across a set of three pillars, which encompass the various aspects of the well-being of citizens across three pillars i.e. quality of life, economic ability and sustainability including a total of 14 categories and 50 indicators. For educational institutions, GRIHA, IGBC and CSE have made guidelines and toolkits at the national level, that can be adopted by the higher education institutions. These also emphasise the sustainability of the educational institutions and the key parameters of each are summarised in subsequent points.

- Green Rating for Integrated Habitat Assessment (GRIHA), 2015 focusing on on-site planning on energy, water and wastewater, solid waste management and transport.
- Indian Green Building Council (IGBC) Green Campus Rating System, 2017 highlights the need for site planning and management, sustainable transportation, water conservation, energy efficiency, material and resource management and health and well-being, green education and innovative design.
- Green Sense- Educational Campus Inventory CSE, New Delhi, 2018 focused on land, energy, water, air waste, consumption, conservation, operations and maintenance.

This paper appraises various parameters such as education, health, housing and inclusiveness, public open spaces, power supply, water supply, wastewater management, transportation and mobility solid waste management and environment that have been identified based on the national and international toolkits and guidelines as discussed above. Considering them as base the key parameters are further divided into two pillars i.e. physical and social, as defined in livability standards and seven sustainable development goals (refer to Table 2). Out of the total SDGs, 7 goals that have been assessed in this paper are goals number 3, 4, 6, 7, 11, 12, and 13.

To analyse the campus on the above parameters the results against each indicator and its subsets has been analysed with reference to the benchmarks proposed by different international/ national agencies and best practices of peer institutions.

TABLE 2: LOCALISED SDGS AND LIVABILITY STANDARDS COVERED FOR APPRAISAL OF THE CAMPUS

Category	Sustainable Development Goals	Livability Standards Indicator	Methods Adopted
Parameters covered in Social Pillar of Development			
Education	4. C- Increase in supply of qualified teachers.	Student-Teacher ratio	Total number of students/total number of teachers available
	4. A- Upgrade education facilities	Percentage of departments with access to digital education	(Total number of departments with digital access/total number of departments) *100
Health	3.8- Achieve universal health coverage	Number of beds in health center per 1,000 population	(Total number of beds in dispensary/total population of the campus) *10000.
	3.C- Substantially increase health financing and recruitment	Healthcare professionals per 1,000 population	(Total number of qualified health professionals/total population of the campus) *10000.
Parameters covered in Physical Pillar of Development			
Housing and Inclusiveness	11.3- Inclusive and sustainable urbanisation	Percentage of students and permanent workers provided residence within the university	(Total strength of student and staff living in campus/total population of the campus) *100.
		Net Density	Total population of the campus/total residential area (in hectares).
Public Open Spaces	11.7- Universal access to green and public spaces	Per capita availability of green spaces	Total area of green space/total population of the campus.
		Per capita availability of public and recreational places	Total area of public and recreational space/total population of the campus.

(contd.)

Power Supply	7.2, 12.2- Achieve sustainable management and efficient use of natural resources	Percentage of total energy derived from renewable sources	(Total installed capacity for generation of renewable energy in campus/total energy consumption from all sources) *100
	6.1- Universal and equitable access to safe and affordable drinking water for all	Per capita electricity consumption Per capita supply of water Quality of water supplied	Total energy consumption in the campus/ total population of the campus. Total quantity of water supplied into the distribution system/total population of the campus (Number of samples meeting or exceeding specified potable water standards/total number of samples tested for water quality) *100
Water Supply	6.4- Sustainable supply and withdrawal of water	Percentage of water connections covered through meters	
	6.2- Adequate and equitable sanitation and hygiene for all	Coverage of toilets Coverage of sewerage network	(Total number of properties with access to individual and/or community toilets/total number of buildings in campus) *100 (Total number of properties with connection to waste water management systems/total number of buildings in campus) *100
Wastewater Management	6.3- Improve water quality by reducing pollution, eliminating dumping and minimising the release of hazardous chemicals and materials	Collection efficiency of sewerage network The extent of reuse and recycling of wastewater	(Total waste water collected per day/total waste water generated in the campus per day) *100 (Quantum of waste water recycled or reused per day/total waste water received at treatment plants per day) *100

(contd.)

Solid Waste Management	11.6- Reduce the adverse per capita environmental impact	Household-level coverage	(Total number of households and establishments covered through doorstep collection/total number of households and establishments in the campus) *100
		Efficiency of collection	(Total quantum of SW collected/total quantum of SW generated in the campus) *100
		The extent of solid waste recovered through reuse	(Average quantum of SW that is processed or recycled/average SW generated in the campus) *100
Transportation & Mobility	11.2- Provide access to safe, affordable, accessible and sustainable transport systems for all	Geographical coverage of E-bus	Total length of e-bus (Km)/total area of the campus
		Availability of E-bus	(Average number of e-bus available per day/total population of the campus) *1000.
		Percentage coverage of footpaths - wider than 1.2m	(Total length of footpath in the campus/total length of road in the campus) *100
		Percentage of traffic intersections with pedestrian crossing facilities	(Total number of intersections with pedestrian crossing facilities/total number of intersections in the campus) *100
		The extent to which universal accessibility is incorporated in a public rights-of-way	(Number of public right-of-way areas designed as per universal design principles/total number of public right-of-way areas in the campus) *100
Environment	13.4.1 Commitment to carbon-neutral university	Scope 1 and scope 2 emissions neutrality achieved	GHG emissions from transport, in campus waste and wastewater treatment, use of DG sets and electricity has been included. Carbon sequestration of trees included
	Campus Carbon Footprint	Per capita carbon emissions (tCO ₂ e/person)	Total GHG emissions (Scope 1+Scope2)/ campus Population

Source: Sustainable Development Goals; Livability Standards, Ministry of Urban Development, Government of India (modified as per campus suitability)

Guru Nanak Dev University -Brief Campus Profile

The campus of Guru Nanak Dev University (GNDU) was established on November 14, 1969. The Guru Nanak Dev University has a vast campus, spread over 500 acres of area with a total population of 14,245 in 2021. It is a residential campus and 30 per cent of the total population resides within the campus. Different activities on the campus can be categorised into various land use. The campus has around 30 blocks including administrative, academic, hostels and construction and management departments. The academic blocks comprise of different faculties that include 60 departments (refer to Fig. 2). Out of the total area, 4.03 per cent of the area is institutional area accounting for 20.17 acres and another 3.5 per cent of the area is under residential use accounting for 17.5 acres. The total built-up area of the campus accounts for only 7.5 per cent.

The remaining area is an open area that comprises playgrounds, parks, gardens, agriculture area, open area and circulation as depicted in Fig. 1. The campus has also a biodiversity-rich botanical garden covering an area of 25 acres having different species of trees, shrubs, cactus flower beds and various other plants. Other than this, various nurseries are located on the campus while 23.18 acres of the area is under different playgrounds spread over the sports and recreational zone.

Campus Appraisal based on Localised SDGs and Livability Standards

In this section, the Guru Nanak Dev University campus has been assessed and appraised based on the selected indicators mentioned

Fig. 1: Built-up Area of the Campus

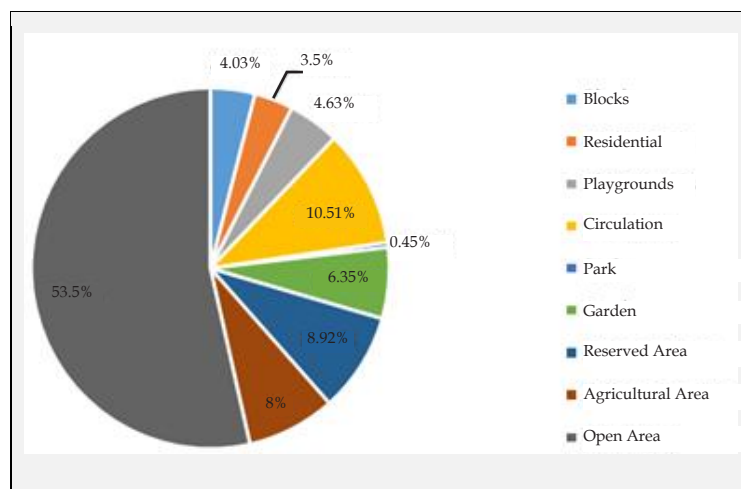
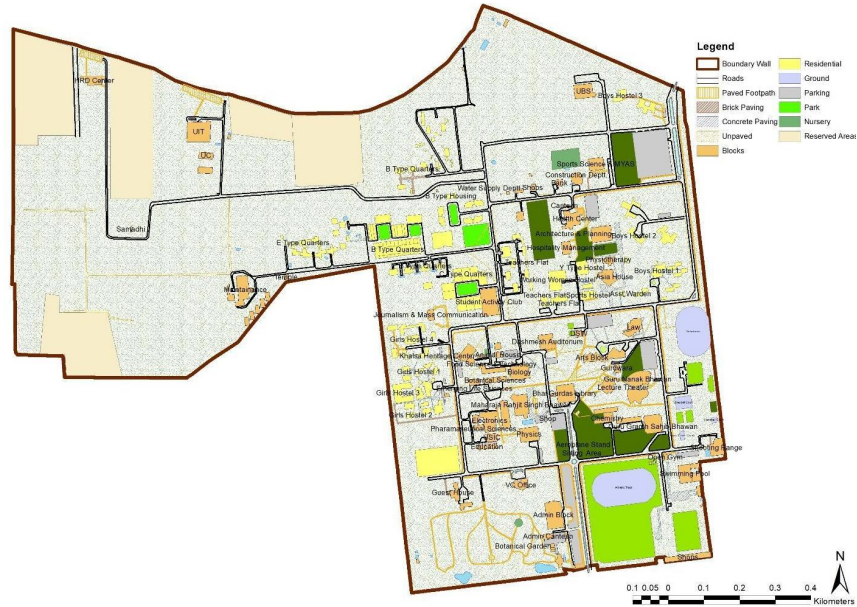


Fig. 2: Land use and Built-up area of GNDU campus



against social and physical pillars as highlighted in Table 1. Under both the pillars, categories and indicators have been selected considering the livability standards and relevant sustainable development goals have also been mentioned. To appraise the campus, data from different departments of the campus have been collected and the campus has been evaluated based on the listed indicators.

Social Pillar

The social pillar of development includes education and health indicators. Under the education category, the student-teacher ratio and access to digital education has been analysed and both are fulfilling the benchmarks set by the Ministry. Student strength in the university campus in session 2020-21 is 11000 and the total teaching staff is 580. Thus, the campus meets the criteria of the 19:1 student-teacher ratio (refer to Table 3).

The campus has a health centre that was established in 1973 as a primary health care facility. There are various facilities available in the health centre that includes Medical OPD, Dental OPD, Sports Dentistry Clinic, Ayurveda OPD and Physiotherapy Center with a total of 25 staff members. In addition, 29 hospitals are on the empanelment list with the university. Therefore, the number of beds in the health centre and healthcare professionals meet the benchmarks. Sustainable

TABLE 3: BENCHMARKING THE SOCIAL PILLARS OF DEVELOPMENT IN THE CAMPUS

<i>Category</i>	<i>Indicator</i>	<i>Results</i>	<i>Benchmark</i>
Education	Student-Teacher ratio	19:1	30:1
	Percentage of departments with access to digital education	100%	100%
Health	Number of beds in health centre per 1,000 population		25 beds per 10000
	Healthcare professionals per 10,000 population	15 per 10000	23 per 10000

Source: Computed Values, 2021

Development goals 3 and 4 i.e., good health, well-being and quality education are achieved by the campus, based on the benchmarking results.

Physical Pillar

The physical pillar of development has been divided into seven categories i.e., housing and inclusiveness, public open spaces, power supply, water supply, wastewater management, solid waste management, transportation and mobility. Each indicator has been assessed based on the data collected from the campus, staff and students, and has been compared to the livability benchmarks (refer to Table 3).

- (a) **Housing and Inclusiveness:** The net density and percentage of individuals both staff and students who have been provided housing within the campus have been analysed. Guru Nanak Dev University is a residential campus that provides housing to its staff and students. The campus provides housing to 30 per cent of the staff members and students which is far more as compared to the University of Mysore, Manglore University, Jamia Millia Islamia, Anna University and Don Bosco University all having only up to 20Per cent residential population of the campus. The campus provides housing to 30 per cent of the staff members and students. There are different types of hostel accommodations for boys and girls separately. Different categories of houses are provided for staff including A, B, C, D, E and teacher flats. The present housing stock in the campus is sufficient to meet the staff housing needs, thus meeting 11.3 SDG.
- (b) **Public open spaces:** The open areas has been analysed based

upon per capita green space availability and per capita recreational spaces available which are far more than the benchmarks set by the Ministry. The university is a lush green campus with only 7.5 per cent of the area as a built-up area. The remaining area is open. The campus has around 35,000 trees and shrubs making it one of the greenest areas of the city. The campus has a botanical garden that has different species of trees in it and makes it biodiversity-rich as well. The campus also satisfies the criteria given by CSE i.e. at least 10Per cent of the area needs to be under forest and 15Per cent green (CSE, 2018) while the campus has 85Per cent of the area under green. The per capita green area of the campus is 103 sq.m which is more than the standard 10-12 sq.m. Similarly, the per capita availability of public and recreational places is 11.23 sq.m., thus making it a green campus and meets 11.7 SDG that focuses on green spaces.

- (c) **Electricity:** Electricity supply has been studied based on the total units consumed by the campus in a year. The electricity supply in the campus is from both renewable as well as non-renewable energy sources. The campus is generating 1.48 MWe solar electricity through rooftop solar panels that are placed on the campus buildings. Solar electricity accounts for 20 per cent of the total electricity consumed whereas the benchmark set under the guidelines is 10 per cent. Another benchmark set by the IGBC that on-site renewable energy generation needs to be at least 10 per cent and can go to more than 50 per cent of the total annual energy consumption (IGBC, 2017) has also been fulfilled by the campus with 20 per cent of its energy generated from the renewable source of energy. It is also recommended to install renewable energy for up to 5 per cent of the entire load (CSE, 2018). For the remaining electricity, the campus is dependent on the grid supply. The per capita electricity consumption of the campus is 320 kWh which is much lower than the national average of 1010 kWh. The per capita electricity consumption in the residential area of the campus accounts for 725 kWh which is also less than the national average. It thereby meets the SDG focusing on efficient and sustainable use of natural resources.
- (d) **Water Supply:** Water supply has been studied based on three indicators i.e., per capita supply of water, the quantity of water supplied and per centage of water connections covered through smart meters. Smart meters are completely

absent in the case of GNDU while the other two indicators are fulfilled by the campus. There are seven tube wells on the campus and around 2.94 MLD of groundwater is extracted to meet the requirement as mentioned. However, based on the demand, the water required is 2.32 MLD therefore, the actual water consumption of the campus is more than the standard. Similarly, the per capita water consumption based on the demand (including agriculture demand) accounts for 163 lpcd, based on the supply of it is 206 lpcd that is much more than the standard water consumption requirement of 135 lpcd. Therefore, there is an urgent need to take conservation measures to limit water consumption.

- (e) **Wastewater:** In wastewater management, four indicators has been analysed i.e., coverage of toilets, the extent of reuse and recycling of wastewater, sewerage network coverage and collection efficiency. Total wastewater generated in the campus accounts for 1970 KLD. The university installed a sewerage treatment plant of 2500 KLD capacity in 2008. The wastewater is treated on the campus thus making it a zero wastewater discharge campus that is in line with the IGBC standards promoting decentralised wastewater treatment systems with 100 per cent on-site wastewater treatment, and at least 25 per cent of the wastewater should be reused on the site (IGBC, 2017). The wastewater is treated on the campus thus making it zero wastewater discharge campus. A total of 1500 KLD (approximately) of wastewater is reused on the campus for forestry, irrigation of plants and gardening purposes. The excess water is stored in the constructed water tank. Hence, the mentioned SDG's and livability standards indicators are completely fulfilled by the GNDU campus (refer to Table 4).
- (f) **Solid waste management:** This aspect has been studied based on three indicators i.e., household-level coverage, the efficiency of collection and solid waste recovered through reuse. Total waste generated on the campus accounts for 1.7 tons. Waste from residential areas, hostels and canteens is collected daily and weekly from the institutional areas. There are tricycles and trolleys to collect waste. The organic waste is segregated at the source and is used on the campus to produce compost. E-waste and biomedical waste are being managed as per the guidelines. The paper waste is recycled as per the university guidelines. Of the total waste,

63.3 per cent of the waste is either reused, recycled or sent to the authorised vendor for proper waste management. Entire campus organic waste is used to make compost; thus it meets the GRIHA guidelines that emphasise complete utilisation of organic waste by using different ways. Similarly, e-waste is sent to authorised recyclers as highlighted in GRIHA and CSE toolkits. However, the extent of waste recovered is less than the 80 per cent benchmark as highlighted in table 4, while the other two indicators are achieved to 100 per cent (refer to Table 4).

- (g) **Transport and Mobility:** There are five indicators i.e., the geographical coverage of e-buses, availability of e-bus, footpath coverage, universal accessibility and pedestrian crossing facilities that have been studied. Since 2018, the campus has been declared a car-free campus. There are two parking places provided at both the gates of the campus and students are not allowed to bring their cars to the campus. This resulted in drastic decrease in the number of cars on the campus. The campus has provided e-bus services to commute within the campus. There are only 8 e-buses and there are issues related to the availability of the e-buses due to lesser frequency. As per the benchmark availability should be ≥ 0.6 , whereas on campus it is 0.47.

For pedestrian movement in the campus, the footpaths has been constructed for enhanced accessibility. In terms of coverage of footpaths wider than 1.2 m, the campus meets the criteria. However, various efforts are required to make these footpaths universally accessible as at present there are various issues related to the continuity of footpaths. Thus, universal accessibility in the public rights of way is only implemented up to extent of 60 per cent against the 100 per cent requirement. In the international context, the guidelines emphasise complete universal accessibility and at least 90 per cent of motorised trips should be by public transportation, NMT or e-vehicles.

- (h) **Environment:** The campus is a lush green campus and has around 34,000 trees and shrubs in the campus. There are 1.48 MWe of solar electricity that is generated on the campus. The campus also has lesser emissions in the transport sector as the cars of the students are not allowed within the campus. The waste and wastewater are treated within the campus.

TABLE 4: APPRAISAL OF PHYSICAL PARAMETERS OF LIVABILITY STANDARDS AND SUSTAINABLE DEVELOPMENT GOALS

<i>Category</i>	<i>Indicator</i>	<i>Results</i>	<i>Benchmark</i>
Housing & Inclusiveness	Percentage of students and permanent workers provided residence within the university	30%	
	Net Density	103 pph	Highest
Public Open Spaces	Per capita availability of green spaces	103 square meters	The total area of green space/Total population of the campus.
	Per capita availability of public and recreational places	11.23 square meters	The total area of public and recreational space/Total population of the campus.
Power Supply	Percentage of total energy derived from renewable sources	25%	(Total installed capacity for generation of renewable energy in campus/Total energy consumption from all sources) *100
	Total electricity consumption per capita	320 kWh	Total energy consumption in the campus/Total population of the campus.
Water Supply	Per capita supply of water	206 lpcd	135 lpcd
	Quality of water supplied	100%	100%
	Percentage of water connections covered through meters	Nil	100%
Wastewater Management	Coverage of toilets	100%	100%
	Coverage of sewerage network	100%	100%
	Collection efficiency of sewerage network	100%	100%
	The extent of reuse and recycling of wastewater	76%	20% or more
Solid Waste Management	Household-level coverage	100%	100%
	Efficiency of collection	100%	100%
	The extent of solid waste recovered through reuse	63.3%	80% or more

(contd.)

Transportation & Mobility	Geographical coverage of E-bus	2.5 Km	>=1
	Availability of E-bus	0.47 per 1000 person	>=0.6 per 1000 person
	Percentage coverage of footpaths - wider than 1.2m	167%	>=75%
	Percentage of traffic intersections with pedestrian crossing facilities		100%
	The extent to which universal accessibility is incorporated in the public rights-of-way	60%	100%
Environment	Scope 1 and scope 2 emissions neutrality Achieved	112%	100%
	tCO ₂ e/person	0.09	1.9 (India, 2019)

Source: Livability Standards, Ministry of Urban Development, Government of India (modified as per campus suitability)

Therefore, all these activities are making the campus a low carbon campus. Considering the Data mentioned above, the per capita carbon footprint of the campus comes out to be 0.09 tCO₂e/annum/person which is far lower than the national level footprint of India i.e., 1.9 (Tiseo, 2021) and a world average of 4.5 (World Bank, 2018). The Scope 1 and 2 emissions neutrality achieved in the campus is 112 per cent against the benchmarking of 100 per cent. Therefore, the campus has taken various initiatives to move towards a carbon-neutral campus.

With the 100 per cent implementation of Sustainable Development Goals 6,7 and 11 the goal of clean water and sanitation, affordable and clean energy, and sustainable cities and communities of the campus could be fulfilled for which the campus needs to focus on smart water meters, solid waste recovery through reuse and incorporating universal accessibility in the design.

GNDU Campus and other Peer Institutions

While comparing the GNDU campus with the peer institutions of comparable size in terms of sustainability parameters, the campus is the flag bearer setting benchmarks for other institutions that they

should strive to achieve. GNDU campus has the maximum green area, i.e. 85%, while only 34.42 per cent of the area is under built-up (refer to Table 5). In terms of energy consumed per year, it has already achieved the benchmark of producing 20 per cent of its energy from renewable sources of energy. However, it can still learn from the University of Mysore consuming less energy per year with greater size than the GNDU campus. GNDU sets benchmarks for other institutions in waste generating, producing the least waste by utilising 40 per cent of its organic waste to make compost and recycling the paper waste as per university guidelines.

TABLE 5: COMPARISON OF GNDU SUSTAINABILITY PARAMETERS WITH THE PEER INSTITUTIONS.

<i>Campus</i>	<i>Total area (acres)</i>	<i>Green area</i>	<i>Energy consumed per year (kWh)</i>	<i>Water consumption (kilolitres)</i>	<i>Waste generation (tonnes)</i>
University of Mysore	717.98	Less than 10%	220.80	3500	226
Mangalore University	353	Above 50%	183.29	3390	211.2
Jamia Millia Islamia	239.04	Above 50%	110		
Anna University	250	Above 50%	999.86	1900	740
Don Bosco University	274	Above 50%	102.28		
Guru Nanak Dev University	500	85%	320	2940	2.1

Source: Green Campus Movement, CSE, 2021

CONCLUSION

Benchmarking is a crucial tool to evaluate the sustainability practices adopted by educational institutions. Various parameters of sustainable development have been identified based on international and national guidelines and toolkits and are further compared with Guru Nanak Dev University Campus. The campus achieves the indicators under livability benchmarks of sustainability in the social pillar with a student-teacher ratio of 19:1, 100 per cent access to digital education and 15 healthcare professionals per 10,000 population. Under physical pillar indicators, the campus provides housing to almost 30 per cent of its residents and

has higher per capita green areas. The campus also generates onsite renewable energy, accounting for 20 per cent of the total load, thus meeting the benchmarks. Similarly, 100 per cent of the wastewater is treated and reused on campus. However, the campus needs to regulate the water supply by providing water connections through smart meters, increasing the e-bus service and achieving universal accessibility in design, and increasing the solid waste reuse in the campus to meet the national and international benchmarks. The campus is an inspirational model for achieving the SDGs in social, housing, green spaces, renewable energy, wastewater treatment and environmental categories. Overall, it has been found that the campus is a carbon-neutral campus and exceeds the commitment to Carbon neutrality in scope 1 and scope 2 emissions.

Note: This paper includes the findings of the Research Project sanctioned under Center for Sustainable Habitat Component-4 of RUSA 2.0 titled "*Sustainability Concerns and Livable Environment: Case Study GNDU, Amritsar*" being undertaken by Center for Sustainable Habitat, Guru Nanak Dev University, Amritsar.

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