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A Framework for Assessing the Sustainability of Egyptian University Campuses

Usama Konbr*, Mai Elsayed, Bahaa Elboshy

Department of Architecture, Faculty of Engineering, Tanta University, Tanta, 31733, Egypt

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Abstract Egypt's 2030 development plan prioritizes sustainable development, including higher education. Egyptian universities have embraced sustainable campuses, necessitating using suitable tools to measure and monitor progress. While the Green Pyramid Rating System assesses sustainability in Egypt, it lacks specific emphasis on university campuses. This study proposes a framework for evaluating the sustainability of Egyptian university campuses. This study was based on two worldwide prevailing sustainability assessment systems for campuses; some selected reports and previous studies were addressed to formulate a proposed framework that was investigated as suitable for the Egyptian context. This study applied this proposed framework to the Tanta University campus to assess its status and define the requirements to increase its sustainability. This study concluded most percentages of criteria from moderate to good. The highest value was 66-92% for education & research while planning & administration recorded 51-57% as the lowest value. Most percentages of indicators range from low to good, where education & research recorded the highest rate at 66-92%, while water indicator got the lowest at 20-26%. Finally, the highest percentage was 69% for the Sibirbay campus, while the lowest was 57% for the university administrative buildings based on the proposed framework. This study's proposed framework for evaluating the sustainability of Egyptian university campuses, applied to the Tanta University campus, provides valuable insights that can inform and guide sustainability efforts in other Egyptian universities, allowing for the assessment's transferability and effectiveness in different institutional contexts.

Keywords Sustainability, Sustainable Campus, Egypt's Vision 2030, Tanta University, Architecture, Urban Development

1. Introduction

The mitigation and adaptation of climate change have been included in the National Egyptian Agenda 2030 [1]. Although the global nature of the problem is significant, sustainable initiatives on a local scale and positive steps could contribute to solving it [2-4].

Consequently, building an evaluation system to measure sustainability is crucial for long-term development [5-7]. The United Nations places great emphasis on sustainability. In this regard, 17 global Sustainable Development Goals (SDGs) have been agreed to be implemented [8].

A sustainable campus integrates the community's understanding of "energy saving" and "resource recycling" by removing boundaries and creating and maintaining environmentally friendly campus settings [5,9,10]. Buildings use 30-40 % of global energy and are responsible for 37% of global CO_2 emissions [11-15]. Building sustainability involves considering the impact of social, economic, and cultural indicators at different stages of the life cycle of a building [16-19].

This study is important for understanding sustainability on Egyptian campuses and reducing climate impacts and can use the general framework proposed by other universities worldwide. This research assumes that the

sustainable campus has a form, determinants, and standards, a general framework that studies the gap between it and the current situation. Moreover, it tries to find the proper answer to some questions, which are as follows:

- What are the challenges facing a sustainable campus?
- How do we achieve sustainability on campus?
- What is the appropriate framework to achieve sustainable campus models in Egypt?

As for the study problem following the Brundtland Report in 1987, many green building rating systems were developed, including HK-BEAM, LEED, GBI Tool, CASBEE, BREEAM, GPRS in Egypt, and many more. However, there are sustainable rating systems for university campuses [20,21]. Sustainable campus rating tools exist globally, such as UI-GreenMetric, STARS, CSAF, and THE. Egypt's Green Pyramid Rating System (GPRS) assesses new buildings neglecting existing ones. Educational buildings have not been adequately and effectively included in this assessment tool [22]. This study proposes a framework for creating a sustainable campus.

This study aims to develop a framework for a sustainable campus by analyzing two assessment systems and previous practices. In addition, the application of a sustainable campus at Tanta University has been investigated to formulate a clear view of the campus situation in Egypt.

2. Literature Review

Sustainable development is a shared construction goal tied to humanity's future destiny. Green campus construction has become a hallmark of university efforts to achieve the goal of global sustainable development [23,24]. As a result of Jean Mayer's 1990 summit of 22 universities, "sustainable development" has gained widespread acceptance worldwide. George Washington University proposed a green university pilot plan in 1997 [24]. AASHE was established in 2005 following EFS West's hosting of the North American Conference on Sustainability in Higher Education in Portland, Oregon, 2004. [25-27]. ISCN's Charter and Rio+20 have provided new sustainability standards for higher education institutions [27], while the Green University Alliance hosted a subforum on sustainable development. The United Nations approved a strategy in 2015 to guide its operations until 2030. STARS created the sustainable campus index to honor top-performing schools and institutions in 17 elements of sustainability as part of the Sustainable Development Goals (SDGs) strategy [24,28,29].

The sustainability initiatives of Saudi Arabian universities are inadequate compared to other countries. Therefore, they recommend campus sustainability plans developed for educational and operational institutions [30-32].

The leading African institutions in the world promote sustainability through a less hierarchical approach to management, environmental research, and other vital fields of study, as well as providing training and incentives for lecturers to grow [33].

In Egypt, some studies deal with strategies to reach sustainable university campuses, including Mansoura University and Tripoli University in Libya.

One study dealt with comprehensive urban design at Aswan University, another dealt with the environmental/social sustainability of landscapes at the American University in Cairo and British University in Cairo, and another dealt with environmental sustainability at Mansoura University [34].

There are multiple concepts of a sustainable campus, as follows:

A sustainable campus protects and improves the health and wellbeing of humans and ecosystems and advances some ways of addressing present and future ecological and social challenges [35,36].

Campuses are small communities that mimic the functions of cities [36]. They strive for sustainability in various dimensions by providing all necessary services and facilities for students and workers [37,38].

Higher education institutions must meet the needs of the present without compromising the needs of future generations. Consequently, resource conservation and enhancement embrace economic, social, and cultural development [39].

In addition, the challenges facing the sustainable campus are that the management, planning, and architecture of campuses are significantly affected by IoT technology [40]. A smart campus provides numerous benefits, but its implementation poses challenges, such as preventing hacks and sabotage, and data access and privacy rules must be controlled [41]. Moreover, to promote the concept of a sustainable campus, walking can be used as a means of transportation between different parts of the campus, but weather and temperature, lack of infrastructure, and safety measures pose problems for walking habits [42-45]. Finally, planning and managing resources and enacting commitments for sustainable development are essential to a university's sustainability. Secondly, sustainability is linked to the long-term viability of a university campus. The operational challenges addressed by campus sustainability are energy, water use, emissions, waste management, materials, food services, green areas, and transportation [46-49].

3. Methodology

The research methodology, as shown in Figure 1, consists of several key processes. Firstly, conducting a literature review to explore the concepts of a sustainable campus and sustainable campus assessment systems, focusing on the Sustainability Tracking, Assessment & Rating System (STARS) and UI-GreenMetric, to compare these assessment systems.

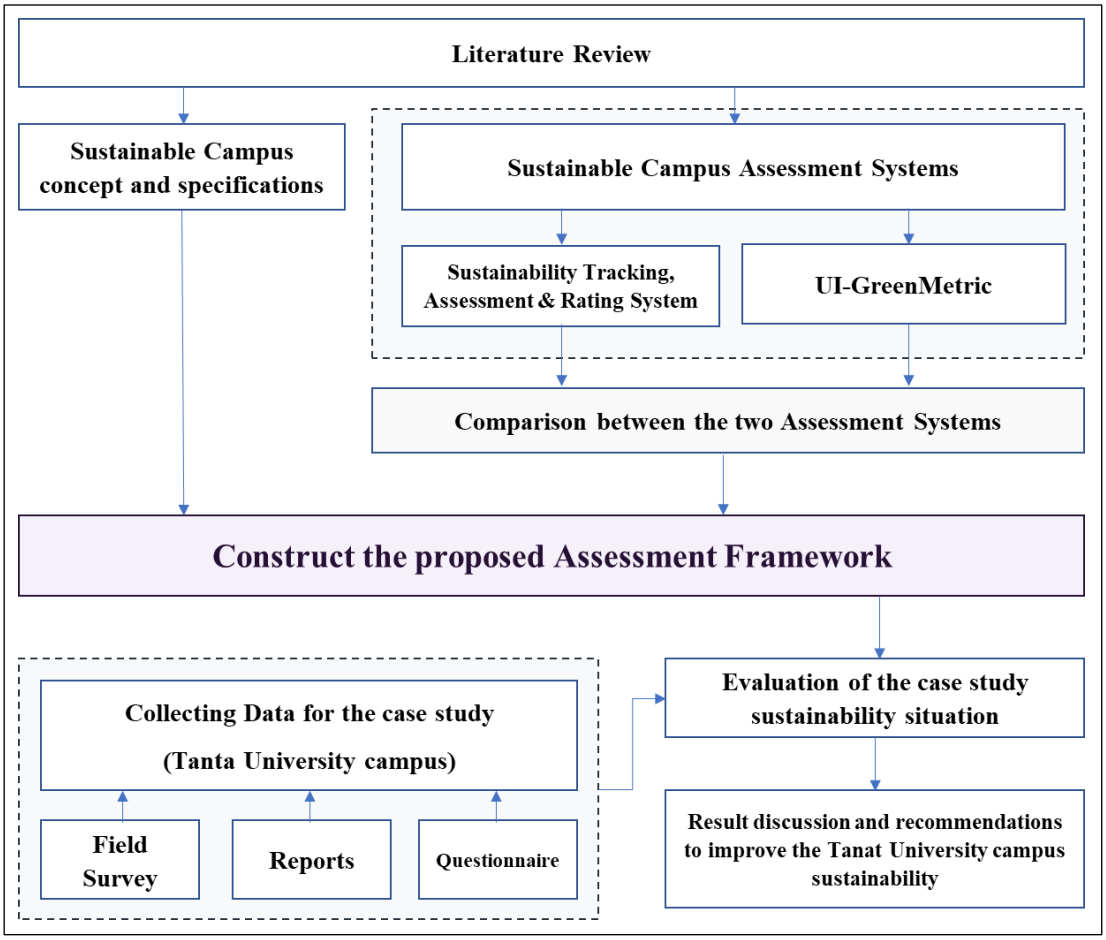

Figure 1. Scheme of the Methodology (the authors)

Based on the literature review, a proposed assessment framework will be constructed. This framework will include relevant indicators to the local Egyptian situation, which was then applied to the Tanta University campus as a case study. The indicators were selected based on their existence to provide a comprehensive and accurate assessment of the sustainability of the campus.

This study recruited participants from a local university and asked them to complete the surveys. Additionally, field surveys and reports were conducted. The proposed assessment framework was used to analyze the data and comprehensively assess the campus's sustainability to assess the sustainability of the Tanta University campus.

Finally, the assessment results were discussed, and recommendations were made to improve the sustainability of the Tanta University campus. The recommendations were based on the findings of applying the proposed framework to define the gap between the proposed guiding and the current sustainability status of this campus. Overall, this research methodology will provide a comprehensive and systematic approach to assess the sustainability of the Egyptian University campus, aiming to improve its sustainability in the long term.

4. Two Worldwide Prevailing Sustainable Campus Assessment Systems

Formulating sustainable campus assessment standards is crucial to encourage and monitor sustainable development [50,51]. Two systems were selected for study and analysis, namely UI-GreenMetric and STARS.

4.1. GreenMetric – UI's GreenMetric University Sustainability Ranking (UI-Green Metric)

The University of Indonesia launched the UI GreenMetric World University Rankings in 2010 to increase university awareness of sustainability issues, combating global climate change, conserving energy, water recycling, and waste, and promoting green transportation. The ranking also provides consulting, rankings tracker, tree rating, events, and branding services [52,53]. The last release was in 2022.

UI-GreenMetric has a set of criteria and indicators for campus assessment and relative weights of the system, as shown in Figure 2. The total points are 10000 points.

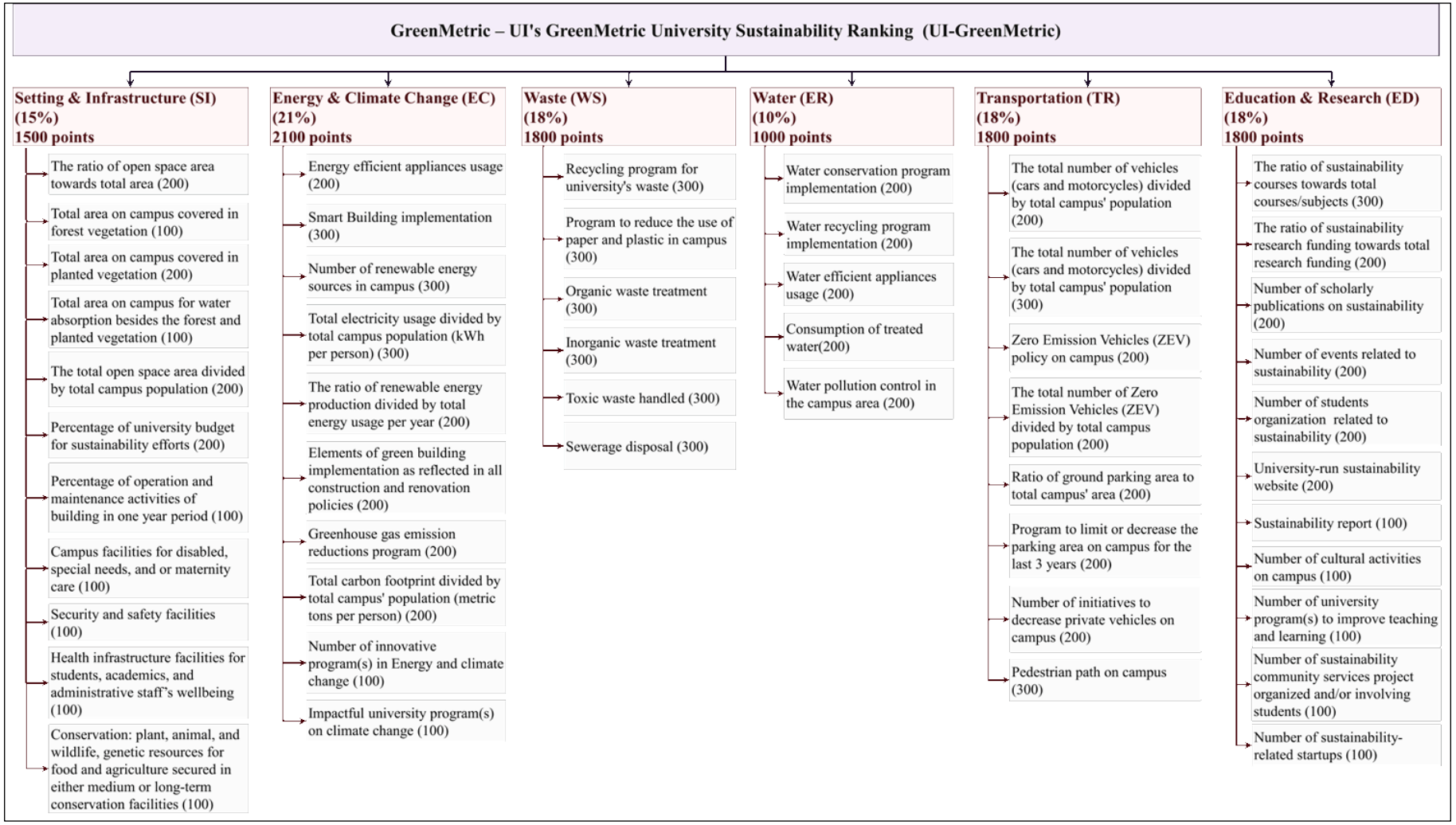

Figure 2. Criteria and Indicators of the UI-GreenMetric (summarised by the authors from [54,55])

As shown in Figure 2, the points corresponding to the elements of this system represent credits with maximum points, which are indicated in parentheses for each indicator. Also, it is noted that: The highest point rate determined is Energy and Climate Change (EC). The lowest point rate determined is Water (WR).

4.2. Sustainability Tracking, Assessment & Rating System (STARS)

The Sustainability Tracking, Assessment & Rating System (STARS) is a self-reporting framework that allows colleges and universities to assess their sustainability performance. It was launched 2006 in the US and Canada; the latest version was released in 2019.

Developing a sustainability framework helps higher education administrators understand sustainability, promotes continuous improvement, and builds a sustainable campus community [56].

The STARS includes many criteria and indicators, as shown in Figure 3. The total points are 205.

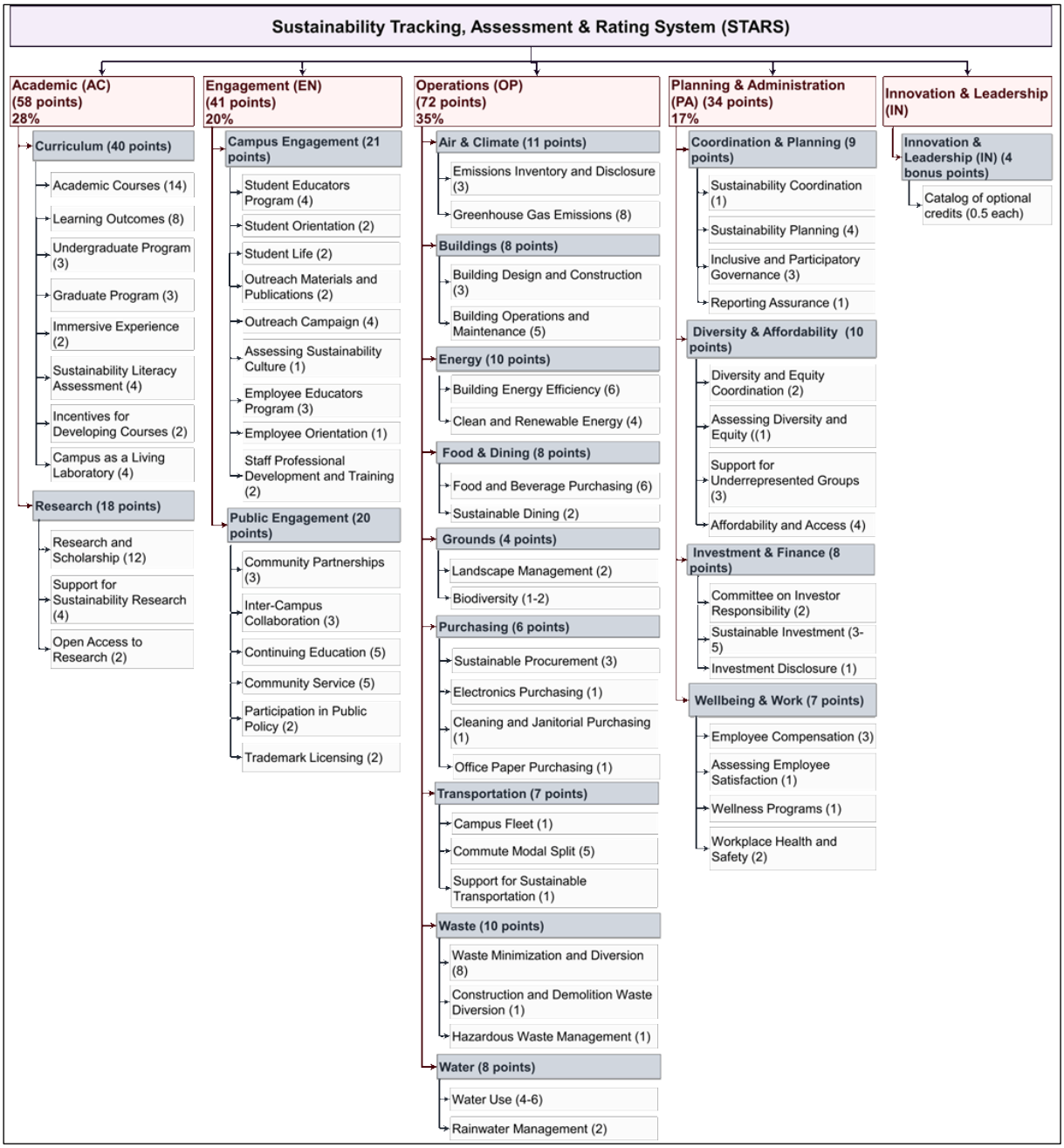

Figure 3. Criteria and indicators of STARS (summarized by the authors from [57])

It is apparent from Figure 3 that the points corresponding to this system's elements represent credits with maximum points, which are indicated in parentheses for each indicator; it is noted that:

The highest point rate determined is operations (OP). The lowest point rate determined is Planning & Administration (PA).

5. Comparison between the Two Assessment Systems

This study, in Figure 2 and Figure 3, states that the evaluation criteria are generally similar between systems and can be known by the indicators for each criterion.

- The Setting & Infrastructure (SI) criterion in the UI-GreenMetric system corresponds to the STARS system's criterion of Operations (OP).
- The Education &Research (ED) criterion in the UI-GreenMetric System corresponds to an Academics (AC) criterion in the STARS system.
- The criterion of operations (OP) in the STARS system corresponds to the criteria of (Energy & Climate Change (EC), Waste (WS), Water (WR), and Transportation (TR)) in the UI-GreenMetric System.

The UI-GreenMetric indicators correspond to the STARS index, with the points for each indicator in parentheses, as shown in Figure 2 and Figure 3. The study then compared common indicators and named criteria. Finally, the proposed framework was extracted using previous reports and studies.

In Figure 4, this study compares the relative weights of the criteria for assessment systems. The percentages of indicators for the two systems were calculated without considering the main criteria for each. UI-GreenMetric prioritizes energy and climate change at 21%, waste, and transportation at 18%, water at 10%, setting & infrastructure at 9%, and buildings at 1%. While STARS prioritizes Education & Research 28.29%, followed by Engagement 20%, Health & Wellbeing 3.41%, Purchasing & Funding 10.37%, Buildings 3.90%, and Planning-Diversity & Affordable 9.27%. From this comparison, it becomes clear that UI-GreenMetric cares about energy & climate change. On the contrary, STARS prioritizes Education & Research.

6. Proposed General Framework for Assessment of the Sustainability of a University Campus

Two worldwide prevailing sustainable campus assessment systems were presented to analyze the sustainability of the campus. A general framework was deducted from similarity indicators for the two assessment systems. Since sustainability assessment systems are local, some indicators abroad are unsuitable for the Egyptian context. Moreover, some elements were missing in the two systems, so they were extracted from previous studies and reports and combined. This study proposed a general framework suitable for the Egyptian context and its determinants, as shown in Figure 5.

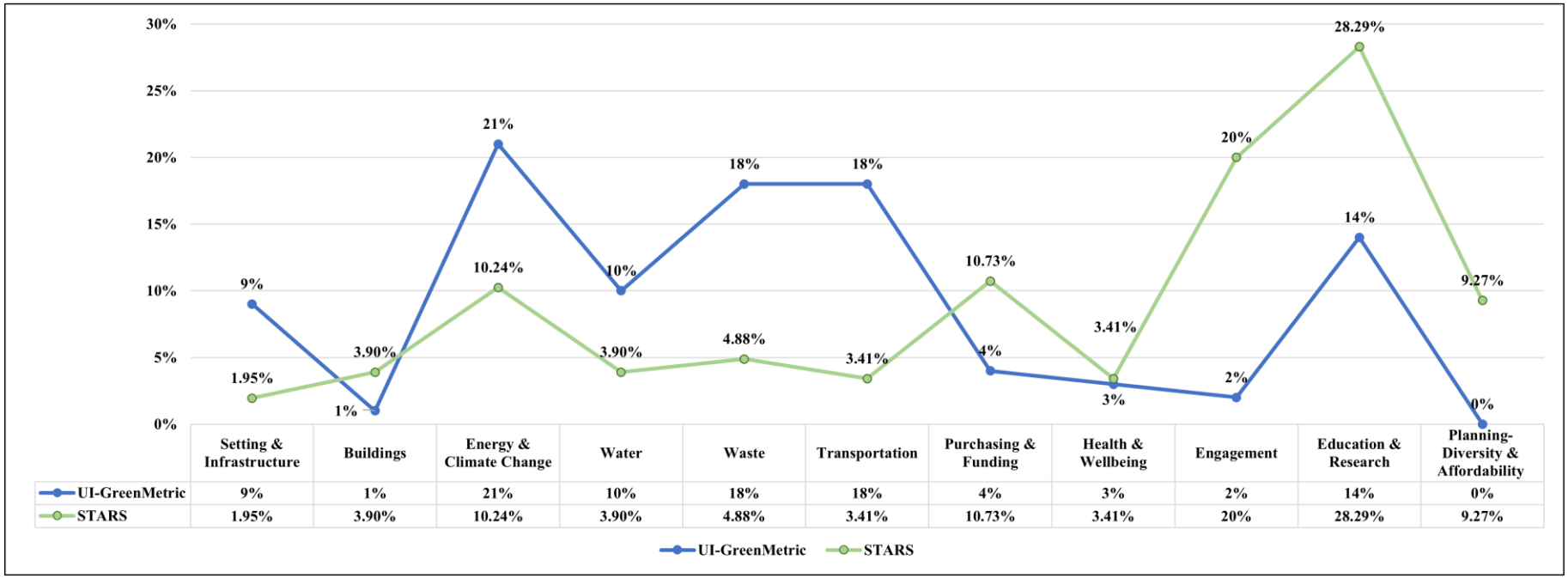

Figure 4. Relative weights for criteria of the two assessment systems (the authors)

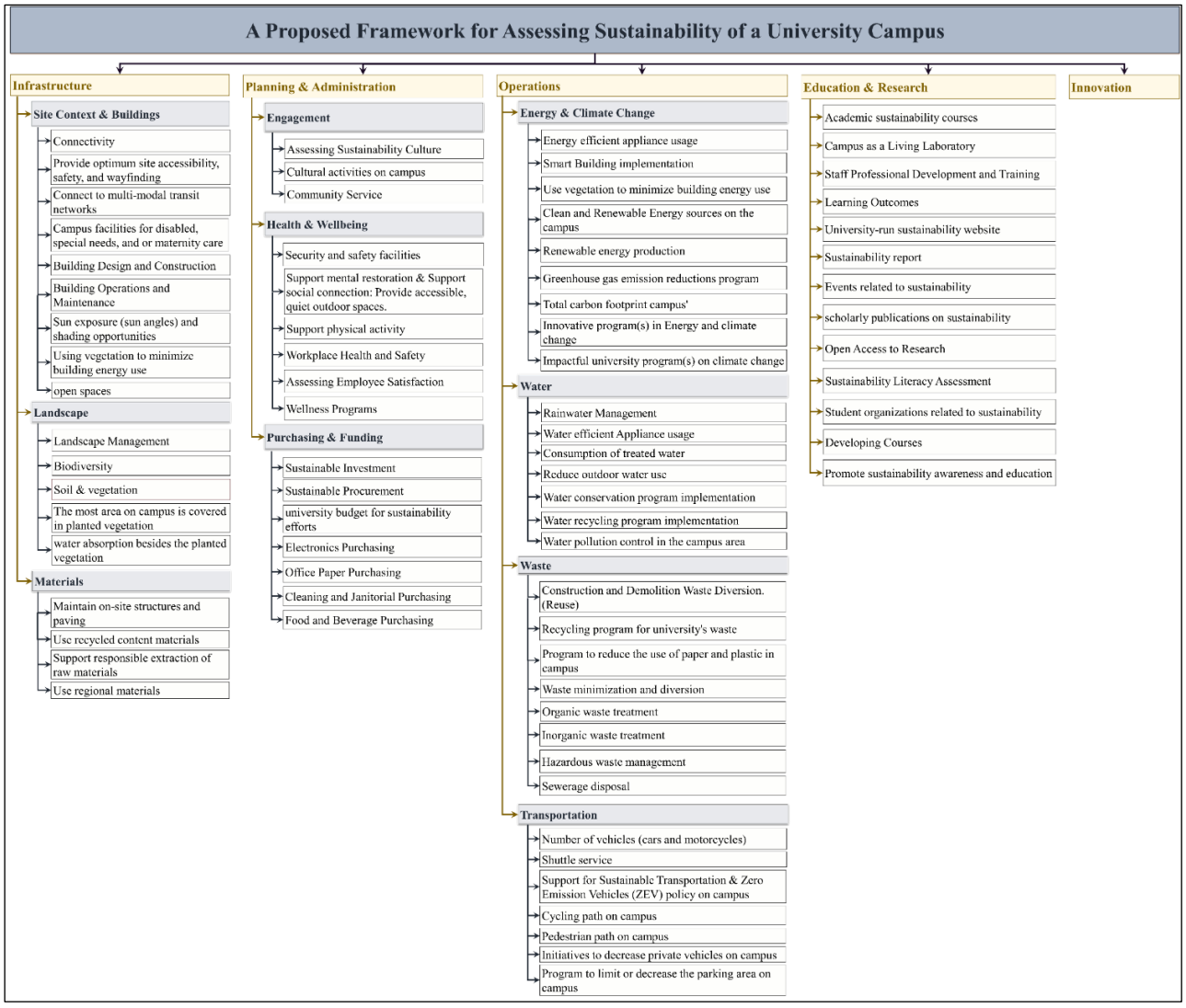

Figure 5. The proposed framework for assessing sustainability for a University Campus (the authors)

7. Applying the Proposed General Framework to the Tanta University Campus

Most data are collected by monitoring the current sustainability practices of Tanta University, taking pictures, and obtaining information from the university's website. The following steps then assess the campus:

First: Interviewing stakeholders and some campus users and obtaining engineering drawings.

Second: Referring to some reports and references to determine some indicators for the evaluation that ensure the results are accurate, such as:

SITES v2 Rating System for Sustainable Land Design and Development [58].

Safety and Security (Principles of Crime Prevention through Environmental Design).

Third: Conducting an electronic survey on the university's sustainability efforts. The questionnaire is available at https://shorturl.at/cejlM.

Fourth: Using all data to evaluate the campus through the proposed framework list as in Figure 5. Then, analyzing the results.

7.1. Location of the Tanta University Campus

Tanta University Campus is in Tanta, Egypt. It has several campuses, including the Medical Campus, the Sibirbay Campus, and the separate faculties distributed in the city's urban fabric, and university administration buildings. For 2021, the number of university students is 121252. Tanta University Campus was ranked to be 566 out of 956 universities worldwide according to the UI-GreenMetric in 2021[59]. The study chose six campuses from it and showed its locations in Tanta city in Figure 6.

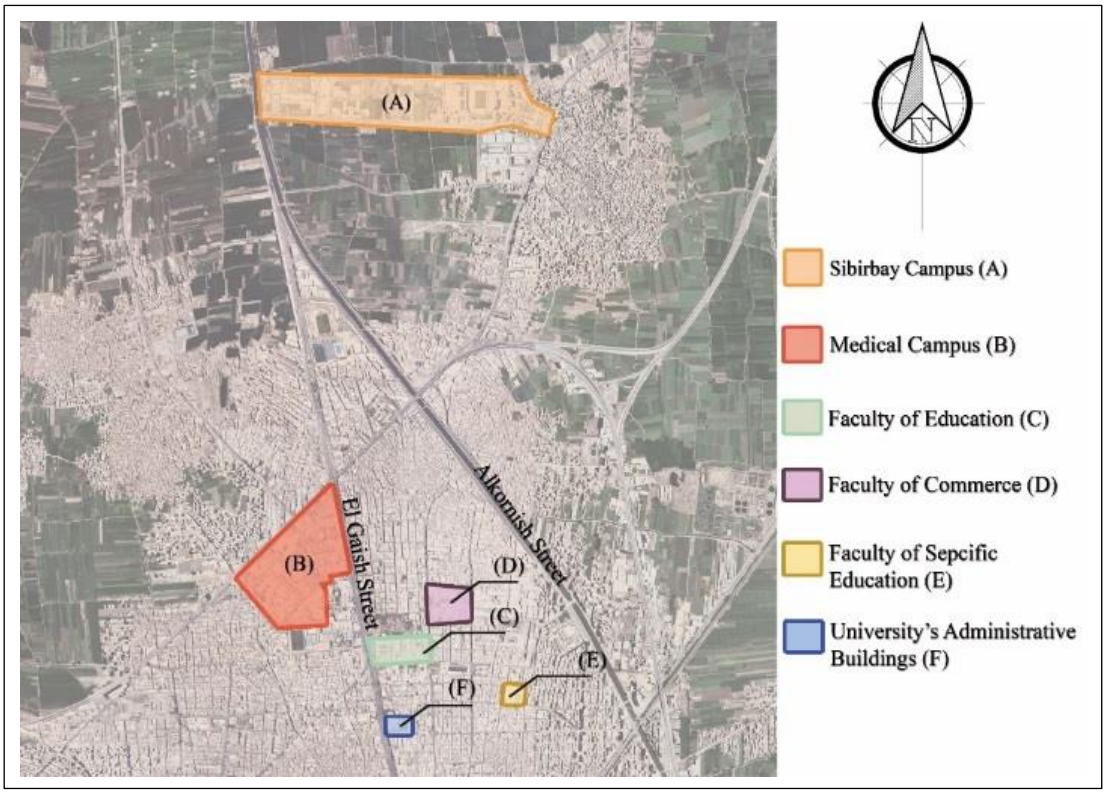

Figure 6. The locations of the university campus in Tanta and the separate faculties distributed in the city's urban fabric (Adapted from Google Earth) [60]

7.2. Practices at Tanta University

This study monitored and analyzed the campus of Tanta University to highlight its current situation using the proposed framework. So that conclusions and recommendations can be drawn about a sustainable campus in the Egyptian context:

7.2.1. Infrastructure

The infrastructure was established before the establishment of the university campus, but after the expansion, it was insufficient, so it was increased after construction.

(a) Site context & Buildings:

Tanta University's campus planning is generally based on district planning, which appears in various sectors through the convergence of functional levels.

Connectivity- Accessibility:

The Sibirbay Campus (A) is divided into four sectors, namely the academic, sports, service, and residential sectors, and is linked by a central spine. There are also pedestrian, vehicle, and bicycle paths, as shown in Figure 7, the connectivity between them is good, but the sidewalks are narrow and high, where trees and seats occupy the most prominent areas, so there is a slight traffic overlap. In addition, there is a square for vehicle circulations located at the beginning of the main entrance. Additionally, the campus is connected abroad through three active gates.

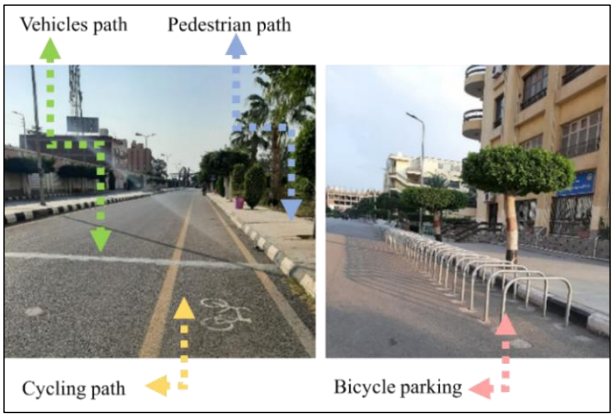

Figure 7. Vehicles, pedestrian, bicycle paths, and bicycle parking (Authors)

The medical campus (B) is divided into three sectors, namely the academic (medical faculties), the medical (hospitals), and residential sectors, separated by a fence surrounding the facilities and connected to the outside through ten gates. Furthermore, some paths for pedestrians and vehicles are separated through very safe crossings. In addition, a vehicle loop connects all parking areas to prevent congestion when searching for parking, bicycles are not allowed to enter campus, and there are no paths.

The Faculty of Education (C) consists of two open spaces in which the buildings are distributed, with links between them. Additionally, pedestrians and vehicles are

separated by not allowing cars to enter the entrance for students. It is connected to the outside through four gates. Furthermore, some buildings boast a distinct historical style, and the Gamal Abdel Nasser memorial statue reflects the community's culture.

The Faculty of Commerce (D) consists of commercial sectors, two main axes, an open space, paths for pedestrians and cars, and parking lots distributed on paths. So, the connectivity between pedestrian circulation and vehicles is moderate. However, there is slight interference between them, and the materials of the tracks differ to reduce the speed of cars, and the presence of two squares eases the rotation of cars. In addition, it is connected to the outside through four gates. Finally, the buildings have a distinct historical style, through their social sustainability is achieved by reflecting the community's cultural identity.

The faculty of specific education (E) consists of the main spine, on which buildings are distributed on both sides and are connected to the outside through three gates. It is close to most services but relatively far from transportation. Additionally, the central open space contains a memorial statue in the form of a Tanura dancer. This is one of the folklores of ancient Egypt, which reflects the community's cultural identity and achieves social sustainability.

The administrative sectors are interconnected through links and paths within the buildings (F). Pedestrian and vehicle paths are also available in the open spaces surrounding the buildings, and there are designated parking lots separated from the pedestrian areas by a small fence and different materials. The university is accessible through four gates. Additionally, one of the buildings has a Greek style and houses a nursery for employees' children, enabling them to work efficiently while keeping an eye on their kids, boosting economic and social sustainability.

Safety: each campus has clearly defined areas with clear visibility and good sight lines, with proper lighting levels varying from one campus to another. However, there are few corridors without lighting and not well monitored. Most paths are connected to the main entrances of various buildings for emphasis or classrooms, with outdoor observation creating a connection between indoor and outdoor spaces. Different materials are used in the tracks to separate pedestrians from vehicles in the open space between buildings to slow the movement of vehicles.

Figure 8. Main Gates (the authors)

Wayfinding: the university's logo is only on the main gates, as shown in Figure 8, and landmarks are typically associated with uses rather than unique buildings or landscapes.

Only on the Sibirbay campus, the Faculty of Commerce and the university administration signs indicate the way. Natural sunlight makes them clear during the day, so they do not require artificial lighting, as shown in Figure 9. Additionally, memorial statues, open areas, and gates are landmarks. In addition, all campuses are connected to multi-modal transit networks.

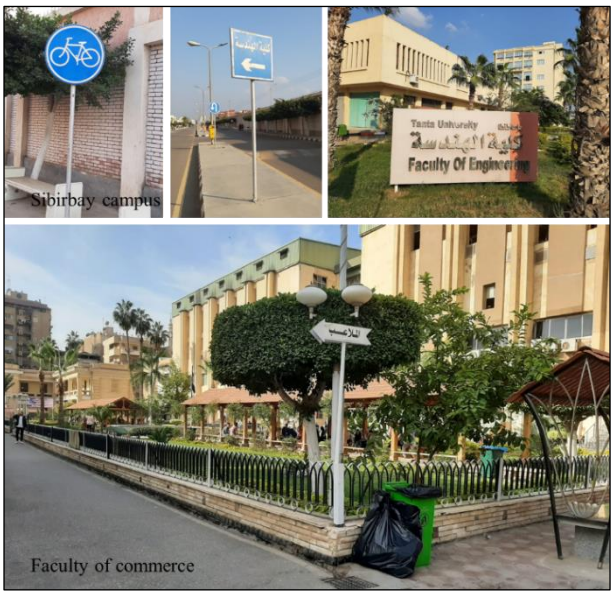

Figure 9. Signs (the authors)

Ramps have been installed at building entrances and some public areas lacking parking to facilitate the movement of disabled individuals. The university has also incorporated programs to accommodate their needs, including a dedicated center for their care and integration into academic studies. However, the campus lacks LEED, BREEAM, or GPRS certification for its buildings. However, it has implemented several sustainable practices that contribute to environmental sustainability, such as sun breakers, air-catching systems, and courtyards. Additionally, covering sewage pipes on building facades has improved the aesthetics and social sustainability of the campus. However, the university's maintenance practices do not meet sustainable site maintenance requirements, although its quality is evaluated periodically.

Open spaces: According to the questionnaire, all campuses have uncomfortable seats, and some spaces are rarely used due to the lack of shadows and some in the back. Most spaces also feature consistent materials, styles, and identities. No inhumane or cramped spaces exist, and most student activities occur there.

(b) Materials:

Maintenance now employs interlocking bricks on select sidewalks, while no recycled building materials were used. Certain paths and spaces also feature vibrant colors to mitigate the thermal island effect.

(c) Landscape:

It uses organic and inorganic fertilizers; some compost is produced on-site from fallen tree leaves and artificial soil (peat moss), and local sand is mixed with artificial fertilizer to modify the soil and increase its quantity. Moreover, biodiversity does not exist.

7.2.2. Planning & Administration

Some practices have been conducted in this criterion as follows:

(a) Engagement:

This is done through supporting a culture of excellence and competitiveness, nurturing the gifted, cultural activities on campus, enhancing partnership axes and areas for environmental development and community service, and promoting human capabilities and skills. The university hosted a local exhibition to arbitrate projects submitted by school students in different and advanced fields, such as Robotics, Embedded Systems, Energy, and the environment, to choose the best project.

(b) Health and Wellbeing:

There is partially achieved physical safety where some broken sidewalks lead to stumbling. Moreover, there are covered rainwater catch basins in the medical campus and bumps, different path materials to reduce vehicle speed, and monitoring cameras for security. However, power wires come out of lampposts and must be covered in small cases, and electronic gates and paths at Sibirbay and medical campuses to detect ID and metals. Hazardous medical waste is disposed of in hidden locations on the medical campus. The College of Commerce and the Medical Complex have fire extinguishers and emergency gathering points. On the other hand, there are Safety facilities in Figure 10.

Some campuses have dilapidated lampposts that do not work. There is little lighting in open spaces at night, but users do not suffer from psychological or physical problems. According to users, parking lots are exposed to direct sunlight; and only a few, but not all, safety measures are implemented by supplying low-altitude vegetation surrounding. Regarding campuses, street furniture is made of local materials such as wood and ceramics and has a uniform design, color, and style.

Physical activity and social connection are achieved through bicycle paths, sidewalks, sports fields, open spaces, seats under trees, and pergolas.

(c) Purchasing & Funding:

Sustainable investment is interested in the green economy and tourism. Furthermore, it tries to purchase or import large laboratory, medical, or engineering devices or auxiliary devices with an energy efficiency rating of less, and it was put a plan for reducing energy consumption [61]. Also, it created a unit to manage electronic waste. Finally, neither recycled paper nor environmentally friendly cleaners are purchased.

Figure 10. Safety facilities (the authors)

7.2.3. Operations

(a) Energy & Climate Change:

Non-energy-saving fluorescent lamps are used. However, now it is being replaced by energy-saving LEDs. Smart lighting is used in the faculty of science building only on the medical campus. In addition, some practices have been implemented to reduce energy consumption and achieve environmental sustainability. It came through sun breakers & light colors in buildings' facades, heights of buildings variations, use of air catching on some buildings' roofs, vegetation, relying on natural ventilation and lighting inside buildings and internal courtyards, as shown in Figure 11 and Figure 12. All of these reduce energy consumption and achieve environmental sustainability. Insufficient shading is the main problem.

The university used solar energy as an alternative to conventional energy to provide electricity, and it increased the temperature of the air conditioners to 26 degrees Celsius, turning off 10% of the air conditioners at peak time and planting 2000 trees [62].

Figure 11. Sun breakers and light colors (the authors)

Figure 12. Height of buildings and landscape, courtyard, and some sustainable practices (the authors)

(b) Water:

According to the climate in Egypt, rainwater is not managed well. Although some buildings have drains that irrigate vegetation directly with surface runoff water and solar-powered reverse osmosis desalination plants, as shown in **Figure 13**, achieving environmental sustainability in the Sibirbay campus. Filters were also installed for drinking water purification in buildings. Finally, drip irrigation rationalizes water use on the medical campus.

Figure 13. Solar-powered reverse osmosis desalination plant [63]

(c) Waste:

It converts paper books into e-books, prints on two sides, and conducts electronic exams. Additionally, the science faculty separates the waste from the source, as in **Figure 14**. Moreover, the Management Unit Electronic Waste and The Crisis and Disaster Management for hazardous materials are responsible for disposing of hazardous medical waste [64]. Additionally, producing high-quality and durable plastic wood uses rice straws. However, the university does not use it and is not a recycling program.

Figure 14. Waste separation in the faculty of science (the authors)

Furthermore, recycling agriculture waste to produce organic fertilizer for plant growth.

(d) Transportation:

Despite having bike parking and paths, bicycle use is almost non-existent on campus, and public transportation is mainly used to access campus. Also, the shuttle service (Taftaf) is only inside the Sibirbay campus but rarely works, as shown in **Figure 15**.

Figure 15. Shuttle service (Taftaf) (the authors)

7.2.4. Education & Research

It uses the campus infrastructure to conduct experiments, such as soil tests. Furthermore, the literacy plan was implemented in cooperation with Haya Karima Institution in the neediest villages, and disabled people were integrated into their studies at the university. Moreover, it opened special departments such as environmental architecture - new and renewable energy engineering and merged sustainability concepts in curricula. In addition, it developed courses, established an educational satellite channel, electronic platforms, staff professional development, and training centers, and promoted sustainability awareness and education. Also, it established centers for sustainable development, robotics, intelligent simulation, and intelligent modeling units, as shown in **Figure 16**.

Figure 16. Robotics, intelligent simulation, and intelligent modeling units (the authors)

7.2.5. Innovation

It supported partnership and innovation for students in all fields and contributed to the state achieving Egypt's 2030 vision.

7.3. Checking of the Proposed General Framework

By determining the availability degree of criteria and indicators met on the Tanta University campus, results and conclusions can be drawn from **Table 1**.

Table 1. The evaluation of the sustainability of the Tanta University campus based on the proposed framework (the authors)

Criteria & Indicators	Sub- indicators	Availability						Notes
		A	B	C	D	E	F	
Infrastructure								
Site Context & Buildings								
Connectivity	Permeability of pedestrian network (short links- numerous intersections - minimal dead ends)	5	5	5	5	5	5	A: All spaces and paths are linked through a continuous main spine. Moreover, the connectivity between pedestrian, cycling, and vehicular circulations is good. However, there is a slight traffic overlap because the width of the sidewalks is narrow, where trees and seats occupy most of the area. Also, in (C), there is a slight overlap between them
	A balance between vehicular and pedestrian networks	4	4	4	4	4	5	
Provide optimum site accessibility	Provide site access and usability	5	5	5	4	3	5	All campuses close to public transportation
Provide safety	Clear, defined spaces and access control	5	5	4	5	5	5	Most spaces are clear, defined and access control
	Natural surveillance with adequate lighting levels	4	4	4	4	4	4	Although natural surveillance is available in (D, E), narrow and unexposed paths with low light levels exist
	Natural surveillance at entrances and walkways	5	5	5	5	4	5	All main gates bear the name and logo of the university
	Clear visibility and good sightlines	4	4	4	4	5	5	
	A variety of options for access	5	4	3	5	3	4	Confirmation of paths and guidance signs
	Site design elements that improve the effectiveness of security and policing efforts	5	5	5	5	4	5	(D) and (E) have narrow and unexposed paths with low light levels
	Absence of different hazards: clearance hazard- object hazard- collision hazard- stability hazard	4	4	3	4	4	4	Some sidewalks are broken in (C)
Provide wayfinding	Clear entrances and gateways	5	5	5	3	4	5	In (E), two gates are not clear
	Viewpoints and sight lines	4	4	3	4	4	5	Most sight lines are clear
	Landmarks	4	4	5	4	5	4	There are various landmarks
	Decision points or nodes	4	4	3	3	4	4	Nodes are visible and clear
	Hierarchy of pedestrian and vehicular circulation	4	4	4	4	4	4	All gates separate vehicles and pedestrians through entrances for each. Also, (A) and (D) have vehicles rotation square, but there is a slight overlap between them
	Different areas and regions	4	4	4	4	3	5	There are various distinct areas
	Orientation devices and systems	4	4	3	4	4	4	Confirmation of paths by plants, different materials, and shaded paths
	Maps and brochures	1	1	1	1	1	1	There are few maps explaining ways

Table 1 continued

Connect to multi-modal transit networks		5	5	5	5	3	5	All campuses connect to public transport and bicycle path in (A)
Campus facilities for disabled, special needs, or maternity care		4	4	2	3	1	1	Ramps at entrances. In (B), there is a center for care for them
Building Design and Construction	Restore soils disturbed by previous development	2	2	2	2	2	2	
	Divert construction and demolition materials from disposal	2	2	2	2	2	2	Doors and windows are reused
	Divert reusable vegetation, rocks, and soil from disposal	-	-	-	-	-	-	
	Protect air quality during construction	-	-	-	-	-	-	
	Buildings were built or renovated according to green building codes, policies, guidelines, and/or rating systems: multi-attribute BREEAM, LEED, or single attribute focusing on one aspect of sustainability	4	3	2	2	2	2	Campuses do not have LEED, BREEAM, or GPRS green building certificates; however, some sustainable practices exist
Building Operations and Maintenance	Plan for sustainable site maintenance	-	-	-	-	-	-	Although building and site maintenance are done, it is not sustainable as it does not support at least one aspect of sustainable sites maintenance
	Storage and collection of recyclables	3	3	3	3	3	3	The iron is sold to scrap dealers
	Recycling organic matter	2	2	2	2	2	2	Fertilizing fallen tree leaves
	Minimize pesticide and fertilizer use	2	2	2	2	2	2	
	Reduce outdoor energy consumption	2	2	2	2	1	1	Using vegetation to reduce energy and temperature
	Use renewable sources for landscape electricity needs	-	-	-	-	-	-	Is not applied
	Protect air quality during landscape maintenance	-	-	-	-	-	-	Is not applied
Open spaces	Accessibility, functionality, and interactivity of spaces	5	4	4	4	4	3	Some open spaces are not used on campus (A) and are insufficient in (B)
	Interconnectivity of spaces with the whole network of spaces on campus	5	4	4	5	5	5	In (B, C), there are some separate spaces
	Presence of central space for activities	4	4	4	5	5	4	(A, B) a space for activities between each group of buildings, according to its specialization. (F) the space is for parking
	Consistency of materials, styles, and identity of spaces	5	5	4	5	5	5	
	Presence of spaces enhances social interactions	5	5	5	5	5	4	
	Humane proportions of designed spaces. (Enclosure and heights)	5	5	5	5	5	5	
	Variety of uses and activities of different spaces on campus	4	4	3	4	4	1	(F) the space for parking
	Definition of spaces using buildings or vegetation	5	5	5	5	5	5	

Table 1 continued

Landscape								
Landscape Management	Organically, without the use of inorganic fertilizers and chemical pesticides, fungicides, and herbicides	3	3	3	3	3	3	Using organic and inorganic fertilizers
	An Integrated Pest Management (IPM) program	-	-	-	-	-	-	The plant is sprayed with the appropriate pesticide when the infection appears only
Biodiversity		-	-	-	-	-	-	There are no natural reserves or heritage buildings in the university
Soil & Vegetation	Use the existing plant material or installing plants that provide shade over paving areas (including playgrounds)	4	3	4	4	4	4	Although there are plants on the sidewalks, they do not provide enough shade, and an attempt is now being made to replace them with bushy trees such as poinciana
	Provide shade with structures covered by energy generation systems that produce renewable energy	3	-	-	-	-	-	
	High-reflectance roof	3	3	3	3	3	3	Roofs colors are bright to reduce temperatures
	Vegetated Roof	-	-	-	-	-	-	
	Parking undercover	-	-	-	-	-	2	One parking on (F)
	Reduce the use of constructed impervious surfaces (e.g., roads, sidewalks, parking lots)	-	-	-	-	-	-	
	Increase the use of vegetated surfaces and planted areas	5	4	4	4	4	4	2000 trees are now being cultivated
	Use shade from appropriate trees, large shrubs, vegetated trellises, walls, or other exterior structures	5	3	3	4	3	3	Some pergolas and shaded seats. In (B), there is a shortage of seats, and now under development
Most of the campus is covered in planted vegetation		4	3	3	3	2	3	All campuses contain much vegetation.
Water absorption besides the planted vegetation		1	-	-	-	-	-	It does not exist on all campuses. But in (A) there is used surface water on roofs to irrigate plants by pipes
Materials								
Maintain on-site structures and paving		4	4	3	4	3	4	Although clean, repair, and refinish existing structures and paving, the maintenance is not sustainable such as not refurbishing and reusing in place
Design for adaptability and disassembly		3	3	3	3	3	3	It uses interlocking bricks pavers on sidewalks
Use recycled content materials	Use plastic lumber made with recycled content	2	-	-	-	-	-	Production of high-quality and durable plastic wood using rice straws was just an experiment
	Use crushed concrete for aggregate bases	-	-	-	-	-	-	Not applied
	Specify new asphalt with recycled asphalt aggregate	2	2	2	2	2	2	Use new asphalt on old
	Use high recycled content steel	-	-	-	-	-	-	Not applied
	Utilize spent iron and foundry sand as fine aggregate in concrete	-	-	-	-	-	-	Not applied
Support responsible extraction of raw materials		2	2	2	2	2	2	Improve land use and respect cultural and community values
Use regional materials		3	3	3	3	3	3	It uses cheap and local materials to reduce the cost of transportation

Table 1 continued

Planning & Administration								
Engagement								
Assessing Sustainability Culture	Awareness of campus sustainability initiatives	2	2	2	2	2	2	There are initiatives but insufficient
	Behaviors	2	2	2	2	2	2	Behaviors are few sustainable
Cultural activities on campus		3	3	3	3	3	2	There are many cultural activities
Community Service		5	5	5	5	5	5	Volunteer to serve the community in the "Decent Life" Initiative
Health & Well-being								
Security and Safety Facilities	Availability of parking lots at reasonable distances on campus	4	4	4	4	5	5	
	The presence of special parking lots for disabled people	2	2	2	2	2	2	
	Low-height vegetation around parking areas to not obstruct visibility	3	2	1	1	1	1	
	Heat island effect prevention by planting deciduous trees on parking islands	2	1	1	1	1	3	(F) One parking is covered. However, (B) is under construction
	The use of local materials to produce the site furniture	3	3	3	3	3	3	
	The flexibility of furniture and durability of materials	3	3	3	3	3	3	
	Furniture comfort and suitability for different users	3	3	3	3	3	3	
	The location is close to most services, such as restaurants, libraries, and banks	4	5	5	5	4	5	
	Support physical activity to site users (e.g., bicycle parking, drinking fountains, emergency call boxes)	2	1	-	-	-	-	In (A), it provides bicycle racks that are not used and emergency call boxes in university cities only
Support mental restoration & support social connection: Provide accessible, quiet outdoor spaces	Provide comfortable seating in the sun and shade	4	3	3	4	3	3	
	Visual and physical access to vegetation	5	5	5	5	5	5	All campuses provide visual and physical access
	Mitigate negative distractions and reduce noise	3	3	3	3	3	3	Vegetation and some fountains reduce noise
	Consideration of microclimates and other site-specific conditions (e.g., sun, shade, wind)	3	3	3	3	3	3	Trees as windbreaks in (A). Sun breakers in buildings' facades. Courtyards and connective tissue in some buildings with shaded paths. However, insufficient shading is the main problem
Support Physical Activity		4	4	3	4	4	4	Bicycle paths on campus (A) are available and pedestrians on all campuses, physical activities are moderately supported but elements that encourage walking are needed.
Workplace Health and Safety		4	4	4	4	4	4	
Assess Employee Satisfaction		2	2	2	2	2	2	
Wellness Programs	Wellness Program	3	3	3	3	3	3	Health insurance
	Smoke-free environments	2	2	2	2	2	2	

Table 1 continued

Purchasing & Funding								
Sustainable Investment		3	3	3	3	3	3	
Sustainable Procurement		3	3	3	3	3	3	It puts a plan to purchase or import large laboratory, medical, or engineering devices or auxiliary devices with an energy efficiency rating of less
University budget for sustainability efforts		3	3	3	3	3	3	
Electronics Purchasing		2	2	2	2	2	2	Some air conditioners save energy
Office Paper Purchasing		-	-	-	-	-	-	It is printed on two sides of the paper; the unrecycled paper is purchased
Cleaning and Janitorial Purchasing		-	-	-	-	-	-	Not applied
Food and Beverage Purchasing		3	3	1	-	-	-	Date palms and some fruit trees are cultivated inside (A) campus
Operations								
Energy & Climate Change								
Energy-efficient Appliance usage		2	2	2	2	2	2	Start to replace lighting with LEDs to save energy and through some practices
Smart Building Implementation		3	4	2	2	2	3	Use electronic gate, footprint in (A), and smart lighting in part of the faculty of science in (B). All campuses contain video surveillance
Use vegetation to minimize building energy use	Reduce energy use	3	3	3	3	3	3	Use trees and plants
	Provide shade structures to shade 100% of all HVAC units	1	1	1	1	1	1	
	Provide a windbreak	1	-	-	-	-	-	Cultivation of trees with dense leaves and high to face the unfavorable winds in the southeast of campus (A)
Clean and Renewable Energy Sources on campus		2	2	-	-	-	-	Some buildings have solar cells in (A) and (B)
Renewable energy production		2	2	-	-	-	-	
Greenhouse Gas Emission Reductions Program		3	3	3	3	3	3	
Total carbon footprint campus		3	3	3	3	3	3	It has been recommended and is being worked on
Innovative program(s) in Energy and climate change		3	3	3	3	3	3	Short, medium, and long-term energy rationalization and efficiency plans
Impactful university program(s) on climate change		4	4	4	4	4	4	Organize the International Environmental Forum

Table 1 continued

Water							
Rainwater Management	1	1	1	1	1	1	Despite the lack of rainwater, surface runoff water is used to irrigate the vegetation by pipes from the rooftops of the buildings directly to the plants in (A)
Water-efficient Appliance usage	-	-	-	-	-	-	Not applied
Consumption of treated water	-	-	-	-	-	-	The water is not treated
Reduce outdoor water use	1	3	1	1	1	1	Drip irrigation in (B)
Implementation of a water conservation program	2	2	2	2	2	2	
Water recycling program implementation	2	-	-	-	-	-	Solar-powered reverse osmosis desalination plant in (A)
Water pollution control in the campus area	3	3	3	3	3	3	There are filters for each building
Waste							
Construction and Demolition Waste Diversion	3	3	3	3	3	3	The iron is sold to scrap dealers, and doors & windows are reused
Recycling program for university's waste	1	3	1	1	1	1	Separation bins from the source in one faculty on campus (B)
Program to reduce the use of paper and plastic on campus	4	4	4	4	4	4	Electronic books and exams. Printing on two sides of the paper
Minimization and diversion of waste	2	3	2	2	2	2	
Organic waste treatment	2	2	2	2	2	2	Use deciduous plants' leaves as an organic fertilizer
Inorganic waste treatment	3	4	3	3	3	3	Electronic management units for all campuses, in addition to (B), have separate bins
Hazardous Waste Management	4	5	4	4	4	4	Although there is a hazardous waste unit, this waste is put outside in plastic bags in (B). Unit to manage electronic waste in (A) and for all campuses
Sewerage disposal	2	2	2	2	2	2	It is done in traditional ways

Table 1 continued

Transportation								
The number of vehicles (cars and motorcycles) is low		2	2	2	2	2	2	The number of cars and motorcycles with combustion engines is high
Shuttle service		5	-	-	-	-	-	There is a Taftaf inside the campus (A)
Support for Sustainable Transportation & Zero Emission Vehicles (ZEV) policy on campus		3	2	2	2	2	2	There is a cycling path in (A) and most employees use cycling.
A pedestrian path on campus	Pedestrian paths are available	4	4	4	4	4	4	
	Safe design: enough lighting, a separate path for pedestrians and vehicles, and handrails	4	4	4	4	4	4	On campus (A), traffic overlaps because of the narrow sidewalks, where trees and seats occupy the largest areas. Also, it is very high. The paths are safe on campus (C) as they are separated from the vehicle paths, but they are broken or are not paved . However, the campus suffers from a lack of lighting. In € is safety because it is small, so it decreases cars speed
	Convenience: the level difference with mild slant, some areas covered with soft material (rubber, wood, etc.), availability of directions and locations information	5	4	4	4	4	4	
	Disabled-friendly: ramps and guiding blocks with a suitable design for pedestrians with physical disabilities	3	3	3	4	2	3	Ramps at entrances of buildings and some open spaces
Cycling Paths on campus	Cycling paths are available	4	4	2	2	2	2	
	Parking paths are available	4	4	2	1	1	1	
	Usage Percentage	4	4	2	1	1	1	
Initiatives to decrease private vehicles on campus		1	1	1	1	1	1	It is starting
Program to limit or decrease the parking area on campus		1	1	1	1	1	1	It is starting

Table 1 continued

Education & Research								
Academic sustainability courses		5	5	4	4	4	3	Most of the curriculum is about sustainability. Also, courses of digital transformation are made.
Campus as a Living Laboratory		5	5	4	4	4	-	
Staff Professional Development and Training		5	5	5	5	5	5	
Learning Outcomes		5	5	4	4	4	2	Most of the curriculum and research are about sustainability
University-run sustainability website		3	3	3	3	3	3	There is a website for the university, but it is general
Sustainability report		4	4	3	3	3	3	
Events related to sustainability		5	5	3	3	2	4	Organize the International Environmental Forum
Scholarly publications on sustainability		5	5	5	5	5	5	
Open Access to Research		5	5	5	5	5	5	
Sustainability Literacy Assessment		5	5	5	5	5	-	It got first place in literacy at the level of Egyptian universities. In (F), there are no students, employees only
Student organizations related to sustainability		4	4	3	3	3	-	In (F), there are no students, employees only
Develop Courses		5	5	5	5	5	5	
Promote sustainability awareness and education		4	4	3	3	3	3	There are electronic platforms and educational channels
Innovation								
Innovation	It would be added as a bonus if the university did something more than what was mentioned in the framework	-	-	-	-	-	-	

A: Sibirbay Campus B: Medical Campus C: Faculty of Education D: Faculty of Commerce E: Faculty of Specific Education

F: University Administrative Buildings 0: not applied 1: Very low 2: Low 3: Moderate 4: Good 5: Very Good

8. Results

Based on a proposed general framework in Figure 5 and that listed in Table 1, to assess the sustainability of the Tanta University Campus and choose six campuses from it, the following results can be shown:

This study shows in Figure 17 that the Tanta University campus has many indicators ranging from low to good. The Education & Research have the highest rate between good and very good, with a percentage of 66-92%, the water has the lowest rate at 20-26%, Site Context & Buildings at 65-72%, a Landscape at 29-42%, Materials at 29-36%, Engagement at 55-60%, Energy & Climate Change at 38-49%, health & wellbeing at 56-62%, Purchasing & Funding at 31-40%, Waste at 53-65%, and Transportation at 40-67%. Accordingly, in Figure 17, the university promotes sustainability through some practices. However, these few practices are not reflected in the sustainability of the university campus, so there is a need to develop plans to achieve sustainability with its three pillars and put mechanisms to implement them. Moreover, the Figure shows the general progress in achieving sustainability on the Tanta University campus.

For Site Context & Building, (A) recorded the highest value at 72%, and (C, E) recorded the lowest value at 65%. As for the Landscape, 42% was recorded for (A) as the highest and 29% for (B, E) as the lowest. As for Materials, the highest rate for (A) at 36% and the lowest for (C, E) at 29%. The Engagement was the highest value at 60%, and the lowest was for (F) at 55%. In addition, Health & Wellbeing recorded 62% for (A) as the highest, while 56% for (C) is the lowest. Purchasing & Funding were recorded at 40% for (A, B) and the lowest at 31% for (D, E, F).

The highest average Energy & Climate Change value was recorded for (A, B) at 49%, while 38% for (C, D, E) was the lowest. Additionally, water was recorded at 26% for (A, B) and 20% for (C, D, E, F). Waste had the highest value at 65% in (B) but the lowest value at 53% in others. Transportation got 67% for (A) at the highest rate, while (E) at 40% was the lowest. Finally, Education and Research recorded the highest average at 92% for (A, B) but the lowest value for (F) at 66%.

This study shows in Figure 18 that most criteria are at the range of moderate to good. In contrast, the Planning & Administration criterion has the lowest value at 51- 57%. While 62-83% Operations range from good to very good, indicating sustainable practices with this criterion, which is one of the most important criteria for achieving environmental sustainability, will be reflected in social and economic sustainability. On the other hand, the Education & Research index records the highest value between 66-92%, which indicates the University's interest in enhancing campus social and economic sustainability, which is reflected in the sustainability of the Egyptian context. Moreover, the Infrastructure criterion records a value of 52-60%. All of these indicate that the University must continue efforts to achieve sustainability and Egypt's Vision 2030.

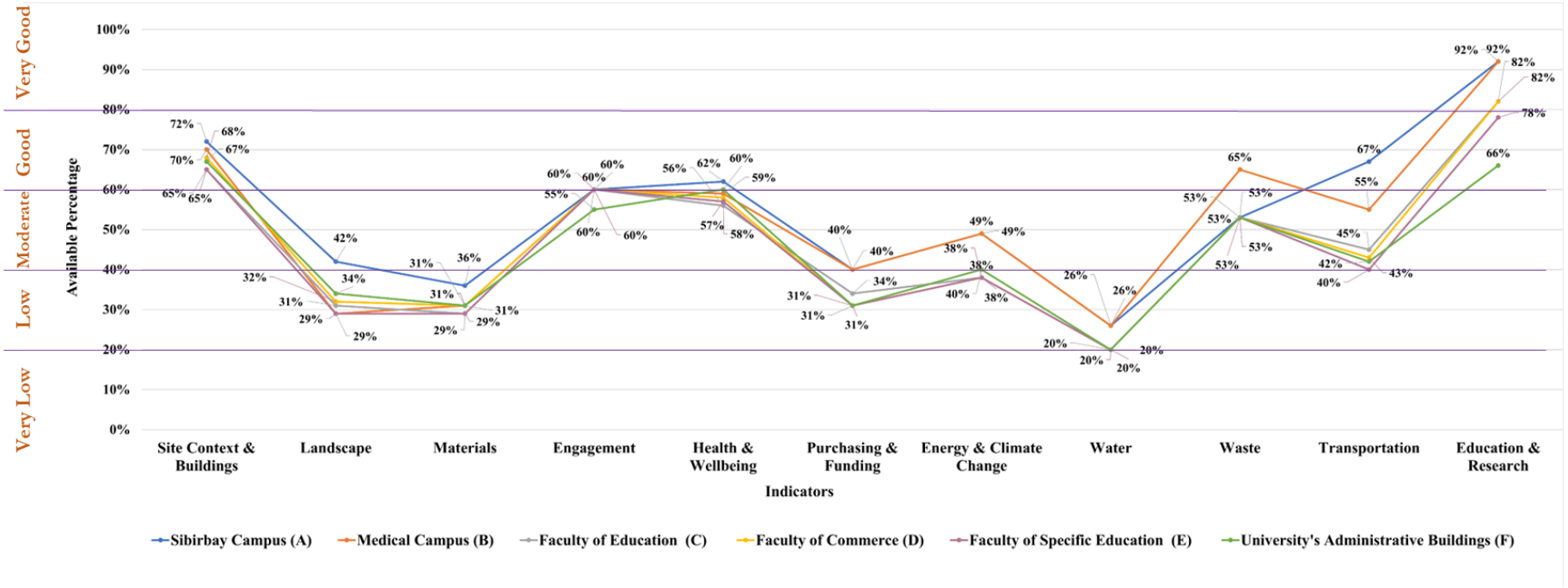

Figure 17. Assessment of proposed framework indicators in Tanta University Campuses (the authors)

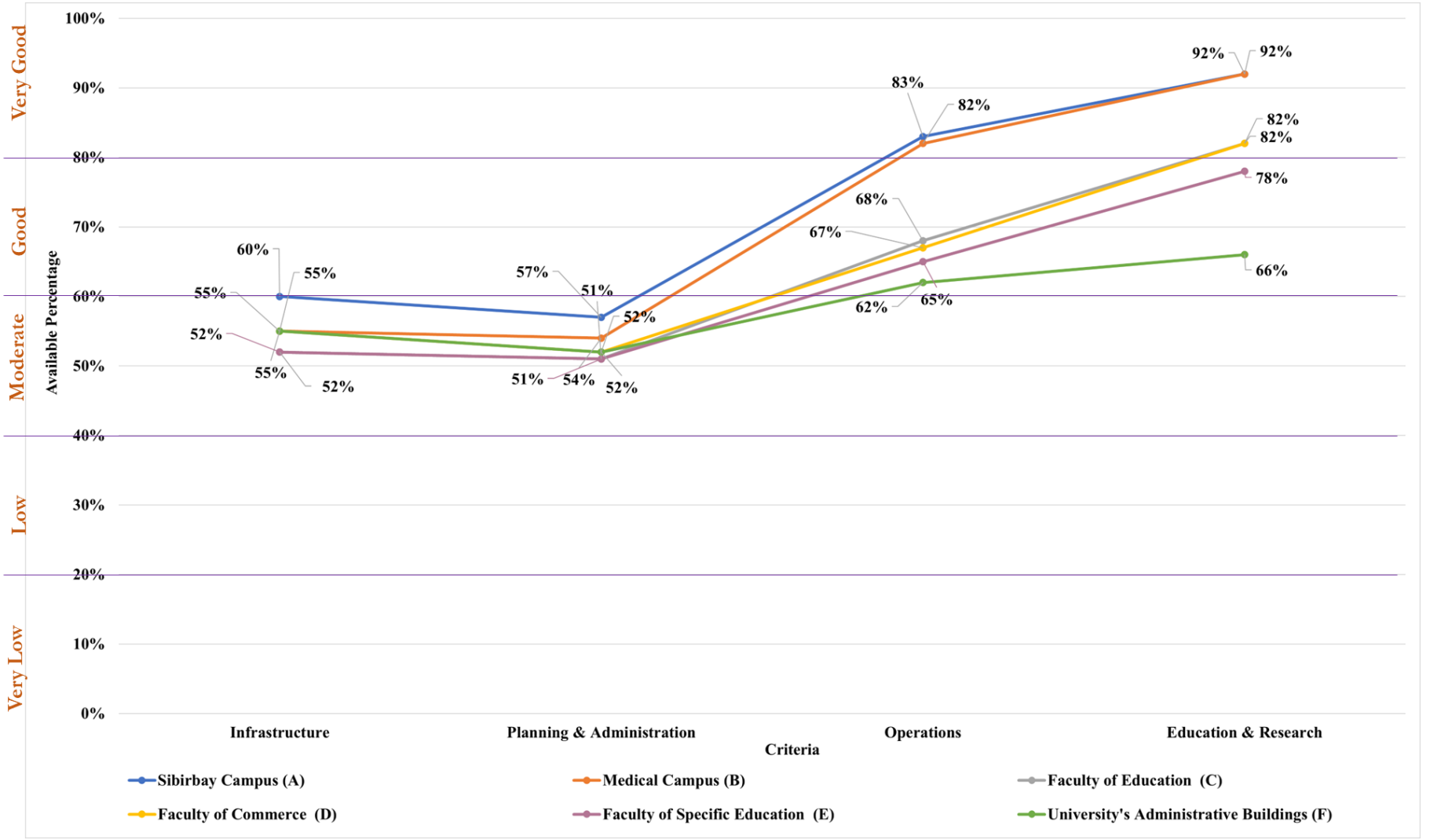

Figure 18. Criteria effectiveness assessment for framework in Tanta University Campuses (Authors)

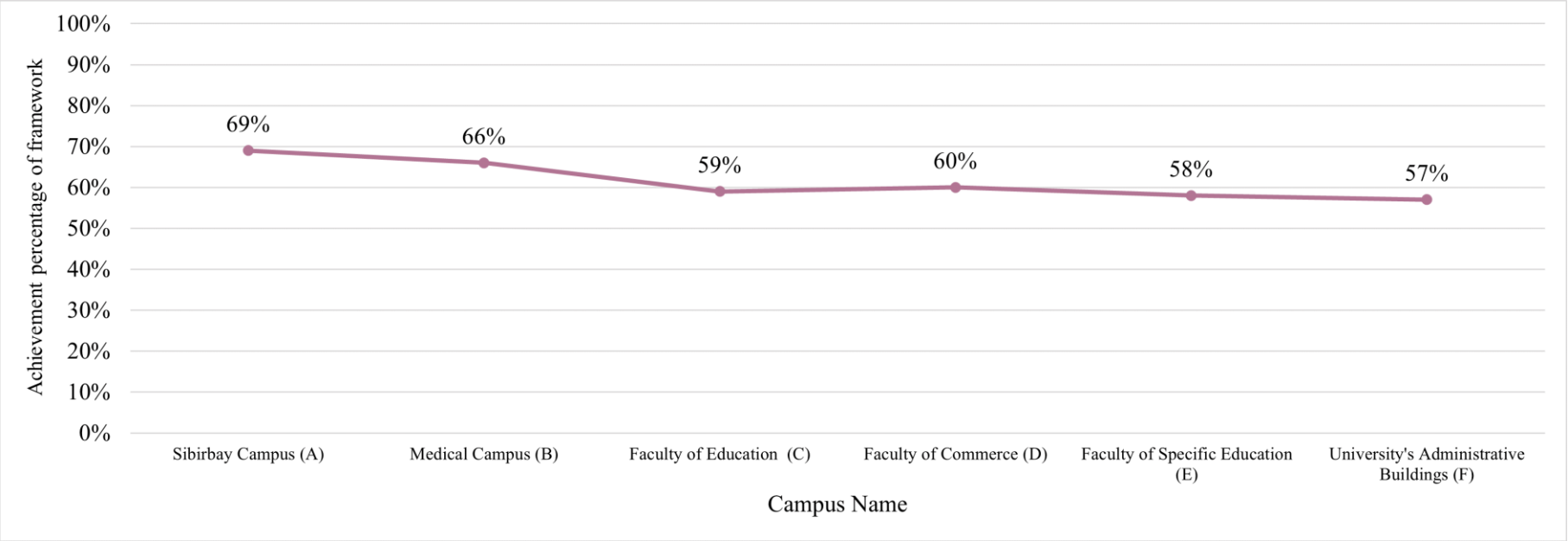

Figure 19. Percentage of proposed framework achievement for each campus (Authors)

Regarding Infrastructure, the highest value was recorded for (A) at 60% and (C, E) with the lowest value at 52%. For Planning & Administration, (A) had the highest value at 57%, and (C, E) had the lowest value at 51%. Furthermore, Operations got 83% for (A) as the highest, but 62% for (F) as the lowest. Finally, Education & Research recorded the highest average at 92% for (A, B) but the lowest value for (F) at 66%.

This study in Figure 19 shows the percentage of framework achievement on each campus, where (A) got the highest at 69% and (F) got the lowest at 57%.

9. Discussion

From the previous analysis of the Tanta University campus, it was found that there are major challenges facing the sustainability of the campus, the most prominent of which was the lack of awareness of the meaning and practices of sustainability, despite the launch of some initiatives, but they are insufficient. This study proposed a general framework, which can be considered a model for achieving campus sustainability in Egypt since there are no assessment systems for campuses. The following is a presentation of how this framework affects sustainability with its three pillars and 17 objectives:

By providing education for all and understanding cultural diversity, Tanta University contributed to goal 4 (quality education) and ranked first among Egyptian universities in literacy. It also contributes to goal 13 (climate action) by improving education and awareness of climate change. Moreover, education achieves gender equality and acquires skills in the face of global poverty and biodiversity loss. On the other hand, the research contributes to goal 9 (industry, infrastructure, and innovation) and goal 16 (peace, justice, and vital institutions) by encouraging students, staff, and research centers to pay attention to sustainability research.

It must increase awareness about sustainability. Moreover, it focused on training employees to raise their awareness, as shown in the establishment of the University Center for Career Development (UCCD), which reflects on reducing the effects of climate change and thus promotes goal 13 (climate action). It organized several climate change conferences and participated in presidential initiatives to enhance sustainable cities and communities. It encourages participation in sustainability initiatives, such as "Decent Life," which enhances the ethics of sustainability within the entire campus.

Building ventilation and natural lighting promote goal 3, and reverse osmosis desalination using solar energy promotes goal 6. Regarding landscape, it promotes goals 3, 6, and 15 by reducing food waste, composting food waste, and planting trees. Moreover, sustainable transport promotes goals 3,9,11,12,13 by reducing air pollution, limiting mobility, maintaining health, and encouraging walking and cycling. Nevertheless, there is still a need to raise awareness of and dependence on it, reducing on-campus cars. Also, using organic fertilizer, composting agricultural waste, recycling, and maintaining public health promote goals 3, 6, 8, 12, and 14 in waste management. However, it is very low and needs to enhance.

10. Conclusions

Given this study and in terms of summarizing its results, it can be viewed through the same five sections that were studied in the theoretical part, and they are the same based on which the proposed general framework was devised to link the importance of the study, its topic, and the precise research point that was settled on one hand, and on the other hand, it indicates whether the research problem and the research hypotheses are answered to apply those theoretical studies that were finally crystallized in the proposed general framework, which was used in the study of the current situation of the university campus in Tanta to assess the extent of interest in the sustainable dimension of this campus from whether or not, and narrowing the gap between this current situation and what this university campus should be.

Thus, for Tanta University, there are five axes to be considered by applying the proposed framework:

First: For the campus infrastructure: The study concluded the following:

(a) Site Context & Buildings:

Connectivity, providing optimum site accessibility, safety, and wayfinding is very good and needs to improve orientation systems on most campuses and enhance safety through security systems and natural surveillance; the campuses have various architectural styles, with some Greek-style buildings, and new buildings are not the same style. Moreover, connection to multi-modal transit networks and campus facilities for the disabled, special needs, and maternity care are very good. As for building design and construction, building operations and maintenance, it should be boosted. However, Sun exposure (sun angles) and shading opportunities, using vegetation to minimize building energy use and open spaces, are available on all campuses.

The proposed framework provides a starting point for architects, planners, and the state's officials to follow and join efforts to create a sustainable campus encompassing most aspects of life in Egypt. Regarding governmental regulations, it is critical to focus on campus sustainability through specific and specialized regulations to incorporate it as a sustainable practice as one of the ways to preserve the total goals of the Egyptian 2030 Agenda, especially for some branches which are still incomplete and new buildings, where these standards can be applied in design and planning. The university must plan and design a sustainable campus before its construction and operation and focus on reducing encroachment on agricultural land

when urbanizing it.

(b) Landscape:

Providing landscape management, biodiversity, soil & vegetation; most areas on campus are covered in planted vegetation but do not provide water absorption besides the planted vegetation and need to improve.

(c) Materials:

It maintains on-site structures and paving, and there is a lack of shade and seats on the sidewalks. However, it does not use recycled content materials or support responsible extraction of raw materials, and it uses regional materials and needs to boost them to achieve sustainability. In addition, recycled content is not generally supported in Egypt or is used with a limited and expensive scope.

Finally, it needs to improve the infrastructure of the university campus in line with achieving sustainability in general.

Second: For the Campus Planning & Administration: The study concluded the following:

(a) Engagement:

The indicator is categorized into three sub-indicators. The first one evaluates the culture of sustainability, indicating that while initiatives are present, they are inadequate. The second component assesses cultural activities on campus that require improvement. Finally, the third sub-component measures community service, which is deemed to be highly satisfactory.

(b) Health & Wellbeing:

It provides security and safety facilities, supports mental restoration & supports social connection by providing accessible, quiet outdoor spaces, and supports physical activity, workplace health & safety; smoking should be banned on campus to preserve the environment and public health. Assessing employee satisfaction and a relatively healthy work environment is considered somewhat satisfactory, providing some wellness programs.

(c) Purchasing & Funding:

It should boost sustainable investment, sustainable procurement, and university budget for sustainability efforts, electronics purchasing, office paper purchasing, cleaning and janitorial purchasing, and food and beverage purchasing, all of which follow established rules that encourage the purchase of recycled materials and prioritize markets that use clean energy; additionally, it should use all advanced products, such as compact and smart litter boxes, to improve sustainability.

Third: For the campus Operations: The study concluded the following:

(a) Energy & Climate Change:

It should boost energy-efficient appliance usage, smart building implementation, use of vegetation to minimize building energy use, clean and renewable energy sources on the campus, and renewable energy production. Furthermore, it must provide a greenhouse gas emission reduction program, measure the total carbon footprint on campus, innovative energy and climate change programs, and impactful university programs on climate change. All of these that can be implemented by solar cells should be installed on all roofs, lampposts, shaded benches, and roofs planted under them that provide shade to plants and reduce energy consumption. Moreover, HVAC outside units must be covered. Implementing a plan to rationalize energy consumption efficiently is also necessary, which has been launched by the university. Also, by installing energy-efficiency appliances and smart water devices, a platform can be created to monitor energy and water consumption on campus.

(b) Water:

It should boost rainwater management, water-efficient appliance usage, treatment, and consumption of treated water, reduce outdoor water use, water conservation, and recycling program implementation, and boost water pollution control in the campus area. Furthermore, water conservation measures include using rainwater systems, green roofs, trees that do not need large amounts of water, drip irrigation, and modern irrigation methods. As the water shortage problem increases, a black & grey water and wastewater treatment plant should be established. It should promote sustainability through media, workshops, integration of curricula, etc.

(c) Waste:

It must boost construction and demolition waste diversion and recycling programs for the university's waste, and program to reduce the use of paper and plastic on campus, waste minimization and diversion, organic waste and inorganic waste treatment, hazardous waste management, and treatment of sewerage disposal. So, it should use organic elements, organic fertilizers, non-use of inorganic and toxic chemicals, support and increase environmentally preferable markets in Egypt, and monitor through government agencies. Garbage separation bins should be provided throughout the university campus and encourage the reduction and recycling of waste by holding competitions and workshops and explaining the reasons and benefits of doing so.

(d) Transportation:

It should be decreased the number of vehicles (cars and motorcycles), the shuttle service (Taftaf) must be activated inside the campus, and the switch from conventional to electric should be insisted. Boost support for sustainable transportation & Zero Emission Vehicles (ZEV) policy on campus, cycling paths on campus, and increase awareness of the importance of cycling. It must enhance pedestrian paths on campus, and walking can also be encouraged by providing services such as drinking fountains, emergency

call boxes, and garbage separation bins, besides cycling as a culture, which is almost absent despite its requirements being available on the campus. Moreover, it must launch initiatives to decrease private vehicles on campus and programs to limit or decrease the parking area; some campuses have parking problems due to insufficient parking lots and a lack of shading. It comes in slight overlapping between vehicles and their circulations. Generally, walking, cycling, and public transportation reduce the carbon footprint, thus boosting environmental, social, and economic benefits, as a suitable approach to sustainability.

Fourth: For the campus Education & Research:

It provides academic sustainability courses, campus as a living laboratory, staff professional development and training, and learning outcomes, it has a website, but it needs to customize a website on sustainability and provides sustainability reports and events related to sustainability. Also, it has scholarly publications on sustainability and open access to research. It must boost sustainability literacy assessment, student organizations related to sustainability, developing courses, and promoting sustainability awareness and education where public awareness of sustainability issues is limited, and training courses and workshops are needed to increase awareness.

The results show that operations are average in terms of implementation, and campus sustainability is still not considered the main issue.

Fifth: For campus Innovation:

The study did not assess it. It would be added as a bonus if the university did something more than what was mentioned in the framework. However, the university encourages innovation and creativity in all fields.

Campus sustainability future research needs to address several areas. This includes expanding and documenting alternative and renewable energy and non-traditional water resources such as grey and black water treatment and rainwater harvesting. In addition, research needs to focus on recycling and reusing materials. It is also crucial to develop methods for measuring the carbon footprint of university campuses and establish sustainability assessment systems based on similar international rating systems. This study thus presents a proposed framework that aids in assessing the sustainability of the university campus within the Egyptian context, with a local perspective. It also serves as a customizable tool for the development of an Egyptian university campus evaluation system, which can be applied beyond the Egyptian context. This framework opens diverse prospects for future research at various levels within this context.

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Conflicts of Interest

The authors declare no conflict of interest.

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