Article

Developing a Novel Index for Assessing and Managing the Contribution of Sustainable Campuses to Achieve UN SDGs

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Abstract: Sustainable campuses have a substantial role to play in achieving the Sustainable Development Goals (SDGs). Worldwide, there are many rating schemes to assess universities' sustainability; UI GreenMetric is one of the most common global rating schemes aimed at encouraging green campuses and university sustainability worldwide. However, none of the existing rating schemes quantitatively measure the contributions of the implementation of its assessment indicators to achieve SDGs. There is a shortage of information on how sustainable campuses contribute to achieving SDGs. Thus, this research aimed to develop a novel index to assess and manage the contributions of sustainable campuses certified by UI GreenMetric to achieve SDGs. This article proposes novel indices, the GreenMetric Indicator Contribution Index (GMICI) and the GreenMetric Sustainable Campus Index (GMSCI), to evaluate the contributions of implementing UI GreenMetric indicators for achieving the SDGs. By implementing questionnaire surveys, we collected the relevant data. Structured questionnaire surveys yielded 35 responses from experts. The contributions of UI GreenMetric indicators to achieving SDGs were evaluated using the Relative Importance Index (RII). The results indicated an important relationship between the GreenMetric indicator and SDGs 3, 4, 6, 7, 8, 9, 11, 12, 13 and 15. This research concludes that the proposed GMICI and GMSCI are a rigorous means for evaluating the contribution of UI GreenMetric indicators to UN-SDGs' achievement.

Keywords: sustainable campus; UI GreenMetric; United Nations; Sustainable Development Goals; index

Citation: Alawneh, R.; Jannoud, I.; Rabayah, H.; Ali, H. Developing a Novel Index for Assessing and Managing the Contribution of Sustainable Campuses to Achieve UN SDGs. *Sustainability* **2021**, *13*, 11770. <https://doi.org/10.3390/su132111770>

Academic Editor: Eila Jeronen

Received: 26 August 2021

Accepted: 15 October 2021

Published: 25 October 2021

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1. Introduction

The Sustainable Development Goals (SDGs) were adopted by all the United Nations (UN) Member States in 2015 as an international call for action to alleviate hunger, protect the environment, and ensure that all citizens can achieve stability and prosperity by 2030 [1–3]. The 17 Sustainable Development Goals are interconnected; they agree that decisions made in one field have an impact on results in others, and that development must find the right balance between social, economic, and environmental sustainability. The success of the SDGs requires the engagement of states, the business sector, and public society and individuals alike to ensure that a healthier world is left to future generations [1–4].

There is a dual need to recognize sustainability in universities [5]. Firstly, universities can be regarded as “small cities” because of their operations; the transportation of people and goods inside can have significant environmental impacts. In terms of waste production, transport, use of water and materials, and energy and electricity use, universities can be seen as complex buildings, due to the scientific, social, and educational activities occurring inside their borders [6]. From this point of view, campuses' externalities on environmental protection and dignity should no longer be neglected [7,8]. Secondly, with a view of the move toward sustainability, universities play a crucial role in society, creating new generations and training professionals [9].

Thus far, the literature has documented numerous methods in which universities have incorporated sustainability into various dimensions of their operations. The institutional framework, campus operations, teaching, research, community involvement, and accountability and reporting are examples of such dimensions. From a theoretical standpoint, scholars have stated that when a university implements sustainability across all of these aspects, it may be called “sustainable” or, in a similar sense, “green” [10,11].

Sustainable campus activities necessitate the implementation of practices that promote energy conservation and sustainable power production; sustainable transportation, such as encouraging the usage of bicycles, carpooling, and public transit; waste management; sustainable building construction and adaptation; water supply management; and health and safety [12–18]. Higher education institutions serve as relevant higher education living laboratories by generating shared knowledge; integrating society and campus stakeholders; and addressing local and global social, economic, and environmental issues through the implementation of sustainable practices and the creation of cooperative environments; outreach programs; and water, electricity, and productive food campuses [19].

Numerous universities in developed countries have become mindful of this environmental problem and have gained importance in introducing and enforcing strategies for green and sustainable campuses [20]. However, the largest number of universities participating in all fields of sustainability are in the United States of America and the United Kingdom [20].

University campuses should serve as test beds for comprehensive approaches toward (re)design, landscape regeneration, citizen engagement, and governance, as well as offering valuable lessons and expertise for broader initiatives. Transforming university campuses into sustainable organizations, as opposed to simply organizations with sustainability programs, provides programmatic models and strategies that can be tailored to the much more nuanced and challenging project of urban sustainability [21]. For more than two decades, universities have indeed been increasingly regarded as major contributors to national sustainability initiatives. Due to the multifaceted existence of sustainable development (SD), universities have been designated as vital collaborators in all related efforts, often in close cooperation with other key communities [22]. Universities have a significant impact on society in two ways: they prepare and teach people and they engage in national and regional government [23]. Universities must help in addressing the major challenges of the 21st century, such as increased environmental and socioeconomic pressures, unequal wages in nations, and global uncertainty. To do so, they should incorporate the idea of sustainable growth into future organizations, science, and education by preparing experts with the expertise, competencies, and skills needed to address ecological, social, and economic challenges in society as a whole [24]. A sustainable university has been described as an educational organization that is concerned with the minimizing of the adverse environmental, societal, and health impacts of resources to fulfill its research, outreach, and citizenship function, as well as addressing any socioeconomic and community problems that arise on a global level.

Numerous assessments of campus sustainability have been developed on national and international levels around the world over the last decade in order to evaluate and recognize universities that have made strong contributions to sustainability efforts [25].

Universities as a whole, and university personnel in particular, should strive to maximize the many benefits offered by the SDGs, not just in terms of teaching and research, but also in terms of outreach programs and serve as advocates for public support for the SDGs [26]. There is still a significant gap in the specificity of worldwide university sustainability rankings that needs to be addressed [27].

A literature review revealed that there are currently few standards or frameworks for consistently integrating the SDGs into university programs. Therefore, a framework is needed to facilitate a more comprehensive integration of the SDGs into university programs [28]. There is a recognized need to create frameworks, methods, and tools that can assist higher education institutions in consistently incorporating the Sustainable

Development Goals (SDGs) into their research and teaching as a core component of their programs. Today, however, research is lacking on the most efficient methods for this purpose [28].

The association between existing sustainable campuses assessment indicators and UN SDGs is currently not explained in terms of evaluating sustainable campuses. Study on this subject is lacking. Furthermore, the contribution of sustainable campuses to achieving the UN SDGs is not previously quantitatively measured. This research used the UI GreenMetric World University Rankings [29], which have been the subject of numerous studies. Hence, the aim of this research was to develop a new index for assessing and managing the contributions of sustainable campuses certified by UI GreenMetric to achieve UN SDGs.

The main objectives were as follows:

1. Identifying the relationship between the UI GreenMetric assessment indicator and UN SDGs.
2. Developing a new index for evaluating and managing the contributions of UI GreenMetric-certified sustainable campuses to achieving the UN SDGs.

Section 2 follows this introduction and reviews the relevant literature related to the relationship between UI GreenMetric assessment indicators and UN SDGs. Section 3 outlines the methods used in this research. The findings and discussion are presented in Sections 4 and 5, respectively. Finally, Section 6 provides the conclusion.

2. Literature Review (UI GreenMetric and Sustainable Development Goals)

The UI GreenMetric World University Rankings were created in 2010 as a tool to assist the development of green universities [25]. The UI GreenMetric is a rating that shows how universities rank in terms of sustainability [30].

Since its establishment, the UI GreenMetric rating has been generally recognized as the first of its type, addressing sustainability problems on university campuses [31].

The UI GreenMetric ranking is focused on quantitative criteria rather than country-specific sustainability report methods. Furthermore, it reports sustainability metrics on the basis of a predefined set of criteria. This enables the comparison of university results (as communicated through self-completion questionnaires and the retrieval of public data display) in the same ranking [32].

Table 1 shows UI GreenMetric as categories and indicators. The rankings evaluate universities according to six categories: “university landscape (setting and infrastructure)”, “electricity consumption (energy and climate change)”, “waste management”, “water preservation”, “green transportation for the public”, and “education and research related to sustainability” [33].

The UI GreenMetric has been recognized internationally as being an easy and usable sustainability rating that serves as a reference and guide, especially in helping universities create sustainable universities and sustainable futures in developed and developing countries [25]. Among the various sustainability measures, the literature review highlights GreenMetric as one of the most powerful tools for evaluating sustainability [34]. However, universities may only strive for success on the basis of ranking indicators. Nonetheless, they should strive for broader goals such as the SDGs, since there is a strong interconnection between the GreenMetric methodology and UN SDGs [31]. Table 2 shows the UN SDGs.

According to Suwartha and Berawi [33], most of the SDGs shown in Table 2 are relevant to the GreenMetric categories, such as SDG3, 12, and 14 for the waste management category; SDG4 for the education and research category; SDG9 and 11 for the setting and infrastructure category; SDG6 for the water preservation category; SDG7, 12, and 13 for the energy and climate change category; and SDG13 and 15 for the green transportation category [33].

Table 1. UI GreenMetric categories and indicators.

The UI GreenMetric World University Rankings		
Category	Indicator	
Setting and infrastructure (SI)	SI.1	The ratio of open space area towards total area
	SI.2	Area on campus covered in forest
	SI.3	Area on campus covered in planted vegetation
	SI.4	Area on campus for water absorbance
	SI.5	The ratio of open space area divided campus population
	SI.6	University budget for sustainability effort
Energy and climate change (EC)	EC.1	Energy efficient appliances usage
	EC.2	Smart building program implementation
	EC.3	Number of renewable energy source in campus
	EC.4	The total electricity usage divided by total campus population
	EC.5	The ratio of renewable energy production towards total energy usage per year
	EC.6	Element of green building implementation
	EC.7	Greenhouse gas emission reduction program
	EC.8	The ratio of total carbon footprint divided campus population
Waste (WS)	WS.1	Recycling program for university waste
	WS.2	Program to reduce the use of paper and plastic in campus
	WS.3	Organic waste treatment
	WS.4	Inorganic waste treatment
	WS.5	Toxic waste treatment
	WS.6	Sewerage disposal
Water (WR)	WR.1	Water conservation program
	WR.2	Water recycling program
	WR.3	The use of water efficient appliances
	WR.4	Piped water consumed
Transportation (TR)	TR.1	The ratio of total vehicles (cars and motorcycles) divided by total campus population
	TR.2	Shuttle services
	TR.3	Zero emission vehicles (ZEV) policy on campus 200 200 200
	TR.4	TR 6 transportation program designed to limit or decrease the ratio of zero emission vehicles (ZEV) divided by total campus population
	TR.5	Ratio of parking area to total campus area
	TR.6	Transportation program designed to limit or decrease the parking area on campus for the last 3 years
	TR.7	Number of transportation initiatives to decrease private vehicles on campus
	TR.8	Pedestrian policy on campus
Education (ED)	ED.1	The ratio of sustainability courses towards total courses/subjects
	ED.2	The ratio of sustainability research funding towards total research funding
	ED.3	Sustainability publications
	ED.4	Sustainability events
	ED.5	Sustainability student organizations
	ED.6	Sustainability website
	ED.7	Sustainability report

Table 2. United Nations Sustainable Development Goals.

Sustainable Development Goals	
SDG #1	End poverty in all its forms everywhere.
SDG #2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
SDG #3	Ensure healthy lives and promote well-being for all at all ages.
SDG #4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG #5	Achieve gender equality and empower all women and girls.
SDG #6	Ensure availability and sustainable management of water and sanitation for all.
SDG #7	Ensure access to affordable, reliable, sustainable, and modern energy for all.
SDG #8	Promote sustained, inclusive, and sustainable economic growth; full and productive employment; and decent work for all.
SDG #9	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
SDG #10	Reduce inequality within and among countries.
SDG #11	Make cities and human settlements inclusive, safe, resilient, and sustainable.
SDG #12	Ensure sustainable consumption and production patterns.
SDG #13	Take urgent action to combat climate change and its impacts.
SDG #14	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
SDG #15	Protect, restore, and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; and halt and reverse land degradation as well as biodiversity loss.
SDG #16	Promote peaceful and inclusive societies for sustainable development; provide access to justice for all; and build effective, accountable, and inclusive institutions at all levels.
SDG #17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Similarly, Hamzah et al. [35] affirmed that the UI GreenMetric system's categories are closely matched with the UN SDGs. These matches include the following: (1) the setting and infrastructure (SI) category, which is related to SDG9 and SDG11; (2) the energy and climate change (EC) category, which is related to SDG7 and SDG13; (3) the waste (WS) category, which is related to SDG3 and SDG14; (4) the water (WR) category, which is related to SDG6; (5) the transportation (TR) category, which is related to SDG13 and SDG15; and (6) the education (ED) category, which is related to SDG4 [35].

Higher education institutions (HEIs) have been urged to combine the pursuit of sustainability with a commitment to the SDGs. This dedication must be present at the strategic level of planning and then be put into action in order for their efforts to be more effective. Despite the significance of the subject, there is a scarcity of research on the SDGs at the strategic level of universities [36].

On the basis of the literature review, this study tested the following main hypothesis: there is a significant relationship between the UN SDGs and UI GreenMetric assessment indicators.

3. Methods

The purpose of this study was to determine whether there is a relationship between the UI GreenMetric assessment indicators and the UN Sustainable Development Goals and to develop a novel index for assessing and managing the contributions of UI GreenMetric-

certified sustainable campuses to the UN SDGs. Therefore, the research methodology included developing the main hypothesis on the basis of the review of relevant literature, as mentioned in Section 2. Then, we collected data about UI GreenMetric assessment indicators and case study. A questionnaire was developed and delivered to the intended audience. A survey was used to collect data, then evaluated using frequencies, means, statistics, *p*-values, and the Relative Importance Index (RII). Contribution indices were constructed. The contribution indices were used to evaluate the contributions of Al Zaytoonah University of Jordan's UI GreenMetric-certified sustainable campus to achieving the UN SDGs.

3.1. Data Collection

Data concerning UI GreenMetric indicators and concerning the case study, Al Zaytoonah University of Jordan (ZUJ), were obtained from the UI GreenMetric website and Al Zaytoonah University of Jordan presidency office. The main tool for data collection was a questionnaire survey. Thus, a structured questionnaire was developed and tested by conducting a pilot study. This survey questionnaire consisted of two sections; the first section obtained demographic data from experts. This study applied the Relative Importance Index (RII) method for weighting UI GreenMetric assessment indicators on the basis of its contributions to achieving UN SDGs; therefore, in the second section of the questionnaire, experts were asked to evaluate each assessment indicator of UI GreenMetric according to their contributions to achieve UN SDGs on the basis of a 5-point Likert scale (varying from 1: very low important contribution, to 5: very important contributions). On the other hand, in the second part of the questionnaire, experts were asked to answer general questions about the contributions of each indicator of 39 UI GreenMetric indicators to the general achievement of each SDG (targets of SDG).

Structured questionnaire surveys were distributed to 65 Jordanian experts (academics, consultants, non-governmental organizations (NGOs), and government officials), and 35 participants (55 percent) completed the survey. On the basis of the central limit theorem, with a sample size above 30, a statistical analysis can be conducted; therefore, 35 respondents/participants were adequate.

In this research, 46% of the respondents were from universities, 23% were from consultant companies, 17% were from government authorities, and 14% were from non-governmental organizations (NGOs). The respondents had different designations, such as the assistant professor, associate professor, senior engineer, project manager, technical advisor, head of a department, and manager or director. Notably, 83% of respondents had more than five years of experience, and 57% had a Ph.D. or master's degree.

3.2. Data Analysis

Prior to analysis, data were categorized and tabulated. The RII method was used to assess the GreenMetric indicators according to their contributions to the SDGs. For this purpose, a Likert scale (5-point) ranging from 1 to 5 was used to assess the significance of implementing GreenMetric indicators to the achievement of SDGs.

We concluded an important association between the UI GreenMetric indicators and the SDGs if the mean of responses was more than 3 (small *p*-value < 0.05). RII was considered only when a significant relationship existed between the UI GreenMetric indicators and UN SDGs. RII was calculated using the following equation for each UI GreenMetric assessment indicator. For all the RII values of each evaluation indicator, the geometric mean was determined. A higher RII value suggests a substantial contribution to SDGs.

$$RII = \frac{\sum_{i=1}^N W_i}{(A * N)} \quad (1)$$

where *W* = weight of UI GreenMetric indicator contribution for each SDG, *A* = the maximum weight (5) in this study, and *N* = total number of participants.

3.3. Developing Sustainable Campus Index

The composite index is a mathematical tool that combines indicators; an index is widely recognized in policy analysis and public communications as a viable method of measuring performance [37]. The creation of indices in this study uses data gathered from the survey about Jordanian experts' opinion on the contributions to the achievement of the SDGs by implementing UI GreenMetric assessment indicators. As stated in the previous section, if the average response value was above 3 (small p -value < 0.05), it was hypothesized that a meaningful relationship existed between UI GreenMetric indicators and SDGs, and consequently, the RII for UI GreenMetric indicators was computed.

$$GMICI_{UGMI_i} = \% \text{ of Achievement} * \text{Geometric mean} \left(RII_{UGMI_i \& SDG_j} \right) * (NSDGs/17) * 100 \% \quad (2)$$

This research proposes the following indices:

The UI GreenMetric Indicator Contributions Index (GMICI) is a metric that sums up the percentage contribution to each UI GreenMetric Indicator (UGMI = SI.1, SI.2, SI.3, SI.4, SI.5, SI.6, EC.1, EC.2, EC.3, EC.4, EC.5, EC.6, EC.7, EC.8, WS.1, WS.2, WS.3, WS.4, WS.5, WS.6, WR.1, WR.2, WR.3, WR.4, TR.1, TR.2, TR.3, TR.4, TR.5, TR.6, TR.7, TR.8, ED.1, ED.2, ED.3, ED.4, ED.5, ED.6, ED.7) to the achievement of SDGs (SDGj:SDG1–17). For each UI GreenMetric indicator, the geometric mean of all RII values is multiplied by NSDGs (no. of SDGs that the UI GreenMetric indicator significantly contributes to achieving divided by 17). Tables 1 and 2 show the UI GreenMetric indicators and the UN SDGs.

GMICI_{UGMI_i}: GreenMetric Indicator Contributions Index.

UGMI_i: UI GreenMetric indicator.

NSDGs: No. of SDGs that the UI GreenMetric indicator significantly contributes to achieving.

RII: Relative Importance Index for each UI GreenMetric indicator.

The UI GreenMetric Sustainable Campus Index (GMSCI) is a measure that represents the total contribution of all UI GreenMetric indicators to achieve the UN SDGs. The summation of all GMICI values for each UI GreenMetric indicators is used to calculate the GMSCI.

$$GMSCI = \sum GMICI_{UGMI_i} \quad (3)$$

3.4. Application of Sustainable Campus Contribution Index

Al Zaytoonah University of Jordan' campus was chosen as a case study to examine the usefulness of the proposed GMSCI for evaluating the contributions of UI GreenMetric-certified campuses to achieving UN SDGs. Al-Zaytoonah University of Jordan is a private higher education institution located in the capital city of Amman. Al-Zaytoonah University of Jordan (ZUJ) offers courses and programs leading to formally approved degrees, such as bachelor's degrees, in a number of fields of study. Additionally, ZUJ provides students with a range of academic and non-academic opportunities and activities, including a library, sports facilities, and administrative services.

Al Zaytoonah University of Jordan was selected as a case study to test the usability of the proposed index because its campus has been a UI GreenMetric-certified sustainable campus since 2018. Additionally, its vision "Towards a competitive university in the labor market, research and sustainable environment" was an influential factor, and the first part of Al Zaytoonah University of Jordan's mission is "An active contribution in the sustainable development of the society ...". Moreover, one of its critical strategic objectives is the raising of its rank in the UI GreenMetric rankings.

4. Results

4.1. Relationship between UI GreenMetric and UN SDGs

On the basis of the expert rating of the contributions of UI GreenMetric indicators to achieving UN SDGs, we determined the weight values of each UI GreenMetric indicator according to its contributions to achieving UN SDGs by RII values, which were calculated only if the mean of responses was substantially more significant than 3 and the p -value was

less than 0.05. Table 3 shows the contributions of each UI GreenMetric indicator according to the RII values. Relevant proof of the relationships between UI GreenMetric indicators and SDG3–4, SDG6–9, SDG11–13, and SDG15 is shown by the RII values in Table 3. These results reinforce previous statements in the literature that there is a relationship between GreenMetric indicators and many of the UN SDGs [33–37].

Table 3. Relative Importance Index of UI GreenMetric assessment indicators.

Contributions of Sustainable Campus (UI GreenMetric-Certified Campus) to Achieve UN Sustainable Development Goals											
Category	Indicator	Relative Importance Index									
		SDG3	SDG4	SDG6	SDG7	SDG8	SDG9	SDG11	SDG12	SDG13	SDG15
Setting and infrastructure (SI)	SI.1							0.87			
	SI.2							0.83			
	SI.3							0.87			
	SI.4							0.85			
	SI.5							0.88			
	SI.6						0.91				
Energy and climate change (EC)	EC.1				0.91	0.71			0.89	0.86	
	EC.2				0.93	0.72			0.83	0.84	
	EC.3				0.96	0.75			0.92	0.89	
	EC.4				0.94	0.74			0.90	0.85	
	EC.5				0.97	0.77			0.95	0.91	
	EC.6				0.94	0.78			0.86	0.87	
	EC.7									0.91	
	EC.8									0.90	
Waste (WS)	WS.1								0.90		
	WS.2								0.88		
	WS.3	0.77									
	WS.4	0.79									
	WS.5	0.91									
	WS.6	0.93									
Water (WR)	WR.1			0.97							
	WR.2			0.93							
	WR.3			0.93							
	WR.4			0.85							
Transportation (TR)	TR.1									0.85	
	TR.2									0.91	
	TR.3									0.94	
	TR.4									0.93	
	TR.5									0.67	0.67
	TR.6									0.79	0.77
	TR.7									0.90	0.73
	TR.8									0.70	
Education (ED)	ED.1		0.83								
	ED.2		0.94								
	ED.3		0.91								
	ED.4		0.91								
	ED.5		0.90								
	ED.6		0.89								
	ED.7		0.85								

Table 3 shows that assessment indicators related to the setting and infrastructure (SI) category contribute significantly to achieving SDG9 and SDG11; the assessment indicators related to the energy and climate change (EC) category contribute significantly to achieving SDG7–8 and SDG12–13; the assessment indicators related to the waste (WS) category contribute significantly to achieving SDG3, SDG12, and SD13; the assessment indicators related to the water (WR) category contribute significantly to achieving SDG6; the assessment

indicators related to the transportation (TR) category contribute significantly to achieving SDG13 and SDG15; and the assessment indicators related to the education (ED) category contribute significantly to achieving SDG4.

4.2. Sustainable Campus Index

The UI GreenMetric Indicator Contributions Index (GMICI) of each indicator and the UI GreenMetric Sustainable Campus Index (GMSCI), which represents the total contribution of all UI GreenMetric Indicators to achieving the UN SDGs, were calculated on the basis of the equations suggested in Section 3.3.

Table 4 shows the UI GreenMetric Indicator Contributions Index (GMICI) of each indicator. On the basis of the GMICI suggested in Section 3.3, we ranked UI GreenMetric indicators as follows:

Table 4. Sustainable Campus Index for assessing and managing the contributions of sustainable UI GreenMetric-certified campus to achieve UN SDGs.

Contributions of Sustainable UI GreenMetric-Certified Campus to Achieve UN Sustainable Development Goals															
Category	Indicator	Achieved (%)	Relative Importance Index											GMICI	GMSCI
			SDG3	SDG4	SDG6	SDG7	SDG8	SDG9	SDG11	SDG12	SDG13	SDG15	All SDG		
Setting and infrastructure (SI)	SI.1	100							0.87				0.87	5.14	
	SI.2	100							0.83				0.83	4.87	
	SI.3	100							0.87				0.87	5.11	
	SI.4	100							0.85				0.85	4.97	
	SI.5	100							0.88				0.88	5.18	
	SI.6	100						0.91					0.91	5.38	
Energy and climate change (EC)	EC.1	100				0.91	0.71			0.89	0.86		0.84	19.78	
	EC.2	100				0.93	0.72			0.83	0.84		0.83	19.48	
	EC.3	100				0.96	0.75			0.92	0.89		0.88	20.62	
	EC.4	100				0.94	0.74			0.90	0.85		0.85	20.05	
	EC.5	100				0.97	0.77			0.95	0.91		0.90	21.09	
	EC.6	100				0.94	0.78			0.86	0.87		0.86	20.29	
	EC.7	100									0.91		0.91	5.38	
	EC.8	100									0.90		0.90	5.31	
Waste (WS)	WS.1	100								0.90			0.90	5.31	
	WS.2	100								0.88			0.88	5.18	
	WS.3	100	0.77										0.77	4.50	
	WS.4	100	0.79										0.79	4.64	
	WS.5	100	0.91										0.91	5.34	
	WS.6	100	0.93										0.93	5.48	
Water (WR)	WR.1	100			0.97								0.97	5.68	
	WR.2	100			0.93								0.93	5.48	
	WR.3	100			0.93								0.93	5.45	
	WR.4	100			0.85								0.85	5.01	
Transportation (TR)	TR.1	100									0.85		0.85	4.97	
	TR.2	100									0.91		0.91	5.38	
	TR.3	100									0.94		0.94	5.55	
	TR.4	100									0.93		0.93	5.45	
	TR.5	100									0.67	0.67	0.67	7.87	
	TR.6	100									0.79	0.77	0.78	9.14	
	TR.7	100									0.90	0.73	0.81	9.56	
	TR.8	100									0.70		0.70	4.10	
Education (ED)	ED.1	100		0.83									0.83	4.91	
	ED.2	100		0.94									0.94	5.51	
	ED.3	100		0.91									0.91	5.38	
	ED.4	100		0.91									0.91	5.34	
	ED.5	100		0.90									0.90	5.31	
	ED.6	100		0.89									0.89	5.24	
	ED1	100		0.85									0.85	4.91	

EC 5 (21.09), EC 3 (20.62), EC 6 (20.29%), EC 4 (20.05%), EC 1 (19.78%), EC 2 (19.48%), TR 7 (9.56%), TR 6 (9.14%), TR 5 (7.78%), WR 1 (5.68%), TR 3 (5.55%), ED 2 (5.51%), WS 6 (5.48%), WR 2 (5.48%), WR 3 (5.45%), TR 4 (5.45%), SI 6 (5.38%), EC 7 (5.38%), TR 2 (5.38%), ED 3 (5.38%), WS 5 (5.34%), ED 4 (5.34%), EC 8 (5.31%), WS 1 (5.31%), ED 5 (5.31%), ED 6 (5.24%), SI 5 (5.18%), WS 2 (5.18%), SI 1 (5.14%), SI 3 (5.11%), WR 4 (5.01%), SI 4 (4.97%), TR 1 (4.97%), ED 7 (4.97%), ED 1 (4.91%), SI 2 (4.87%), WS 4 (4.64%), WS 3 (4.50%), TR 8 (4.10%).

Notably, “EC5: the ratio of renewable energy production towards total energy usage per year” has the greatest contribution indices. The value of the UI GreenMetric Sustainable Campus Index (GMSCI) was 303.41, as shown in Table 4.

4.3. Case Study: Contribution of Sustainable UI GreenMetric-Certified Campus to Achieve SDGs

The contribution of the actual UI GreenMetric-certified sustainable campus to achieving the UN SDGs was assessed using the proposed the UI GreenMetric Indicator Contributions Index (GMICI) of each indicator and the UI GreenMetric Sustainable Campus Index (GMSCI), which represents the total contribution of all UI GreenMetric indicators to achieve the UN SDGs. Al Zaytoonah University of Jordan (ZUJ) was chosen as a case study to assess the usefulness of the Sustainable Campus Index (GMSCI). The efforts of ZUJ to achieve UN SDGs were evaluated on the basis of its achievement of UI GreenMetric indicators.

Table 5 shows that the contribution of implementing UI GreenMetric indicators at ZUJ can be ranked as follows:

Table 5. Contributions of Al Zaytoonah University of Jordan sustainable campus (UI GreenMetric-certified campus) to achieving the UN Sustainable Development Goals.

Contributions of Sustainable UI GreenMetric-Certified Campus to Achieving UN Sustainable Development Goals															
Category	Indicator	Achieved (%)	Relative Importance Index											GMICI	GMSCI
			SDG3	SDG4	SDG6	SDG7	SDG8	SDG9	SDG11	SDG12	SDG13	SDG15	All SDG		
Setting and infrastructure (SI)	SI.1	50							0.87				0.87	2.57	
	SI.2	50							0.83				0.83	2.44	
	SI.3	75							0.87				0.87	3.83	
	SI.4	100							0.85				0.85	4.97	
	SI.5	75							0.88				0.88	3.88	
	SI.6	50						0.91					0.91	2.69	
Energy and climate change (EC)	EC.1	50				0.91	0.71			0.89	0.86		0.84	9.89	
	EC.2	50				0.93	0.72			0.83	0.84		0.83	9.74	
	EC.3	75				0.96	0.75			0.92	0.89		0.88	15.47	
	EC.4	100				0.94	0.74			0.90	0.85		0.85	20.05	
	EC.5	50				0.97	0.77			0.95	0.91		0.90	10.54	
	EC.6	100				0.94	0.78			0.86	0.87		0.86	20.29	
	EC.7	75									0.91		0.91	4.03	
	EC.8	75									0.90		0.90	3.98	
Waste (WS)	WS.1	50								0.90			0.90	2.66	
	WS.2	75								0.88			0.88	3.88	
	WS.3	75	0.77										0.77	3.38	
	WS.4	25	0.79										0.79	1.16	
	WS.5	75	0.91										0.91	4.01	
	WS.6	50	0.93										0.93	2.74	
Water (WR)	WR.1	50			0.97								0.97	2.84	
	WR.2	75			0.93								0.93	4.11	
	WR.3	75			0.93								0.93	4.08	
	WR.4	100			0.85								0.85	5.01	
Transportation (TR)	TR.1	75									0.85		0.85	3.73	
	TR.2	50									0.91		0.91	2.69	
	TR.3	50									0.94		0.94	2.77	
	TR.4	75									0.93		0.93	4.08	
	TR.5	75									0.67	0.67	0.67	5.90	
	TR.6	50									0.79	0.77	0.78	4.57	
	TR.7	100									0.90	0.73	0.81	9.56	
	TR.8	75									0.70		0.70	3.08	
Education (ED)	ED.1	25		0.83									0.83	1.23	
	ED.2	75		0.94									0.94	4.13	
	ED.3	75		0.91									0.91	4.03	
	ED.4	75		0.91									0.91	4.01	
	ED.5	100		0.90									0.90	5.31	
	ED.6	25		0.89									0.89	1.31	
	ED.7	25		0.85									0.85	1.24	

ZUJ-EC 6 (20.29%), ZUJ-EC 4 (20.05%), ZUJ-EC 3 (15.47%), ZUJ-EC 5 (10.54%), ZUJ-EC (9.89%), ZUJ-EC 2 (9.74%), ZUJ-TR 7 (9.56%), ZUJ-TR 5 (5.90%), ZUJ-ED 5 (5.31%), ZUJ-WR 4 (5.01), ZUJ-SI 4 (4.97), ZUJ-TR 6 (4.57), ZUJ-ED 2 (4.13%), ZUJ-WR 2 (4.11%), ZUJ-WR 3 (4.08%), ZUJ-TR 4 (4.08%), ZUJ-EC 7 (4.03%), ZUJ-ED 3 (4.03%), ZUJ-WS 5 (4.01%), ZUJ-ED

4 (4.01%), ZUJ-EC 8 (3.98%), ZUJ-SI 5 (3.88%), ZUJ-WS 2 (3.88%), ZUJ-SI 3 (3.83%), ZUJ-TR 1 (3.73%), ZUJ-WS 3 (3.38%), ZUJ-TR 8 (3.08%), ZUJ-WR 1 (2.84%), ZUJ-TR 3 (2.77%), ZUJ-WS 6 (2.74%), ZUJ-SI 6 (2.69%), ZUJ-TR 2 (2.69%), ZUJ-WS 1 (2.66%), ZUJ-SI 1 (2.57%), ZUJ-S 2 (2.44%), ZUJ-ED 6 (1.31%), ZUJ-ED 7 (1.24%), ZUJ-ED 1 (1.23%), ZUJ-WS 4 (1.16%).

ZUJ had a GMSCI of 205.91, as shown in Table 5. The UI GreenMetric Indicator Contributions Index (GMICI) of each indicator impacts the GMSCI value. One of the most remarkable findings was that by prioritizing the adoption of UI GreenMetric indicators with high GMICI values, ZUJ's contributions to achieving the UN SDGs were able to be increased.

5. Discussion

The results show that the implementation of indicators in UI GreenMetric contributed significantly to achieving the UN SDGs. Indicators from the setting and infrastructure category contributed significantly to SDG9 and SDG11. The campus's setting and infrastructure would explain the campus's proclivity for environmental sustainability. Indicators in the setting and infrastructure category will ultimately indicate whether or not a decent university-designated green campus exists. This category encourages participating universities to have more outdoor open spaces for environmental greening and sustainability.

The collection and disposal of waste is a critical component of achieving a healthy world. The actions of staff and students on campus will generate a significant amount of waste; as a result, recycling systems and waste control should be among the university's concerns, such as a recycling scheme, hazardous waste collection, organic waste sorting, inorganic waste storage, sewage disposal, and measures to limit the use of paper and plastic on campus. The implementation of indicators in the waste category contributes significantly to SDG9 and SDG11.

The university's commitment to topics relating to energy usage and climate change is evident in this being the most weighted metric. Several indicators of energy efficiency, such as the use of energy-saving tools, smart building adoption, policy relating to sustainable energy use, overall energy use, energy recycling initiatives, aspects of green building, climate change adaptation and mitigation, and greenhouse gas and carbon reduction strategies, contribute substantially to the achievement of SDGs 7–9 and 11–13. By implementing these indicators, universities are encouraged to maintain their efforts toward building energy efficiency and to be more mindful about the existence and source of energy.

Another important category in the UI GreenMetric system is water usage on campus. The goal is to inspire colleges and universities to limit their water use, develop recycling programs, and conserve wildlife. Amongst these indicators are water-saving initiatives, water recovery programs, water use reduction programs, and the use of treated sewage. The implementation of indicators in the water category contributes significantly to SDG6.

Transportation on campus has a significant impact on greenhouse emissions and pollution levels. The implementation of indicators in water category contribute significantly to SDG13 and SDG15. A more sustainable community would be encouraged by implementing transportation policies that restrict the number of cars on the road and encourage using campus buses and bicycles. Students and staff would be encouraged to stroll across campus instead of using private cars under the Pedestrian Plan. Carbon emissions on campus can be reduced by using ecologically responsible public transportation.

The implementation of indicators in the category of research and education contributes significantly to achieving SDG4. The category of research and education plays an integral part in the achievement of sustainable development. The sustainability curriculum provides a process of learning in which learners become conscious of sustainability and comprehend the idea of sustainable development.

The application of the Sustainable Campus Index (SCI) shows that the case study, Al Zaytoonah University of Jordan (ZUJ), contributes to the achievement of SDGs, as shown in Figure 1. ZUJ is nearly self-sufficient in terms of electricity and depends mostly on supplies of green energy to satisfy the need for ZUJ campus electricity. ZUJ con-

structured a photovoltaic solar panel system in 2016 at a cost of approximately USD 1,700,000, with an estimated payback period of approximately 26 months. It primarily generates solar energy (1754 kWh) and wind power (3 kWh) to sustain its yearly consumption (2.5×10^5 kWh/year). Solar panels are installed on the buildings on the ZUJ campus in the shape of a roof top. Furthermore, in all of its campus facilities, ZUJ uses energy-efficient heating, air conditioning, and LED lighting. Ultimately, ZUJ is in the phase of retrofitting its electrical machines and appliances with energy-saving features that will decrease overall power usage [38].

Figure 1. Contributions of Al Zaytoonah University of Jordan (UI GreenMetric-certified campus) to achieving the UN Sustainable Development Goals.

ZUJ obtains about 10% of its electricity using non-renewable sources. This equates to a net carbon footprint of roughly 150 metric tons per year, calculated at a rate of 0.018 metric tons per human per year [38].

ZUJ's water supplies come from artesian wells utilized exclusively for drinking water and treated wastewater for irrigation. Projects for rainwater collection are also underway. Prior to distribution, the water is checked and handled on a daily basis, and it is committed to irrigation and drinking water standards. ZUJ utilizes its own wastewater treatment plant that treats and redirects reclaimed water into ZUJ's irrigation system. Throughout ZUJ's campus, economic water control devices are used, for example using water-conserving toilets and drip irrigation. Information from ZUJ financial department on the gross annual spending on water since 1997 was compiled and outlined in. The number of expenditures on water in 1997 was significant because ZUJ relied on water outsourcing (USD 1.4/m³). ZUJ has begun to rely on water provided by artesian wells at a cost of JOD 0.25/m³ since 1998. The cost of water from artesian sources rose to JOD 0.5/m³ after 2014. Plants requiring less water were cultivated for the landscape area on ZUJ's campus. In general,

there are nearly 1660 trees on the ZUJ campus, as well as a 5200 square meter green area with a natural grass stadium. Olive trees make up a large portion of the trees on the ZUJ campus, since they have a limited water consumption rate, and the extraction of olive oil has a high economic benefit. The amount of recycled water used on ZUJ campus averages approximately 120 cubic meters per week [38].

Introductory partial waste sorting and recycling projects were initiated by ZUJ for reclaiming glass bottles, aluminum cans, and plastics. ZUJ is also interested in developing paper and plastic waste diversion systems on campus. Much internal documentation is completed online via soft record transmission and archiving throughout the campuses of academic and non-academic organizations. Moreover, organic waste from tree trimmings is stockpiled for future reuse. For this reason, the university is considering using a wood-chipper. Inorganic waste, including hazardous medical waste produced by the pharmacy and nursing schools, is currently treated, and is disposed of off campus by a professional specialist contractor [38].

ZUJ runs a commuter bus service to the nearby residential suburbs to transport students to campus. ZUJ's campus is non-residential; therefore, students take advantage of the university's twice-daily bus service. These buses are mostly fueled by diesel and are maintained properly and inspected for emissions as per the regulations of the local traffic authority. The number of vehicles accessing ZUJ's campus per working day varies from 500 to 600. The ZUJ car ratio is around 0.075 cars per person each day. On campus, zero-emission vehicles (ZEV) are uncommon, and workers will require an administrative incentive to expand their usage [38].

ZUJ expends almost 5% of its annual operating budget on financing research projects in a variety of scientific fields. Sustainability research is covered by the funding provided by ZUJ. The university devotes approximately 12 percent of its entire research budget allocation to sustainability research. The courses offered by the various disciplines of ZUJ cover sustainability very well. Furthermore, numerous articles on sustainability research themes have been written by faculty members. The university funds student initiatives aimed at increasing knowledge and education about sustainability. ZUJ is now in the phase of officially creating an executive body for sustainable growth to manage the implementation of sustainability targets in the ZUJ's strategic plan [38].

ZUJ has continued to successfully increase the standard of protection and safety at its campus over the last few years. It was very effective to add and upgrade surveillance cameras around campus to know the risks and take effective actions. In addition, to track and regulate who is accessing and leaving the university, the university applied electronic gateways. Installed card readers restricted access to approved persons only and offered valuable identifying information. During the past three years, the cases of ZUJ student abuse that occurred four years ago have almost vanished on the ZUJ campus [38].

Recently, ZUJ has made important achievements in sustainable development, with the goal of minimizing its running costs and reducing the detrimental impacts on the environment and humans by enhancing electricity, water, and wastewater facilities, which form a large part of the ZUJ operating costs. Therefore, via the construction of solar electricity panels and the implementation of LED lighting, ZUJ has made important contributions in the field of sustainable development. ZUJ applies the drip irrigation method and the disposal of wastewater for irrigation purposes, and moreover uses water-efficient appliances in the field of water and wastewater [38].

In 2020, ZUJ rose in the UI GreenMetric rankings to number 213 according to these enhancements. The ZUJ's UI GreenMetric score is being used as an external evaluation measure to determine the magnitude of the ZUJ's sustainability achievement [39].

6. Conclusions

Governments worldwide have adopted policies to achieve the UN SDGs, and sustainable university campuses can play a critical role in this effort. Currently, there is a dearth of research on this subject, and no current index explains the relationship between the eval-

uation metrics and the UN SDGs in a quantitative manner. Higher education institutions must gather additional data to decide which aspects can be prioritized to optimize the contribution of sustainable campuses to achieving the UN SDGs. Thus, this research aims to develop a novel index to assess and manage the contributions of sustainable campuses certified by UI GreenMetric to achieving the SDGs.

The findings of this study are expected to help us better understand the role of sustainable campuses in achieving the UN SDGs. These findings will add contributions to the body of knowledge and the practice in many ways.

To the best of the researchers' knowledge, the proposed indices in this study are new; as the first study of its kind in Jordan, the findings of this study will provide new insight into existing sustainable practice, which may serve as a guide for future studies. This study provides data on the current knowledge and literature on sustainable campuses and their contributions to the achievement of the UN SDGs. This research provides ideas and guidance that can assist higher education organizations in putting a greater emphasis on meeting the UN SDGs.

More significantly, the suggested indices for assessing and managing sustainable campuses will guide researchers and policymakers around the globe in creating new sustainable campus assessment methods or upgrading current sustainable campus assessment systems. The findings of this study can support the development of sustainable campus assessment tools and the improvement of the achievement of UN SDGs in countries. Because the understanding of the contributions of sustainable campuses to achieving UN SDGs is still limited, this research will raise awareness and knowledge among scholars and practitioners as to the way in which to improve UN SDG achievement. In summary, by incorporating the UN SDGs into the assessment and management of sustainable campuses, the contribution of sustainable campuses to achieving the UN SDGs can be greatly increased. As a result, policymakers, professionals, higher education institutions, and sustainability managers can use the proposed indices in different universities to assess and manage the contributions of UI GreenMetric-certified sustainable campuses to achieve UN SDGs.

This study achieved the objectives mentioned in the introduction. In order to explore if a relationship exists between the UI GreenMetric assessment indicators and the UN SDGs and to develop a new index for assessing and managing the contributions of the UI GreenMetric assessment indicator, we conducted a literature review and developed a hypothesis, as discussed in Section 3. A questionnaire was developed and distributed to the targeted audience. Data were gathered through a survey and analyzed according to frequency and the Relative Importance Index. Contribution indices were constructed and were used to assess the contributions of the UI GreenMetric assessment indicators to achieving the UN SDGs. The results confirm that there is a significant relationship between the UN SDGs and the UI GreenMetric assessment indicators.

This study found that implementing the UI GreenMetric indicators contributes to achieving the UN SDGs, namely, SD3, SDG4, SD6, SDG7, SDG8, SDG9, SDG11, SDG12, SDG13, and SD15. The contributions of Al Zaytoonah University of Jordan's UI GreenMetric-certified sustainable campus to achieving the SDGs were assessed. The GMSCI value is 215 for Al Zaytoonah University of Jordan. While this research achieved its objectives, it has limitations. This study only assessed sustainable campuses certified by the UI GreenMetric. However, the study's results may be used to create a new index for evaluating and managing other types of sustainable campus evaluation systems. The lack of a previously developed index and the shortage of information on the topic represents the second limitation, preventing the comparison of the proposed index in this research to other existing indexes.

The GMICI and GMSCI assist us in determining the contributions of UI GreenMetric indicators to the achievement of the UN SDGs. As a result, we conclude that these indices are useful for evaluating the contributions of UI GreenMetric-certified sustainable campuses to achieving UN SDGs.

Author Contributions: Conceptualization, R.A., I.J., H.R. and H.A.; methodology, R.A., I.J., H.R. and H.A.; software, R.A., I.J., H.R. and H.A.; validation, R.A., I.J., H.R. and H.A.; formal analysis, R.A., I.J., H.R. and H.A.; investigation, R.A., I.J., H.R. and H.A.; resources, R.A., I.J., H.R. and H.A.; data curation, R.A., I.J., H.R. and H.A.; writing—original draft preparation, R.A., I.J., H.R. and H.A.; writing—review and editing, R.A., I.J., H.R. and H.A.; visualization, R.A., I.J., H.R. and H.A.; supervision, R.A., I.J., H.R. and H.A.; project administration, R.A., I.J., H.R. and H.A.; funding acquisition, R.A., I.J. and H.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Al Zaytoonah University of Jordan, grant number (13/11/2020-2021), project titled “Developing a Novel Framework for Assessing and Managing the Contributions of Sustainable Construction Project to Achieve Sustainable Development Goals in Jordan”.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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