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A Framework for the Assessment of Public Buildings Sustainability in the Palestinian Territory

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Abstract

Public authorities in developing countries have a significant role in the application of sustainability in the building sector. They are responsible for: (i) adopting new regulations and guidelines about sustainability requirements in the design, construction, and management of buildings and (ii) the use of sustainability as an essential requirement for the construction and renovation of public buildings. However, since the application of sustainability in the construction sector approach is still embryonic in developing countries, a significant effort is required to adopt international knowledge and experience in sustainability. This paper aims to fill this gap by developing a framework for assessing the sustainability of public buildings in the Palestinian territory. The framework includes establishing sustainability indicators for public buildings based on the literature review and the opinion of a panel of experts. The paper presents the methodology followed to identify these indicators and uses the Step-Wise Weight Assessment Ratio Analysis method (SWARA) for their ranking and weighting. As a major result, the paper provides a set of indicators for assessing the sustainability of public buildings and the ranks and weights of these indicators. The set of indicators is organized in the following categories: energy efficiency, water efficiency, green city, and Indoor environment.

Keywords: Public buildings; Sustainability; Developing countries; Social; Economic; Green; Energy; Water; Indicator; Framework

Introduction

This paper presents a framework for the assessment of the sustainability of public buildings in Palestine. The significance of this research is threefold. The first fold is related to the significant environmental, social and economic role of the building sector 7 [1]. Indeed this sector is responsible for approximately 40% of the energy consumption, 36% of CO_2 emissions, 33% water consumption, and 30% of waste generation 18,4 [2,3]. In addition, the building construction industry consumes a significant amount of resources: 25% of wood and steel products and 70% of cement [4]. The second fold concerns the application of sustainability in public buildings, which provide services to the community such as education, health, sport, culture, and administration [5]. They also host the administrative and technical staff of the public sector. Public buildings also significantly impact the environment, primarily through energy and water consumption. Moreover, this sector requires high investments to meet the sustainability challenges [6]. Gelderman et al. [7] reported that the research about sustainability studies focused on the private sector resulting in a lack of studies in the public sector. The assessment of four public buildings in Catalonia [8] showed that the public service was an ideal target for implementing decision-making methodologies to ensure a balance in social inclusion, environmental preservation, and economic development viability.

The third fold concerns Palestinian territory as an example of developing countries. Indeed, sustainability was mainly designed and applied in developed countries [9]. Standards and certificates were set in these countries for designers, practitioners, and decision-makers. Examples of these certificates are LEED in the USA, BREEAM in the UK, CASBEE in Japan, DGNB in Europe, GB Tool in Canada, Life-cycle-based tools in the Netherlands, and Eco-Effect in Sweden [2,9,10]. Since these certificates were developed within developed countries, they could not be directly applicable to developing countries because of specific policies, regulations, public awareness, geography, climate, resource, and construction materials [4]. Ali [11] emphasized that building assessment has become a necessity in developing countries to encourage and support the construction industry to enter the path of sustainability. Vyas [12] developed a framework to measure the sustainability of a building based on factors applicable to Indian status. Banani et al. [13] proposed a sustainable framework assessment for non-residential construction in Saudi Arabia.

Public authorities in developing countries have a significant role in the application of sustainability in the building sector. They are responsible for: (i) adopting new regulations and guidelines about sustainability requirements in the design, construction, and management of buildings and (ii) the use of sustainability as an essential requirement for the construction and renovation of public buildings. However, since the application of sustainability in the construction sector approach is still embryonic in developing countries, a significant effort is required to adopt international knowledge and experience in sustainability. This paper aims to fill this gap by developing a framework for assessing the sustainability of public buildings in the Palestinian territory. The framework includes establishing sustainability indicators for public buildings based on the literature review and the opinion of a panel of experts. The paper presents the methodology followed to identify these indicators and the use of the Step-Wise Weight Assessment Ratio Analysis method (SWARA) [14] for their ranking and weighting.

Research Methodology

Research design

Figure 1 details the methodology followed in this research. It includes 3 phases. The first phase identifies a set of sustainability indicators for the public buildings in Palestine using both literature review and analysis of practices and needs in this sector. The second phase concerns the consultation of a panel of experts about the first set of indicators and their importance. Finally, the third phase includes analyzing the experts' opinions using the SWARA method to figure out the final set of sustainability indicators for the public buildings in Palestine and determine a weighting system for these indicators.

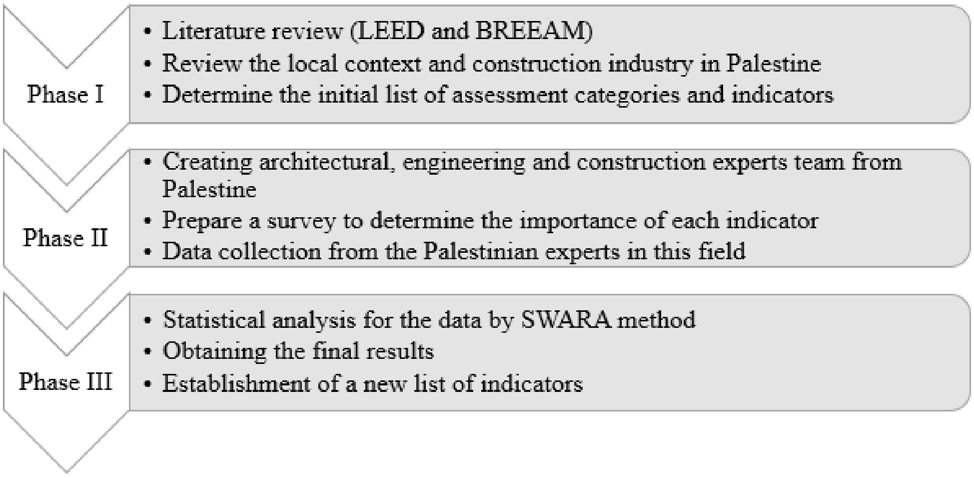

Figure 1: Methodology followed for the determination of sustainability indicators for public buildings in Palestine.

Sustainability indicators for public buildings in Palestine

Since the concern for sustainability in the building sector in Palestine is recent, there is a great need to investigate international practices in this area and their adaptation to the local context [15]. This adaptation should consider the specific situation in Palestine, mainly the occupation, which reduces the power of control of the national authority over its lands, borders, and resources [16]. The construction industry is one of the main sectors that affect the Palestinian economy. In 2010, this sector recorded a growth rate of about 36%. In addition, this sector is the second-largest contributor to the Goss Domestic Product (GDP). It accounted for about 13% of the GDP in 2014 [15].

Establishing guidelines for sustainable buildings in Palestine requires determining indicators for the three pillars of sustainability: environment, social and economic. It should be based on the international experience and the specificities of the public buildings in the Palestinian context. Analysis of the international sustainability assessment methods (LEED and BREEAM), other international experiences, and the Palestinian Green Building Guidelines allowed constructing the first set of indicators. The proposed methodology follows the proposition of Balaras et al. [3] for a three-level sustainability assessment hierarchy: Issues, Categories, and Indicators (Criteria). The level "Issue" defines the general themes to assess sustainability: environment, society, and economy. Each issue has different "Categories". Each category illustrates the specific aspect related to some indicators. Finally, the "indicator" describes the category's aspect and represents the main valuation entries used to describe a building. These indicators can be qualitative or quantitative.

The following sections present successively the environmental, social, and economic indicators

Environmental indicators

Table 1 summarizes the environmental category. It includes four subcategories: (I) Energy efficiency (II) Water efficiency (III) Green city and (IV) Indoor environment quality.

A. Energy efficiency

The energy efficiency of buildings has become a critical concern in the building's life cycle management. As mentioned before, the building sector constitutes a significant consumer of energy in the world. Energy consumption is also associated with excessive use of resources. Moreover, the energy production process is responsible for harmful and toxic emissions into the atmosphere [4]. Therefore, most assessment tools focus on energy management [17]. Energy has the highest weighting among the other categories with 25% and 21% scores in the LEED and BREEAM sustainable rating systems, respectively. The energy category for Palestine is particularly critical because Palestine suffers from deprivation from exploiting its natural resources, such as the production or import of electricity and natural gas. The Palestinian National Authority (PNA) has to import 100% of petroleum products from the Israeli market and around 87% of electrical energy from the Israeli Electric Corporation (Said, 2019). The energy efficiency category includes four indicators: (EE1) Primary energy consumption, (EE2) Renewable energy production, (EE3) Air conditioning energy consumption, and (EE4) Heating energy consumption and type of energy, as seen in Table 1.

Table 1: First set of indicators for sustainable public buildings in Palestine (Environmental category).

Category	ID	Indicator	Short Definition
Energy Efficiency	EE1	Primary energy consumption	The amount of energy consumed in various tasks other than heating and air conditioning, such as lighting, electrical equipment, etc.
	EE2	Renewable energy production	Power generation on-site from various renewable sources, especially solar energy, to generate electricity
	EE3	Air conditioning energy consumption	The amount of energy consumed in air conditioning (in cooling systems).
	EE4	Heating energy consumption and type of energy	The energy consumed in the heating system determines what type of energy is used: electricity, gas, or others.
Water Efficiency	WE1	Water consumption	The amount of water consumed in the building.
	WE2	Hot water consumption	The amount of hot water consumed in the building.
	WE3	Irrigation water consumption	The amount of water consumed in the building for irrigation purposes.
	WE4	Rainwater harvesting	The amount of rainwater collected and reused in the building for cleaning, flush water, and firefighting.
	WE5	Recycled greywater	The amount of greywater collected and reused in the building for cleaning, flush water.
	WE6	Connection to public sewage	The internal ducts of the building are connected directly and securely with the public sewers.
Green City	GC1	Greenspace	Use of vegetation to provide ambient outdoor cooling.
	GC2	Solid waste production	Provision of solid waste collection and sorting services
	GC3	Greenhouse gas emission	Presence materials with a high green gas emission or contain substances that negatively affect the individual or the environment in the building.
Indoor Environment	IE1	Thermal comfort	Achieve a high level of thermal satisfaction for users and the distribution of thermal areas in the building to increase energy efficiency.
	IE2	Humidity comfort	Maintain a suitable and satisfactory humidity ratio for users to achieve thermal satisfaction in the building.
	IE3	Indoor acoustic comfort	All populated rooms or areas must remain within the permissible limits for transmitting sound to and from an occupied place.
	IE4	Indoor air quality	Provide the necessary amount of outdoor and fresh air for the users inside the building.
	IE5	Safety and security	Ensure that the building is safe and can face earthquakes, floods, and fires while providing public safety requirements.

B. Water efficiency

Water scarcity constitutes a significant challenge in Palestine because of the considerable damages to the water resources and infrastructures [16]. Consequently, the public authority is concerned with the improvement of the water efficiency system. In addition, it is necessary to consider new water sources such as rain harvesting and greywater treatment. The policy for water efficiency category is based on six indicators: (WE1) Water Consumption, (WE2) Hot water consumption, (WE3) Irrigation water consumption, (WE4)

Quantity of rainwater harvesting, (WE5) Recycled greywater, and (WE6) Connection to public sewage as seen in Table 1.

C. Green city

Green areas constitute an essential factor for the quality of life. Considering the high density of buildings in urban areas, they have a crucial role in achieving the objective of a green city. Three indicators are considered for the contribution of public buildings to the green city: (i) Percentage of green areas (GA1), (ii) Solid waste production (GA2), which aims to reduce construction waste by sorting solid construction waste for secondary use and recycling, and (iii) the reduction of Greenhouse gas emissions is considered as one of the priorities towards sustainable development of any country.

D. Indoor environment quality

This category aims to improve the quality of the internal environment, maintain users' health and comfort, and improve productivity. Most people spend approximately 90% of their time in buildings [4]. There is a tangible link between individuals' health, comfort, productivity, and environmental conditions [18]. According to the Palestine Higher Green Building Council (2013), the improvement of the indoor environment could (i) reduce the number of workdays lost due to illness by an average of 3 days per person per year and (ii) increase individual productivity by about 5%. This category is the second after the energy category by weight, with 22% and 15% in the LEED and BREEAM sustainable rating systems, respectively.

This category includes five indicators: (IE1) Thermal comfort, (IE2) Humidity comfort, (IEQ3) Indoor acoustic comfort, (IE4) Indoor Air quality, and (IE5) Safety and security, as seen in Table 1.

Social indicators

This category focuses on the social services of public buildings. It is essential to understand population needs and seek long-term collective well-being [8]. It helps improve inclusion, equity, employment, security, education, satisfaction, participation, and accessibility to public services. In addition, it must ensure that the community values are involved in the decision-making process. Tammy et al. [19] showed that the rating system tool failed to understand the social dimension of buildings. Table 2 summarizes the list of the indicators of the social category. It includes five indicators. The Public transport service indicator (SA1) which concerns the availability of building to the members of society, especially disabled people. It encourages the building's location to be near to public transportation services. The second indicator concerns the use of public facilities for social activity (SA2). The 3rd indicator measures the daily occupation rate of the building (SA3), while the fourth indicator focuses on the hourly occupation rate of buildings (AS4). The last indicator is related to cultural heritage (AS5).

Table 2: First set of indicators for sustainable public buildings in Palestine (Social category).

Category	ID	Indicator	Short Definition
Social Issues	SA1	Public transport service	The building is available to all ages and members of society, especially the disabled, and near public transportation.
	SA2	Use for social activities	The building can be used for community activities outside of official working hours.
	SA3	Occupation rate (day/year)	Intensive daily use of the building.
	SA4	Occupation rate (hour/year)	Intensive hourly use of the building.
	SA5	Culture and heritage	Develop the site to fit its job and protect the vital system and general culture of a community while preserving the heritage values.

Economic indicators

The economic factor is crucial in developing countries, which must be considered in buildings sustainability assessment. However, the economic dimension is not central in BREEM, LEED, GB Tool and CASBEE. While economic incentives and financing schemes are commonplace programs for green building design in the United Kingdom, the United States, and Japan, they are not yet implemented in developing countries [17,19]. The economic category concerns the total building operations and maintenance costs. It includes two indicators (Table 3): (i) The Operational energy expenses (EC1), which covers services related to heating, air conditioning, lighting, and others, and (ii) the Operational water expenses (EC2), which covers services such as potable water, flush water, cleaning, and irrigation.

Table 3: First set of indicators for sustainable public buildings in Palestine (Economic category).

Category	ID	Indicator	Short Definition
Economic Issues	EC1	Operational energy expenses	The cost required to operate all services requires energy, such as heating, air conditioning, lighting, etc.
	EC2	Operational water expenses	The cost required to operate all services requiring water, such as potable water, flush water, cleaning, and irrigation

Experts' opinion

The set of indicators established in the previous section was submitted through a questionnaire to a panel of experts for evaluation and extension. This approach was used by Olawumi [20] to identify and prioritize sustainability practices in construction projects. In addition, they reported that it helped reach consensus in complex projects. Experts were selected according to their experience and expertise in the construction and building sector and sustainable and green buildings. The questionnaire is composed of two sections. The first section concerns the experts' profile, including education level, expertise, and working sector. The second section includes the evaluation by the experts of the importance of sustainability indicators according to a 5-level score (Table 4). Low scores indicate low significance, while high scores indicate high relevance. Experts were also invited to propose additional indicators for the sustainability of public buildings. Twenty-nine (29) responses were received from experts. Table 5 summarizes the profile of these experts. Around 60% of them are Ph.D. graduates. They cover extensive construction activities such as architecture, civil and buildings engineering, mechanical engineering, management and urban planning, and environmental engineering. Around 55% of the experts are architects. Around half of the experts works in the public sector, and the other half works in the private sector.

Table 4: Scores used in the experts' evaluation of the importance of sustainability indicators.

Score	Significance
1	Completely unimportant
2	Unimportant
3	Neutral
4	Important
5	Very important

Table 5: Profiles of experts.

Experts' Personal Questions			
Classification			No.
1	Gender	Male	23
		Female	6
2	Education Level	Bachelor	6
		Master	6
		PhD	17
3	Specialization	Architecture	16
		Civil and building engineering	7
		Management and urban planner	3
		Mechanical and energy engineering	3
4	Working Sector	Public Sector	14
		Privet Sector	15

Data analysis

Data analysis aimed at ranking the indicators according to the experts' opinion and determining their relative weight to determine the global score of sustainability. This work was conducted using the Stepwise Weight Assessment Ratio Analysis (SWARA) method [14]. This method was used by Zolfani & Chatterjee [21] to analyze the experts' opinions. In this method, experts use their knowledge and experiences to determine the importance of each indicator [22]. The indicators ranking and weighting are then determined according to the following five steps [14] (Figure 2):

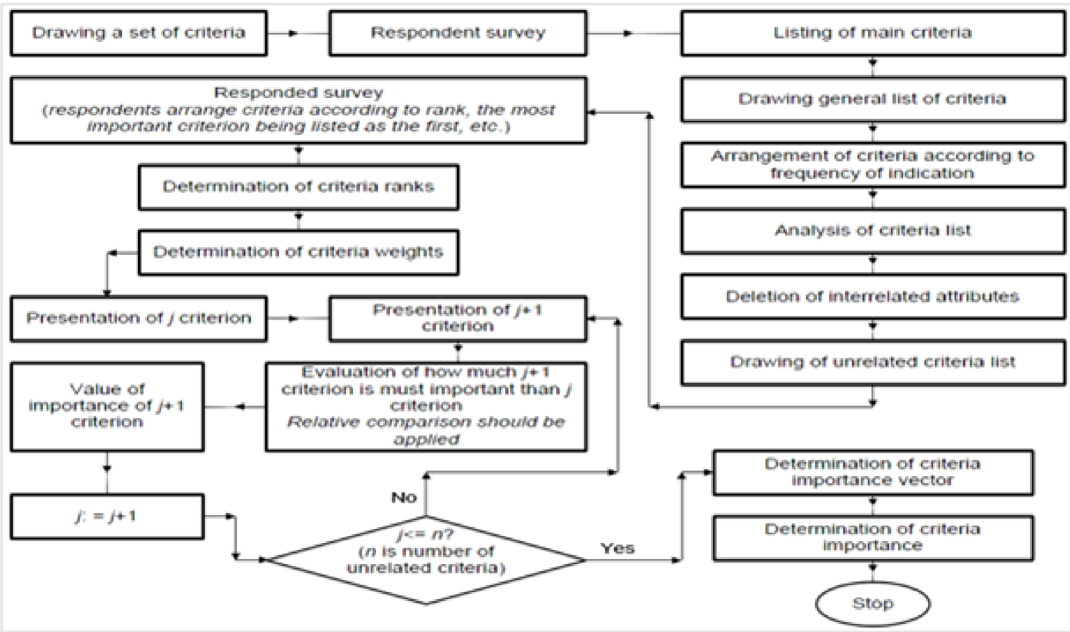

Figure 2: Determining the criteria weights based on the SWARA method [14].

Step 1. The criteria are sorted in descending order based on their expected importance.

Step 2. Starting with the second criterion, the respondent expresses the relative importance of criterion j in relation to the previous criterion (j-1) for each specific criterion. This ratio is called the comparative importance of average value, sj.

Step 3. Determination of the coefficient kj as follows:

$$Kj = \begin{cases} 1, & j = 1 \\ sj + 1, & j > 1 \end{cases} \quad \text{(Eq.1)}$$

Step 4. Determination of the recalculated weight qj as follows:

$$qj = \begin{cases} 1, & j = 1 \\ \dfrac{kj - 1}{kj}, & j > 1 \end{cases} \quad \text{(Eq.2)}$$

Step 5. The relative weights of the evaluation criteria are determined as:

$$Wj = \frac{qj}{\sum_{K=1}^{n} qk} \quad \text{(Eq.3)}$$

Wj indicates the relative weight of the j-th criterion, while n indicates the number of indicators.

The values of all quantitative indicators (X) are transformed to qualitative indicators (Xq) using the following relation:

$$Xq = \text{int}\left[\frac{X - Xmin}{(Xmax - Xmin}*5\right] + 1 \quad \text{(Eq.4)}$$

Finally, the score of each building is calculated using the following equation

$$Score = \sum_{i=0}^{n}(Xi * Wi) \quad \text{(Eq.5)}$$

Results and Discussion

General overview

Table 6 shows the heat map of the evaluation by the 29 experts of the set of indicators established in the previous section. It shows that the majority of experts (around 66%) gave a high score (S=4) to a very high score (S = 5), while only 10% gave a very low (S=1) to low (S=2) scores to the set of indicators. Around 24% of the experts gave an intermediate score (S=3). However, the global score varies between 99 (use of the buildings for social activity) to 127 (thermal comfort), with a mean value of 113 and a standard deviation of 10.5.

Table 6: Heat-map results based on number of respondents to each category and indicator.

Category	ID	Indicator	Scale for Quantitative Parameters 1 to 5 (1 Less important, 5 More important)					Global Score
			1	2	3	4	5	
Energy Efficiency	EE1	Primary energy consumption	0	1	5	6	17	126
	EE2	Renewable energy production	0	2	4	7	16	124
	EE3	Air conditioning energy consumption	0	3	5	5	16	121
	EE4	Heating energy consumption and type of energy	0	1	5	7	16	125
Water Efficiency	WE1	Water consumption	0	0	3	13	13	126
	WE2	Hot water consumption	3	3	8	8	7	100
	WE3	Irrigation water consumption	2	3	9	10	5	100
	WE4	Rainwater harvesting	1	1	7	12	8	112
	WE5	Recycled greywater	2	2	9	10	6	103
	WE6	Connection to public sewage	0	5	5	5	14	115
Green City	GC1	Greenspace	0	2	6	6	15	121
	GC2	Solid waste production	1	0	4	14	10	119
	GC3	Greenhouse gas emission	1	3	8	7	10	109
Indoor Environment	IE1	Thermal comfort	0	0	8	2	19	127
	IE2	Humidity comfort	0	2	8	10	9	113
	IE3	Indoor acoustic comfort	0	3	9	13	4	105
	IE4	Indoor air quality	0	1	6	4	18	126
	IE5	Safety and security	1	2	3	6	17	123
Social	SA1	Public transport service	1	3	6	11	8	109
	SA2	Use for social activities	1	5	9	9	5	99
	SA3	occupation rate (day/year)	0	3	13	8	5	102
	SA4	occupation rate (hour/year)	1	3	11	10	4	100
	SA5	culture and heritage	0	6	8	10	5	101
Economic	EC1	operational energy expenses	0	1	7	5	16	123
	EC2	operational water expenses	2	3	8	11	5	101

Rank and weight of sustainability categories

Table 7 shows the rank and weight of each category of indicators as calculated by the SWARA method and the scores in Table 6. The values of parameters sj, Kj, qj and Wj are determined by the equations Eq. 1 to Eq. 5 presented in section 3.1.

Table 7: Ranks and weights of the sustainability categories according to the experts' opinion and the SWARA method.

Sustainable Categories	Global Score	Rank	Comparative importance of average value (sj)	Coefficient (Kj)	Recalculated weight (qj)	Weight (Wj)
Energy Efficiency	124	1		1	1	0.184
Indoor Environment	119	2	0.05	1.05	0.95	0.175
Green City	116	3	0.03	1.03	0.92	0.170
Economic	112	4	0.04	1.04	0.89	0.163
Water Efficiency	109	5	0.03	1.03	0.86	0.159
Social	102	6	0.07	1.07	0.81	0.148

According to the experts, it indicates that Energy efficiency and Indoor environment obtained the highest rank, which means that these categories are of the highest importance in public buildings' sustainability. This result agrees with the importance of energy in the international sustainability certificates. It also highlights the importance of energy in Palestine because of the lack of resources. Experts also highlighted the importance of the indoor environment in public buildings for both the health and productivity of employees and users' comfort. The social dimension obtained the lowest rank. In the Palestinian context, this dimension is not considered by experts as a significant issue.

Table 8 provides the weights of the sustainability categories in the Palestinian Green Building Guideline (PGBG). It shows that this guideline does not consider the social and economic categories. It agrees with the experts' opinion concerning the importance of energy efficiency, but it provides for water a higher priority than that given by the experts. This difference could be related to the low consumption of water in public buildings. Nevertheless, both the PGBG and experts agree with the importance of the sustainability category associated with the indoor environment.

Table 8: The weight of sustainability categories in the Palestinian Green Building Guideline (PGBG).

Domain	Weight
Energy Efficiency	0.30
Water Use Efficiency	0.25
Indoor Environment	0.15
Site Sustainability	0.15
Materials and Resources	0.10
Innovation and Building Integrated Design	0.05

Importance of indicators in each category

This section analyzes the importance of indicators in each category according to the experts' opinions. This analysis is based on the global score of each indicator. It also provides the weight of each indicator in its category as determined by the SWARA method. This weight could be used for the determination of the score of each category. The global score could then be determined according to the weights of categories provided in Table 7. Table 9 shows the rank and weight of the indicators of the category Energy Efficiency. It could be observed that the 4 indicators have close scores and consequently close weights. Therefore, experts consider that these indicators are of almost the same importance and should be considered in assessing the sustainability of public buildings.

Table 9: Rank and weight of indicators of the Energy efficiency category.

Indicator	Score	Weight
EE1 (Primary energy consumption)	126	0.255
EE4 (Heating energy consumption)	125	0.253
EE2 (Renewable energy production)	124	0.250
EE3 (Air conditioning energy consumption)	121	0.243

Table 10 summarizes the rank and weight of the indicators related to the Water efficiency category. It shows that the global water consumption obtains the highest weight, followed by the connection of buildings to the public sewage service. Rainwater harvesting also gets a high weight, which indicates the importance of this issue in Palestine because of water shorting. On the other hand, hot water and water consumption for irrigation obtained the lowest weights because of their low use in public buildings.

Table 10: Rank and weight of indicators of the water efficiency category.

Indicator	Score	Weight
WE1 (Water consumption)	126	0.195
WE6 (Connection to public sewage)	115	0.173
WE4 (Rainwater harvesting)	112	0.171
WE5 (Recycled greywater)	103	0.157
WE2 (Hot water consumption)	100	0.152
WE3 (Irrigation water consumption)	100	0.152

Table 11 provides the results related to the indicators Green City. The green space and Solid Waste production obtained high and close weights, while the greenhouse gas emission obtained a low weight. This result shows that greenhouse gas emission is not yet considered a major environmental issue by experts. Results concerning the indicators of the Indoor Environment are given in Table 12. Experts' opinion shows that care should be paid in public buildings for thermal comfort, air quality, and safety, which obtained high and close scores. While humidity and acoustic comfort are considered of lower priority. Table 13 summarizes the results related to the indicators of the social category. Access to public transport service obtained the highest weight, while the other indicators obtained closed scores. Therefore, according to the experts' opinion, public buildings should be accessible by public transport service. On the other hand, the occupation rate of public buildings and their use for social activity are considered of low importance.

Table 11: Rank and weight of indicators of the category Green city.

Indicator	Score	Weight
GC1 (Greenspace)	121	0.348
GC2 (Solid waste production)	119	0.342
GC3 (Greenhouse gas emission)	109	0.311

Table 12: Rank and weight of indicators of the indoor environment category.

Indicator	Score	Weight
IE 1 (Thermal comfort)	127	0.216
IE 4 (Indoor air quality)	126	0.214
IE 5 (Safety and security)	123	0.208
IE 2 (Humidity comfort)	113	0.189
IE3 (Indoor acoustic comfort)	102	0.175

Table 13: Rank and weight of indicators of the social category.

Indicator	Score	Weight
SA1 (Public Transport Service)	109	0.214
SA3 (Occupation Rate (day/year))	102	0.200
SA5 (Culture and Heritage)	101	0.198
SA4 (Occupation Rate (hour/year))	100	0.196
SA2 (Use for Social Activities)	99	0.194

Table 13 summarizes the results related to the indicators of the social category. Access to public transport service obtained the highest weight, while the other indicators obtained closed scores. Therefore, according to the experts' opinion, public buildings should be accessible by public transport service. On the other hand, the occupation rate of public buildings and their use for social activity are considered of low importance. Concerning the economic category, the expenses related to energy consumption are considered of high importance, while those related to water consumption are less important (Table 14). This result could be associated with the low water consumption in public buildings as compared to water consumption.

Table 14: Rank and weight of indicators of the economic category.

Indicator	Score	Weight
EC 1 (Operational Energy Expenses)	123	0.549
EC 2 (Operational Water Expenses)	101	0.450

Conclusion

This paper presented a framework for the assessment of existing public buildings in Palestine. It aims to assist the public authority in establishing standards for sustainable buildings and evaluating the sustainability of existing public buildings. The framework is based on the review of international standards for sustainable buildings, their adaptation to the Palestinian context, and the opinion of a panel of experts.

The proposed framework includes 25 indicators covering six categories of sustainability, namely energy efficiency, water efficiency, green city, indoor environmental, social aspects, and economic aspects. According to the experts' opinion, Energy efficiency and indoor environment are of the highest importance in public buildings, while the social dimension is less important.

Both energy consumption and renewable energy production are essential in the energy efficiency category, while water consumption is considered very important in the water efficiency category. Furthermore, experts highlighted the importance of the ratio of green space and solid waste production in the category of green city and that of thermal comfort, indoor air quality, and safety in the indoor environment category. Finally, accessibility by public transport and energy expenses were considered as the most important in the economic and social categories, respectively. In future work, this work will be pursued by enlarging the experts' panel to civil society representatives and experts in the economic and social sectors.

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