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Sustainability Impact Assessment of University Master Plans
With reference to Palestinian universities in Gaza

**A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of
Master in Architectural Engineering**

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Abstract

Population growth, global climate change, increasing inequity in income distribution and education opportunities and so many other problems in the 21st century necessitate an urgent action to address sustainability issues in our communities. Sustainability can be seen as a necessity in order to avoid the costs of deteriorating social, environmental, and economic systems. On the other hand, sustainability can be seen as a source of new opportunities to improve the rate and extent of human development. In addition to the life-supporting services provided by healthy environmental, social, and economic systems, pursuing sustainability leads to the identification of vast new opportunities to create values.

As sustainability is of critical importance to continued human prosperity, a growing number of entities ranging from individuals to organizations, institutions, corporations, and governments, have begun to define their own responsibilities toward global sustainability.

Specifically, these groups are articulating more precise principles of sustainability to guide their actions and are making internal and external commitments to improve the sustainability of their operations. They are also identifying ways to assess and report on their performance against sustainability targets.

Since universities are looked upon with high regard, it is the responsibility of the university to set an example of how the environment is respected and conserved.

It is the mission of the university to find ways in which society can be improved, scarce resources can be managed, and environmental values can be preserved. Students, who learn and practice a sustainable lifestyle while in university, may be inclined to transfer these practices into their daily lives after they graduate.

But, due to bad situation in Palestine, Palestinian universities and especially in Gaza, have been for long suffering from several problems related to sustainability such as lack of financial abilities, insufficient land, polluted ambient air, deteriorated infrastructure and very low level of public awareness and commitment, etc.

This research chose a unique method to assess sustainability in master plans of Palestinian universities. Several indicators and measures were used for this assessment in order to empirically determine sustainability problems of these plans and to provide the most optimum solutions for them. Specific concentration was directed to the Master Plan of Islamic University of Gaza (IUG) current campus.

Indicators and measures were chosen based on a thorough review of the different sets available globally. There was also a review of the different software available with greater emphasis on Sustainable Project Appraisal Routine (SPeAR) software.

This research is the first of its kind to deal with sustainability issues in master plans of Palestinian universities in Gaza. It will help these universities to develop the suitable means to raise sustainability levels in their master plans. This in turn will contribute to the development of the overall sustainability level in Palestinian society.

Keywords: Sustainability, Sustainability Impact Assessment, University Master Plans, Gaza, Palestine.

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DEDICATION

To the spirit of my father , God's mercy upon him , to my mother whose support and advice in life have always been of great importance.

To the spirit of my Brother Samir, God's mercy upon him.

To my sons Mohammed and Ahmed.

To my cute daughter Sara who helped and supported me.

It is to all of you that I dedicate this work!

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Abbreviations

EIA	Environmental Impact Assessment
EIRs	Environmental Information Resources
SIA	Sustainability Impact Assessment
SEA	Strategic Environmental Assessment
IUGMP	the Islamic University of Gaza Master Plan
SAQ	Sustainability Assessment Questionnaire
LEED	Leadership in Energy and Environmental Design
CSAF	Canadian Sustainability Assessment Framework tool
UW	University of Waterloo
U-M AA	University of Michigan Ann Arbor
CSUMB	California State University at Monterey Bay
UVa	University of Virginia
ASPIRE	Sustainability Poverty and Infrastructure Routine for Evaluation
IUG	the Islamic University of Gaza
AUG	Al Azhar University of Gaza
ERSC	Environmental and Rural Studies Center
NPE	National Policy on Education
UC Merced	University of California, Merced
UNDP	United Nations Development Program
EQA	Environment Quality Authority
NGOs	None Governmental Organizations
AQAC	Accreditation and Quality Assurance Commission
EPA	Environmental Protection Agency
UNEP	United Nation Environmental Program

PCBS	Palestinian Central Bureau of Statistics
ppm	part per million
WHO	World Health Organization
MCM	Million Cubic Meter
SPeAR	Sustainable Project Appraisal Routine
ULSF	University Leaders for a Sustainable Future
KWH	Kilo Watt Hour
Sq m	Square meter

Chapter 1: Study Introduction and Importance

1.1. Introduction

Recently, sustainability and related issues such as global warming, environmental problems, societal and limited resources have become more important at the global level. Therefore, more awareness must be paid from everybody (researchers, engineering, planners, officials, professionals, faculty, and students) to conserve our planet.

Environmental Impact Assessment (EIA) which is a science-based tool that has emerged since the early 1980s in response to problems of air quality, water quality, toxic chemicals, and other environmental threats. The focus was usually on assessing conditions and risks for particular facilities, industries, or watersheds. This assessment then became the basis for documents such as Environmental Information Resources (EIRs) and for environmental management policies designed to reduce environmental risks. Since its inception, the field has evolved from measuring the effects of particular chemical pollutants on a single species to a more broad-based assessment of the impacts of multiple stressors on ecosystems. (Wheeler, 2004)

After the emergence of concepts, theories and principles of sustainability as a result of Brandtland Definition (1987), more emphases were directed to the overall social and ecological systems and their interrelationships. More recently, Sustainability Impact Assessment (SIA) has been used as a means for investigating sustainability issues in a more empirical way and suggesting provisions for solution of different problems related to sustainability.

SIA is a developed and expanded tool for ensuring that there are sufficient supplies of the ecological, material, human, and social resources necessary to allow humans to meet basic needs and to support continued development, and ensuring that access to this sufficient supply of resources is equitable both among all members of the current generation and future generations. (Elliot & Thomas, 2009)

To organize and sustain the relationship between generations and to ensure the equitable distribution of resources among all generations; efficient education system should be followed and at the top of which universities as the leader institutions. Universities are so important to advancing sustainability in society because a sustainable university campus is an academic institution committed to sustainability.

One of its main targets is to help students understand the roots of environmental degradation and how to counteract against them.

A sustainable campus community acts upon its local and global responsibilities to protect and enhance the health and well being of humans and ecosystems. It actively engages the knowledge of the university community to address the ecological and social challenges in the present time and in the future (Cole, 2003).

Universities in Gaza have been for long suffering from many problems such as lack of financial abilities, insufficient land and very low level of public awareness. It is a national duty and an obligation on stakeholders, planners, engineers and architects to plan, design, preserve and maintain sustainable universities. This is in addition to reducing expenditure on limited resources by using passive and integrated design to solve some of these problems.

This study contributes to enhancing sustainability levels in master plans of Palestinian universities in Gaza with special reference to Islamic University Master Plans in Gaza.

Some results of this study show that the Palestinian universities need urgent action to address Sustainability Impact Assessment of their master plans. The results of assessing the Islamic University of Gaza Master Plan show that some areas suffer from many problems and need improvements. These problems related to environmental and natural resources such air quality, waste hierarchy and discharge, design and operation, transport, materials, water use and energy. Furthermore, the lack of awareness and addressing sustainability subjects in curriculums.

1.2. Importance of the study

Importance of this study stems from several factors:

- It is the first study to highlight the significance of sustainability assessment in master plans of the Palestinian universities.
- It is the first study in this regard which uses sophisticated tools to analyze and measure sustainability levels in master plans of Palestinian universities.
- The important findings it provides represents a distinguished reference not only for university administrators, but also for many other Palestinian institutions which are in desperate need for sustainability assessment.

1.3. Goal and objectives of the study

The main goal of this study is to develop a comprehensive framework for assessing and enhancing sustainability levels in master plans of university campuses in Gaza. In order to achieve this goal, the following objectives should be fulfilled:

- To study existing methods of SIA.
- To find out methods of SIA in university campuses.
- To choose suitable indicators and measures for Sustainability Impact Assessment in university campuses by utilizing computerized methods.
- To use the chosen indicators and measures for the assessment of university campuses in Gaza.
- To assess the sustainability level in the master plan of the Islamic University of Gaza.

1.4. Research problem

1.4.1 Definition

The Palestinian University campuses, especially in Gaza, have been for long suffering from serious problems in their environmental, economic, and social circumstances. The implications of this situation increases with the current circumstances under siege, raw materials' crisis, increasing environmental, social and economical degradation. As time passes, the need for considering principles of sustainability increases. Considering principles of sustainability in Palestinian university campuses will contribute in enhancing sustainability in the Palestinian community as a whole. Urban planning, urban design, and architectural design have a significant and clear impact on sustainability levels in these campuses.

The Palestinian university campuses don't meet the criteria of sustainability due to many difficulties and obstacles. For example; these universities currently; don't have programs in recycling, energy conservation, efficient building design, pollution prevention, emissions reduction, alternative-fuel vehicles, and storm water management. On the other hand, the density (Footprint area) of some universities is too high compared with other universities. Furthermore, some of them don't have green areas for students' recreations.

However, improving sustainability levels in these universities is not an easy task and needs to answer a set of questions about how to remedy this issue.

1.4.2 Research questions

The main research question of the study is:

What is the significant effect of Sustainability Impact Assessment of university master plans on the development of the current and future of master plans of Palestinian universities in Gaza?

To achieve the answer of this question, it is very important to find answer for the following questions:

- What are sustainability indicators and measures?
- What sustainability indicators and measures are used in sustainability impact assessment of university master plans?
- What sustainability indicators and measures most suitable to be used in sustainable impact assessment of university master plans in Gaza?
- What is the relationship between these indicators and measures, and urban planning, urban design, and architectural design in university in Gaza and especially the Islamic University of Gaza?

1.5. Hypothesis

The low profile of sustainability levels in university campuses in Gaza refers to many reasons among them factors related to urban planning, urban design and architectural design, but the main and the significant one is the master plan as an important stage reflecting the various aspects of architecture and urban design of university campuses. Improving sustainability level of the university master plans in Gaza will ensure overcoming the main problems of these universities related to environment, social and economic, and upgrade the public awareness of sustainability.

1.6. Methodology

In this study, scientific and objective manner using analytical and computerized tools were used. SPeAR tool was used in this study for assessing the Islamic University of Gaza Master Plan (IUGMP). For this purpose, data was collected from IUG and related institutions, scoping and interviews were conducted with actors, stakeholders and interested parties.

Also a Sustainability Assessment Questionnaire (SAQ) among students, faculty and staff of IUG, was used to enhance the previously mentioned tool.

Validation was made to compare the results of SPeAR with findings of SAQ.

Finally development for SPeAR program was made to be adapted for assessing sustainability in Palestinian universities.

Based on the results, discussion was made and necessary recommendations were given.

1.7. Scope of the study and limitations

The study evaluates sustainability level in the master plans of Palestinian universities in Gaza with special reference to the Islamic University of Gaza Master Plan.

This study is considered only the first step toward a more sustainable campus. The indicators presented in it provide a baseline of information about IUG sustainability performance. It tries to show some key focus points on strength and weakness areas and how those can be addressed from the perspective of a more sustainable universities. The information presented for each indicator can be used to guide decision-making and prioritization of areas for further study.

1.8. Review of existing studies

Cole (2003), and his team have developed a framework to assist Canadian universities in assessing their sustainability status. Their idea depended on dividing dimensions of assessing sustainability into main categories and sub categories to facilitate the task. The ecosystem dimensions were: air, water, land, materials, and energy. While, the people dimensions were: knowledge, community, economy and wealth, governance, and health and wellbeing.

Each of these ten dimensions was then further broken down into “elements” and “sub-elements” until the level of indicators is reached. For instance; “People” subsystem is broken down into five dimensions, one of which is “Health and Well-being.” This dimension is then divided into five elements, and so forth.

An Excel spreadsheet was designed to help with the indicator management, and describe the proposed aggregation process. This initial aggregation method was quite simple, and was viewed as a first, rough attempt at developing a campus sustainability index in order to stimulate dialogue on the subject. It was inspired by the Leadership in Energy and Environmental Design (LEED™) program. Each indicator was weighted after measured; the indicators which couldn't be measured were excluded.

Then, Canadian Sustainability Assessment Framework tool (CSAF) was designed with the intention to balance their goals of flexibility and comparability. They attempted to eliminate indicators that unfairly bias a particular type of campus, with the

aim of making all indicators represent important sustainability issues and goals for all campuses.

Crystal (2004), on the other hand, assessed sustainability in Waterloo University as a case study by using the CSAF, which was developed by Cole under the supervision of campus sustainability experts across Canada, as a proposed strategic plan to direct the sustainability work done on campuses across Canada. The motivation for the project came from an apparent gap in existing campus sustainability frameworks in terms of their potential application to Canadian university campuses.

This indicator-based assessment can be a mean by which University of Waterloo (UW) establishes how sustainable it has become and what areas need focus in order to push UW ahead of all other universities in Canada on the grounds of campus sustainability. The final goal is to have the University of Waterloo publish an annual “Sustainability Report” that uses the CSAF as its foundation.

There is a strong desire from students in UW to establish their university as being the innovative leader in Canada. Due to Crystal (2004, p.8-9) "...one initiative which will assist with establishing this position could be the implementation of the CSAF. The University of Waterloo will be able to properly assess its social, economic and environmental sustainability. Furthermore, UW will be in position to make steps to improve in areas that the assessment focuses".

As a result, it is obvious that UW made steps to improve its performance. For example, a survey was recently made to understand the computing behaviors of staff and faculty in fall 2009. The information collected will enable an understanding of the energy consumed by most computing equipment, and thus creating a benchmark point for future projects. The main goal was that this information will inform users about the impact that computing equipment is having in the University's budget and on the environment.

More importantly, Rodriguez (2002) used assessment framework called the “triple bottom line” concept, which recognized environmental, social and economic spheres of sustainability. Each sphere was divided into categories and further into indicators. Environmental categories ranged from water use to greenhouse gas emissions, social categories from wages to community development and financial categories from revenues to investment policies. A total of fifty indicators were presented. Life cycle analysis was used for certain indicators to measure upstream and downstream impacts. Data gathering and analysis were conducted in close collaboration

with over thirty departments of University of Michigan Ann Arbor (U-M AA). Some of the important results of the assessment showed:

- Both positive and negative trends and provided a baseline for setting short- and long-term goals.
- The framework for assessing sustainability introduced can be used as the foundation for future assessments of sustainability at the U-M AA.
- Regular sustainability assessments will allow the U-M AA to monitor the success of its sustainability initiatives and identify new areas of opportunity.
- In addition, regular publication of the results of future assessments will establish a regular and transparent channel of communication between the U-M AA and the wide variety of internal and external stakeholders interested in the U-M AA's sustainability performance.
- Finally, concerns about environmental, social and economic issues were voiced with increasing frequency on university campuses across the nation.
- U-M AA may lead the way among universities in the continuing evolution toward the sustainable campus.

Cole (2001) used SPeAR tool in his Doctor of Philosophy (PHD) research to assess sustainability in master planning. Using major indicators; environment, economy and society as the basis for SPeAR allowed the tool to have a universal application, from product development to major development projects. However, to be able to make an assessment of where a project sits in respect to each of the mentioned indicators, a set of sub-indicators were involved.

SPeAR tool were used to assess sustainability in California State University at Monterey Bay (CSUMB), it combines balancing the use of existing buildings and infrastructure against developing new systems and buildings that can be better suited to a University for the 21st Century. The final plan has taken an important step toward realizing sustainability. CSUMB provided challenges in all four quadrants of the SPeAR diagram. The ranking is based solely upon interpretation of the many documents and workshops that were reviewed and attended by the research team. Each sub-indicator has best and worst case outcomes defined and then the notes column is filled in with pertinent comments and references to other documents that back up the individual sub-indicator rating. The program automatically sums the sub-indicators and

produces the final diagram. As with the other case study the detail spreadsheet provides an auditable record of the entire planning process.

SPeAR also was used in the University of California, Merced (UC Merced) which is the tenth campus of the University of California being developed to increase the University's enrolment capacity and to provide the benefits of a research university to Californians in the San Joaquin Valley. The findings of the University Of California Merced's assessment illustrated those areas which need improvement. They included which were: project siting and land use, transport options and affordability, materials waste, and hierarchy. While areas of high scores included cultural inclusion, regulations and guidance, and building energy.

Also, Nirah Holdings Limited (NIRAH), 2006 has used SPeAR which has been prepared by Ove Arup and Partners (Arup) to accompany an outline planning application for the proposed development of Nirah at Bedford. Arup's sustainability appraisal tool "SPeAR" has been selected in order to assess the strengths and weaknesses of the project. The tool allows for analysis of the complex expectations and needs for the site and considers the different priorities of those involved in and affected by a development on the site.

Within the same field, University of Virginia (UVa), 2008, illustrated that the Arup SPeAR™ Assessment provided a framework for planning, identifying areas of weakness and strength in UVa's current sustainability performance. As a component of this work, UVa appointed Arup to provide a baseline assessment of its sustainability performance. The sustainability framework used for the assessment was based on the Arup SPeAR™ that broadly reflected the three major categories used in the triple bottom line of environment, economic, and equity. In addition to the report, a tracking system and spreadsheet were in use by UVa which will allow the university to track progress made in indicator areas over time.

In addition, Lisa and Sally, (2008), developed Minnesota State Colleges and Universities master plan update review. The framework developed sustainability issues that included potential for geothermal and solar thermal heating and cooling systems study, energy conservation, roofing studies, infrastructure and any exterior envelope plan for improvement, day lighting, healthy indoor environment, appropriate site selection, renewable materials, sustainable economy (budget improvement). Significant

repair, replacement and/or improvement projects funded through campus operations budget such as repair and placement, or foundation funded projects, gifts and grants, and projects funding.

The Facilities Master Plan update process assured on-going maintenance and stewardship of existing physical assets and also enabled swift and flexible response to programmatic changes driven by student, economic, community and regional needs.

Recently, Engineers against Poverty and Arup has developed a Sustainability Poverty and Infrastructure Routine for Evaluation (ASPIRE) tool in recognition of the fundamental role infrastructure plays in tackling poverty and contributing to sustainable development. It is a software based tool for assessing the sustainability of infrastructure projects which recognizes poverty reduction as an overarching objective. It provides a holistic appraisal framework encompassing the four key dimensions of environment, society, economics and institutions. ASPIRE has been developed to help those funding, commissioning and implementing infrastructure projects consider a wider range of issues and stakeholder concerns. ASPIRE was used in many projects in poverty areas such as Angwin Eco Village California USA. The vision behind the development of Angwin Eco Village is to create a community with strong commitment to sustainability, social equity and environmental preservation. ASPIRE has been applied during the Identification stage of the project life cycle, during the master planning process for the Angwin Eco Village scheme. Overall, the Angwin Eco Village performs highly in the integrated appraisal evaluation. The assessor suggested ASPIRE would be valuable from the outset and could be used as an 'actions' tracker, to continuously track performance throughout the project's longevity and life cycle.

1.9. Examples of university master plans sustainability assessment

For more important information about the efficient usage of sustainability assessment tools in university master plans, the following universities are considered.

1.9.1 University of California, Berkeley

The 2009 Campus Sustainability Plan has defined a vision of long term sustainability and described steps being taken to achieve the vision, with focus on individual and concrete action. It aimed to take advantage of the opportunities to use the campus as a research and learning laboratory for sustainability. By Protecting and enhancing the

campus environment; conserving natural resources through their sustainable use in building projects, transportation, and campus operations; significantly reducing campus greenhouse gas emissions; conducting innovative research on sustainable technology and practices; increasing awareness of these values through instruction and example; and collaborating with a diverse and engaged campus community on these issues to help fulfill the University's mission.

While the annual campus sustainability reports (e.g., the 2009 Campus Sustainability Report) concentrate on transparency for traditional environmental indicators – like energy and water usage and recycling – UC Berkeley separately reports on social and economic measures of sustainability.

Student, faculty, and staff were committed to taking a leadership role to promote environmental awareness, global thinking and local action. Key strategies for sustainability were addressed such as: Protecting and enhancing the campus environment; Reducing campus greenhouse gas emissions; Conserving natural resources through their sustainable use in building projects, transportation and campus operations; Purchasing environmentally preferable products, minimizing the use of toxic substances, and handling wastes responsibly; Conducting innovative research on sustainable technology and practices; Increasing awareness of these values through instruction and example; and Collaborating with a diverse and engaged campus community on these issues to help fulfill the university mission.

1.9.2 University of Wisconsin–Milwaukee

On the other hand, University of Wisconsin–Milwaukee in its Master Plan Update Board of Regents, 2009, has used a toolkit assessment. This tool was produced by Good Company, a private sector business based in Oregon, USA, in the summer of 2002. Their objective was to produce a fairly simple and straightforward tool that they could market to potential university and college customers interested in sustainability assessment. The tool has 20 core indicators and 10 supplementary indicators, each with a performance benchmark attached (Good Company, 2002). One of the major strengths of this tool is that it is quite compact and focused, while still maintaining some depth of sustainability issues and coverage of both human and ecosystem dimensions. It is a tool of manageable size and is thus very useful for high-level decision-makers.

To simplify the assessment process, the working team has divided the project into four phases:

- Phase A includes Building and Infrastructure Assessments, Space Needs and Utilization Assessment, and Parking Study.
- Phase B includes: Academic Program Distribution, Site Studies, Decision Tree, Research
- Phase C includes: Design Guidelines, Detailed Site Studies.
- Phase D includes: Implementation Plan, Final Master Plan Document.

They used the green principles category such as community, social and economic, water resources, energy and emissions, natural systems, transportation options, and materials. Then they developed a comprehensive approach to transportation. After that, they developed the campus life by improving the study space, learning common , activating first floors of existing buildings, recreation and open spaces, athletics, collaboration space and student house. Observing that they assessed sustainability depending on modern or recent parameters not traditional parameters (environmental only). Finally, the result of this study was a proposed sustainable master plan of the future university campus to be updated over time.

1.10. Conclusion

It is very important to address sustainability issues in our communities; especially Palestinian universities campuses master plan .The Palestinian universities are for long suffering many problems especially in sustainability issues due to many reasons related to the special circumstances in Palestine and especially in Gaza.

Many researches refer to Cole (2001), Cole (2003), Crystal (2004), Rodriguez (2002) and others in this regard were established on the international level by using different tools and frameworks. But this study is the first one to highlight the importance of sustainability assessment in master plans of the Palestinian universities using computer tools.

Chapter (2): Universities' Situation in Gaza

2.1. Introduction

Universities are important primary sources for the development of the community in all areas of life. These institutions play an important and active role in the overall development in the social, economic, political, cultural and other aspects of life. They are the most appropriate institutions to preserve values and ideas that community seeks to produce and promote successive generations.

Furthermore, the universities play a major role in the preparation and development of resources needed for scientific and technological progress and cultural development of any society.

Universities in Gaza were established as a solution for large number of students who can't cover fees of education abroad and desire to complete their education locally. They have been suffering from many problems due to various obstacles and constraints related to the political, economic and social situation in Gaza, as well as in Palestine as a whole. Scarcity of land, lack of funding, problems in design and operation are the most important issues in these universities.

This chapter highlights the concept of the university and its function and role as an academic institution, the emergence of universities in Gaza and the current situation of these universities.

2.2. Concept and function of the university

The university is a complex social organization occupying a strategic position in the education ladder. Within the university context as learning organization, there is a prima facie, fertile group for the development of the individual. University education is the culmination of a long process of human development which starts formally from the elementary level, running through middle and secondary school organizations. (Lewis, 2008, Nakpodia, 2009)

The university is made up of people with different backgrounds in terms of needs, skills, talents, status, competencies, knowledge, behavioral styles, interest and perceptions. (Nakpodia, 2003) In fact, the skills and high level manpower needed for the growth and development of any nation are produced by the universities. According to the National Policy on Education (NPE, 2004), universities as learning organizations are centers of excellence, teaching, research and store houses of knowledge.

Universities have an obligation to support local and regional communities, making every action lead to community improvement. Higher education institutions are anchor institutions for economic development in most of their communities, especially now that the private sector moves facilities, capital, and jobs frequently as mergers, acquisitions, and globalization become the norm for corporation. (Cortese, 2003)

According to Garrison (1959: P26), "the Function of the university is to help you learn to think for yourself and how to use the tools of thinking in a grown- up, responsible and socially effective way".

From the researcher point of view, the University is a society for a mixture of social, psychological, environmental, and educational activities. The final products of these activities are human resources, research and services such as consultancies and training . The quality of these products is a good indicator to what extent the University has the privilege of turn and uniqueness. University education in particular is one of the important indicators in measuring the degree of development of societies. The university is a place of knowledge, experiences, experiments and warehouse of solutions to many of society's problems; this means that the university stands at the top of the pyramid of the society, which would qualify it to play an important role in cultural, economic, social and political life. Contribution of the university in the community development is the most important role it plays.

2.3. Aims of university education

According to (Nakpodia, 2003) there are four aims for university education as follows:

1. The acquisition, development and inculcation of the proper value orientation for the survival of the individual and the society.
2. The development of the intellectual capacities of individuals to understand and appreciate their environment.
3. The acquisition of both physical and intellectual skills, which will enable individual to develop into useful members of the community
4. The acquisition for an objective view of the local and external environs.

The benefit of university education to society is to form partnerships with local and regional communities to help make them socially vibrant, economically secure, and environmentally sustainable. Because students learn from everything around them, activities such as, teaching, research, operations, and relations with local communities should be integrated to form a complex web of experience and learning.

2.4. Current situation of universities in Gaza

Universities in Gaza were selected due to the special situation of Gaza, its limited area, rapid growth of population, high level of poverty, scarcity of resources and land, and degradation of environmental aspects.

2.4.1. Background of Gaza strip

Gaza strip lies on the Eastern coast of the Mediterranean Sea at geographic coordinates of 31° 25' N, 34° 20' E. The Strip borders Egypt on the southwest and the Palestinian occupied lands on the east and north (Figure 2.1). It is about 41 kilometers long, and between 6 and 12 kilometers wide, with a total area of 360 square kilometers. The strip takes its name from Gaza, its main city (Fact world book, 2010). The population is about 1.5 million people; one million of the population is refugees (UNRWA, 2010).



Figure (2.1): Gaza Strip borders
Source: (Theodora, 2010), reproduced

Gaza strip has a temperate climate, with mild winters, and dry, hot summers subject to drought. The terrain is flat or rolling, with dunes near the coast. The highest point is 105 meters above sea level. Natural resources include arable land (about a third of the strip is irrigated), and recently discovered natural gas (Fact world book, 2010).

Environmental issues in Gaza strip are in a critical state manifested by shortage and pollution of resources coupled with long- term environmental degradation that has accumulated over previous years of occupation. In an already densely populated area, there are rapid population growth, scarcity of water, limited access to water resources, desertification; salination of fresh water; sewage treatment; water-borne disease; soil degradation, depletion and contamination of underground water resources (EQA, 2004).

The economy of the Gaza Strip is severely hampered by high population density, limited land access, strict internal and external security controls, and the effects of Israeli military operations, and restrictions on labour and trade access across the border. Per capita income was estimated at US\$ 3,100 in 2009, a position of 164th in the world. Seventy percent of the population is below the poverty line according to a 2009 estimate (Fact world book, 2010).

Gaza acquired its current boundaries in 1948 Arab–Israeli War. Then, Gaza continued to be under the Egyptian control. At first it administered the territory through the All-Palestine Government and then directly from 1959 until 1967, when Israel occupied it following the Six-Day War. In 1993, the Palestinian Authority was set up as an interim administrative body to govern Palestinian population centres, with Israel maintaining control of Gaza's airspace, some of its land borders and territorial waters. After that, Israel withdrew from Gaza in 2005. Since July 2007, following the 2006 Palestinian legislative election; Hamas has functioned as the effective government in Gaza (Wikipedia, 2010) .

2.4.2. The emergence of Palestinian universities in Gaza

The emergence of Palestinian universities in Gaza refers to two main factors. First, the desire of the Palestinian people, the positive and determination hard to collect education, and made its follow-up of higher education in Arab universities and the world. Second, recognition of national leadership that the Palestinian people's needs and priorities of education, under the occupation, had to create institutions and national higher education on Palestinian land. (Ministry of Education, 2003)

In 1978, it deemed necessary to a group of community leaders to establish a higher education institution in Gaza Strip to serve thousands of students and to help them save their time, money and effort. On that account was the establishment of the Islamic University of Gaza (IUG, 2010). This was followed by the establishment of

university-Azhar University and Al Quds Open University, the University of Al-Aqsa, University of Palestine, and many other universities (Elholi, 2004). Table (2.1) illustrates the first established universities.

The Palestinian universities are mostly the result of private initiative, non-profit and non-governmental organizations. The Palestinian higher education is unique in this regard, both in the Middle East and in most parts of the world, where government institutions are the norm. The structure of non-profit and non-governmental Palestinian universities is one of their defining characteristics (Ministry of Education, 2003).

No.	University	Date of Emergence	Number of Students 2009-2010
1	Islamic University of Gaza	1978	17,052
2	Al-Azhar University of Gaza	1990	19,914
3	Al-Quds Open University	1991	60,000
4	Al-Aqsa University	2001	13,436*
5	University of Palestine	2003	1000
* The total number of students in Gaza and Khan-younis.			

Table (2.1): The first established universities in Gaza.

Source: Admission and Registration Deanships of these universities, 2010, reproduced.

2.4.3. Obstacles and constraints

Despite, the important role of the Palestinian universities in Gaza strip in providing local and international labor market with qualified and trained personnel over the past years, they are suffering various obstacles relate to many reasons. Some of these reasons refer to the general situation in Gaza strip and on the other hand some refer to the master planning and design of these universities.

A. Political constraints

Palestinian universities in Gaza have been affected by the Israeli occupation which resulted in limited access to water, limited logistic options such as raw material for construction, importing required equipment, instruments, papers, books, or even spare parts for maintenance. For example, some buildings of IUG were damaged on the last war on Gaza and remained without reconstruction due to the lack of raw materials.

It is important to note that virtually all universities sustained damages, with a total of six university buildings damaged beyond repair and sixteen moderately damaged. Damages to universities account for 77% of the total damages to education facilities. (UNDP, 2009) Percentages of damages of Palestinian universities in Gaza are shown in table (2.2).

Furthermore, Israeli's seige, and restrictions on movement everywhere prevents students and faculty from Gaza to travel abroad to complete their education or to exchange experts and knowledge with others. It also forbids the arrival of specialists and scientific expertise and stakeholders to provide expertise, support, and carry out the situation of the Palestinian universities.

Table (2.2): Percentage of damages of selected Universities in Gaza

Source: (UNDP, 2009), reproduced

	University	% of damages
1	Islamic University of Gaza	67.7 %
2	Alaqsa University	5.8 %
3	Al-Quds Open University	0.6 %
4	Alazhar University	19.2 %
5	University of Palestine	0.6 %

B. Financial constraints

The economic development of the occupied Palestinian territories largely depends on donor funding. According to the Resource Development in IUG the main sources of funding are from local and international NGOs, little of these resources are from students' fees.

The availability of secure funds is an essential requirement for the implementation of any development project. (EQA, 2004)

Deteriorated political situation and political affiliation in Gaza resulted in lack of funding for most activities in Gaza; universities are one of these activities. It is important to know that, after last war on Gaza, funding is employed for emergency relief. The report of UNDP (2009) highlighted that Gaza's recovery efforts benefited from greater support from Arab donors and Islamic international NGOs and organizations than from traditional donors, United Nations organizations and Western

international NGOs. The repair of hospitals, clinics, schools, universities, the rehabilitation of damaged agricultural infrastructure and the emergency repair and reconstruction of houses was essentially performed with support from Arab funding and by NGOs and organizations such as Islamic Relief, Qatar Red Crescent, Qatar Charity, Human Appeal International, Al-Rahma Charity Association, Mercy Malaysia, and Muslim Hands. UN agencies, traditional donors and Western NGOs have tended to emphasise input-driven emergency relief and cash-based programmes over structural rehabilitation works that the Israeli-imposed embargo on the Gaza Strip aims at preventing.

C. Scarcity of land

Gaza strip has a limited area of 365 sq km, with a rapid growth of population, due to this situation universities also suffer from the growth in the number of enrolled students over the years despite of the limited area of the university. For example, Al Azhar University of Gaza (AUG) started with 2 faculties i.e. Faculty of Education, & Faculty of Religious Studies. Due to its success, other new faculties were established to reach twelve faculties in 2010. (AUG, 2010) The number of students in AUG is doubled from year 2005 to 2010 as shown in (figure 2.2). As a result the area required for each student decreased from 2.8 to 1.5 sq m.

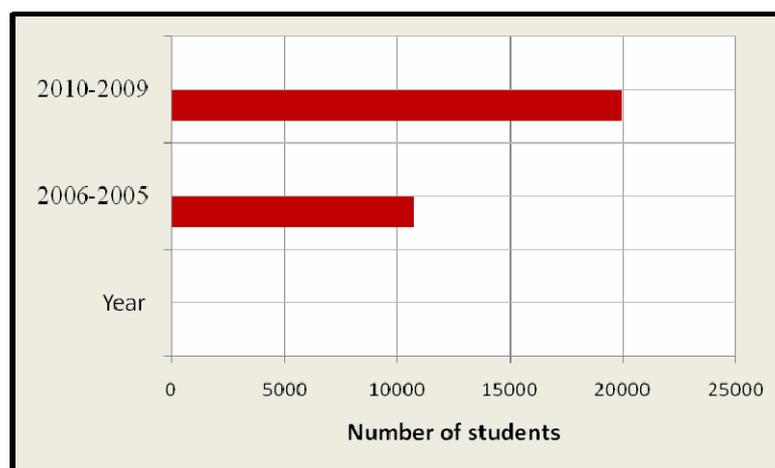


Figure (2.2): Total number of students in AUG from 2005 to 2010

Source: Admission and Registration Affairs of AUG, 2010, reproduced

Furthermore, the Islamic University of Gaza (IUG) started with three faculties then in 1980 three more faculties were accomplished and due to its success and the needs for

further specialists, other new faculties were established to reach thirteen faculties in 2010. The number of students in IUG increased from 5,000 up to 20,000 students in 2011 as shown in figure (2.3), this means that the specified area for each student decreased from 16 sq m to 4 sq m.



Figure (2.3): Total number of students in IUG from 1978 to 2011

Source: Admission and Registration affairs of IUG, 2010, reproduced

According to the Accreditation and Quality Assurance Commission (AQAC), the area required for a student in the comprehensive university (a university which includes a master program) is at least 15 sq m. Figure (2.4) shows the proportion of area specified for each student in the selected universities in Gaza.

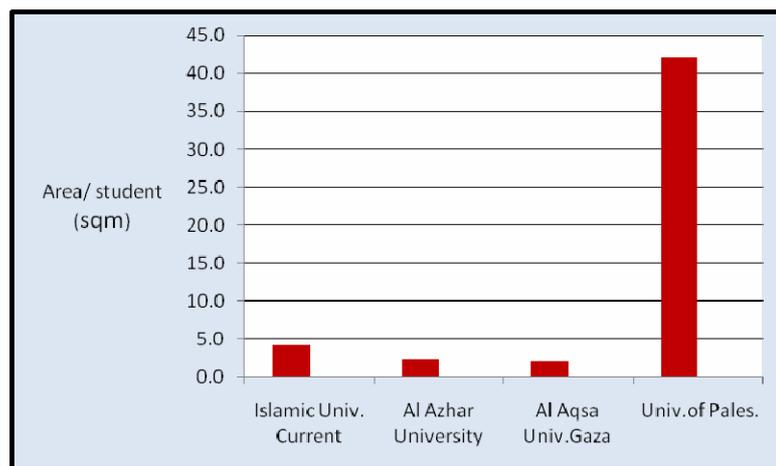


Figure (2.4): Area per student in the selected universities in Gaza

Source: The researcher, 2010.

Also the total area of the site for the comprehensive university shouldn't be less than 50,000 sq m; according to AQAC. Figure (2.5) illustrates the sites areas of the selected universities in Gaza.

The figure shows that al Aqsa and Al Azhar universities are suffering from lack of land specified for facilities.

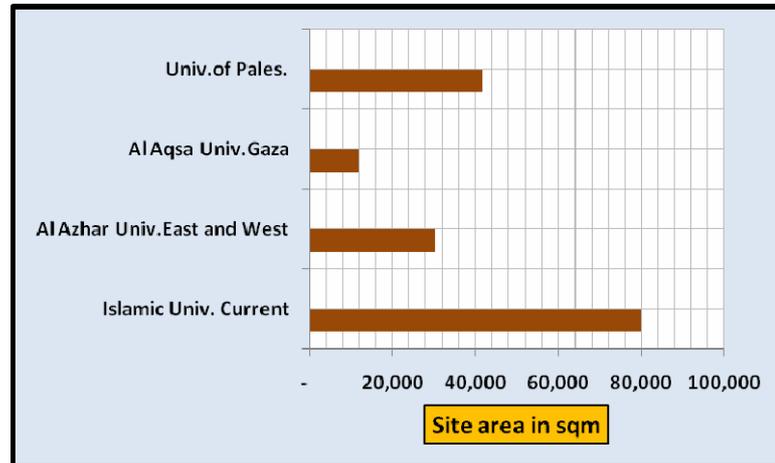


Figure (2..5): Total sites areas of the selected universities in Gaza.

Source: the researcher, 2010

Due to the limited area and the increasing number of faculty students and staff; IUG, AUG and Al Aqsa universities seek to establish new extension universities to accommodate these numbers of population. "Due to the growth of the university beyond its capacity the board decided to shift the university campus from the crowded area in Al Rimal South district due to the following reasons: Presently, all the universities have been clubbed together which supports more than 40,000 students coming from different regions. And secondly, in order to maintain the securities of the ministries and UNRWA headquarters which are located in the same area". (AUG, Master Plan, 2008)

D. Building construction and renovation

Universities in Gaza are not based on green design principles such as using a building energy management system or environmental management system to monitor water and waste management systems and using new cleaner construction technology to reduce environmental impact. They aren't even designed to decrease heat loss in winter or reduce cool air loss in summer. Using recycled materials, recyclable materials, avoidance of toxic construction materials, paints and other materials, high-insulation or turf roof of the buildings are not considered.

Best practices are not utilized in the design of universities in Gaza to ensure healthy and sustainable facilities. Buildings are not designed to be energy efficient or based on life-cycle performance.

E. Energy conservation

According to the World watch Institute, about 40% of the world’s total energy usage is dedicated to the construction and operation of buildings. Three fundamental strategies should be taken to increase energy performance: reducing demand, taking advantage of natural systems, and increasing efficiency. Demand is reduced by optimizing the building footprint and orientation on the site, use of lighting controls and task lighting, occupant controls and occupant behavior changes. Natural systems can be utilized by orienting buildings to take advantage of natural light and natural ventilation (e.g. operable windows). Increasing efficiency can be achieved through the use of suitable building materials, limited use of air conditioning, use of high-efficiency lighting and appliances (Victoria, 2006). This means using passive systems and energy efficient active systems.

From observations in some northern faculty's offices in Teba building in IUG, artificial lights were lighted all over the day due to the lack of daylight. From calculations, it was obvious that the electricity consumption increases in winter and summer months due to the use of mechanical heating and cooling (Figure 2.6).

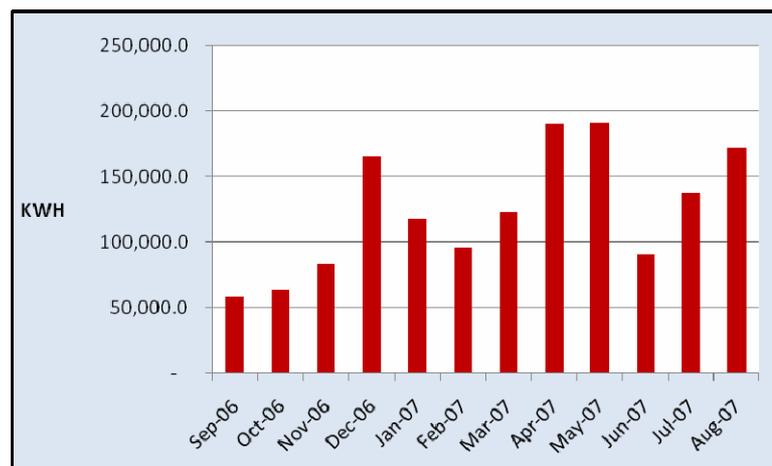


Figure (2.6): Monthly electricity consumption in IUG 2006-2007
Source: IUG Department of Finance, 2010, reproduced

F. Waste reduction practices

Waste reduction practices such as the use of e-communications, double sided copying, "waste free lunch" program, are very important to lower adverse impact on environment. Universities in Gaza use e- communications inside and outside to high extent while they don't address double sided copying or "waste free lunch" program such as using reusable dishes or containers for food and drinking.

G. Recycling of solid waste

Recycling involves putting a material through some kind of process so it can be used again. In certain situations this can be an intensive process so the benefits are lost. However, recycling can reduce demand for raw materials, reduce emissions to air and water in the production process, and reduce disposal impacts through less waste going to land fill. Solid waste including paper, plastic, metal and electronic waste. From interviews and observation there are no usage of recycling, separate recyclables containers such as "white and colored office paper" and "bottles and cans" in various universities in Gaza are not available.

H. Sustainable food program

Sustainable food means to plant sources of food on the university land such as local organic food. None of the Palestinian universities in Gaza has a program for planting food inside the university site due to the lack of site area; planting food in the inner site will minimize the needs for transportation which have an adverse impact on the environment. On the other hand, these plants will increase the green area. IUG plants some olive and palm trees, while other universities have very little of such plants.

I. Water conservation practices

These practices including efficient toilets, minimal irrigation, and harvested rainwater, almost all universities in Gaza don't have great attention in water conservation except the using of dual toilet and sprinklers for irrigation. According to (Al khaldi, 2010) the principal of the Environmental and Rural Studies Center (ERSC) in IUG, the harvesting rainwater system is not effective due to its high cost.

J. Sustainable landscaping and green spaces

According to the Palestinian AQAC, the area of green spaces should be at least 25 % of the total site area. In Palestinian universities in Gaza, there is lack of green spaces as shown in figure (2.7).

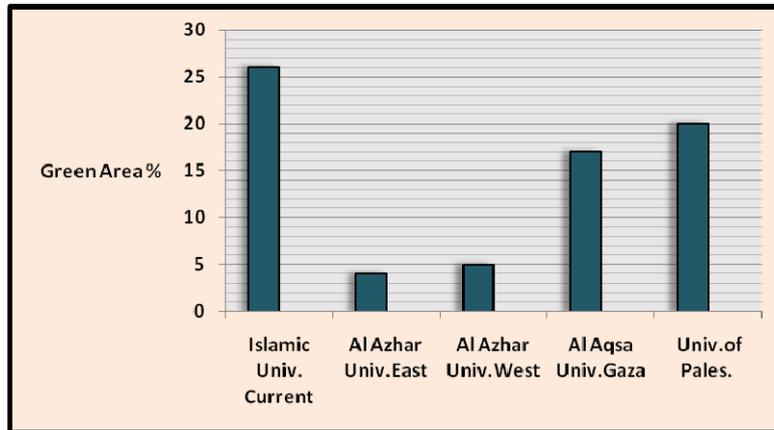


Figure (2.7): The percentage of green area to the total site area.

Source: Engineering Offices of these universities, 2010, reproduced

K. Sustainable transportation program

Including bicycle/ pedestrian friendly system, bus passes programs and biodiesel project. Sustainable transportation options should be incorporated into sitting decisions to reduce dependence on car travel, reduce the amount of impervious pavement on the site, and reduce the financial, environmental and community costs associated with excessive parking supply. (Victoria, 2006) In Gaza, IUG, AUG, and Al Aqsa university which accommodate more than 40,000 students are located in the same area which is served by public transportation, but there is no policy for pedestrian friendly system as the private and public transportation enter to the inner of the site.

L. Green purchasing

Purchasing from environmentally and socially responsible companies (products are non-toxic, water and energy conserving; IUG Purchasing Department doesn't have a policy of green purchasing. However, they select appliances and instruments which reduce electricity consumption such as LCD screens. (Purchasing Department of IUG, 2010)

M. Environmental or sustainability assessments/ audits

Interviews were made with the president of University of Palestine Dr. Salem El Sabbah on August, 2010, and the principal of ERSC of IUG on September, 2010, they declared that there is no environmental or sustainability assessment program to assess the level of sustainability in these universities.

2.5. Conclusion

Palestinian universities are suffering many problems due to the general situation of Gaza under occupation and due to difficulties related to lack of funding, scarcity of land, design and operation.

To solve and mitigate these problems; issues of sustainability guidelines should be considered. The next chapter illustrates the identification of sustainability, the necessity of addressing sustainability in our community especially in universities in Gaza strip.

Chapter (3): Sustainability of University Master Plans

3.1. Introduction

The overall aim of sustainable university master plan is to achieve a healthy and high quality life for all users of the university, the whole society and subsequent generations, with equitable and geographically balanced and socially cohesive economic development, which reduces the impact on the global and local environments.

“Universities, as centers for research, teaching and training of qualified personnel for the nation, must be increasingly available to undertake research concerning environmental education and to train experts in formal and non-formal education. Environmental education is necessary for students in all fields, not only natural and technical sciences, but also social sciences and arts, because the relationship between nature, technology and society mark and determine the development of a society”. (UNESCO-UNEP, 1977, p: 33)

The fundamental educational task of universities is to make the choice for a sustainable planetary habitat of interdependent life forms over and against the pathos of the global competitive marketplace. (O’Sullivan, 1999; O’Sullivan, Morrell & O’Connor, 2002)

This chapter illustrates the concept of sustainability and its fundamental premises. Furthermore, it explains the necessity of addressing sustainability in our communities due to the recent global changes in all aspects of life. In addition, this chapter focuses on addressing sustainability in the Palestinian universities in Gaza with more focus on the benefits of assessment using a suitable comprehensive tool. Selection of this tool depends on specific criteria and a survey of the alternative existed tools.

3.2. The Concept of sustainability

Historically, the term "sustainable" arose among those with environmental concerns, and most of the literature and assessment instruments reflect this emphasis. However, it is increasingly recognized that sustainability cannot be achieved without addressing social justice issues. There can be no sustainable communities and institutions without social justice. Therefore, humane consideration toward the whole community of life is an essential part of true sustainability. (John B., 1998)

Sustainability is an evolving paradigm for planning and decision- making. It is a promise, a dynamic condition which requires a basic understanding of the

interconnections and interdependency among ecological, economic, and social systems. (The sustainability Education Center, 2002)

Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. (Brundtland Commission (United Nation), 1987) In the decade, following the publication of the Brundtland Report, over 100 alternate, more detailed definitions of the sustainable development, and the related term sustainability, were proposed (Elkington, 2002, Murcott 1997). Although they may differ in scope depending upon whether they are designed for individuals, companies, or national governments, most definitions of sustainability share the same foundation. This foundation consists of three fundamental premises (Rodrigues, 2002) as follows:

3.2.1 Continued development depends upon the availability of critical inputs:

This dependence can be either direct or indirect. These inputs fall into one of four categories:

- **Ecological:** renewable resources, such as food and timber, and services, such as protection from ultraviolet solar radiation, water filtration by wetlands, and many other services, which are provided by healthy natural ecosystems.
- **Material:** non-renewable resources.
- **Human:** knowledge and the means, including income, health, human rights, freedom, and opportunity, to apply that knowledge.
- **Social:** trust, reciprocity norms, equity, and other conditions that permit coordination and cooperation for mutual benefit.

The two other fundamental premises according to Rodrigues (2002) are:

3.2.2 There are limits to the availability of finite material resources and to the regenerative capacity, or carrying capacity, of ecological resources.

- **Ecological, social, and economic systems are interdependent complex systems. As such, they are heterogeneous, dynamic, non-linear, and adaptive groupings of agents whose actions have impacts within each of the three realms.**

However, most definitions of sustainability agree that sustainability, regardless of what entity it considered, involves two critical elements as mentioned by (Sustainable Measures, 1998):

- ◆ Ensuring that there are sufficient supplies of the ecological, material, human, and social resources necessary to allow humans to meet basic needs and to support continued development, and
- ◆ Ensuring that access to this sufficient supply of resources is equitable both intergenerational (among all members of the current generation) and intra-generationally (between this and future generations).

In simple words, sustainability can be defined as reducing impacts of projects and humans on environment and conserving resources so that current and future generations can live and learn in a healthier environment.

3.3. Importance of sustainability

The importance of sustainability can be defined in two ways. First, sustainability can be seen as a necessity in order to avoid the costs of deteriorating social, environmental, and economic systems. Second, sustainability can be seen as a source of new opportunities to improve the rate and extent of human development. (Rodriguez, 2002)

Sustainability as a necessity, began with Thomas Malthus' seminal essay on the Principle of Population in 1798, and continued with Meadows book in 1972: Limits to Growth. Scientists have long warned of the dangers of unconstrained expansion of human consumption. International leaders convened for the first time around the issues of global environmental and development needs at the U.N. Conference on Human Environment in Stockholm in 1972 . Lester Brown founded the World Watch Institute, now publishers of the annual State of the World publication, in an effort to increase access to information about emerging environmental problems. (Rodriguez, 2002)

Today, countless publications and websites chronicle the ways in which human society is failing to abide by the sustainability postulates, and thus risking the health of the global ecosystems and life-supporting natural services upon which it depends. While debate over the extent and risk of these failings occurs, most scientists and experts agree upon a number of core challenges to the health of environmental and social systems. (EPA 1990, Elkington, 2001)

The list below is derived in part from a national risk ranking exercise undertaken by the U.S. Environmental Protection Agency (EPA) to illustrate the necessity of addressing sustainability issues:

3.3.1. Global climate change

The atmospheric concentrations of key anthropogenic greenhouse gases (i.e., carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and tropospheric ozone (O₃) reached their highest recorded levels in the 1990s, primarily due to the combustion of fossil fuels, agriculture, and landuse changes. Projected concentrations of CO₂ in the year 2100 range from 540 to 970 parts per million (ppm), compared to about 280 ppm in the preindustrial era and about 368 ppm in the year 2000. (UNEP, 2001) While the effects of increased levels of atmospheric greenhouse gases are complex to predict, the Intergovernmental Panel on Climate Change (IPCC) has forecasted that global mean temperatures will increase from 1.4 to 5.8 degrees centigrade, with average predictions in the neighborhood of 2.5 degrees centigrade (IPCC, 2001a). Further, it is predicted that global warming will cause a 50 cm rise in sea level that risks displacing millions of people in low-lying delta areas and small island states, a shift in agricultural production zones that risks reducing production capabilities in the tropics where food deficiencies already exist, and an increase in the frequency of severe weather events. (UNEP, 1997)

3.3.2. Habitat destruction, species extinction, and loss of biological diversity

Over 90% of the original vegetation in the world's 25 most diverse regions, or hotspots, has been lost. (Conservation International, 2002) Habitat destruction and overuse of resources has also led to shrinking amounts of productive cropland and collapsing fisheries around the world.

3.3.3. Stratospheric ozone depletion

Without the blocking effect of stratospheric ozone, Ultraviolet Radiation (UV-B) can enter the Earth's atmosphere. UV-B radiation has adverse human health effects, and can disrupt natural ecosystems. Following the phase-out of CFCs in industrialized countries mandated by the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer, much progress has been made in repairing the hole in the ozone layer. However, production in many developing countries remains a concern. (UNEP, 1997)

3.3.4. Population growth

The world's human population is currently growing at approximately 1.2% per year. Six countries account for roughly half of this annual growth: India (21%), China (12%), Pakistan (5%), Nigeria (4%), Bangladesh (4%), and Indonesia (3%). The United Nations Population Division estimates that by 2050, world population will register

between 7.9 billion (low variant) and 10.9 billion (high variant), with the mean projection of 9.3 billion (UNEP, 2001). By 2025, the total population living in urban areas is projected to double to more than 5 billion people (Figure 3.1), putting increasing pressure on urban resources. 90% of this increase is expected to occur in urban areas within developing countries. (UNEP, 1997)

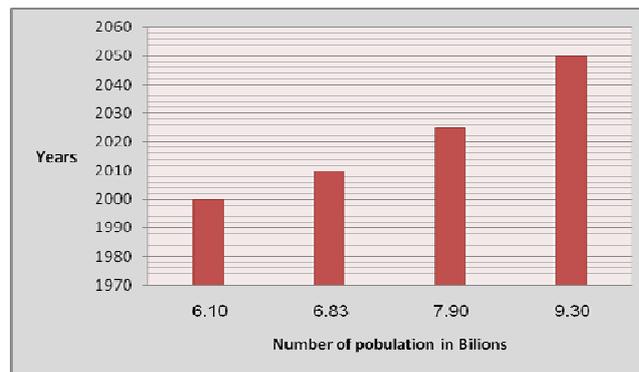


Figure (3.1): World Population Growth and Projection.
Source: UNEP, 1997, reproduced

3.3.5. Access to fresh water

Underground water tables are falling in many areas as withdrawal rates exceed rates of recharge. Under China's agricultural plain, which produces around 40% of the country's grain, the water table is falling by 5 feet per year. Nearly one sixth of the world's population lack access to improved water sources. (UNDP, 2001)

By 2020, water use is expected to increase by 40 percent, and 17 percent more water will be required for food production to meet the needs of the growing population. According to another estimate from the United Nations, by 2025, 1.8 billion people will be living in regions with absolute water scarcity, and two out of three people in the world could be living under conditions of water stress. (UNEP, 2007)

3.3.6. Human health

Over one third of the world's population lacks access to basic sanitation. This and other health problems are concentrated predominantly in the developing world. (UNDP, 2001) The lack of sanitation produces pollution and other environmental problems which in turn lead to many diseases.

3.3.7. Increasing inequity in income distribution and education

Of the 4.6 billion people in developing countries, 1.2 billion live on less than \$1 a day, 2.8 billion live on less than \$2 a day, and 854 million adults are illiterate, over half of them women. (UNDP, 2001)

On the other hand, a study by the World Institute for Development Economics Research at United Nations University reports that the richest 1% of adults alone owned 40% of global assets in the year 2000. The three richest people possess more financial assets than the lowest 48 nations, combined. The combined wealth of the 10 million millionaires grew to nearly \$41 trillion in 2008.

Related to wealth condensation are the effects of intergenerational inequality. The rich tend to provide their offspring with a better education, increasing their chances of achieving a high income. Furthermore, the wealthy often leave their offspring with a hefty inheritance, jump-starting the process of wealth condensation for the next generation.

As a result, those who are unable to afford an education, or choose not to pursue optional education, generally receive much lower wages. There is a link between income inequality and social cohesion. In more equal societies, people are much more likely to trust each other, measures of social capital suggest greater community involvement, and crime rates are consistently lower. For instance, crime rates, and mental health problems are lower in countries like Japan and Finland compared to countries with greater inequality such as the US and UK.(Wikipedia, 2010)

3.4. Sustainability in Gaza

The previous problems mentioned are globally, but many of these problems do in Gaza.

3.4.1. Micro-Climate change:

Smoke and gases from coal-fired power plants in Ashdod and Ashkelon in Israel are transferred to Gaza Strip. The Israeli industries in the West Bank and around Gaza Strip, as well as industries in Israel form the greatest threat to atmospheric pollution in the Palestinian Territory. Climate experts expect that gases emitted from the 1948 territory will be increased by 40% by the year 2020. (PCBS, 2009)

The forms of climate change in Gaza strip include decrease in rainfall amounts and increase of temperatures. Data showed that the amount of rainfall ranged between 230 mm in the south (Rafah) to 430 mm in the north of Gaza strip, the total average rainfall

reaches to about 330 mm annually. Heavy rain is limited to fewer than 50 days, with around 70% of the rain falling during November to February. Summer temperatures reach 37° centigrade and in the winter temperature may drop to Zero. Gaza strip is affected by annual waves of hot, dry, sandy and dust Khamaseen winds which originate from the Arabian Desert during the months of April, may and mid- June. (PCBS, 2009)

3.4.2. Annual population growth

Population density of the Palestinian territories is high in general and in the Gaza Strip in particular. This is because of the concentration of about 1.5 million people in the area does not exceed 365 km² most of them are Palestinian refugees who have been deported from their villages and towns that were occupied in 1948. The population density estimated for the year 2009, 4,073 person / km² in Gaza Strip. Annual growth rate is 3.4 %. (PCBS, 2009) Also, the available water resources are less than the actual needs of the population. According to Environment Quality Authority (EQA, 2004), the water demand for different purposes is expected to rise from current level of 125 MCM/ year to about 230 MCM/year by the year 2020.

Rapid population growth is partially or completely limited by poor health. Human health dynamics are further complicated by the increased density of humans because high densities facilitate the increase and spread of infectious organisms among people (Pimentel et al, 1998).

3.4.3. Human health

A household sample survey to collect information on living conditions was carried out in the Gaza Strip, 3–12 March 2009. The survey showed that around 1% of the population was suffering severe acute psychological distress. Children between five and nine years old (especially girls) seem to have been particularly affected. A few weeks later, World Health Organization (WHO) carried out a second survey to measure the prevalence of psychological distress among 500 adult patients visiting five primary health-care centres in the Gaza Strip. The results revealed that 37% of the adults surveyed showed psychological distress. There were no discernible differences between males and females. Older patients showed higher rates of prevalence, approximately 70%. (WHO, 2010) It is important to know that human health plays an integral role on human existence, productivity and development.

Human health depends on the continued flow of nature's goods and services. It is quite obvious that acting to sustain natural capital to reduce future risks to human health would help alleviate many of the existing local and global health problems. (McMichael et al, 2003)

3.4.4. Increasing inequity in income distribution and education.

The average poverty line for the reference family (consisting of six individuals, two adults and four children) in the Palestinian Territories in 2007 reached to about U.S. \$ 580, while the extreme poverty line for the same family reference about U.S. \$ 482. Rate of poverty among Palestinian families during the year 2007, according to real consumption patterns is 55.7% in Gaza Strip. While 57.3% of households with a monthly income less than the national poverty line 76.9%. About 23.8% of the families of the Palestinian territories suffer from extreme poverty; 43.0% of them in Gaza Strip. Furthermore, about 48.0% of households with a monthly income less than the extreme poverty line; 69.0% of them in Gaza Strip.

In 2009, available statistics showed that 45.4% of the youth (15-29 years) were enrolled in education, 86.5% among them are from (15-17 years), 50.9% (18-22 years) and 11.6% (23-29 years). Statistical indicators also showed that dropout rates (both of those who were previously enrolled and left or not attending) had reached 29.0% distributed to 32.8% for males compared to 25.0% for females.

In addition, 8.0% of males in the age group (15-29 years) have completed at least the first university degree compared to 10.0% for females in the same age group, whereas 3.7% of males haven't completed any educational stage compared to 2.5% for females in the age group (15-29 years). Furthermore, 0.8% of the youth (15-29 years) are still illiterate, of whom 0.9% are males and 0.8% females. (PCBS, 2009)

Social sustainability is systematic. It involves human capital that invests in education, health, and nutrition of individuals and is now accepted as a part of economic development. Ultimately, there can be no social sustainability without environmental sustainability because environmental sustainability supplies the conditions for social sustainability (Goodland, 1995).

Many of the existing local health problems are associated with poverty, inequity, and illiterate. Poverty produces from the unfairly distributed resources. Problems of unsustainability related to lack of education which leads to lack of awareness and

recognition of the needs to maintain, preserve natural resources as well as reduce adverse impacts on environment.

3.4.5. Solid waste generation and disposal

There are three landfills in Gaza; in south, central and northern Gaza respectively. All have been established with donations from international agencies and have basic infrastructure and equipment, including weighbridges to measure the weight of trucks. According to Al Shami (2008), the total quantity of solid wastes ranges from 1000 to 1200 Ton /Day; 600 to 800 Gram for individual, Figure (3.2). The aim of sustainability is to find a solution for solid waste management that produces zero waste. Such solution is based on waste minimization. Reducing the amount of solid wastes and the efficient disposal of these wastes contribute to reducing the impact of environmental pollution and enhance sustainable urban areas.



Figure (3.2): Solid waste pollution in Gaza

Source: (Al Shami, 2008)

3.4.6. Depletion of water resources and deteriorating of water quality

Gaza is an arid area with scarce water resources. The extraction of ground water currently exceeds the aquifer rate. The total existing Palestinian consumption is about 125 Million Cubic Meter (MCM) /Year, whereas the total renewable amount from rainfall, return flow and lateral inflow is estimated at about 85 MCM/ Year. As a result, the ground water level is falling and chloride concentrations are increasing, making the water unfit for either human consumption or for irrigation. The utilization of the Israeli wells around the border of Gaza has accelerated the increase of salinity of the groundwater. However, water use in domestic sector in 1995, 2004 and the projected 2010 are presented in figure (3.3). This increase of water use is due to the population growth.

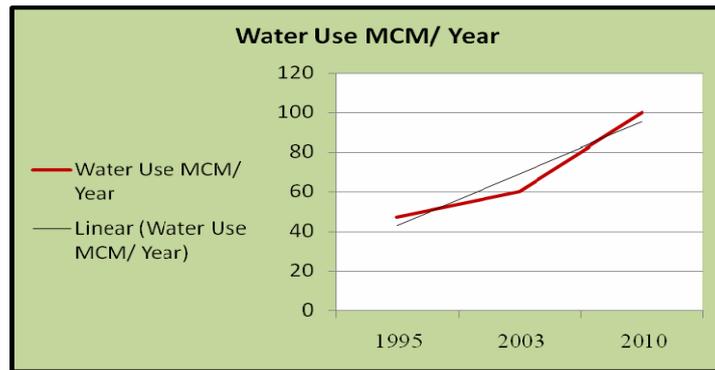


Figure (3.3): overview of domestic water use in Gaza.

Source: (EQA, 2004)

The water demand for different purposes is expected to rise to about 230 MCM/Year by the year 2020. (EAP, 2004)

3.4.7. Depletion of natural resources

Sand resources in Gaza, especially the coastal sand dunes, represent important environmental value. These dunes traditionally project the coastal areas against the sea. Secondly they have a natural water cleaning capacity, they are the habitat for flora and fauna and finally, they represent certain natural landscape values. Meanwhile, a total amount of at least 25 MCM of sand is estimated to have been excavated from an area of about 5,200,000 sq m. These excavated amounts are used mainly for building purposes in the last 20 years. Only 12 % of the sand excavations are licensed. Sand mining occurs without planning or regulation; it is hardly recognized as an activity responsible for large scale destruction of natural landscape in Gaza. (EAQ, 2004) Extensive sand mining will affect not only the need of such non-renewable resource, but also the purification of natural water and biodiversity.

3.4.8. Waste water and sanitation

The uncontrolled discharge of untreated sewage to the ground surface and the excessive has polluted groundwater resources and led to high nitrate levels in certain area. Approximately **70-80 %** of the domestic waste water produced in Gaza is discharged into the environment without treatment, either directly, after collection in cesspits, or through leakages and overload in treatment plants. Most waste water is discharged into the Mediterranean via 18 different pipelines (EAP, 2004) as shown in figure (3.4).



Figure (3.4): Waste water disposal in Gaza
Source: (Al Shami, 2008)

3.4.9. Soil contamination

Soil is exposed to many of the human, agricultural and industrial activities, which have negative effects on the fertility of the soil and land. The most prominent issue is the excessive use of fertilizers and pesticides. Because of the large increase in population and the limited agricultural area, people have to use fertilizers and pesticides to increase the productivity of agricultural land.

The annual rate of use of agricultural fertilizers reached 12,000 tons of chemical fertilizers, and the annual rate of use of pesticides reached 893.3 tons, consisting of about 160 types, 19 of them are internationally banned for health reasons. The agricultural fertilizers and pesticides dangers are reducing soil fertility and water pollution.

According to Agricultural Statistics for the year 2009, the costs of plant intermediate consumption used for pesticides reached 19.7%, while 26.0% of these costs used for fertilizers. (PCBS, 2010)

These are some of the risks in Gaza, but not all, with no room to put in this study.

Such indicators; dangerous of population growth, the crises of fresh water, unmanaged solid waste and sanitation disposal, and unfair distribution of income and education; sounding the alarm for urgent and rapid action to address sustainability issues in all projects.

Universities are academic institutions which host a significant number of community individuals. For example, universities in Gaza accommodate more than 50,000 individuals, those are representatives of approximately more than 50,000 households which equivalent to approximately 300,000 person (20% of the total population in Gaza) as the average members of each household is 6 persons. (PCBS,

2009) Those students spend the majority of time and practice their life activities in the campuses. Therefore, urgently, sustainability should be addresses in university campus master plans.

3.5. Benefits of sustainability in University Campus Master Plans

The sector of higher education is well poised to support transition to a sustainable society. (Henson, 2007) According to Aber (2009), "It has become clear that finding a way to meet the basic needs of all current and future humans on a finite and stressed planet requires transformative change in thinking, values, and action which must be led by higher education".

An academic institution committed to sustainability should help students understand the roots of today's injustices and motivate them to seek justice and humaneness in full integration with understanding the roots of environmental degradation and modeling environmentally sustainable practices. (John B., 1998)

David Orr, professor at Oberlin College in Ohio and advocate of campus sustainability encourages universities across the world to consider their respective campuses as "living laboratories". These "living laboratories" allow students to learn, faculty to teach and staff to work within a system that is understood as being a model for the world community beyond the university. As a practice tool for what students want to accomplish once they graduate, the university campus as a "living laboratory" allows students to undertake projects that will enhance the biophysical, social and economic environment of their university. Efforts to create a sustainable campus have lacked a strategic plan to direct the focus in a way that would allow areas that have been identified as "areas of concern" to be considered in a coordinated fashion from year to year. (Legacy, 2004)

A sustainable campus community acts upon its local and global responsibilities to protect and enhance the health and well being of humans and ecosystems. It actively engages the knowledge of the university community to address the ecological and social challenges that we face now and in the future. (Cole, 2003)

Finally, it requires educational institutions to rethink their mission and to re-structure their courses, research priorities, community outreach, and campus operations. By preparing students -and the whole campus community- to be more adept decision makers in the increasingly complex, dynamic, and uncertain future that we all face,

integrating sustainability into all of the major activities of educational institutions also presents a tremendous opportunity. (Calder, 2005)

All environmental problems, social and economic risks mentioned could be solved by commitment to reduce greenhouse gas, conducting leading research on climate change and other environmental issues such as waste reduction and management, educating the environmental leaders of tomorrow, educating students in environmentally responsible practices, and first of all establishing a comprehensive campus sustainability master plan.

3.6. The role of university campus master plan in solving sustainability problems

Sustainable planning means that to think in a totally integrated way about planning and that issues of infrastructure, economic, and environmental effects on the surrounding community all be considered in parallel. Also, it means how do we have a plan that works today and at future milestones of the development? Planning from the very start is the only way to reach success.

Master planning means organizing the development of a single parcel of land by locating building(s) or other facilities in particular places, arranging for roads, sewers, water, electricity, and other infrastructure, and developing plans for grading, drainage, landscaping, lighting, and other site improvements. Developers must do master planning at the outset of a development project, and typically pay architects, landscape architects, or planning consultants to assist with this task. Master planning may be a relatively simple proposition for a single house on a small lot, essentially treated as part of the building design. Or it may be a very complex process for a large development covering many acres, done by a design and planning team entirely separate from the building architects.

One main master planning question is whether particular ecological features should be preserved or restored. When it comes to positioning buildings on the site, additional questions come into play. How the building should be positioned to create an attractive, walkable street frontage? To maximize yard or garden space for inhabitants? To maximize solar access? To respect neighbors? Such considerations must be addressed both within the building sitting and within architectural design. They require a detailed study of the site and an ability to understand the many different issues and needs that converge on any particular development project. (Wheeler, 2004)

This means that addressing sustainability in the university campuses master plans is a necessity because the university is a production factory of all active human resources in communities. Stakeholders of these campuses will transfer their sustainable practices inside to their outside community, and this leads to a more sustainable society.

Furthermore, universities are institutions regarded with respect and appreciation so; they can't play an active role in spreading the concept of sustainability in the society, without achieving a significant level of sustainability in its master plan.

Sustainability Impact Assessment could form a major instrument in decision making and for measurement of sustainability in all communities. But it may face some problems such as willing of decision makers to do such assessment. Furthermore, it may face the lack of measurement instruments and tools, and provision of accurate data.

The next chapter discusses the definitions of sustainability impact assessment, the benefits of assessment, tools, and measurements and indicators.

3.7. Conclusion

Sustainability is a necessity nowadays because many environmental, social, economic and limited resources problems threat our planet. These problems are existed at the global level. In our region and especially in Gaza, these problems exceeded due to the scarcity of land and increasing of population growth. Also, it refers to economic bad situation and inequity in education and income distribution.

Universities as educational institutions have the responsibility of transferring sustainability to the students who will transfer it to their society. So, it's very important to accomplish a sustainable campus master plan.

To measure the level of sustainability in these campuses, assessment tool should be selected depending on specific criteria. A survey for existed sustainability assessment tools of universities was made. The next chapter will identify the selected tool, its advantages and its usage in assessing IUG master plan.

Chapter (4): Sustainability Impact Assessment (SIA)

4.1. Introduction

This chapter discusses the definition of Sustainability Impact Assessment and the benefits of using it in assessing sustainability of university master plan. It also illustrates indicators and measures used in this assessment.

A survey for some existing assessing tools is presented. In addition, tools selection criteria is discussed. Depending on these criteria; the suitable tool for assessing sustainability in the Palestinian universities master plans was selected. SPeAR ; a computerized assessing program is chosen according to those criteria. In SPeAR the problem was divided into four major categories: Social equality, Economic vitality, Environmental integrity, Natural resource conservation. Then these categories were divided into indicators and sub-indicators to simplify the assessment process. There are significant advantages of SPeAR, but the more distinguished one is the graphical outputs.

4.2. Sustainability Impact Assessment

Impact assessment is a small group of forecasting tools used for improving the basis for policymaking and project approval process. They are all based on methodologies that attempt to incorporate concerns from diverse stakeholder groups into the assessment process. (Ness, 2006)

Environmental Impact Assessment (EIA) has been used since 1960s for evaluating potential environmental impacts of large development projects with the aim to reduce the negative effects. (Sadler, 1999) In the EU, a directive that made EIA compulsory for proposed public and private projects (e.g. construction projects) that are likely to have environmental impacts was introduced in 1985. (EU Commission, 1985; 1997)

Evolving from EIA in the 1990s, Strategic Environmental Assessment (SEA) is a tool for evaluating potential environmental impacts of strategic decisions. (Partidario, 1999) There are two major differences between SEA and EIA. SEA has to be carried out earlier than EIA, and it is performed for conditions that involve less information, higher uncertainty and less concreteness, which is often the case with political decisions; whereas EIA is performed in concrete conditions of a particular project. Despite these differences many of the principles and procedures are similar in both

processes. (Partidario, 1999) In both EIA and SEA, involvement of the public is part of the process, and diverse interests should be able to have a voice in connection with the recommendations.

More recently, the EU has introduced the more comprehensive tool of Sustainability Impact Assessment (SIA). The intention is to move from the sectoral and often fragmented assessments to an integrated assessment covering environmental, economic and social parameters. The goal of this new tool is to better be able to identify “the likely positive and negative impacts of proposed policy actions, enabling informed political judgments to be made about the proposal and identify trade-offs in achieving competing objectives”. (EU Commission, 2002)

SIA was first applied in early 2003 and is now used for all major Commission initiatives. An analysis of the first SIAs carried out by Wilkinson et al. (2004) concluded among other things that none of the assessments had followed the Commission guidelines completely. (Ness, 2006)

4.3. Benefits of Sustainability Impact Assessment in university campuses master plans

Campus sustainability assessments serve several functions. Andrew Nixon and Dr. Harold Gasser, researchers in the area of campus sustainability, identify three of these functions (Nixon, 2002) as follows: to help an institution understand where it stands with regards to sustainability objectives. These objectives may include self-defined sustainability policies or goals; externally defined, voluntary declarations, charters or environmental/sustainability management systems; widely accepted sustainability indicators or metrics; and mandatory regulations (Legacy, 2004). To identify problem areas and develop strategies for improvement. Assessing institutions “state of sustainability” helps identify relative strengths and weaknesses. A campus sustainability assessment can provide detailed information to inform specific solutions and strategies for change and to help build a “culture of commitment”.

Assessments are good for building diverse stakeholder commitment to sustainability because it provides the campus community and other stakeholders with opportunity to participate in visioning and decision-making processes that ultimately affect them. (Nixon, 2002)

4.4. Sustainability indicators and measures

To measure the level of sustainability in any project, and to know to what extent the institution committed to sustainability, a number of sustainability indicators and measures should be selected.

An indicator of sustainability is defined as a package of data in order to simplify, quantify and communicate complex and detailed information for use by decision-makers, policy-shapers, and the public. (Chambers et al., 2000; Rodenburg, 1995; van Delft, 1998)

Sustainability indicators typically focus on a range of issues and are, ideally, broad enough to permit a complete appraisal of systems spanning both natural and managed ecosystems. These indicators can measure more than one aspect of the parameter and will commonly focus on both time, threshold (e.g.; efficiency, sufficiency, equity, and quality of life). Examples include:

- CO2 emissions per capita
- Percentage of forest renewal for harvested forest areas
- Renewable energy consumed versus total energy consumed
- Recovery of residential materials per capita

Sustainable development dictates that meeting all three: social, environmental and economic imperatives is necessary. It is counterproductive to debate, which may be more fundamental. Without satisfying ecological imperatives, we poison ourselves, deplete our resources, and destroy the basic life support systems essential to the human and non-human survival. Without satisfying the economic imperative, we cannot provide the necessities of life, let alone meaningful work. Without satisfying the social imperative, our societies will collapse into chaos. Given the interconnected nature of sustainable development, failure in any one area will result in failure in the other two (Dale, 2001).

Recently, with the widespread and globally concerns of sustainability issues, many tools were established to assess sustainability levels starting from planning stage up to the final stage and to make follow up and monitoring over time during the project life cycle.

4.5. Criteria of Sustainability Impact Assessment tools selection

Three main approaches can be used to measure and analyze sustainability:

- **Accounts:** these are constructions of raw data that are then converted to a common unit, monetary, area or energy.
- **Narrative assessments:** these combine text maps and tabular data. They might use indicators but they are not a cornerstone.
- **Indicator -based assessments:** these may include text, maps, graphics and tabular data, such as the narrative assessment, but they are organized around indicators. (Dalal-Clayton, 2002) Some examples of these approaches are presented in Table (4.1); the table focuses on the performance of the tools in the field of transparency, potential for consistency, potential for participation and usefulness of decision makers.(Losano-Ros,2005)

Table (4.1): three main approaches to measure and analyse sustainability
Source: (Losano-Ros, 2005)

Approach	Accounts	Narrative assessments	Indicator- based assessments
1. transparency	Low	Medium	High
2. potential for consistency	High	Low	High
3. potential for participation	Low	High	Medium
4. usefulness of decision makers	Medium	Medium	High
Examples	Index of sustainable Economic Welfare Genuine Progress Indicator	State of environment reports	Well- being Assessment Dashboard of Sustainability

From table (4.1), it is obvious that indicator- based assessment is scored high among the other three, so it is preferred. These approaches assess sustainability in general not specific for universities. For this purpose a comparison made by Shriberg (2002) is presented in table (4.2). This comparison was of 11 tools developed specifically for universities. These tools converge in:

- Decreased throughput;
- Incremental and systematic progress;

- Sustainability education as a core function;
- Cross- functional reach;
- Cross- institutional action. (Shriberg, 2002)

Table (4.2): summary of major strength and weakness of cross-institutional sustainability assessment tools

Source: Shriberg (2002)

Assessment tool	Major strengths	Major weakness
National wildlife federation's state of the Campus Environment	<ul style="list-style-type: none"> • Comprehensive • Combines eco-efficiency and sustainability • Identifies barriers, drivers, incentives and motivations • Identifies process and current status 	<ul style="list-style-type: none"> • Little use of the term "sustainability" small sample within each college/ university
Sustainability Assessment Questionnaire	<ul style="list-style-type: none"> • Emphasis (cross-functional) sustainability as a process • Useful as a conversational and teaching tool • Probing questions that identify weakness and set goals 	<ul style="list-style-type: none"> • No mechanism for comparison or benchmarking • Difficult for large universities to complete
Auditing instrument for sustainability in higher education	<ul style="list-style-type: none"> • Flexible framework for institutional comparisons • Process-orientation which helps priorities and set goals through development stages • Created through international consensus 	<ul style="list-style-type: none"> • Difficult to comprehend motivations are potentially excluded
Higher Education 21s sustainability indicators	<ul style="list-style-type: none"> • Process-orientation that moves beyond eco-efficiency with a relatively small set of indicators recognizes sustainability explicitly and strategically 	<ul style="list-style-type: none"> • Difficult to measure and compare • Indicators may not represent most important issues
Environmental workbook and report	<ul style="list-style-type: none"> • Useful in strategic planning and prioritizing • Collects baseline data and best practices 	<ul style="list-style-type: none"> • Operational eco-efficiency and compliance focus • Difficult to aggregate and compare data • Motivation are largely ignored

Greening Campuses	<ul style="list-style-type: none"> • Comprehensive, action orientation • Incorporating processes • Explicitly and deeply addresses sustainability • User friendly manual with case studies, recommendations 	<ul style="list-style-type: none"> • Calculations and comparisons difficult • Focus on Canadian community colleges • Resources out of date
Campus ecology	<ul style="list-style-type: none"> • Cross functional, practical "guide" and framework • Baseline for current tools 	<ul style="list-style-type: none"> • Environmentally focused(not sustainability) • No longer "state –of-the- art"
Environmental performance survey	<ul style="list-style-type: none"> • Process-oriented • Compatible with environmental management systems 	<ul style="list-style-type: none"> • Operational, eco-affiance focus • Neglect of sustainability and cross-functional initiatives, benchmarking and sustainability
Indicators snapshot guide	<ul style="list-style-type: none"> • Quick, prioritized environmental "snapshot" • Opportunity for more depth on issues of concern 	<ul style="list-style-type: none"> • Operational, eco-affiance focus, with little reference to process, motivations benchmarking and sustainability
Gray pinstripes with green ties	<ul style="list-style-type: none"> • Model for data collections and reporting • Links programs and reputations 	<ul style="list-style-type: none"> • Not sustainability specific • Neglects decision making processes and operations
EMS Self assessment	<ul style="list-style-type: none"> • Rapid self assessment focused of processes 	<ul style="list-style-type: none"> • Operational eco-affiance focus

The conclusion to which Shriberg (2002) arrives is that ideal cross- institutional sustainability assessment should:

- **Identify important issues:** "Sustainability assessment tools must be address contextually appropriate issues of major importance to campus environmental, social and economic efforts and effects"
- **Be calculable and comparable:** "The ability to calculate progress toward sustainability is often a limiting factor in assessment."
- **Move beyond eco-efficiency:**" eco-efficiency indicators stress material utilization, environmental performance and regulatory compliance, while

sustainability indicators stress issues at the nexus of the environment, society and economy with the goal of no negative impacts."

- **Measure processes and motivations:** "the tools to measure sustainability must delve deep into decision making by asking about mission, rewards, incentives and other process –oriented outcomes."
- **Stress comprehensibility:** "Sustainability assessment tools must be comprehensible to a broad range of stakeholders."

4.5.1. Sustainable Project Appraisal Routine (SPeAR)

For assessing IUG Master Plan a computerized assessment program; SPeAR selected as a tool to help balance the many factors that affect a sustainable project. It is, however, just a tool and not a solution. Achieving success still relies on the determination of all stakeholders in a project to provide benefit for current and future generations (Cole, 2001).

SPeAR is an extension of the 3-category model or triple bottom line, which lumps environmental issues with natural resource conservation. In SPeAR the problem was divided into four major categories: Social equality, Economic vitality, Environmental integrity, Natural resource conservation. SPeAR is an attempt to tackle the issue of complexity by using sets of indicators and sub indicators that are ranked from worst practice to beyond best practice.

In the SPeAR model environmental Integrity covers the effects of the project on the environment; natural resource conservation deals with what the project takes from the environment. The goal of SPeAR is to make sure that all the sustainable opportunities have been reviewed and then optimized. Its focus is on individual project improvement. (Cole, 2001)

A series of primary indicators allocated to the 4 major categories which are social, economic, resources and environment; is shown in table (4.3). For example, Social responsibility, Health and welfare, Amenity, Access, Form and space and Stakeholder satisfaction are used as indicators for Social category.

Then, these indicators were divided into smaller sub- indicators to simplify the assessment. These indicators and sub-indicators are developed from existing, approved and universal indicators as illustrated bellow.

Table (4. 3): SPeAR tool's major categories and primary indicators.
Source: SPeAR , 2009, reproduced

Category	Social	Economic	Resources	Environment
Primary Indicators	Social responsibility Health and welfare	Social benefits	Materials	Air quality
	Amenity	Competition effects	Water use	water discharge
	Access	Employment and skills	Energy	Land use
	Form and space	transport	Waste hierarchy	Natural and cultural heritage
	Stakeholder satisfaction	viability		Design and operation
	-	-	-	transport

4.5.2. SPeAR's Indicators background

Indicators for the SPeAR program were used to be as far as possible universal indicators that had already gained acceptance in the international community.

A number of indicators particular to aspects of sustainability are already in existence such as (Cole, 2001):

4.5.2.1. A corporate Global Warming Indicator:

Was developed by the United Nations Environment Program, provides guidance on how to measure CO₂ and other greenhouse gas emissions using for example, fuel and electricity bills.

4.5.2.2. The Index of Corporate Environmental Engagement:

It was developed by Business in the Environment, measures and compares the extent to which top companies in the UK are managing their environmental affairs;

4.5.2.3. Corporate Social Responsibilities (CSR)

Has been evolving over the last few years, and continues to grow in popularity and applicability. In September 1999 the Dow Jones Sustainability Group Index (DJSGI)

launched the first global index intended to track the performance of companies, which are leaders in sustainable development. The index has over 200 companies and is made up of the top 10% most sustainable firms;

4.5.2.4. Financial Times Stock Exchange (FTSE):

Has also recognized the need for social responsibility and, using principles provided by the government organizations and businesses, has produced the FTSE 4.

4.5.2.5. Good Index:

It was published on the 10th July 2001. The Indices 'provide a workable means of meeting the complex needs of socially responsible investment, and offer practical guidelines for companies who desire to be committed to CSR'.

The following three themes are central to the Indices:

- Working towards environmental sustainability;
- Developing positive relationships with stakeholders;
- Upholding and supporting universal human rights.

4.5.3. Advantages of SPeAR

When evaluating the computerized SPeAR tool depending on Criteria of Sustainability Impact Assessment tools selection previously mentioned, it was obvious that it meets the majority of these criteria; as it is an indicator – based assessment tool, it addresses contextually appropriate issues of major importance to campus environmental, social and economic efforts and effects. Also, eco-efficiency indicators stress material utilization, environmental performance and regulatory compliance, while sustainability indicators stress issues at the nexus of the environment, society and economy with the goal of no negative impacts. In addition, the outputs are represented graphically and with spread sheet to be understood by decision makers and any stakeholder.

According to (Cole, 2001), "SPeAR has many advantages as a tool for assessing sustainability impact assessment". Some of these advantages are:

- Allows the sustainability of a project to be assessed and illustrated graphically at all project stages, demonstrating continual improvement and evolution of a project over time;
- Allows the various aspects of sustainability to be balanced and the inter-relationship of these assessed;

- Identifies where there may be room for improvement and so achieve optimum benefit;
- The logical and transparent methodology is fully adaptable;
- Demonstrates the interaction between the various social, environmental, economic and natural resource indicators of sustainability;
- The spreadsheet behind the production of the SPeAR Diagram ensures that all assessments are fully audit traceable;
- Prompts innovative thinking to include sustainability into project design and demands team coordination and consensus.

4.6. Conclusion

It was obvious that Sustainability Impact Assessment (SIA) is very important for assessing sustainability in universities master plans. Significant criteria should be followed to choose the suitable sustainability indicators and measures.

It was clear that SPeAR program has many advantages. Some of them, are the interaction between the various social, environmental, economic and natural resource indicators of sustainability. The graphical aspects which allow continual improvement and evolution of a project over time, and many other advantages. Depending on these advantages and the tool selection criteria, SPeAR was chosen to be used for assessing sustainability of universities master plans in Gaza. The next chapter will be about assessing sustainability in the Islamic University of Gaza Master Plan (IUGMP).

Chapter (5): Sustainability Impact Assessment of IUG Master Plan.

5.1. Introduction

Sustainability consideration should be taken to the master plan of any projects especially universities. Such as the appropriate use of particular selected site which reflects sustainable development needs. The site should also contain mixed uses, respect the surroundings, and add values and vitality to the local community.

Preparation of master plan helps in avoiding cost of changes in future. For example, thinking in infrastructure in parallel with project usage, operation, occupation, and future expansion helps in reducing the cost of changing, pressure on environment, and resources consuming.

Planners and designers need to consider better alternatives of the master plan from the beginning to tackle sustainability issues.

Due to many obstacles; universities in Gaza strip gradually accomplished their buildings or even re-used existed buildings or sites which are not well planned or designed for the purpose of education from the beginning. These universities haven't opportunities to prepare comprehensive master plans related to sustainability.

This chapter discusses SIA of IUG master plan from various aspects by using a computerized program (SPeAR). It is necessary to assess the university's commitment to sustainability criteria, to complete its vision and mission, to convoy the ranks of international universities in sustainability issues and to recognize the strengths and weaknesses areas. Furthermore, to recommend an action plan for priorities to be developed and improved.

5.2. Justification

The Islamic University of Gaza (IUG) was selected to be assessed because:

- It was the first emerged university in Gaza.
- Its buildings were planned and designed to be used for education purposes,
- It was the first university in Gaza which has a planned master plan, despite the many obstacles that hindered the completion of all facilities at the same time. However, the whole master plan had been accomplished gradually.

5.3. Background of IUG

It was established in 1978, starting with three faculties only. IUG developed its facilities and academic departments to have twelve faculties in a variety of disciplines to offer BA, B.Sc., MA, M.Sc., Diploma and higher diploma. IUG is a home to the well-planned programs, a way to the different community levels and a place for researchers and good teachers. IUG is a member of four associations: International Association of Universities, Community of Mediterranean Universities, Association of Arab Universities and Association of Islamic Universities. Due to its success and because of its highly qualified graduates, IUG has won both national respect and international fame.

5.3.1 Vision

"IUG strives to be the leading Palestinian University working to develop educational and cultural standards in Palestinian society according to professional Values and Principles" (IUG website, 2010).

5.3.2 Mission

IUG tries according to (IUG, 2010) to:

- Provide high quality education to students, particularly those living in Gaza Strip.
- Encourage academic and scientific research to meet the challenges.
- Participate effectively in developing Palestinian community.
- Promote knowledge and professional skills and science advancement.

5.3.3 Location and adjacent

IUG is located in the western part of Gaza city, on a flat site with an area of approximately 80,000 sq m, as shown in the Figure (5.1) the adjacent land uses are:

East: UNRWA Gaza headquarters (2).

North: Public Prosecutor Office and Palestinian Red Crescent (3).

West: Al- Azhar University (4) and Al-Azhar Park.

South: Residential buildings and Ministries Complex (5).



Figure (5.1): Location and adjacent of IUG
Source: the researcher

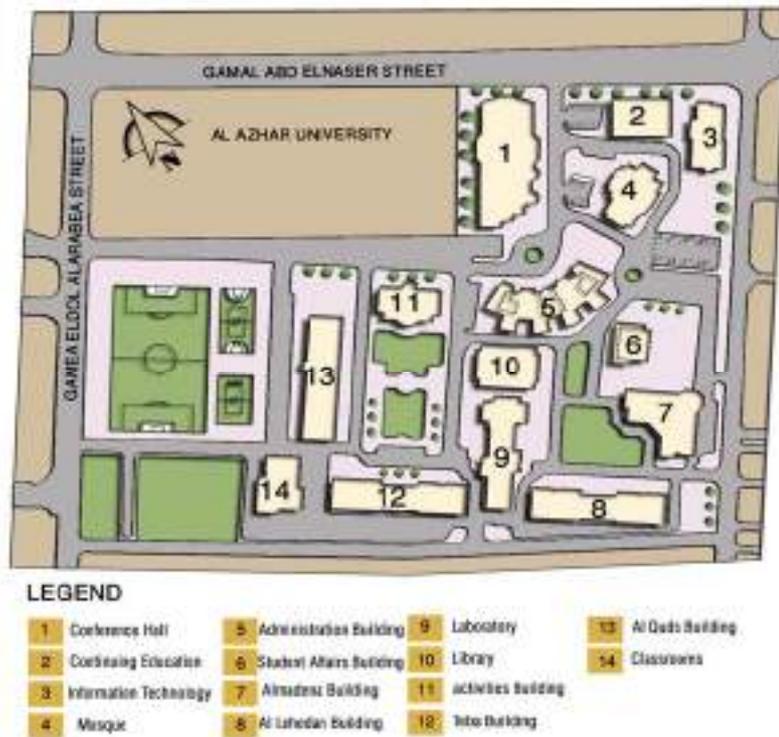


Figure (5.2): IUG Master Plan
Source: The researcher

5.4 Sustainability Impact Assessment of IUG Master Plan

To assess SIA of IUG data was collected by various methods:

- Interviews with decision makers of IUG.
- Visiting the site.
- Reports and information from various departments.

This data then was analyzed by the researcher and used as information for SPeAR program.

- A base set of sub-indicators were then individually assessed on a -3 to +3 ranking.
- The rank of each sub- indicator depends on answering questions available on SPeAR, also on the best practice included for each indicator.
- The researcher proposed that the minimum application of such sub – indicator in IUG took 0 ranking.
- SPeAR tool then averages the scores for all the sub-indicators within an indicator to produce an overall rating of that indicator.
- The ratings are displayed within wedges in a circle as different colors; dark green (+3) as beyond best practice, red (-3) as worst case.
- This circle does not give a single overall score; it is a graphic visualization of the sustainability of a particular project at a point in time as it clearly shows where a project is weak and where it is strong.
- These results then were used to focus on areas that need improvement and treatments.

5.4.1 Society

Including the community or users in projects adds value to projects enabling objectives to be achieved and is very important for the overall sustainability of a project. It also brings many benefits to the local community and helps local people to create a community that they are proud of. Many of the process lead to community development which in turn leads to a sustainable community, which is essential for sustainable development. (SPeAR, 2009)

5.4.1.1 Social responsibility

One of IUG mission is to participate effectively in developing Palestinian community (IUG, 2010).

- **Community and citizenship:** IUG has a positive relationship with the surrounding, context and with the city and the region as a whole. It also enhances community interaction by providing enrollment opportunities for students from the north to the south. On the other hand, gathering of students from different faculties in the same lectures of universities requirements, open spaces, recreation places, or in the

library helps increase the level of harmony between different groups. However, there is no involvement of the local community; users, neighbors, and students; especially participation in sustainability issues; except contractors' participation in construction and maintenance. Community's participation is represented by providing information regarding the purpose, process, and vision for the Master Plan.

- **Stakeholders relationship:** Engagement of stakeholders including employees, members, customers, government, regulators, competitors, Non- Governmental Organizations (NGOs), pressure groups and local communities, enables to identify actual community and user needs, understand local issues and avoid conflicts (ARUP, 2009). In IUG there is a good relationship between all stakeholders represented in wise administration and continues successful appears in fulfillment of aims.

- **Donation:** Deanship of Students' Affairs (DSA) is responsible for many of the outside the classroom/off campus aspects of students, including scholarship and student aid; student support services; student activities. Thus, 11,716 students get benefit from the Students' Affairs Deanship in the academic year 2006-2007 representing 72% of the total students' number.(DSA, 2010)

- **Internal and external reporting:** to stakeholders about IUG performance such as social, environmental and economic reporting is existed, such as annual reports from different departments, for example, the annual report about "Monitoring and environmental health"(Monitoring and Environmental Health, 2010).

Community Service and Continuing Education Deanship (CSCED) was established in 1993 to address the Palestinian society, through the appropriate use of financial and human resources. The deanship managed to provide community with different services such as; training courses, information technology, administrative and technical consultations. In addition to that, it makes intensive efforts to develop the local community and the abilities of university students and alumni, to improve the administrative and technical skills of the personnel of governmental, non-governmental and private sector. Moreover, it improves the performance of Islamic University personnel by using all advanced means of technology in laboratories, and workshops.

To achieve these objectives, CSCED has established many departments and centers to guarantee the continuity of the academic process. Among these centers and units, there are a specialized institute's service for blind people, beside other centers to improve the abilities of graduates. There are also Community Development Institute and English Language Institute. From 1993 to 2008, 19,643 people joined courses, in

1,272 programs offered by the Community Service & Continuing Education, making IUG the largest provider of continuing education in the Gaza Strip (IUG website, 2010).

Alumni of IUG influence their communities and corporations as many of them currently hold prominent business roles as prime ministers, ministers, and economists. They carry their training, life styles, and professional experience with them into the community. To support graduates, the Department of Alumni Affairs Deanship of Community Service and Continuing Education at IUG in collaboration with Sharek Youth Forum, organized its first annual Career Day on November, 2009, which was held in the Conference Centre at IUG. Representatives of nearly (40) companies and institutions attended, they provided (165), permanent and temporary jobs for graduates.

Social identity: It is clear that IUG maintains and conserves the identity through many activities, programs and units. Architectural Heritage Unit was established in 2000. It was known as Architectural Conservation and Urban Rehabilitation Unit (ACURU) in the Faculty of Engineering. Recently, the center is known as "Iwan Center" (Iwan Center, 2010)

The Center aims to promote and undertake the preservation, rehabilitation, and adaptive reuse of architectural heritage in Gaza Strip. In addition, it aims to enhance students' awareness of the cultural and architectural heritage by identifying the elements and architectural details of the historical buildings, archaeological sites. On the other hand, the center established variety of training workshops for students such as painting on glass. To encourage youth participation, large wall plate in the courtyard of the university is prepared for painting the architectural heritage in Gaza city. This is with the participation of a group of young artists to attract more students towards the event.

Social awareness is an important objective of Iwan center. To promote this awareness, Social Awareness Unit was established. It is concerned with the Social awareness programs and the importance of preserving and rehabilitating historical buildings. Figure (5.3) shows some of Iwan's Center training activities

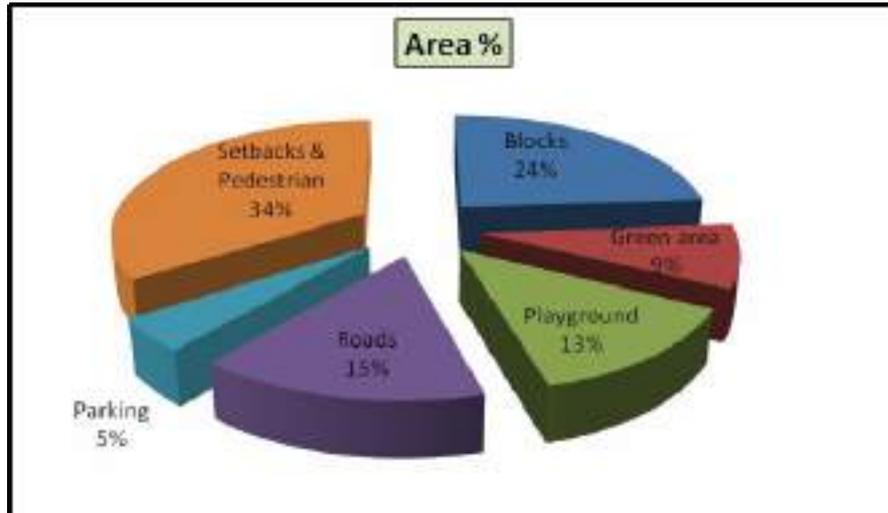


**Figure (5.3): Painting on glass in Iwan Center.
Source: Iwan Center, 2010**

5.4.1.2 Amenity

- **Landscape:** While most universities have a Campus Master Plan, very few have a Landscape Master Plan. Landscape can be enhanced by good design. The design itself can add character to the area; environmental quality can be improved with trees and plants. It should be assured that the design doesn't have a negative impact on the landscape (Georgia Tech, 2008).
- **Green space** can be defined as a space that consists of approximately 80% vegetation (Spear); this includes grassed areas and parks. The development should avoid destruction of green spaces and avoid making access more difficult for existing communities.

The total area of IUG site is 80,000 sq m, 60% greater than the minimum area required for Palestinian comprehensive universities according to the Palestinian Accreditation and Quality Assurance Commission (AQAC, 2010) requirements for Palestinian universities which is 50,000 sq m. This doesn't take into consideration the number of students. As shown in figure (5.4), the percentage of landscape, including green space, playground and parking, to the total area of IUG represents 26 % which considered optimum comparing with the Palestinian quality requirements which is 25% (AQAC, 2010).



Figure(5.4): Percentage of land use distributed in IUG
Source: The researcher, 2010

The percentage of green spaces in IUG is 9%. The quality of green space is good, and the access of this green space is easy. However, the distribution of the green spaces in IUG for male and female is not fair. The total number of female is 12,031 students greater than the total number of male which is 7,748. The specific green space area for male is approximately 5,000 sqm while the green space area for female is approximately 2,000 sq m. Figures (5.5) and (5.6) illustrate the congestion of the green space area specified for female compared with one for male.



Figure (5.5): female green space area
Source: The researcher, 2010



Figure (5.6): Male green space area
Source: the researcher, 2010

Leisure facilities: The provision of services and leisure to the university community including food and other types of amenities should reflect the strategic priorities of the university (Georgia Tech, 2008).

The current services of IUG; such as female's cafeteria is uncomfortable as it is located in the underground floor and not large enough to accommodate large number of students. Furthermore, area of the windows is small and high as shown in figure (5.11) so, there are lack of daylight, air quality and good views.

Linear walk corridors contained within linear park along the entrances of IUG are attractive and affordable. As shown in figure (5.7). Setbacks/buffers are not adequate to serve as visual transitions and to avoid noise and vibration from the surrounding main streets.



Figure (5.7): linear park along the west entrance
Source: the researcher, 2010

In IUG master plan there is monumental land mark (focal point), at the northern entrance and in front of the administration building as shown in figure (5.8), to reflect the identity of IUG as an Islamic educational institute, and to represent welcoming feature for university community and visitors.

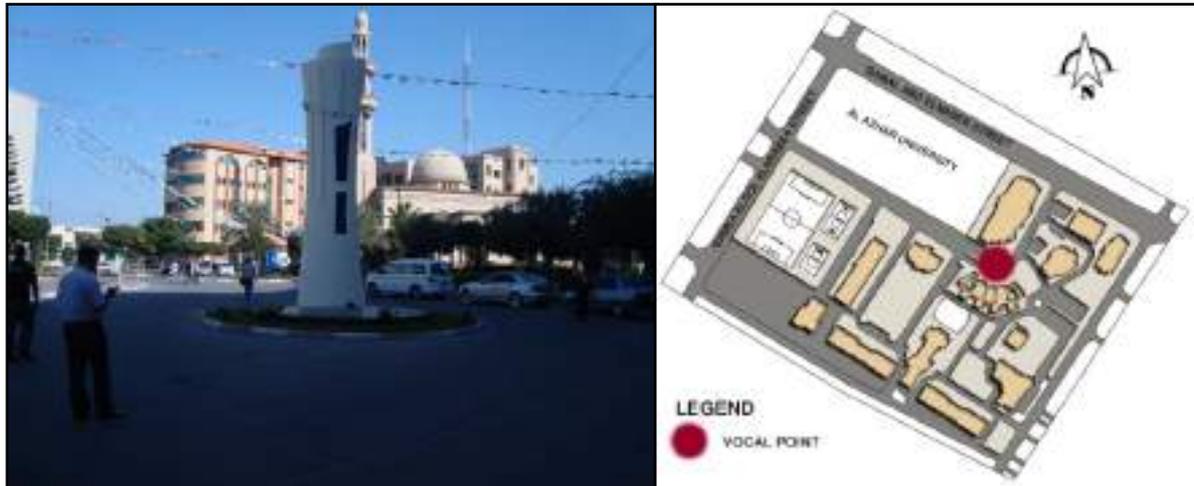


Figure (5.8): Monumental land mark (focal point)

Source: the researcher, 2010

- Amenity conflict:** In terms of land use, land tenure, property and license, there is no conflict with surrounding land uses; land use is controlled by regulations and laws. Until the year 2006, there were no specific regulations for educational buildings in Gaza (Al Moghany, 2006). However, IUG followed the regulations of the surrounding areas as follows: Minimum setback of 5m and coverage area didn't exceed 60%. There is also no specific height or a number of floor limits. But the Central Planning Council (CPC) in Gaza clarifies that if there are more than five floors of any building; many considerations should be taken while preparing the designs (e.g. wind load protection, fire escapes, etc.) (Al Azhar University Master Plan, 2008). Taking into considerations the above cited requirements, and land area of (80,000 sq.m), the allowed built up area could reach up to 240,000sq.m. However, IUG total built up area is 76,236 sq m and footprint area which is the total area of the ground floors of all buildings; is 20 % of the total area of the site. These areas are too small compared with the estimated area mentioned above.

- Noise and vibration:** The main sources of noise and vibration pollution are transportation, construction facilities, and industrial factories such as the use of industrial machinery and equipment, engine and power stations (EQA, 2004). Noise

and vibration in IUG master plan is emitted by transportation inside and outside, and by construction equipments. These equipments utilized for the fabrication, demolition, renovation or removal of any structure or facility including all related activities, also from equipments, engines, and electricity generators.

5.4.1.3 Access

- **Public transport:** Integration of public transport into project is about achieving good design. By doing so, the reliance on private car use is reduced. This enhances equality and increases opportunities for social interaction. It also reduces pollution and resource use.

In IUG, public transport is as an option to encourage alternative modes of travel and provide preferential opportunities as it located directly onto public transport station.

The site is presently served by four access roads along the eastern, western, northern and southern site boundary as shown in the Figure (5.9). The northern road is 30 meter wide which incorporates double lane flow of traffic in each direction; this road serves as a link between the eastern and western parts of Gaza. The site is accessible to a number of public transport services. Public bus services, taxis, etc are the common modes of transport, which provide access to the city centers.

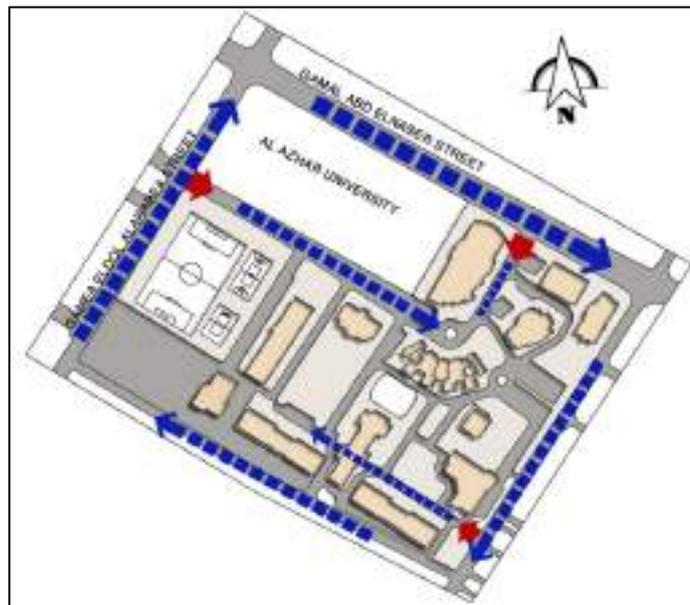


Figure (5.9): Existing traffic and circulation of IUGMP

Source: The researcher, 2010

- **Key facilities:** According to the Palestinian Environmental Law, 1999, Article (5) " This law shall guarantee: The right to every individual to live in a sound and clean environment and enjoy the best possible of health care and welfare". For the quality of life, access to key facilities such as banks, parks, kindergarten, childcare and children's center is an important factor. Facilitating the access to these facilities facilitate women to seek employment. Location of IUG in the center of Gaza is a good opportunity to have fast and easy access to these facilities. Furthermore, there is a health and support service inside IUG which is an essential element of social sustainability.
- **Access for physically impaired people:** accessibility for physically impaired people from all entrances of IUG is available. Ramps are available at all buildings entrances and also elevators area is suitable for handicaps.
- **Training:** Training is beneficial to individuals and society, enabling people to develop their skills, knowledge and life choices. It leads to greater employment opportunities and involvement in decision- making and supports economic sustainability. Training is an effective tool to ensure project success. For this purpose, IUG established Training and Projects Department .This department offers training services, administrative and developmental consultations besides other services in information technology and projects management. It also prepares financial and developmental proposals suggested by the Deanship. Training and projects Department has carried out more than 1,375 training course presented to more than 22,263 participants. These courses were attended by Arab and international experts who noticeably participated beside local experts in the succession of these courses (IUG, 2010). The vision of this department is to become a pioneer institute in the field of training and consultations in Palestine. To develop the Datum of other departments in the Deanship, gain accreditation to grant international certificates and develop the Palestinian community through these services.
- **Housing:** there are no dormitories in IUG because all of the students and staff are from Gaza Strip. IUG promotes its employees in providing lands, decent homes through loans and subsidizes.
- **Telecommunications:** Alternative means of communications are provided for students, faculty and staff for example have the provision of free internet access,

appropriate information about exams, lectures, enrollment, grades, events and activities for public community through IUG website.

5.4.1.4 Form and space

Form and space of each project should be examined to recognize that they meet the requirements of security, comfort and a sense of well-being. The needs of different users should be considered to create a safe environment free from crime.

- **Internal and external security:** In IUG there are no secluded areas, dark corridors or car parking. Public spaces are designed to be viewed from all areas; there is no need for security system. In any case, there are night guards and the campus is lighted all night long.

- **Scale:** The consideration of the human and pedestrian scale is very important. Buildings on IUG campus were designed with consideration of human scale.

Buildings are ranges from four to five stories maximizing the efficiency of land use. Fenestration, materiality and datum lines are integrated to create a comfortable visual aesthetic. Buildings on campus varied in depth from 40 m such as Almadina almonawwara and Conferences building to 19m like Alguds , Teba, and ELhedan buildings. The maximum depth prevents the penetration of light and air in the majority of buildings. Primary facade lengths vary within two categories: moderate; 80 m like the Conferences, Teba, Alguds, ELhedan, and Administration buildings as shown in Figures (5.10, 5.11), and small; 35 m for example Almadina almonawwara, the Central Library, Staff Cafeteria, and CSCED building.



Figure (5.10): Teba building facade length

Source: The researcher



Figure (5.11): Alguds building façade

Source: The researcher

Massing is used to relate a building to its immediate context with reference to adjacent buildings and topography. Massing is the result of the scale, height, and footprint (ground floor area) of a building and generally determines the relationship of the building to pedestrians. Most buildings on campus have a relatively intimate relationship with pedestrians and with its context.

- **Public and private realm and Communal circulation area:** The project should enhance the quality of public realm by providing high quality public space. In IUG there are a variety of public and private spaces such as the area beside the playground which is proposed to be used for recreation, athletic and setting area for the public and children as shown in figure (5.12). These recreational facilities and surrounding circulation have an area of 15,400 m²; represent 19.25 % of the total area.



Figure (5.12): proposed public recreation area beside IUG playground

Source: Engineering office, 2010

- **Severance:** The above mentioned recreations and athletics areas facilitate meeting of staff, faculty, students and community and increase positive social interaction which is beneficial for health and well being.
- **Right of light:** During the day period the density of occupancy would be maximum in the campus and lectures classes need daylight extremely. Buildings receive approximately 4 hours sunlight during summer which represents 33% of the total sunlight hours per day, while in winter this percentage reduces to at least 12-15 %. But underground floors suffer from lack of daylight's penetration as in Female Cafeteria as shown in figure (5.13).



Figure (5.13): Lack of light access in female cafeteria

Source: the researcher

5.4.1.5 Stakeholder satisfaction

For any project to achieve the appropriate social sustainability levels, all requirements of users should be considered.

- **User control:** All aspects at IUG are manually controlled by users; there are no centrally controlled systems. For example; shading devices, temperature settings, lighting controls, natural ventilation, because almost all buildings are naturally ventilated and lighted.
- **All users satisfaction:** There is a good circulation of air in buildings, but due to nature of weather, level of humidity in some buildings such as Media and Press, Physical Research, Geochemical and Sea, and vertebrates, invertebrates, and marine biotechnology laboratories, is ranges from 63 to 66 RH%, while the limit is 60 RH

Occupants of buildings have no means of feeding back comments to the designers and operators of the building they occupy. Furthermore, there is no consideration to occupant comfort issues including thermal comfort, noise, traffic generation and light effect such as glare, flicker from fluorescent luminaries. Temperature measurement in various buildings ranges from 28 C° to 35 C°, while the limit is 30 C°. Some of these measurements are shown in table (5.1).

Table (5. 1): Geochemical and Sea laboratory thermal comfort measurements
Source: Health and Environmental Monitoring, 2010, reproduced

Measured Item	Readings	Standard	Notes
Temperature C ⁰	30.1	Max 30	Not Suitable(NS)
Humidity RH %	64	Max 60 RH %	NS
Light Intensity Lux	258	300 Lux	NS
Air speed m/s	0.4	0.3 – 0.7	Suitable

- **Indoor air quality:** The indoor air quality isn't monitored. Indoor air pollution generally generated from outside as well as from occupants, ventilation system and materials. Smoking is prevented in the campus. Pollution is generated from dust, transportation, construction and maintenance.

5.4.1.6 Health and well-being

- **Occupational Health and safety:** It is illustrated that the area of health and wellbeing scored highly as there is a health and safety policy which includes a zero fatality policy. To insure the excellent performance of this policy and to maintain the occupational safety, the department of Prevention and Safety is established to provide the necessary equipment to fight the fire, continuous monitoring to ensure the safety of the devices of the fire, follow the work of the elevators in all university buildings and maintenance, and follow-up images of early warning in the premises of the university to maintain its integrity. This department works with a high performance system to manage risk. Personal Protective Equipment (PPE) is provided for employees.

In the same field, Medical Clinic was established in 1982 (IUG website); the function of which is to follow-up sources of drinking water; places to prepare food and

drink and the chain of waste disposal; preventive measures in workshops and laboratories, maintain a healthy environment for the University; and health education. Absence of any reported health and safety accidents during the last 5 years is a good indicator of this area (Department of Prevention and Safety, 2010).

- **Provision of support facilities:** Staff is an organization's key. So, it is necessary to support them. Support can be provided to them in the form of welfare initiatives, baby care facilities, gym, etc. some of these facilities are provided such as gym for male and female.
- **Condition of work:** good work –place may benefit from reduction in health care costs, higher creativity, productivity and profitability .The conditions of work for IUG employees are good comparing with other universities in Gaza. IUG employees have the opportunity to obtain health insurance, maternity, training and provident fund (IUG systems and Laws, 2003)

5.4.2 Economic

Economic is very important factor affected the sustainability of each project. Financial viability is critical for performance of the institution. It is the guarantee of continues improvements, innovations, researches, training, and protection from risks. The institution should guarantee the provision of fund from various resources and try to invest these funds to preserve resources for future generation needs.

5.4.2.1 Viability

- **Financial viability and risk:** Resources Development Center (RDC) was recently established in IUG after the necessity of finding an office to follow up the university projects, relations and financial support. It helps IUG to be a successful institution, to continue its career in education and community service, and to support long term sustainability objectives. RDC is committed to securing the financial resources, time, and loyalty of alumni, friends, corporations, and foundations to promote the University's mission of advancing learning, and communication with Arabic, regional and international institutions. RDC's tasks are:
 - ✓ Connect between donors and the University's Directors and Deans;
 - ✓ Support the University projects;
 - ✓ Maintain the efficiency of the University financial and technical support;

✓ Strengthen the relation with the University Alumni and Friends (RDC, 2010).

- **Expenditure on improving and innovation:** Researches and development are financed to encourage innovation in the field of renewable energy, material minimization, and social impact. The percentage of awards for scientific research is 1.3 % of the total budget of IUG. 6.4 % of this percentage is specified for students' awards for their distinguished researches (Interview with Alhalaq, 2010) to promote researches and enhance the desire of innovation.

- **Products and services** The design of products and services doesn't follow sustainability principles. Information about products manufacture, use, maintenance and disposal is available but the situation in Palestine in general and especially in Gaza doesn't allow the opportunity for alternatives and selections.

IUG has recently purchased LCD PC'S for IT laboratory to conserve electricity consumption depending on product labels used (Al Namira, 2010).

- **Operation management tools and techniques:** There are no operation management tools and techniques to reduce wastage. IUG tries hard to improve efficiency and to drive continuous improvement by following European Quality Assurance (EQA) standards which are ISO Registrars providing Quality and Environmental Management System assessment and certification to the ISO 9000, ISO 14000, and AS 9100 series of International Standards. In addition, applying the Leadership and Quality Assurance in Applied Science, Computing, Engineering, and Technology (ABET). (Interview with Assistant for vice president for academic affairs, director of quality unit, 2010)

5.4.2.2 Competition effects

- **Vitality:** There is no doubt that IUG added local vitality to the area by providing financial benefits through the provision of employment opportunities for faculty and staff. It also enhances the quality of life for business related activities through improvements of economic infrastructure such as bookshop and stationery, coffee net, and fast food restaurants. Provision of small business such as canteen, cleaning, transportation is also taken in consideration.

- **Diversification and choice:** The diversification leads to a more stable economy for the community and the University and to an increase of wealth distribution in the local area. Furthermore, diversification of disciplines in the university increases local

community choice and opportunities. Low tuition fees compared to universities abroad, increasing the turnout of students to enroll at IUG.

- A commitment to equal opportunities is existed (Abu Daqqa , 2010).

5.4.2.3 Employment and skills

- **Jobs numbers :** To understand the role of IUG in providing opportunity of employment, it is important to know that the number of full time administration and academic staff is 932 , and the number of part time staff is 289, that means the total number of jobs is 1,221 (IUG Personnel Department, 2009). The indicator of the commitment from IUG to use local labour, materials and services is clear; as the majority of its employees are from Gaza.

- **Conditions of employment:** are flexible; due to the needs of the work force There are contractual basis of employment offered to support a low staff turnover, higher productivity and increased motivation through a closer match between employment and life style. Also there is a monitoring system for all these activities. To increase the efficiency of employment and working; IUG invests a proportion of expenditure on training and skills. Unfortunately there is a lack in focus on sustainability learning or skills including explaining and promoting the 'what', 'why', and 'how' of sustainability to others this was clear from the survey which was completed by students and staff.

5.4.2.4 Transport

- **Dependency:** The need to travel and the cost of travel are reduced to the minimum level at IUG; technology such as video conferencing used to reduce the need to travel outside the university. Also, communication through IUG website and e-mails provide opportunities to save money and time consuming in traveling.

- **Public transport and vehicle use:** public transport is an available option at IUG but not to a large extent, greater reliance on private cars.

- **Water and rail transport:** is not considered as part of development strategy due to the political situation in Gaza.

- **Fright traffic:** Inside IUG there is a little need for road haulage or Heavy Goods Vehicles (HGVs), width of roads in IUG ranges from 4 m to 8m. Area of the roads in IUG represents 15 % of the total site area, which indicates that the capacity of road infrastructure is over. Construction costs interlock roads is \$40/ sq m, the total cost of

construction is about \$48,000. Operating and maintenance cost of such infrastructure is a burden on IUG economy. (Engineering Office,IUG,2010)

5.4.3 Natural Resources

Realizing the importance of safeguarding natural resources is the efficient way to preserve them from deterioration. Priority issues include: local and natural materials, energy, valuable lands, landscapes, water; especially ground water, areas of high biodiversity.

5.4.3.1 Materials

The simplest and most effective way of dealing with waste is to ensure that it doesn't arise. The aim is to maximize efficient use of materials; this includes a reduction in overall quantity of materials used. This must be included in contract specifications and procurement policies reflecting the need to reduce waste. There are good reasons for encouraging re-use, such as; energy and raw material savings, reducing the need for manufacture of new products, and reducing disposal needs and costs. (SPeAR, 2009)

- **Renewable resources and material re-use:** There is no awareness of how to use sustainable materials or to re-use materials in IUG. There was an attempt to re-use paper due to the closure. Although this attempt represented a small proportion of the total costs; reduction of paper consumption was 20%. (Purchasing department, IUG, 2010)

Furthermore, there is no attempt to increase the use of recycled materials as all wastes are sent to landfill, no sourcing of timber from sustainability managed forest. In IUG waste levels are not being monitored, targets for waste reduction are not being set. (Service department, IUG, 2010)

All demolition materials are sent to landfill, high utilization of disposal material and no consideration of design for recycling.

- **Material specification and supply:** There is no material specifications and purchasing policy to require suppliers to demonstrate their approach to sustainability. Furthermore, employees are not aware of the need to re-use materials. (Engineering Office, 2010)

- **Local materials:** On the other hand, it is important to use local materials or local services and labours where possible in order to reduce transportation and also reduce the associated impacts of transport such as energy consumption. In IUG Only

139 employees (15%) from the total number of 932, daily commute from the southern part of Gaza strip to IUG and vice versa. (Personnel Department, 2010) The branch of IUG in the south (Khanyounis) indicates that IUG has a policy to reduce the cost of travel. The use of imported materials is not mandatory, where local materials are viable alternatives. IUG has a commitment to use local material in future.

5.4.3.2 Water Use

Water is not a renewable source, vital for public health and environment. In addition to basic human health and sanitation, a clean and adequate water supply provides benefits such as irrigation for agriculture, biodiversity, aesthetics and recreational opportunities. Safeguarding resources and ensuring affordable supplies are essential for sustainable development.

In IUG there is no design to avoid or reduce water consumption, no re-cycling, grey water treatment system or rainfall capturing, and no consideration of water efficiency in operations, process or appliances except water-efficient landscaping by using sprinklers (Al Khaldi,2010).

The other indicator, there is no monitoring to assess water consumption levels or water losses, and no awareness of performance or the need to reduce water consumption via education or awareness programs for occupiers. Water for construction purposes is supplied from on-site renewable sources such as the provision of wells with an auxiliary water source from municipal supply, where water consumption competes with the local communities' water sources. Rely in part on the municipal water, prevents water shortage (Engineering Office,IUG, 2010).

5.4.3.3 Energy

Climate change is a greater threat to global sustainable development. There are a number of greenhouse gases associated with energy consumption. In order to limit the impacts of climate change as much as possible, energy consumption must be reduced and if possible significant changes in how energy is produced and used need to be made. Energy produced from non renewable sources consumed in buildings caused highly emissions of carbon dioxide. All energy sources have both advantages and disadvantages, but renewable sources are more sustainable. (SPeAR, 2009)

- **Energy efficiency, sources and monitoring:** To ensure that energy resources will be available for future generations, action should be taken to improve building

design to conserve energy and take advantage of passive renewable resources. Also, to significantly reduce use of energy production methods those are major contributors to global warming. In IUG the construction and operation have not been designed to avoid or reduce energy consumption. The reliance is on electricity, there is no use of renewable resources. Figures (5.14,15,16), illustrate that the total average monthly consumption of IUG electricity is large especially, when knowing that great nightly losses of electricity is due to wrong behaviors and lack of awareness of users; this was according to IUG study in 2008. Figures illustrated that the coldest and hottest months have the greatest consumption due to the usage of heating and cooling devices. It is important to take into consideration that the Palestinian power plant in Gaza was bombed in June, 2006 and completely stopped for about 6 months. During this period the dependency in IUG was on the onsite generators.

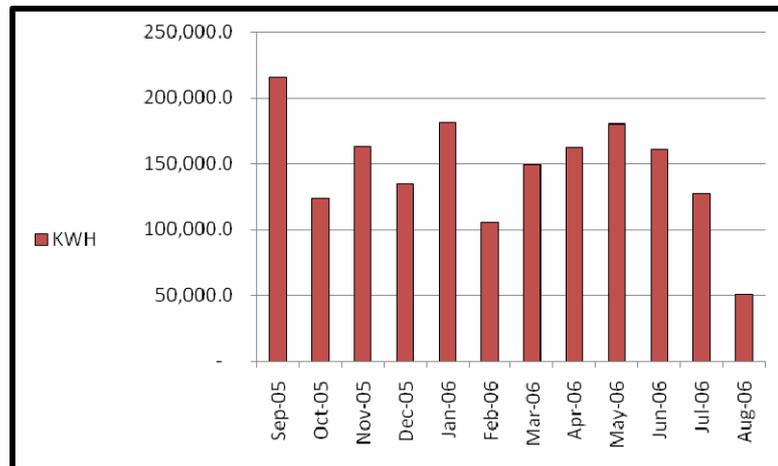


Figure (5.14): IUG Monthly Electricity Consumption 2005 -2006

Source: Department of Finance, IUG, 2010, reproduced

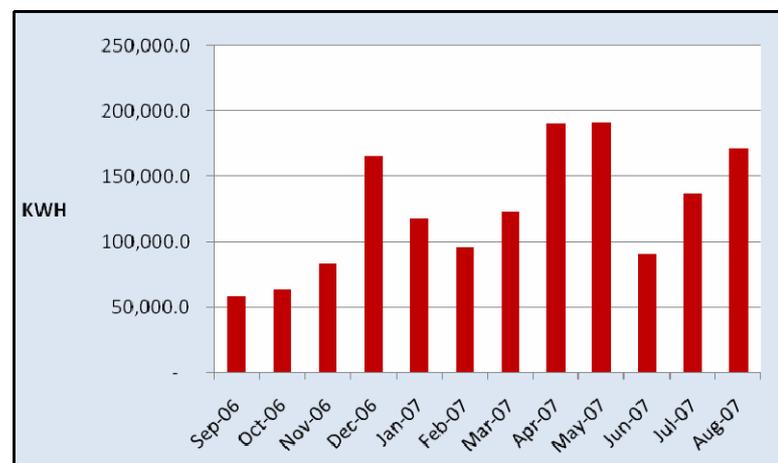


Figure (5.15): IUG Monthly Electricity Consumption 2006 -2007

Source: Department of Finance, IUG, 2010, reproduced

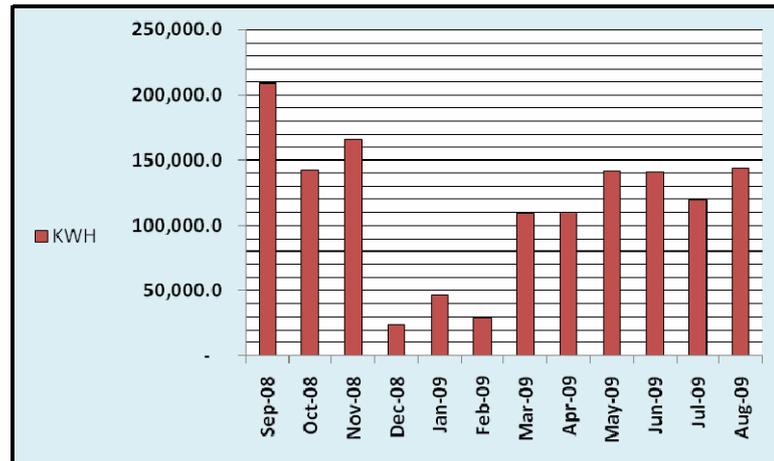


Figure (5.16): IUG Monthly Electricity Consumption 2008 -2009

Source: Department of Finance, IUG, 2010, reproduced

Figure (5.17) shows the nightly consumption losses which represent high ranges (18%) compared with the total amount of consumption.

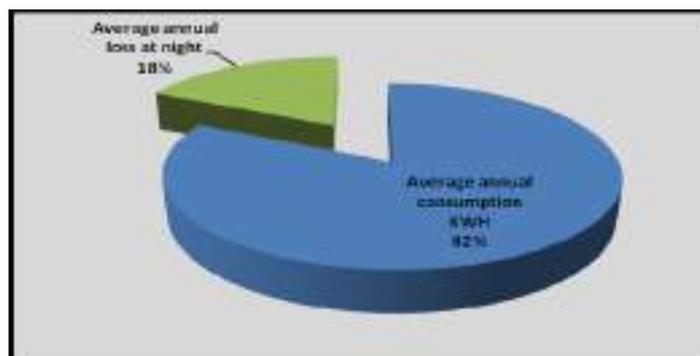


Figure (5.17): IUG electricity losses at night compared with the total consumption.

Source: IUG study, 2008, reproduced

This indicates that there is low energy efficiency in operations, process or appliances, no policy or targets to reduce energy consumption, renewable energy not considered as an alternative energy sources, and energy monitoring to assess energy performance levels, management system and purchasing policy that includes "green energy" is not provided. Furthermore, there is no awareness of efficiency or performance in energy usage.

- **Daylighting:** In IUG natural light is usually used instead of artificial light during daylight hours. It is important to know that natural light provision in buildings aids suffers of Seasonal Affective Disorder (SAD). SAD is a type of winter depression that affects an estimated of 7% of the UK population every winter between September and April, in particular during December, January and February. SAD prevents those

people from functioning normally without continuous medical treatment. The remedy is exposure to levels of illuminance of 2500 lux or more. Greater exposure to natural light is known to lessen the effects of this disorder, thus giving a non- visual, biological reason for daylighting (SADA, 2009).

The goal is to reduce energy consumption by at least 20 %. This percentage represents the amount of electricity losses at night.

5.4.3.4 Waste hierarchy

Waste has two main impacts on sustainability. On the one hand, the amount of waste represents an indicator of how efficiently the usage of resources. On the other, dealing with waste has an impact on the environment. If given the choice, the best option is to prevent or reduce the amount of waste that is generated. If we avoid making waste, we don't have to worry about disposing or recycling it later. Recycling is an important component of the overall waste management hierarchy; it is still the least preferred option because you have to generate the waste in order to recycle it. Reuse falls in the middle in that if an item can be reused, either by the original user or by someone else before it is disposed or recycled, then the waste of that item is prevented or at least delayed. (SPeAR, 2009)

Recycling is defined as the process by which salvaged materials become reusable. It reduces the demand for new products. In hazardous waste management practice, recycling refers to the effective use or reuse of a waste as a substitution for a commercial product in an industrial process. It also refers to reclaiming useful constituent fractions within a waste material or removing contamination from a waste to allow it to be reused (EQA, 2004). However, recycling can reduce demand for raw materials, reduce emissions to air and water and reduce disposal impacts through less waste going to landfill.

Re- use refers to re-using materials and products where possible rather than using a new material or product each time. This can be encouraged by extending the design life of products and materials and maximizing the value extracted from them, such as re-using bricks, aggregates and packaging.

- **Waste avoidance and reduction:** In IUG there is no monitoring or measuring of waste quantity. This indicates that waste reduction is not a wide objective of IUG. On the other hand, there is no awareness of the need for waste reduction.

- **Recycling:** In terms of recycling there is no waste storage, waste segregation or recycling facilities, also there are no waste management initiatives. **Best Practical Environmental Option (BPEO):** Where disposal is unavoidable (BPEO) should be chosen, for example incineration with energy recovery in preference to land fill. In IUG, BPEO is considered as disposals of laboratories are sent to Al Shifa Hospital Incineration. Majority of potentially recyclable or reusable materials sent to land fill (Health and Environmental Monitoring, 2010).
- **Hazardous, special waste generation:** According to Palestinian Environmental Law, article (13): "1st. It is forbidden to import any hazardous wastes to Palestine, 2nd. It is forbidden to pass hazardous waste through the Palestinian territories or through the territorial water or free economic zone of Palestine, unless a special permit is obtained from the ministry". In IUG there is no production of hazardous.
- **End of life:** More importantly, there is no attempt or policy to address end of life issues such as designing for re-use and recycling to reduce end of life impacts.
- **Refurbishment:** it is maximized to a high standard, where this brings the existing building up to the operational performance of a new building, like most of the buildings that were damaged in the recent war on Gaza.

5.4.4 Environment

In this section, the evaluation of existing environmental activities was made. This included; air quality, water quality, sewage treatment, disposal, solid waste management, site selection, open spaces, biodiversity and other ecosystem aspects. It is obvious that fauna, flora and climate changes are interconnected.

5.4.4.1 Air quality

Air quality is a significant aspect of environmental sustainability; this includes achieving major long term cuts in green house gas emissions, and maintaining and improving the overall quality of air. Clean air is considered a basic requirement of both human and ecosystem health and well-being. However, air pollution continues to pose a significant threat to the environment and communities worldwide.

According to the World Health Organization (WHO) assessment of the burden of disease due to air pollution, more than 2 million premature deaths every year are attributed to the effects of urban outdoor air pollution and indoor air pollution (caused by the burning of solid fuels). More than half of this burden is generated by the

populations of developing countries where air pollution levels are at their highest. Many countries have legislated national air quality standards. The WHO has also set health guidelines intended for worldwide use based on experts evaluation of current scientific evidence. These guidelines relate to four common air pollutants; particular matter, Ozone, nitrogen dioxide and sulphur dioxide. (Arup, 2009)

- **Direct and indirect emissions:** Air quality indicators are direct and indirect emissions. Direct emissions are releases to air as a result of industrial or commercial processes, such as process stack emissions. In IUG there are no direct emissions. Indirect emissions include those associated with energy supply and transport. In IUG, no attempt has been tried for monitoring air quality because of the lack of the monitoring equipments. Estimates of the sources of air pollution indicate that transportation contributes to 40-50 % to the air pollution of Gaza (EQA, 2004). IUG surrounded by congestion nodes with high level of traffic.

- **Green house gas management, dust and particular matter:** Electricity generation is the main source of air pollution in IUG. It produces direct emissions from generators in- site and indirect emissions off-site. On average, electricity sources emit 1.297 lbs CO₂ per KWH (0.0005883 metric tons CO₂ per kWh) (Carbonfund, 2010).

The amount of CO₂ emitted as indirect emissions from electricity generation at IUG is at its high levels due to the large amount of electricity losses consumptions at night, the average annual consumption at IUG 1,542,173.8 kwh/year as illustrated from table (5.3) which is equivalent to 2,000,199 lbs CO₂ per kwh (907 metric tons CO₂ per kwh) .

Table (5.3): Average annual electricity consumption and CO₂ emissions.

Source: Department of Finance, 2010, reproduced

Year	Annual consumption.(kwh) KWh	CO₂ Annually emissions(mt/kwh) metric tons
2005-2006	1,756,118.0	1,033
2006-2007	1,488,479.0	875.7
2008-2009	1,381,924.5	813
Average	1,542,173.8	907

Transportation methods in IUG is private cars, they used petroleum fuel, in spite of that employees needn't to travel long distances, there is no commitment to walk inside the campus, there is no commitment to clean energy, also there is no purchasing policy to purchase goods that have required the use of large amounts of non-renewable energy in production. There is no consideration of measuring or monitoring greenhouse gas emissions. (Al Khaldi, 2010)

Local air quality issues such as provision of air circulation only, are specifically being measured in some buildings as mentioned before. tables for these measurements are available in appendix (4). No particular measures undertaken to control dust, particulates or other atmospheric emissions. (Health and Environmental Monitoring, 2010)

- **Ozone depleters:** There is no plan to phase out substances with ozone depleting in site such as CFCs which emit as a result of using air conditioning. Furthermore, those substances are not named in contracts or purchasing policies as being banned for use such as refrigerators. (Purchasing department, 2010)

5.4.4.2 Land use

- **Site location:** Master plan of IUG has been developed on vacant AWQAF land at the western edge of Gaza city.
- **Planning intent:** The campus was designated by planners and regulators on a derelict site as the planners intended; by doing so, the derelict land has been rehabilitated.
- **Context:** IUG integrates well with surrounding environment such as building design, landscape, planting and over all it added vitality to the context.
- **Diversity/ mixed use:** IUG is surrounded by mixed- use pattern within easy access; such as banks, supermarkets, post offices, bookstores and other public institutions such as directorate of the police, Public Prosecutor Office and the offices of UNRW.
- **Open spaces:** IUG site is covered and surrounded by buildings with few areas for open spaces and recreation such as IUG playground inside and Al Azhar Park outside the campus.

- **Contaminated land:** Land of IUG site is sandy with depth of seven meter; it is arable and not contaminated. It is recommended to be used for infiltration (Ministry of Agriculture, 2010).

5.4.4.3 Water discharge

A sustainable management of water resources should be considered in IUG Master Plan to maximize the water availability such as, storm water collection and rainwater harvesting by using unpaved paths, reuse the treated wastewater for irrigation and siphons, desalinate brackish water, promoting saving water measures, developing irrigation techniques to reduce water consumption and selecting plant species need less water and setting up awareness program. It is appropriate and essential to implement a Wastewater Management System including collection and treatment of wastewater.

- **Drainage systems:** Usually development increases impermeable surface area, so precautions should be taken to reinforce natural water cycles such as infiltration drainage where possible. Usage of rainwater and greywater is a sustainable drainage to minimize storm water runoff. There is no consideration of sustainable drainage principles; the majority of walkways is paved which prevent leakage. As well as, rainwater collection system is not in force.
- **Risk management of water pollution:** There are challenging water quality targets in IUG. Continues monitoring and tests for water quality levels are made every 4 months. There is no history of breaches of legislation for example; there are no discharges of waste water from sanitation or cooking to surface and ground water.
- **Sewage treatment:** For sewage treatment, IUG has drainage network collects sewage to public drainage on Jameat Addowal al Arabia Street. IUG depends on municipal water for irrigation and washing. On –site wells are used for portable water after filtration. (Health and Environmental Monitoring, 2010) The operational costs of maintaining the water quality is not large as all tests are made in the Environmental and Rural Studies Center at IUG.

The actual concentration of nitrate in the groundwater at IUG is 66 mg/1 as NO₃ while the maximum value according to the Palestinian Regulatory is 70 mg/1 as NO₃. Also solid wastes (TDS) and Chloride do not exceed the allowable limits. This indicator means that the water quality is good (Documents of various tests for portable water are available in appendix).

Recommended actions should be taken in consideration to increase the water quality to reach the WHO guidelines such as, enforcement of ground water protection zones, management of the use of fertilizers and pesticides, criteria for collection and treatment of wastes and development of monitoring system for groundwater quality.

5.4.4.4 Natural and cultural heritage

New development always maximizes the loss of soils, hedges, woodland, biodiversity and cultural heritage.

- **Habitat conservation:** In spite of lack of data about the quantity of soil which was lost, trees, soils and other habitats should be maintained by stopping the establishment of new buildings. On the other hand, there is no special characteristic area in the site such as dunes or archaeological resources to be preserved.
- **Biodiversity:** It is essential to protect biodiversity in order to maintain a diverse ecosystem, which can support a full range of species. Biodiversity means the number of species types, it is commonly classified into three components; ecosystem, species and genetic. Nature seeks balance within itself by adapting the environmental changes that happen for one reason or another. But if there were drastic changes in the ecosystem disciplines, nature cannot maintain the same balance, thus resulting in a loss of biodiversity and its rooting habitats. The main cause of deterioration of nature and biodiversity are pollution of land, water depletion pollution, and expansion of urban areas and infrastructure (EQA, 2004).

In IUG there is a landscaping policy to specify the use of native species for planting, to maximize the area's biodiversity value as there are 20 olive trees, 70 Phoenix dactylifera (Date Palm) trees, Ricinus communis, Eucalyptus camaldulensis, Nicotiana glauca, and Cupressus sempervirens trees. Nearly, all wildlife species depend in a way or another upon the trees, shrubs and grasses. However, the continuous deterioration and/or fragmentation of wild vegetation seem to have adverse impacts on wildlife ecology and population; particularly terrestrial. (Abed Rabou, 2008)

Birds are among the best known parts of the Earth's biodiversity, as they are the most conspicuous groups in any fauna. However, birds are universal, penetrating the remote deserts, oceans and mountains on Earth. They are considered as good indicators of the degree of human disturbance in the various ecosystems worldwide. They have long served humans for game, food, and feathers, as well as in their predatory capacity as destroyers of insects and rodents. (Abed Rabou, 2007)

A significant number of avifaunistic species were determined in IUG. It has quite a rich bird fauna, especially during the migration seasons; spring and autumn. Such as *Streptopelia senegalensis* (Laughing Dove), *Tyto alba* (Barn Owl), *Merops apiaster* (European Bee-eater), *Upupa epops* (Hoopoe), *Dendrocopos syriacus* (Syrian Woodpecker), *Hirundo rustica* (Barn Swallow), *Pycnonotus xanthopygos* (Yellow-vented Bulbul), *Saxicola torquata* (Stonechat), *Prinia gracilis* [Graceful Prinia (Warbler)], *Nectarinia osea* (Palestine Sunbird), *Corvus corone* (Hooded Crow), *Carduelis chloris* (Green Finch), *Motacilla alba* (White Wagtail), *Passer domesticus* (House Sparrow), *Halycon smyrnensis* (White-breasted Kingfisher), *Columba livia* (Rock Dove (Pigeon)), and *Streptopelia turtur* (Turtle Dove). In addition, there are Herpeto fauna such as *Agama* and *Chameleo* Chameleo.

Palestine is a home to a large variety of smaller mammals; from bats (over 30 species), rats, and cats. In IUG; Norway Rat, *Mus musculus*, Bat, and Domestic cats are found. (Abed Rabou, 2010)

- **Cultural heritage resources:** Cultural heritage is a resource which should be protected for historical purposes and for enjoyment of future generations. There are no historic or listed buildings on the site, but IUG buildings express the Islamic style and reflect the valuable cultural heritage of the local community. Most importantly, there are wider heritage issues related and concerned such as preservation of many buildings in Gaza. For this purpose, Iwan Center has been established as mentioned before. Also, the establishment of the Oral History Department and the Natural History Laboratory.

5.4.4.5 Design and operation

It is possible to inform key players to sustainable issues and guide the project in terms of sustainability. This is done by using assessment techniques as part of the decision making process. Getting sustainability onto the agenda at the start is the most powerful tool to realizing a more sustainable project (SPeAR).

- **Assessment methods:** In IUG there is no use of assessment methods or tools to inform design, construction, operations or management of sustainable systems.

- **Environmental Management System (EMS) with certification to ISO 14001:** IUG doesn't have an Environmental Management System for construction and operation phases of development such as ISO 14001 an international standard or equivalent or even go beyond best practice (Engineering Office, 2010).

- **Appropriate technology:** There is no cleaner technology to reduce environmental impact. Buildings are not operated or maintained in accordance with sustainability principles. Thermal conditions such as efficient walls and reflective, insulated roof systems which are extremely desired for occupants' satisfaction are not considered in buildings design.
- **In use management and management regime:** It is obvious from existed buildings; neither resource efficiency nor management system is interpreted to drive improvements in sustainability issues.

Building occupants should be aware of the need to improve resource efficiency such as energy, water and waste management by participating and involvement in sustainability activities and initiatives for example; establishment of student green center to monitor sustainability issues, to aware students faculty, and staff about sustainability.

Developments usually have some form of landscaping associated with them. These landscapes need labour and energy intensive to manage. For example; planting which involves grass usually involves regular mowing and input of fertilizers and pesticides. It is possible to create landscapes that are self sustaining. For example; landscapes which need negligible or no maintenance, and not dependent upon light energy input and chemical pesticides. Landscapes in IUG are plants on a regular basis and depend on pesticides; natural fertilizers treated with temperature and need intensive care. (Services department, 2010)

There is a little concern of light, internal temperature and wind protection, through design. There is no adverse wind in public circulation, but there is no consideration of optimizing aspects of design for example using Leader in Energy and Environmental Design (LEED) criteria. Microclimate measurements were done for seven buildings of IUG and results illustrated that some buildings need to be developed, while others scored high. Measurements for some of these buildings such as Plastic and Soil laboratories are shown in tables (5.4) and (5.5).

Table (5. 4): Plastic Laboratory Microclimate measurements

Source: Health and Environmental Monitoring, 2010, reproduced

Measured Item	Readings	Standard	Notes
Temperature C ⁰	29	Max 30	Suitable
Humidity RH %	53	Max 60 RH %	Suitable
Light Intensity Lux	447	300 Lux	Suitable
Air speed m/s	0.5	0.3 – 0.7	Suitable
Noise dB	78	Max 85 / 8 work hours	Suitable

Table (5. 5): Soil Laboratory Microclimate measurements

Source: Health and Environmental Monitoring, 2010, reproduced

Measured Item	Readings	Standard	Notes
Temperature C ⁰	30	Max 30	Suitable
Humidity RH %	66	Max 60 RH %	N/S
Light Intensity Lux	215	300 Lux	N/S
Air speed m/s	0.14	0.3 – 0.7	N/S
Noise dB	89	Max 85 / 8 work hours	N/S

- **Flexibility:** There is flexibility to change use and extend life of buildings because there is no specific building for each faculty, and there is not a special design for each faculty except the amphitheaters.
- **Life cycle environmental impact:** In terms of life cycle environmental impact, there is no consideration of environmental impact on design, construction, operation and end of life.

5.4.4.6 Transport

Air quality should not cause harm to human health or the environment, therefore a reliable and suitable integrated transport system is vital. Emissions of carbon dioxide and other greenhouse gases from transport are also contributing significantly to climate change. A key objective is to encourage people to walk, cycle or use public transport more and use cars less. (SPeAR, 2009)

- **Public Transport:** IUG is located directly near public transport nodes, it takes less than five minutes walk; less than the limited standard mentioned in SPeAR which is 10 minutes. But fuel consumption and production of emissions is high as large number of public, employees and visitors enter the campus with their private cars. Furthermore, pedestrian or walking mode should be considered.
- **Green transportation:** No Green Travel/ Transportation Plan (GTP), no encouragement from management of car sharing.

5.5 Results

As a result of using SPeAR for assessing sustainability of IUG; the following findings were determined and illustrated in the generated report in Appendix. Table (5.6) and figure (5.18) illustrate a summary of final results.

Table (5.6): Summary of Final Results of IUG Master Plan Assessment Using SPeAR.

Source: SPeAR, 2010

SOCIAL	Average Score (-3 to 3)	ENVIRONMENT	Average Score (-3 to 3)
Social Responsibility	2	Air Quality	-2
Amenity	2	Land Use	1
Access	2	Water Discharge	-1
Form & Space	2	Natural & Cultural Heritage	1
Stakeholder Satisfaction	1	Design & Operation	-3
Health & Wellbeing	1	Transport	-2
Average Score for SOCIAL	2	Average Score for ENVIRONMENT	-1
NATURAL RESOURCES	Average Score (-3to 3)	ECONOMIC	Average Score (-3 to 3)
Materials	-2	Viability	0
Water Use	-1	Competition Effects	1
Energy	-2	Employment / Skills	1
Waste Hierarchy	-2	Transport	-1
Average Score for NATURAL RESOURCES	-2	Average Score for ECONOMIC	0

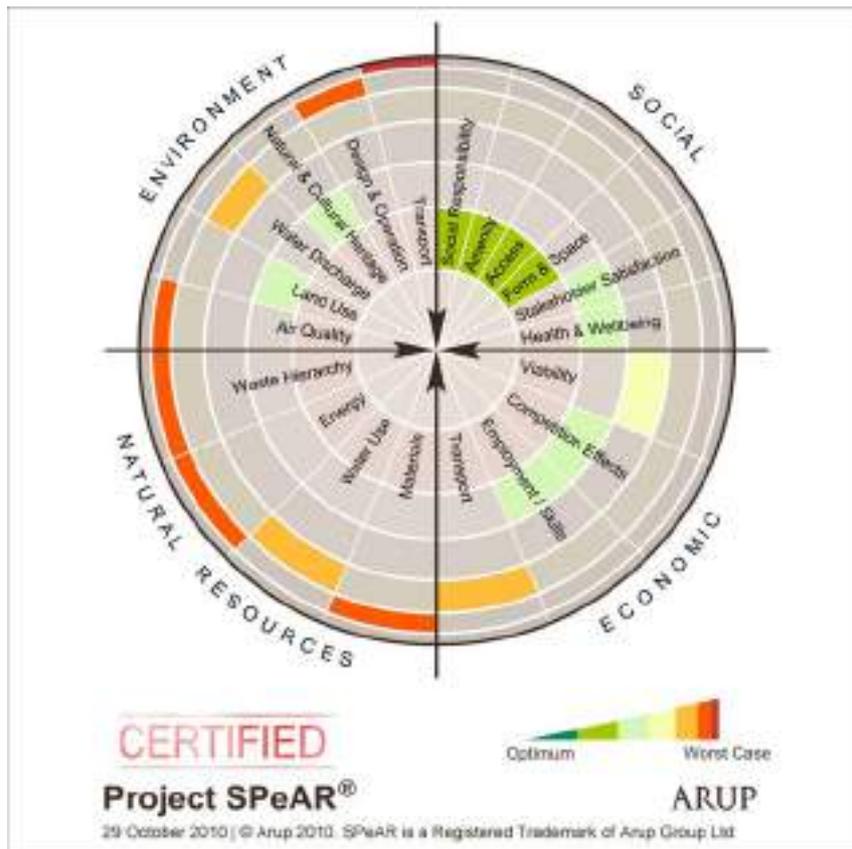


Figure (5.18): Chart of the final assessment sustainability in IUG
Source: SPeAR, 2010

From table (5.6) the average score of the Social category is (2) equivalent to 75% which mean that this area needs some monitoring and improvements to reach the optimum score which is equal to 3. The average score of the environmental category is (-1) equivalent to 42% which is less than the compulsory score (0). This means that this area needs more attention to be developed to reach the sustainable required level. On the other hand, the average score of the natural resources is (-2) equivalent to 35%, this score is critical and nearly beside the worst case which is (-3). The natural resources category needs great efforts and urgent action to be maintained. This category should be at the top of priorities of IUG decision makers. Economic category scored (0) which represent the compulsory score (this means that only the minimum requirements 50% is reached). This area needs to be taken into consideration to avoid more deterioration and to gradually reach the optimum score. Figure (5.17) illustrates these scores. Some scores of sub-indicator are available in appendix (2).

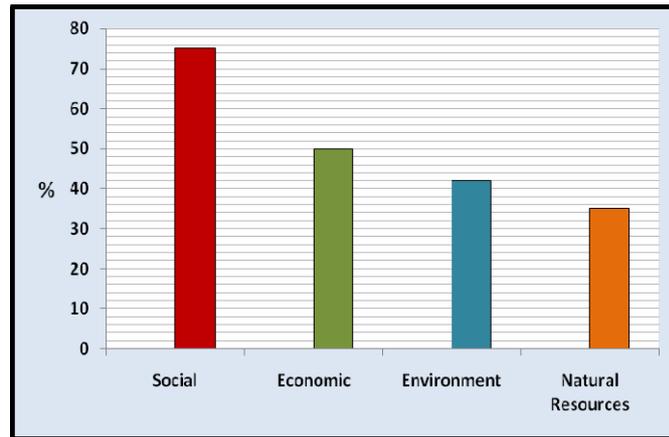


Figure (5.19): Scores of various categories of SIA of IUG Master Plan
Source: the researcher

5.6 Conclusion

By analyzing the different indicators of sustainability in the Islamic University of Gaza (IUG), the results showed that the areas need improvements range from -1 to -3 are: Air quality, waste hierarchy and discharge, design and operation, transport, materials, water use and energy, while other areas scored good range from 0 to 1. The information presented for each indicator can be used to guide decision-making and prioritization of areas for further study.

In the next chapter a questionnaire SAQ will be used and verification for the two results will be made.

Chapter (6): Using Sustainability Assessment Questionnaire (SAQ) for SIA of IUG

6.1. Introduction

This chapter focuses on developing of SPeAR program to be specified for universities by using a Sustainability Assessment Questionnaire (SAQ) as a tool for assessing sustainability in the Islamic University of Gaza (IUG). The SAQ was firstly distributed on a sample of 13 representatives from critical campus constituencies, including students, faculty, staff, and administration. The response rate was 77 %. The weights and ranks of the various aspects will be calculated by using equations developed by Lozano (2003), and then the results will be compared with the results of SPeAR program as a validation. Furthermore, the educational aspects of the SAQ will be added as sub- indicators to SPeAR program with proposed "Best and Worst Case" to be a specific and comprehensive program for assessing sustainability in universities especially the Palestinian universities in Gaza with reference to the Islamic University of Gaza (IUG). Finally, an assessment of sustainability will be made for IUG by using the modified SPeAR with the scores of educational aspects resulted in the SAQ.

6.2. Sustainability Assessment Questionnaire

The Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities is a qualitative questionnaire developed by University Leaders for a Sustainable Future (ULSF), a non-profit association of signatories to the Talloires Declaration based in Washington DC, USA, between 1999 and 2001. (ULSF, 2010)

The SAQ aims to:

- Raise consciousness and encourage debate about what sustainability means for higher education practically and philosophically;
- Give a snapshot of the state of sustainability on the campus; and
- Promote discussion on next steps for the institution.(ULSF, 2010)

It was designed to help assessing the extent to which college or university is sustainable in seven critical areas of higher education according to (ULSF, 2010):

- 1.** The university would appropriately incorporate the concepts of sustainability into all academic disciplines and in liberal arts and professional education requirements. Likewise, a firm grounding in basic disciplines and critical thinking skills is essential to pursuing a sustainable future. Institutions committed to sustainability often prominently feature certain topics in their course offerings, e.g., Globalization

and Sustainable Development; Environmental Philosophy; Nature Writing; Land Ethics and Sustainable Agriculture; Urban Ecology and Social Justice; Population, Women and Development; Sustainable Production and Consumption; Architecture and energy, and many others.

2. Sustainability would be integrated into faculty and student research on topics such as renewable energy, sustainable building design, ecological economics, indigenous wisdom and technologies, population and development, total environmental quality management, etc.
3. The institution would be continually engaged in reducing its "ecological footprint." In its production and consumption the institution follows sustainable policies and practices: for example, CO2 reduction practices and the use of emission control devices; sustainable building construction and renovation; energy conservation practices; local food purchasing program; purchasing and investment in environmentally and socially responsible products; regularly conducted environmental audits; and many others. Furthermore, these operational practices would be integrated into the educational and scholarly activities of the school.
4. Since research and teaching are the fundamental purposes of academic institutions, knowledge of sustainability would be a critical concern in the hiring, tenure and promotion systems. The institution is expected to:
 - Reward faculty members' contributions to sustainability in scholarship, teaching, or campus and community activities.
 - Provide significant staff and faculty development opportunities to enhance understanding, teaching and research in sustainability.
5. The institution would engage in outreach and forming partnerships both locally and globally to enhance sustainability.

The university would support sustainable communities in the surrounding region and develop relationships with local businesses that foster sustainable practices. The institution would also seek international cooperation in solving global environmental justice and sustainability problems through conferences, student/faculty exchanges, etc.

6. Student opportunities would reflect the institution's commitment to sustainability in the form of:
 - New student orientation, scholarships, internships and job placement counseling related to community service, sustainability and/or justice issues;

- An Environmental or Sustainability Council or Task Force with strong student representation;
 - Student groups actively engaged in promoting sustainability on campus and in the local community.
7. The written statements of the mission and purpose of the institution and its various units would express a commitment to environmental responsibility and sustainability. The institution would have institutionalized this commitment with paid positions (such as Energy Officer or Director of Sustainability Programs). The institutional concern for sustainability would be further reflected by public events on campus (such as lectures, conferences, Earth Day celebrations, etc).

The SAQ is primarily qualitative and impressionistic; it doesn't include a rating/scoring system. The goal of the assessment exercise is to provide a comprehensive definition of sustainability and a snapshot of a college or university on the path to sustainability. So, a rating/scoring system would make the instrument prematurely quantitative and difficult for most to complete without extensive research. Indicators need to be constantly monitored, evaluated and improved. The SAQ will be used as a foundation for continued research and collaboration. (ULSF, 2010) This tool clearly describes its use of the term sustainability through provision of definitions at the beginning of the Sustainability Assessment Questionnaire (SAQ). This is a definite strength, as it establishes the common ground or starting point from which participants can answer the questions. It is a fairly straightforward questionnaire, does not require intensive data collection or analysis or a great deal of time and covers a range of sustainability issues. Perhaps its greatest strength is that it facilitates dialogue, community and capacity building, and helps with the determination of common objectives for improvement. (Cole, 2003)

Also, it is very useful for universities to start dealing with reporting about sustainability issues and to enhance faculty, staff, and students' recognition and awareness about sustainability. The primary weakness of the tool is openly recognized by its creators; it is totally subjective, qualitative, and impressionistic. This limits the ability of the tool's results to be compared across campuses, or even to compare a single institutions' change in performance over time. The tool does miss many possible indicators of sustainability and is quite simplistic in scope, design, and structure. (Cole, 2003)

This tool takes the form of a questionnaire, with 25 questions requiring responses. The Questionnaire is designed so that the user can grade the indicator, either by chosen or writing a number from five deferent choices, 0 to 4. Due to Lozano (2003), the choices can be categorized where:

0 (I don't know), means that there is a lack of information for the indicator. This is the minimum grade that can be assigned.

1(none), means that the information presented is of poor performance, this is an equivalent of around 25% of the required full information.

2 (a little) means that the information presented is of regular performance, an equivalent of around 50 % of the full information required by the indicator.

3 (quite a bit) this means the information presented is considered to be of good performance, an equivalent of around 75 %.

4 (a great deal) this means the information has an excellent performance; this grade fulfils totally what the indicator asks for. This is the maximum grade could be given.

The Questionnaire was distributed among a sample of 13 representatives of faculty, staff, and students; the response rate was 77%; some of this sample individuals completed the questionnaire alone while others by dialogue with the researcher. The results are presented in table (6.1). The responses were then summarized. This resulted in a list of indicators that the respondents answered and a rank order of these indicators according to their scores was made. Each indicator average score was calculated by multiplying the grade by the percentage of voices the indicator gained, then the results were totaled and divided by 100.

Table (6.1): The results of the Questionnaire (SAQ)

Source: The researcher, 2010

Aspects	Indicator	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	Avg. score
curriculum	Offers courses which addresses topics related to sustainability	20*0		40* 2	40 *3		2
	Sustainability into traditional disciplinary education such as math	40*0		40* 2	10 *3	10* 4	2
Research and scholarship	The amount of faculty research or scholarship being done in the area of sustainability	20*0		60 *2	20 *3		2
	The amount of students research or scholarship being done in the area of sustainability	10*0	10* 1	50 *2	20 *3	10*4	2
Operations	Building construction and renovation based on design principles such as LEED		40*1	40*2	20*3		2
	Energy conservation including lighting, heating, etc		30*1	50*2	20 *3		2
	Waste reduction such as e-com., double sided copying		50*1	30*2	20 *3		2
	Recycling of solid waste	10*0	70*1		20 *3		1
	Sustainable food program	10*0	60*1	20*2		10*4	1
	Waste conservation		30*1	20*2	30 *3	20 *4	2
	Sustainable landscaping	10*0	40*1	20*2	20*3	10*4	2
	Sustainable transportation	10*0	70*1	10*2	10 *3		1
	Green purchasing	20 *0	60 *1	10 *2	10% *3		1
	Reduction of toxic material	30*0	40* 1	20* 2		10*4	1
	Environmental or Sustainability assessment	10*0	70*1	10*2	10 *3		1
	operational practices integration into the educational and scholarly activities of the school	20*0	30*1	30*2	10 *3	10*4	2

Aspects	Indicator	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	Avg. score
Faculty & staff developments & rewards	Hiring faculty members contribution to sustainability	10*0	30* 1	30* 2	10 *3	20* 4	2
	Tenure and promotion	30*0	30* 1	20* 2		20* 4	2
	Hiring staff members contribution to sustainability	40*0	30* 1	30* 2			1
	enhance ,teaching, understanding , and research in sustainability	20*0	10*1	50*2		20*4	2
Outreach & services	Partnership locally or international corporation in solving global environment and sustainability through conferences, faculty/ student exchange	40*0		40*2	10 *3	10*4	2
Student opportunities	Encourage students to consider sustainability issues when choosing a career path, or involved in sustainability initiatives	20*0	60* 1	10*2		10*4	1
Adm, mission & planning	Formal written statements of various units reflect a commitment to sustainability	40*0	20* 1	10*2	20*3	10*4	1

Also, to calculate the percentage of the total of each aspect the following formulas were used:

$$A_t = \sum^n C$$

$$A_r = \frac{A_t}{\text{Max (grade)}} \times 100$$

Equation 1 Aspect total

Equation 2 Aspect relative

Source: Lozano (2003)

Where: A_t = Aspect total, total sum of the core indicators

C = Grades of the different core indicators

n = Number of core indicators in the aspect

A_r = Aspect relative, the percentage of what the sum of the indicators is in respect to the maximum grade achievable

Max (grade) = the maximum grade achievable; in this case 4

Depending on calculations by using these equations; the aspects relatives are shown in table (6.2).

Table (6.2): Aspects relatives and ranks of IUG educational performance depending on SAQ

Aspect	Aspect relative %	Rank
curriculum	50	1
Research and scholarship	50	1
Outreach and services	50	1
Faculty & staff developments and rewards	43.75	2
Operations	37.5	3
Student opportunities	25	4
Administration, mission and planning	25	4

Comparing the result of design and operations indicator which is corporate between SPeAR program and SQA, the score in SPeAR was (-3) which equivalent to approximately 25 %, because the moderate score 0 in SPeAR is equivalent to 50 %; and in SAQ the score is equal 37.5 as illustrates from table (6.2); this score is equivalent to (-2) in SPeAR. It is obvious that design and operations area needs improvements.

6.3. SPeAR developments for universities

From table (6.3) it is clear that the hierarchy of indicators and sub- indicators in the Social category is designed for different companies and projects not specifically for universities; it represents a good foundation for universities but highlighted indicators in table (6.3) such as Donations to voluntary, Global supply chain, housing type, Education and lifelong, customer satisfaction, supplier satisfaction and Other stakeholders satisfaction are not suited for universities. Universities differ substantially in their core competence, having their core competence in education and research. So, the developments of SPeAR was by replacing the previously mentioned highlighted sub- indicators with new ones related to educational performance and was selected from SAQ.

The proposed additional indicators for the educational aspects and best and worst case were as follows:

1. Curriculum

1.1. Available and essential courses

- ◆ Number and percent relative to total of courses taught each year related to sustainability concepts.
- ◆ Number of students enrolled in sustainability – related courses.

Best case is monitoring and encouraging these courses and challenging more enrollments of students in these courses; while, the worst case, no monitoring or encouragement are available for these courses.

1.2. Administrative support

- ◆ Number and percent of departments and colleges including sustainability curriculum.
- ◆ Sustainability courses included in general education requirement
- ◆ Existing of available sustainability – related majors and minors.
- ◆ Number of units and centers for sustainability in the administrative structure.

Best case, a great concern of involving departments and colleges including sustainability curriculum, courses and majors and minors related to sustainability, while worst case, no focusing or support these curriculum and courses.

2. Research and scholarship

2.1. Grants

- ◆ Total revenues from grants and contracts specifying sustainability – related research.

2.2. Publication and products

- ◆ Published research with focus on sustainability – related issues

2.3. Programs and centers

- ◆ Number and function of centers on campus providing sustainability- related research or services.

Best case, increasing grants for scientific research to more than 3% of the total budget , publication research and number of centers focusing on sustainability year by year, worst case, no support or concerning of grants or research related to sustainability issues.

3. Outreach and service

3.1. Community activity and service

- ◆ Student, faculty, and staff contribution to community development and services
- ◆ Partnership for sustainability with educational, business, and government entities at the local level
- ◆ Quantity and composition of student groups focusing on one aspect of sustainability

3.2. Service learning

- ◆ Existence and strength of service learning programs
- ◆ Total faculty, staff, and students involved in service learning projects

Best case, significant contribution from students, staff and faculty to community development and services by partnership and composition of students groups focusing on aspects of sustainability. Worst case, no partnership, contribution or recognition from staff, students, and faculty of sustainability aspects.

The proposed hierarchy of Social category in SPeAR program for universities is illustrated in table (6.4).The highlighted sub- indicators represent the educational added aspects.

Table (6.3): The hierarchy of indicators and sub-indicators in the Social category in SPeAR

Source: SPeAR, 2010, reproduced

Category	Indicator	Sub- indicator
Social	Social responsibility	Community and citizenship
		Stakeholder relation
		Donations to voluntary and community
		Internal and external report
		Social identity
		Global supply chain
	Amenity	landscape
		Leisure facilities
		Green space
		Noise and vibration
		Amenity conflict
	Access	Public transport
		Key facilities
		Access for physical impaired
		Training
		Education and lifelong learning
		Housing type
	Space and Form	Telecommunications
		Internal and external security
		Scale
		Public and private realm
		Communal/ circulation areas
		Severance
	Stakeholder Satisfaction	Rights of light
		User controls
		Indoor air quality
		Occupation Satisfaction
		Employee satisfaction
		Customer satisfaction
		Supplier satisfaction
	Other stakeholders satisfaction	
	Health and wellbeing	Health & safety management
Occupational safety		
Provision of support facility		
Deliver key health target		
Conditions of work		

Table (6.4): The proposed hierarchy of indicators and sub-indicators in the Social category in SPeAR

Source: the researcher, 2010

Category	Indicator	Sub- indicator
Social	Social responsibility	Community and citizenship
		Stakeholder relation
		Community activity and service
		Internal and external report
		Social identity
		Service learning
		Amenity
	Leisure facilities	
	Green space	
	Noise and vibration	
	Amenity conflict	
	Access	Public transport
		Key facilities
		Access for physical impaired
		Training
		Available courses
		Administrative support
		Telecommunications
	Space and Form	Internal and external security
		Scale
		Public and private realm
		Communal/ circulation areas
		Severance
		Rights of light
	Stakeholder Satisfaction	User controls
		Indoor air quality
		Occupation Satisfaction
		Employee satisfaction
		Grants
		Publication and products
		Programs and centers
	Health and wellbeing	Health & safety management
Occupational safety		
Provision of support facility		
Deliver key health target		
Conditions of work		

Final scores and chart before and after adding educational aspects are shown in table (6.6) and figure (6.1).

Table (6.6) illustrates the results of assessing IUG sustainability after and before adding educational aspects

Social Category	Scores before adding educational aspects	Scores after
Social Responsibility	2	1
Amenity	2	2
Access	2	1
Form & Space	2	2
Stakeholder	1	1
Health & Wellbeing	1	1
Total score	2	1

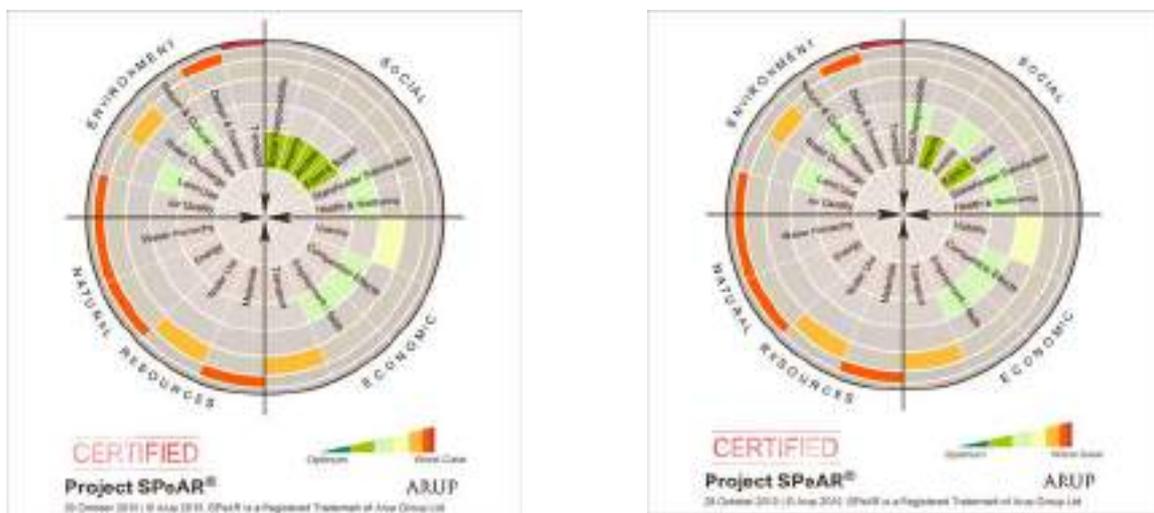


Figure (6.1): charts illustrate the results of assessing IUG sustainability before and after adding educational aspects

It is obvious from table (6.6) and figure (6.1) that the score of the social category assessment of IUG changed from (2) before adding the educational aspects to (1) after adding these educational aspects. So it is important to take the educational aspects into consideration when assessing the sustainability impact assessment of IUG with special focusing on social responsibility and access sub- indicators.

6.4. Conclusion

In this chapter it was important to develop a tool specified for assessing universities master plans as these institutions differ substantially in their core competence, having

their core competence in education and research in addition to the other aspects related to sustainability issues. When reviewing indicators in the SPeAR program, it was clear that the educational indicators are missed. The SAQ tool was used to complete these indicators. To develop a comprehensive tool including all required aspects and categories for assessing sustainability of universities master plan, the researcher combined the two previously mentioned tools by adding the educational aspects from the SAQ to the SPeAR program. The results before and after combination were shown. This final developed tool is appropriate for starting to monitor and report sustainability in Palestinian universities in Gaza especially in IUG.

Chapter (7): Conclusions and Recommendations

7.1. Conclusions

Depending on the analytical study which accomplished in the previous chapters for the current situation in Gaza strip. With special focusing on the Palestinian universities in Gaza strip and with specific focusing on assessing sustainability of the Islamic University Master Plan conclusions and recommendations were derived. It was obvious that IUG as all Palestinian universities in Gaza suffers from many problems related to sustainability due to the bad situation in Palestine as an occupied territory. In addition, there is no awareness of sustainability issues among staff and students. On the other hand, assessment tools are not used to assess the level of sustainability in IUG. As a result of assessing the level of sustainability in IUG; some areas scored well and need more monitoring and developments but others scored low and need urgent action to stop deterioration.

7.1.1. General situation in Gaza strip:

- Environmental, social, economic and limited resources problems threat our community.
- The current situation of Gaza strip is critical and many problems exist.
- Limited area, rapid population growth, scarcity of land, environmental pollution, access to fresh water, inequity in education and income distribution are only some of these problems.

7.1.2. Palestinian universities in Gaza strip:

- Palestinian universities in Gaza have been suffering from many problems in their master plans due to the general situation of Gaza.
- Palestinian universities in Gaza face obstacles and constraints related to lack of funding, scarcity of land, design and operation.
- Universities represent leaders for the whole community and have the responsibility of transferring sustainability to their students.
- Palestinian Universities should establish systems to foster the change that is needed to ensure sustainability becomes institutionalized in higher education systems and society as a whole.

- Graduates have the responsibility to transfer sustainability issues to their community.
- It was obvious that Palestinian universities in Gaza urgently need sustainability impact assessment of their master plans because most of them suffer from the lack of assessment.
- Sustainability Assessment is very important but it may face problems such as the willing of decision makers and stakeholders.
- Sustainability issues should be addressed in universities master plan in Gaza.
- Improving the sustainability level of the university master plans in Gaza will ensure overcoming the main problems of these universities related to environment, social and economic, and upgrade the public awareness of sustainability.

7.1.3. Sustainability assessment of IUG:

- By analyzing the different indicators of sustainability in the Islamic University of Gaza (IUG), the results showed that IUG suffers from problems related to its master plan. The scores of areas need improvements range from -1 to -3. Areas need improvements are: Air quality, waste hierarchy and discharge, design and operation, transport, materials, water use and energy. This means that these areas should be monitored and developed gradually to reach the optimum score which is 3.
- It was obvious that there is a lack of awareness of sustainability issues among staff and students of IUG.
- Other areas scored well and ranges from 0 to 2 such as social responsibility, amenity, access, form and space, stakeholders satisfaction, health and wellbeing, land use, cultural heritage, competition effects, skills and viability. This means that these areas recognized the minimum needed requirements of sustainability but need more awareness and improvements to reach the optimum score which is 3.
- Comparing and verification the results of SPeAR with another sustainability assessment tool which was SAQ, the results showed that areas need improvement are design and operation, research, services and curriculum.
- Universities, in their core competences, differ substantially from other institutions. Their core competences are in education and research in addition to the other

aspects related to sustainability issues such as environmental, social, economic, and limited natural resources.

- Educational aspects were missed in SPeAR program. SPeAR program is used generally for institutions and companies. The researcher combined the two previously mentioned tools SPeAR and SAQ by adding the educational aspects such as research and curriculum from the SAQ to the SPeAR program.
- It was important to develop SPeAR to be a comprehensive tool that includes all required aspects and categories for assessing sustainability of universities master plan.
- After adding the educational aspects to the SPeAR program it will be used exclusively for assessing sustainability impact assessment of universities master plan. This tool is appropriate for starting to monitor and report sustainability in Palestinian universities master plan in Gaza especially in IUG.
- IUG university should demonstrate its commitment to make society more sustainable by incorporating sustainability directly into teachings, research, operations, facilities management, purchasing, and their interactions with local and regional communities

7.2. Recommendations

According to the previous conclusions which illustrated the bad situation of the Palestinian universities in Gaza strip with reference to IUG; the following recommendations should be taken into consideration:

7.2.1. Environmental aspects:

- ◆ To reduce energy consumption in IUG gradually for example: a 10 percent reduction by 2015 and a 15 percent reduction by 2020, from the base year of 2011. This can be achieved through monitoring, reducing the loss of electricity during the night, and encouraging the purchase and use of Energy Star certified products and organize an energy saving competition among the faculties.
- ◆ Site lighting lamps should be replaced by PL lamps to save consumption of electricity.

- ◆ An energy-efficient appliance purchasing policy should be implemented requiring the purchase of Energy Star products in all areas under state purchasing contracts and regulations.
- ◆ Electric metering for each building should be installed for better monitoring of energy use.
- ◆ Minimizing campus waste by building upon its long-standing recycling program.
- ◆ Implement a mechanism for the review and approval of placing new trash containers on campus to separate and classify solid wastes for recycling.
- ◆ Air quality should be improved by reducing emissions from internal transport and generators. To fulfill this goal, an air quality monitoring system should be implemented.

7.2.2. Natural resources:

- ◆ No potable water is used for irrigation in IUG. Harvesting rainwater system should be implemented to be used in irrigation.
- ◆ Protection of natural resources in the new campus especially steep slopes which are high priority.
- ◆ In IUG new campus, to reduce energy consumption through proper building placement and design, development of efficient utility systems and transportation demand management. In addition to energy conservation, development of renewable energy sources should be done after making a feasibility study.
- ◆ Incorporate water saving technology into new green buildings, including low flow fixtures, and underground rainwater cisterns to collect rainwater and condensate for use in irrigation.
- ◆ Protection of natural resources such as rare threatened and endangered species habitat and specimen trees.

7.2.3. Transportation:

- ◆ Implement a vehicular traffic reduction program on campus. This can be achieved by implementing ring road around IUG or offsite parking.
- ◆ Providing access to—and encourage the use of—public transportation for all faculty, staff, students and visitors.

7.2.4. Educational aspects:

- ◆ Every student should take at least one course in sustainability.
- ◆ Undergraduates should be required to take a course on issues related to the environmental or sustainability.
- ◆ The universities should offer courses which address topics related to sustainability such as globalization and sustainable developments; environmental policy and management; environmental philosophy; land ethics and sustainable agriculture, urban ecology and social justice, sustainable production and consumption, and many others.
- ◆ Universities should enhance faculty and student research in the area of sustainability.
- ◆ Establish centers for research, education and policy development on sustainability issues.
- ◆ Encourage students to consider sustainability issues when choosing a career path by providing job fairs and career counseling focused on work in sustainability enterprises.
- ◆ Provide orientation programs on sustainability for faculty and staff.
- ◆ Accomplish Green Students Council for monitoring the occupants' performance and to increase the awareness of those occupants of sustainability issues.

7.2.5. Future plans:

- To accomplish a construction standards policy to recommend that all new campus construction is built to the U.S. Green Building Council's LEED Silver standard or any sustainable standards.
- To use assessment tools for assessing Sustainability Impact Assessment in all university campuses master plans from the earlier stages to avoid the cost of changes.
- Provide bike lanes on all new campus walkways.

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