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Measuring the Sustainability of the Planning and Design Establishment for the Outdoor Spaces and the Landscape on the Campus "University of Diyala as a Case Study"

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Abstract

This study aims to Many higher education institutions worldwide have started integrating sustainable development (SD) programs into their systems as part of a gradual, systematic change of transition towards implementing the concept of sustainability in its environmental, social-economic aspects to measure the impact of these changes. By analyzing and interpreting the data and design a model tool Sustainability assessment for the Diyala University campus, and its statistical analysis to determine the steps taken by the university towards sustainable development. The tool included three main axes: the environmental axis, which includes planning and design indicators, climate change, vegetation and soil cover, water and energy conservation, green transport, waste management and the social axis. It included the indicators of community participation, education, research, and the economic axis. It included indicators to direct the capital's investment in the sustainability of the campus. The number of the overall indicators studied reached to 83 indicators. The statistical program SAS was used in data analysis to study the correlation and clustered analysis of the axes and indicators included in the campus sustainability assessment tool, the study found the respondents (who participated in the survey), they have linked the environment and economy axis with a level of 0.59 in applying the results of the clustered analysis which showed that there are two main clusters, A and B, where the largest cluster A included 63 indicators out of 83. Most of the environmental study indicators included vegetation cover, climate change, water, energy conservation, waste management, and indicators of the economic axis Encouraging capital investment in campus sustainability. The social axis is to promote the principle of awareness and community participation in consolidating sustainability as a measure that must be adopted. The second cluster includes the environmental indicators of the university's design in terms of planning, design, protection from weather factors, the use of mass transportation that does not pollute the environment, and the preservation of resources. A long way is still to go before the Diyala University campus and the university at its first steps, it seeks an organized change towards sustainability. This model can be applied to other local universities

Keywords: Measuring Sustainability, Campus, tools Sustainability

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Introduction:

The topic of sustainable development has become a subject of controversial issue in all disciplines and societies and one of the most comprehensive concepts. Sustainable is development Compatible with the requirements of the nowadays without affecting the ability of future generations to meet their requirements. Thinking about sustainability has become three main dimensions, environmental, economical and social sustainability with the need to integrate the three dimensions in a way to ensure the balance among the three dimensions. [1].Today, the social responsibility of higher education institutions is generally recognized in contributing to a sustainable society. Since the 1970s, policy measures have been implemented to integrate environmental education into the curricula of higher education institutions [2] .The responsibilities of higher education institutions today are summarized in a concept called a "sustainable university" or "sustainable campus". The campus concept or university sustainability can be dealt with and defined in multiple ways; However, the different expressions indicate largely overlapping dimensions. [3] defined a sustainable campus as follows: "The sustainable campus community works in accordance with its local and global responsibilities to protect and promote the health and well-being of people and ecosystems. Actively sharing the knowledge of the university community to cure the environmental and social challenges that we face now and in the future. Worldwide, this interest in sustainability has been used as assessment tools for sustainability systems in higher education [4]. Significant progress has been made towards sustainable development, which can be seen in a wide range of fields through the application of environmental management systems such as ISO14001 and EMAS and holding specialized conferences annually to address sustainability in Universities and discussing the latest developments in this field, such as the Association for the Advancement of Sustainability in Higher Education (AASHE), the International Sustainable Campus Network (ISCN) and Environmental Management for Sustainability in Universities, providing evaluation tools such as "AMAS" and proposing classification systems such as (Green League, STARS, Green Matric). [5] [6] .Difficulties found in measuring sustainability in universities , especially in countries that are in early stages of sustainable development programs, and there are many methodologies to measure sustainability in universities, including those that depend on data that are converted into known units such as spaces, money and energy ... or the so-called account-based evaluation, and descriptive analytical evaluation. It depends on charts, illustrations, and tabular information, in addition to evaluation that relies on indicators and tools, which are among the most widely used sustainability methods. [7] [8] classified methods for assessing sustainability in universities into an account-based evaluation, a descriptive analytical evaluation, an indicator evaluation, and each of these methods has strengths and weaknesses. As for the evaluation of accounts, description and analysis, they tend to be more objective, and he added that the evaluation of indicators provides higher levels of transparency and consistency and is more useful in making decisions about the development of sustainability in universities, and since nearly two decades ago many evaluation tools have developed, and there is a relatively large number of them available. To help universities measure their sustainability and some are still under improvement, [9] points out that the quality of the assessment tool is represented by its comprehensiveness of

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the most important axes of sustainability in the university, raising its environmental efficiency, and being measurable and comparable. [10] indicated through his review of studies related to the structure of sustainability assessment tools in universities. It was found that there are many similarities in the main axes of these tools and it was noted that the preparation of environmental indicators is the largest in most of the tools, followed by Academic and administrative indicators and the lowest innovation indicators, Table (1) in the study [11] to assess the performance of sustainable development (SD) in nine Indian higher education institutions through surveys, documentation, direct observations, interviews with professors, researchers, students and employees, and gathering information that shows The study showed that although Indian universities apply sustainable development strategies, and try to join with scientific systems of sustainability such as STARS and UI Green- Metric, these institutions do not follow a comprehensive and systematic approach in implementing the sustainability of Indian higher education institutions, and the degree of their commitment is nearly 50% currently. By the standards of global systems. One of the local experiences in measuring campus sustainability that used sustainability measurement tools is a study conducted by[12] to assess the sustainability of the University of Baghdad and Al-Mustansiriya University, where the researchers summarized the most prominent aspects, including the planning and design aspects of a sustainable campus, including the planning aspects of the landscaping of land uses, the considerations of external spaces, the considerations of the movement paths (sidewalks and vehicles), the considerations of water and resource conservation and the environmental considerations represented in the management of climate change, limiting greenhouse gas production and aesthetic considerations. As for the design considerations, they included environmental design considerations, green building uses and practices for roofs and openings, treatments for the quality of spaces and the interior environment and functional considerations, which included water and resource conservation considerations, flexibility and adaptation considerations. Therefore, study aimed to reach to build a sustainability assessment tool for Iraqi universities and to be applied on Diyala University as a case study that includes, in its axes, emphasis on how to assess the sustainability of the local campus. For measurement by academics researching in this field, progress is made to assess the sustainability of Iraqi universities. [13]

Table (1) Sustainability Assessment Tools in the Empty Campus

NO	Tool	Abbreviation	Year
1	Sustainability Assessment Questionnaire	SAQ	2001
2	Graphical Assessment of Sustainability in University	GASU	2006
3	Sustainable University Model	SUM	2006
4	University Environmental Management System	UEMS	2008
5	Assessment Instrument for Sustainability in Higher Education	AISHE	2009
6	Benchmarking Indicators Questions – Alternative University Appraisal		2009
7	BIQ-AUA		

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8	Unit-based Sustainability Assessment Tool	USAT	2009
9	The Green Plan	Green Plan	2012
10	Sustainable Campus Assessment System	SCAS	2014
11	Adaptable Model for Assessing Sustainability in Higher Education	AMAS	2014
12	Sustainability Tracking, Assessment and Rating System	STARS	2014
13	Green Matric – UI's Green Metric University Sustainability Ranking		20`4

[14]

Methodology- field study:

First - location and space:

In order to reach a clear vision of the reality of local universities and regarding the requirements of a sustainable campus. Diyala University which located in Baquba city was chosen as study case, and considered as a general model that could be adopted in the rest of local universities. Diyala University established in 1999 as the first scientific center in the province for the urgent scientific needs for community of Diyala governorate, the land, earlier used as scouts and sports camp changed later to a new university that includes several colleges, College of Education, Physical Education and Science, and later the Faculties of Agriculture, Veterinary Medicine, Medicine, Religion, Law, Economics and Engineering. The university has more than one sub - campus that extended Inside the urban suburban of Baquba city. The center of Diyala Governorate, outside the campus of the original university, which is located in the Mouradia area, which is 11 km distance south of city center, meaning that it occupies a semi-urban site of the city, the area of the campus is 165.5 hectares Figure (1), the site is characterized by easy and smooth access due to the location on the main road linking the city and the capital, as well as its free of noise, traffic congestion and industrial areas, thus ensuring the protection of the main Campus from the external influences and create an academic urban environment suitable for campus users, Figure (1).

Site plans

The first basic plan of the university was developed in 2005 by the president of the university at that time, the architectural professor (Moamal Ibrahim). The basic plan included the design of the eastern part of the university campus and its merging with the western part, which was not originally designed and includes old buildings on which the founding colleges of the university were established, and in 2011 a modernization was carried out on Basic plan for the entire site and adding additional areas to the original space, to make the plan more flexible for future expansion Figure 3. The university includes fourteen colleges, and the number of students in elementary studies is 16994, evening studies are 5456, and postgraduate studies are 852 students, and the number of teaching staff is 1376. The University of Diyala ranked (12) out of 61 Iraqi universities and ranked (633) out of 912 international universities in the global Green- Metric UI classification approved by the Ministry of Higher Education and Scientific Research for the year

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2020.

Several basic plans were drawn up for the development of the campus at the first Diyala University in 2005 by the architectural Moamal Ibrahim, the eastern part of the campus, he added new colleges, which are belong to the medical group, law and economics, with public services (bank, nursery, kindergarten, calculator center, central library and mosque). The designer followed the philosophy of the domes. Islamic arches and the open courtyard in the middle of the buildings in a compact urban fabric as the buildings clustered around a central building

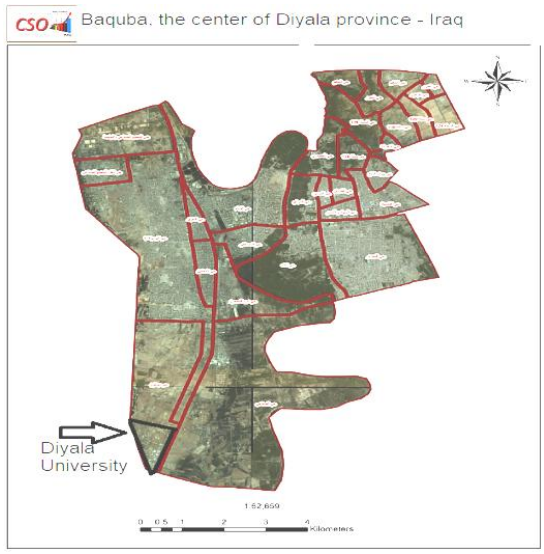

Figure 1. The location of Diyala University from the city of Baquba- Source - Iraqi Ministry of Planning

: Figure 2. Base Plan 2010 - De apartment of Construction and Projects University of Diyala

Second - field survey

The field survey of the university's site was conducted, the reality of the situation to determine all the variables by relying on the accurate site observation of the researcher and visual observation to collect information and analyze the basic plan. The field survey concluded some changes in the uses of the collective land between the basic plan and the reality of the situation, including:

- Replacing the parking space assumed in the master plan as a private car park for the University Teaching Hospital, with three buildings for male and female student's dormitories at the university.

- Changing the use of the main axis of the campus entrance, which is designed in the plan in the

form of a water channel with concrete terraces on both sides to sit on a flat ground.

- Construction a new road linking the Deanship of the College of Agriculture and the central library building.

Figure 3. Map of the University of Diyala campus, the reality of the situation, prepared by the researcher

- Establishing a walkway for the walking narrow road with a width of 4 m linking a car park back to the university teaching hospital, and it runs straight and crosses the main axis of the university entrance and ends at the College of Science. Figure (3).

- The construction of two buildings, internal sections, one for male students and the other for female students, and both buildings were located near the parking lot next to the site.

- Many of the buildings in the campus plan are not implemented on the ground - as well as the movement paths, umbrellas, roads, sewage services and water treatment plants, most of these services have not been completed. Figure (3).

- The round-road that surrounds the university has partially completed ends at the boundaries of the College of Agriculture, which could contribute to greater flexibility in limiting the movement of cars and the sustainability of the campus. Figure (3).

- The university established new investment projects, shopping centers and a closed swimming pool. These projects changed the use of the land in the master plan 2010. Figure (2).

Third - Preparing the sustainability measurement tool:

[15] classified the methods of evaluating sustainability in universities into three methods, assessment based on accounts, descriptive and analytical evaluation, and evaluation of indicators. Each of these methods has strengths and weaknesses. Comparison between the three main environmental, economic and social axes are indicators for measuring and analyzing sustainability in universities. The structure of the evaluation tool includes Main axes, each axis includes several, The values of the values were designed according to the data, indicators and documents obtained from the university and accordance with the environmental conditions of the nature of the study area, after designing the assessment tool for the sustainability of the campus, it was presented to specialists and academics in the field of environment, sociology and economics working at the university before obtaining the answers directly from them reached 25 specialists who were carefully selected by the researcher. They occupy administrative and executive positions, academics, and specialists in management, economics and sustainability facilities within the university's administrative staff.

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The evaluation tool identified three aspects, environmental, economic and social. The environmental pillar included the inclusion of indicators for sustainable site planning, sustainable design of university buildings, climate change management on campus and the associated factors, soil sustainability and vegetation cover, waste management, water conservation and sustainability, renewable energy and green transportation inside the university campus this axis took the largest part of the evaluation tool because of the great importance ,of influence on the campus site. As social axis, it included indicators of social media and community participation, and the economic axis included indicators of the sustainable economy, sustainable campus services Figure 4. Resources are drawn from the axes and indicators, the evaluation tool is from previous studies and some indicators related to the nature of the study area, which is characterized by a fragile and variable climate that tends to extremism in high temperatures most days of the year, were added to it.

The documents were obtained from the university, which was helpful to know the plans and directions of the university's policy in the long and short term, the degree to which it adheres to the Cam pus Sustainability Standards This step is considered as a review of The university's history in the sustainability of the campus and the extent to which a clear policy was drawn up to implement sustainable development steps for decision-makers and in engaging the university community to define its future directions.

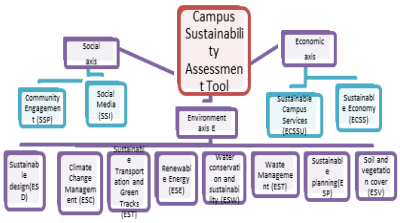

Figure 4. Illustrating the campus sustainability tools By Researcher

Results and discussion:

The data were collected, Excel program used, and then statistically analyzed. The Statistical Analysis System -SAS (2012) program was used. The results of the correlation coefficient analysis and the cluster analysis of the indicators of the campus sustainability assessment tool were measured in order to link the study axes and to know the weight and importance of the indicators studied by experts The field of sustainability on campus and the extent to which these indicators relate to each other Figure 4. The correlations between the three main axes of sustainability (environmental, social and economic) showed a positive correlation value, but differed in their ratios, where the highest values of the correlation between the environmental axis and the economic axis were found, which amounted to 0.59, followed by the correlation

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between the economic and social axis 0.48 and the lowest value was found for the correlation coefficient between the environmental and social axis which reached to 0.32 Figure 4, that this sequence in the values of the correlation coefficient clearly expresses the direction of the university's policy towards the sustainability elements on the campus and gives priorities to specific strategies to be carried out as steps towards implementing the elements of sustainability on the campus. The university's loss of most of the basic infrastructure services is a major factor that drives those in charge of university administration to link between the environmental and economic elements in achieving sustainability at the present time, therefore taking the highest values when taking expert opinion. The self-evident that it is known that the four elements of sustainability in higher education start from the base of the pyramid of sustainable environment and economics and ends at the top of the pyramid societal sustainability and education In other words, the university is still in its first steps towards achieving the goal.

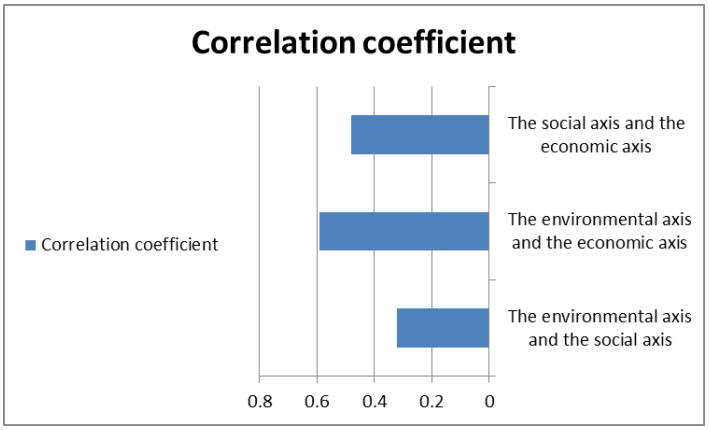

Figure 5. Correlation coefficient between evaluation tool axes By Researcher

The cluster (Figure 6) analysis divided the study elements and indicators into two groups: A and B. Group A included a number of indicators from the evaluation tool 63 indicators, and group B included a number of 20 indicators, refer to Figure 6. Group A formed two secondary clusters, the same as of the third and fourth degree. The cluster formed at the AAAA2 level consisted of Three groups at the same level of convergence. The first is a combination of the indicators of water conservation ESW1,2, which is the calculation of water consumption and the preservation of water quality within the campus with the indicators of climate change management ESC13 Procurement of local materials and the management of clean transportation inside the campus EST7 The use of local stones in paving walking paths and their classification according to color. The second group of cluster AAAA2 may also be from several sustainability indicators converged under this cluster is energy conservation and renewable energy ESE3 is the university's support for replacing the devices with other energy-saving ones with the green transportation index on campus EST1. The university provides mass transportation in The University and the Soil and Vegetable Cover Index ESV15 , the university is keen on establishing sewage and housing networks. The occurrence of these indicators falls under one group, this is because the university did not implement these provisions, so it clustered close to each other. As for the third group under cluster AAA2, it included all of the ESV5,10 vegetation indicators,

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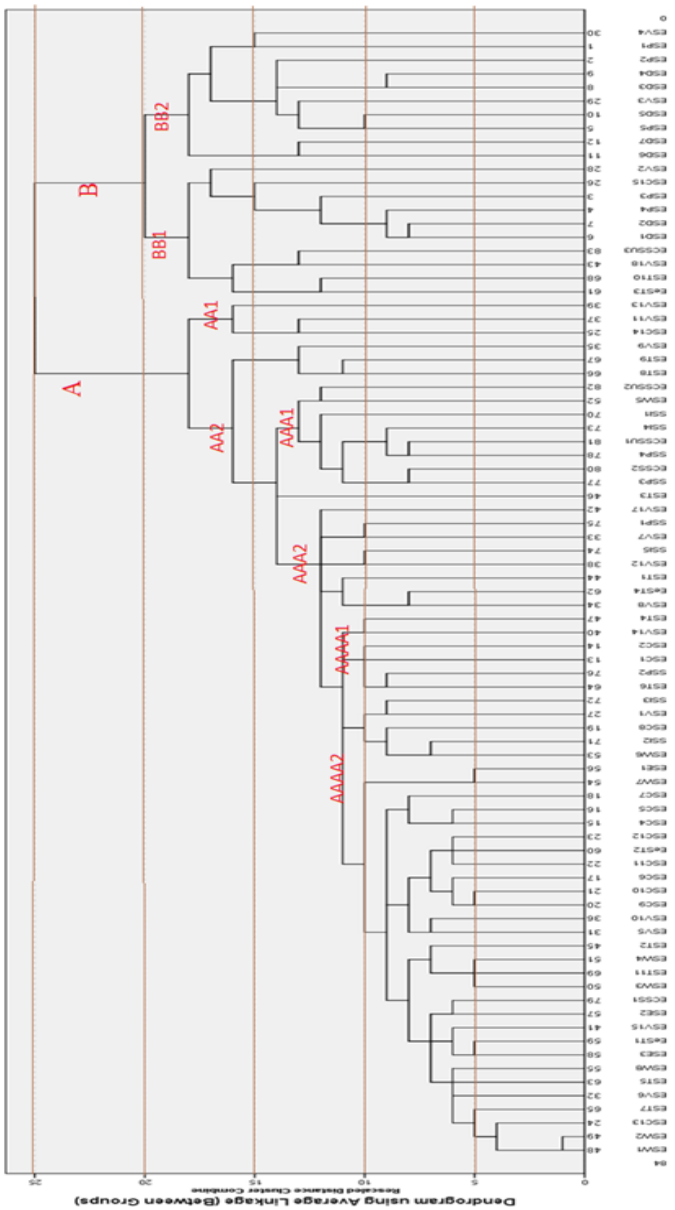

production of clean energy from organic waste and planting trees that provide shade to walking paths, squares, green lawns, and climate change management indicators. 11ESC 6,9,10, the use of equipment and machinery with a low pollution source, the calculation of the quantities of CO2 gas, the university administration develops a plan to limit and control pollution, the university and the university **Figure 6. Cluster Chart, Campus Sustainability Assessment Tool, University of Diyala** faces climate change, the gathering of two indicators only, namely ESW7, the use of smart taps ESE1, the university administration is keen on utilizing solar energy and wind energy, we note that at the level of the AAAA2 cluster and its branches, indicators have gathered, which are of a sustainable nature for site services, and intertwined with indicators that require the university administration to develop plans and policies to implement these indicators that contribute to improving air quality, reducing pollution and feeling thermal comfort for users of outdoor spaces on campus. While group B included.

The second part of the clusteral plan consisting of group B (Figure 6) which consists of two main clusters, cluster B1, and most of its indicators consist of design and planning standards and

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indicators of vegetation cover and waste management (eST3 + EST10 + ESV18 + ECSU3 + ESD1 + ESD2 + ESP3 + ESP4 + ESV2 + (ESC15).

And cluster B2(ESD6+ESD7+ESP5+ESD5+ESV3+ESD3+ESD4+ESP2+ESP1+ESV4), respectively are indicators of organic waste disposal methods, clean energy-powered transportation fluid inside the campus, examination and treatment of soil problems from pollutants, establishing Mini-Shops to serve Campus users, study the orientation of university buildings, achieve spatial containment action of buildings, surrounding outdoor spaces, preparing plans to confront dust storm,heavy rains, and planting adapted trees to the campus environment. From storms, rain, high temperatures, establishing, spreading Mini-Shops and linking them to indicators that work to achieve this, such as planting trees to improve the surrounding environment around buildings and movement paths, taking care of the soil and benefiting from its waste in improving organic matter and providing collective transportation that operates with clean energy that does not pollute the environment

Conclusions and Recommendations:

The results of the statistical analysis of the campus sustainability assessment tool for the correlation factor between the three main sustainability elements show that the best correlation coefficient was found between the environmental and economic axis with a value of 0.59, as this value reflects the tendency of those in charge of campus sustainability at the University of Diyala to integrate between environmental management and the diversity of income sources The university as a first step to embark on the sustainability of the campus. It is also noted from the results of the cluster analysis of the sustainability assessment tool designed by the researcher to measure the sustainability of the Diyala University campus that there are two main clusters in the first design, A, which included 63 indicators. The indicators of the three axes overlapped in convergence. The extent of the university's progress in making practical steps in the sustainability of the campus in all the environmental indicators presented and the economic axis The indicators that were associated with the environmental indicators were mostly about maximizing and diversifying the sources of income on the campus from investment projects related to sustainable development on the campus and finally the social axis The indicators that showed a cluster convergence in cluster A centered around the principles of participation community in sustainability issues and spreading a culture of sustainability within the university campus.

The second part of the cluster plan Cluster (B) Under this cluster, the planning and design indicators for the campus emerged, where the importance of the university's relationship with the city, the orientation of the buildings, their construction style, the roads inside the campus, and the method of their assembly followed.

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