

Towards Achieving Environmental Sustainability of Landscape “Case Study: Fayoum University Campus, Egypt”

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Abstract:

Landscape has been recognized as a major tool in the achievement of environmental Sustainability. The paper objective is bringing out the interrelationships between landscape design and sustainable development. It begins by looking at the theoretical and conceptual issues in landscaping, sustainability and environmental impact design. It then goes on to assess the intensity and scale of environmental impacts from landscape design. It argued that landscaping is a pre-requisite to environmental sustainability. Hence the paper asserted that unsustainable use of landscape elements leads to environmental problems like biodiversity loss, climate change, global warming, soil and coastal erosion, and pollution. The paper identifies the negative and positive impacts from landscape planning. Findings from the study show that the positive impacts outweigh the negative impacts, by analyzing some successful global programs in unique projects to quantify benefits and produce landscape performance through environmental sustainability. Then summarized some strategies for applying in the practical frame work. the paper methodology is:

1- Theoretical approach: explaining the relationship between landscape, environment and sustainability then analyzing chosen projects and concluding strategies for applying in the practical study.

2- Practical approach: analyzing the existing case study of fayoum university campus and applying strategies which environmental sustainability and evaluating the outputs.

Are derived from the theoretical study towards The paper concludes that landscape have fundamental role to achieve environmental sustainability on the highest level.

Keywords: landscape , Environmental sustainability , landscape impacts , environmental landscape.

Introduction :

Landscape architecture is one of the preconditions for environmental Sustainability. Sustainable landscape architecture creates ecological designs for the outdoor and urban environment. It begins with appropriate systems which address function, cost, energy efficiency, beauty, and environment. Sustainable development means the use of environmental resources in perpetuation of existence (see Wright, 2008) Singh, 2009; to help protect habitat, contribute to storm water management, conserve water, among other objectives. The current trend in the practice of landscape architecture is to find the balance of “aesthetics and function” required for Successful environmental Sustainable design. The paper summarized some strategies to applying in landscape projects to achieve Environmental sustainability of landscape using and relying the global projects and experiences. The paper introduces a practical framework to enhance landscape through environmental sustainability , with important reference and application in one of the Egyptian high education institutions; Fayoum University Campus.

Structure of the Paper:

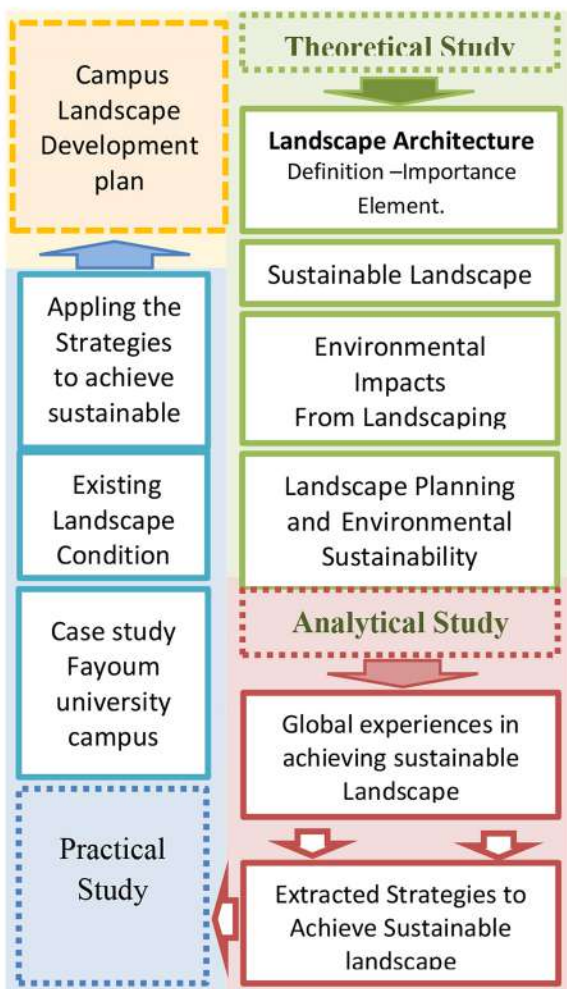


Fig. 1. chart structure of the paper.
Source: The author

1- Landscape Architecture:

1. 1-Landscape definitions:

Landscaping means the creation of an environment that is enabling, convenient and comfortable for living, working and circulation. Landscape Architecture is an appropriate way of conserving the biodiversity and other components of the landscape. From this point of view, Kanagabsabai (2010) perceived landscaping as a means of maintaining a healthy, clean and pure environment. Also, from ecological point of view. Jay and

Scott (2011) declared that the landscape structure affects the abundance, distribution, and interaction of organisms.

1. 2 -The importance of landscape:

Landscape architecture is rooted in an understanding of how the environment works and what makes each place unique. It is a blend of science and art, vision and thought. It is a creative profession skilled in strategic planning, delivery and management. Landscape architects bring knowledge of natural sciences, environmental law and planning policy. They lead teams, engage stakeholders and manage conflicting demands. They also create delight with beautiful designs, protecting and enhancing our most cherished landscapes and townscapes. Landscape Architecture has great benefit in economic, health and Psycho-social and environment aspects.

1.3 -Landscape Architecture Elements:

There are two main components in landscape design. These two parts are Softscape and Hardscape. Hardscape is designing elements that are solid and unchanging as the years go by such as (signboards, sidewalks, furniture elements..., Etc). Softscape are elements that are fluid and changing as they mature like (Grass, trees shrubs, flowers soil and water element ..Etc.). The ideal landscape is a balance of both hardscape and softscape.



- Sidewalk and walkway materials must be slip resistant and easy to maintain.
- Locate obstacles such as signs, street furniture, and newspaper stands to the side of the travel way.

Street Corner and curb Extension



- Street corners provide space for place-making elements such as landscaping, benches, bicycle racks, and improved lighting.
- Street corner amenities can be associated with small plazas to enhance the public landscape.

Furniture Elements Trash, seating, lighting and signboards



- Should be conveniently located for pedestrian traffic near benches, bus stops, and other activity nodes.
- Pedestrian-scale lighting can be integrated into bollards, walls / seat walls, buildings, and Pavement.

Softscape Element

Grass, Trees Shrubs Flowers and Soils.



- Using low-profile shrubs and upward branching trees to maintain visibility and sight distance at intersections, driveways, crossing, and other Critical areas.

Water elements Fountains, Water Pools, Canals



Table 1. landscape elements Source; (Streetscape Handbook, adopted by author.)

2 - Sustainable Landscape:

Sustainable architecture is architecture that seeks to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space. Sustainable architecture uses a conscious approach to energy and ecological conservation in the design of the built environment. The idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations .



Fig. 2.The basic dimensions of sustainability Source: Hasna, Abdallah M. “Dimensions of sustainability.” Journal of Engineering for Sustainable Community Development 1.2 (2006)

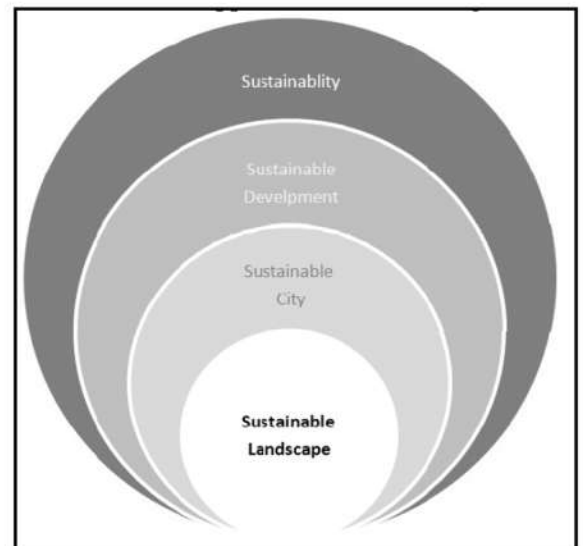


Fig. 3.Hierarchy of sustainability Source: Importance of Humane Design for Sustainable Landscape S. Toofan (2014)

A change of lifestyles and attitudes toward the local and global environments is important, the development of scientific knowledge-bases that provide skills, techniques, and methods of implementing specific environmental design goals is urgent. To enhance environmental sustainability, a landscape must holistically balance and integrate all three principles - Sustainable Design, Economy of Resources, and Life Cycle Design - in design, construction, operation and maintenance, and recycling and reuse of architectural resources. These principles comprise a conceptual framework for sustainable landscape Architectural design.

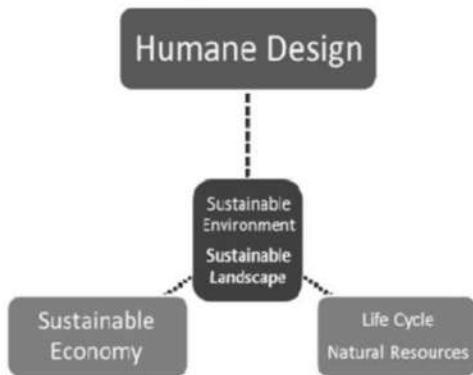


Fig. 4. Humane Design for creation sustainable landscape.

Source: Importance of Humane Design for Sustainable Landscape S. Toofan (2014)

3- Environmental Impacts From Landscaping:

- The positive impacts of landscaping include the socio-economic effects, as well as the provision of contact with culture and nature.
- Other positive impacts are environmental conservation, initiatives for waste management, improved concern for urban appearance, improvement of environmental condition, as well as making the most of professionals like landscape architects, planners, curators, sculptors, estate

managers, horticulturists, artists, and environmentalists.

- Moreover, some unquantifiable impacts are made on the environment

Through landscaping. For example, social welfare improvement,

Amenities, cultural heritage, and environmental change. Harris (2006)

Established that there is a significant relationship between landscape planning and environmental impact design. He opined further that landscape protection is a possible way of combating the changing perspectives on the earth, as well as the associated problems like pollution, depletion of earth's protective ozone layer, deforestation, species extinction, global warming and climate change. Landscape planning is very important in order to cushion the effects of environmental hazards and risks.

4- Landscape Architecture and Environmental Sustainability:

- Landscape architecture is a strategy for achieving the social, economic and environmental objectives of sustainable development. The social objectives include participation in Environmental monitoring and management, promotion of cultural identity, institutional development, as well as empowerment. Also, the economic objectives include growth equality and efficiency, while the ecological objectives include biodiversity conservation, retention of ecosystem integrity, as well as management of global resources.

- Landscape architecture could be viewed as an environmental approach to the attainment of sustainable development. For instance, from landscape ecological approach, many landscape planners have perceived the conservation of plants as a means of enhancing the quality of the environment, (Given 1995; Bell et al.,

1994; Haines – Young, 2000; and Clouston, 1979).

- Sustainable development requires an understanding of the interaction between human activities and natural processes (Joseph, 2009).

Rising rate of urbanization has inflicted several problems on the Environment, while there will always be a need for general Environmental awareness-raising, today there is even more urgent priority—namely to demonstrate how the concept of sustainable use can be applied to real life situation (Christafferson, 1998).

5 - Experiences Achieved Environmental Sustainability of land scape.

California Academy of Sciences San Francisco, California, U.S.A



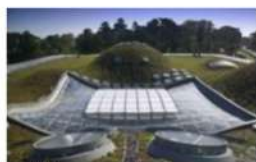
The living roof's 3,500 square-foot observation deck is one of the museum's most popular exhibits. the green roof reduces storm water runoff by more than 90 percent, lowers energy needs for air conditioning,



The living roof was planted with 1.7 million native California plants. that adapted to the local ecosystem, this landscape requires little irrigation and attracts numerous species of birds, butterflies, and insects.



Create 1.5-acres of new landscape space around the museum. Flexible outdoor rooms supply opportunities



The roof opens to allow cool night air to flow into the building below. By using natural

for sculpture, exhibits, cafes, receptions, and informal gatherings. A large building overhang and strategic planting design.

ventilation instead of air conditioning to regulate interior temperature, the building becomes more energy efficient.

HtO Park Toronto, Ontario, Canada :



This unique urban public space offers a sand beach, grass-covered green space amid paved pathways, and a planked boardwalk along the Waterfront.



The project creates a sense of community, offering relaxing gathering spaces for mental restoration and social interaction in a working utility.



The lush green grass and trees are irrigated with lake water rather than drinkable city water. This water conservation strategy saves the city thousands of dollars each year in avoided water treatment costs.



The paths are made of porous materials, allowing rainwater to infiltrate the soil beneath. This effective stormwater management technique helps alleviate the problems associated with rapid runoff, such as water pollution and flooding .

Burbank Water and Power Eco-Campus Burbank, California, U.S.A



The structure was saved from the junkyard and acts as a giant trellis, creating an interesting juxtaposition of industry and nature.	The project creates a sense of community, offering relaxing gathering spaces for mental restoration and social interaction in a working utility.
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Table 2. Experiences and global projects (achieved Environmental sustainability, OECD 2015, adopted by author.)

6- Summarized Strategies for achieving Environmental Sustainability of Landscape:

Reducing of Energy, Carbon, Water and Waste - Promote of Healthy and Safety life.

- Reducing of air , water and land pollution.
- Creating or maintain a functioning soil ecosystem and utilize strategies to promote infiltration and maintain water future integrity of the watershed
- Developing of plant communities that serve as a foundation for a healthy ecosystem.
- Utilizing of strategies to promote and change the climate to be more suitable and comfortable for users
- Energy conservation which Refers to reducing energy through using less of an energy service
- Using the landscape to reconnect people to nature and to apply the aim of the place.

7- Managing resources and materials efficiently by reducing material needs, reusing materials generated onsite, and recycling materials as much as possible.

Figure 5. Summarized Strategies for achieving Environmental Sustainability of Landscape, (adopted by author.)

7- Case Study Fayoum University Campus:

Fayoum is a city in Middle Egypt. Located 100 kilometers (62 miles) southwest of Cairo, as shown in figure 6. The city located today at a height of 22 meters above sea level on the banks of the Bahr Youssef canal which penetrates the Fayoum depression of its southeastern part and is divided into eight distributary canals which provide the Fayoum with water necessary for cultivation and drinking. The total population of the city of Fayoum is 851,125 inhabitants (Census 2014).



Figure 6. Fayoum location . (Surce: Google earth)

Fayoum University is a governmental university located in the Egyptian city of Al Fayoum in northern Egypt. From 1976 to 2005, Fayoum University was a public institution within the University of Cairo. In August 2005, it was established as an independent campus with 2,000 faculty members and enrollment of about 25. 000 students.

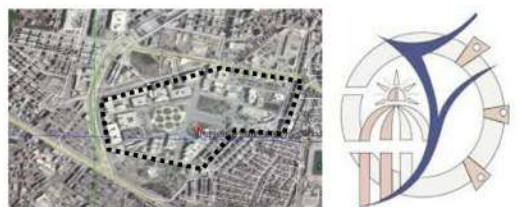


Figure 7. location of Fayoum University (Surce: Google Earth)

The evaluation of the existing conditions of the Fayoum University landscape was primarily achieved through site observations, and allowed for a site condition inventory, a functional analysis, and an aesthetic appraisal of the campus environment. Identification of primary landscape organizing elements and features that contribute to the existing physical character has been noted, and relevant problems and issues described. An inventory map was developed to describe the various landscape features, and a photographic data bank was compiled to illustrate in detail the conditions of the Fayoum University Campus. The map and inventory photos are included as a frame of reference.



Fig.8. Map, Google earth , adopted by author

7.1.1 Key plan of existing landscape condition :

Campus lawns:

Athletic Field	Pedestrian path
Active lawns area	Parking area
Green Area	Major Intersection
Trees	Entrance
Circulation:	
Main path	

Campus Features:		Building:	
Building	Academic building	Space between buildings	Residential building
Campus boundary	Administration		

Fig. 9. Key plan of existing landscape condition
Source: The author.

7.1.2 Campus Zoning:

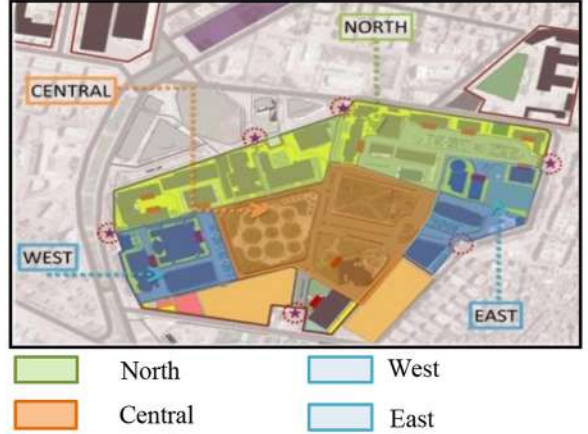


Fig. 10. Campus Zoning , Source: The author.

7.1.3 Overall Campus;

- Weak campus landscape image and character.
- Lack of visual consistency of campus landscape design.
- Incoherent organization of landscape components.
- Absence of a clearly organized and functional pedestrian-bicycle pathway system.
- Lack of built features that promote social gathering and interaction.



Fig. 11. Overall campus pictures, source: Author.

7.1.4 Central Campus:

- Lack of edging to control access and storm water.
- Absence of pedestrian improvements at roadway intersections.
- Weak relationship between campus passive spaces, special use lawns, and athletic fields.
- Undefined parking area.
- Inconsistent use of furnishing and lighting styles.



Fig. 12. Central campus pictures, source: Author.

7.1.5 North Campus:

- Lack of traditional-style built landscape features and structures.
- Lack of memorable outdoor spaces that maintain a comfortable pedestrian scale.
- Weak relationship between campus building spaces.
- Weak relationship of the Campus precinct to neighboring land uses.



Fig. 13. North campus pictures, source: The author.

7.1.6 West & East Campus:

- Weak attractive landscape of Main campus gates.
- Undefined parking area.



Fig. 14. West & East campus pictures, source: The author.

7.2 Existing Features:

Pedestrian Path – Pavers



Trash Receptacles :



Table 3. Existing features:

Source: The author)

Benches :



7.3 Summary of Key Issues:

Existing landscape components and site features have generally been designed as a response to individual building architecture, the relationship between the landscape, furnishings theme, signage, circulation system, lawn spaces, and special features is indistinct. Additionally, the general absence of unified design in terms of site furnishings, landscaping, lighting, outdoor spaces, circulation, and edges has resulted in a somewhat illegible campus environment.

Lighting:



8- Applying Strategies for achieving environmental sustainability of landscape in Fayoum University Campus, Introduction :

The Campus landscape development plan, has been developed to achieve the strategies of environmental sustainability of landscape which summarized form theoretical study to conclude and review practical results in achieving environmental sustainability throw landscape. Campus landscape development plan has been divided into several parts, which allow for the implementation of the strategies as shown in the analysis below.

Pergolas



8.1 Campus Landscape Development

Plan:



Program:

1. Entrance water feature.
2. Active lawn area (1).
3. Active lawn area (2).
4. Main plaza.
5. Active lawn area (3).
6. Building courtyards.
7. Theater.
8. Parking area.
9. Athletic field.

Fig. 15. Campus Landscape Development Plan
Source: Author.



Fig. 16. Section A-A (Source: Author)



Fig. 17. Section B-B (Source: Author)

8.2 Campus Landscape Development Framework:

8.2.1 Development Issues:

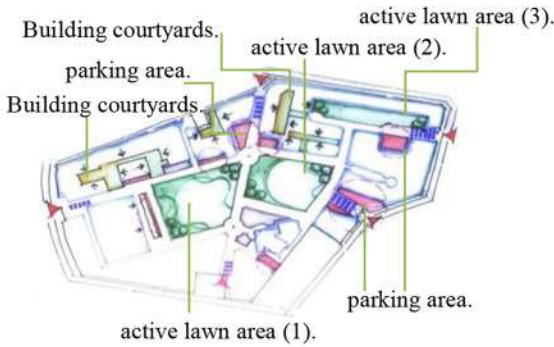


Fig. 18. Development Issues, Source: Author

8.2.2 Circulation study:

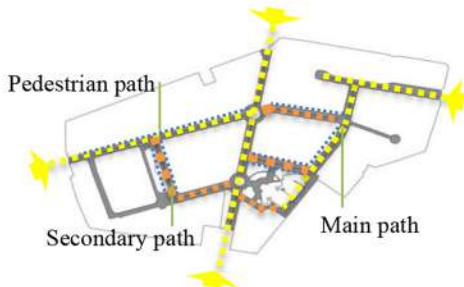


Fig. 19. Circulation study, Source: Author

8.2.3 Development Zoning:

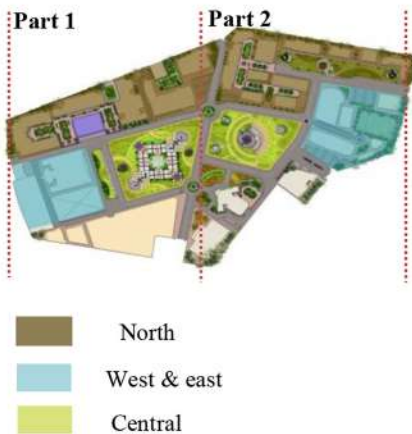


Fig. 20. Development Zoning, Source: Author

8.2.3 Softscape Study:

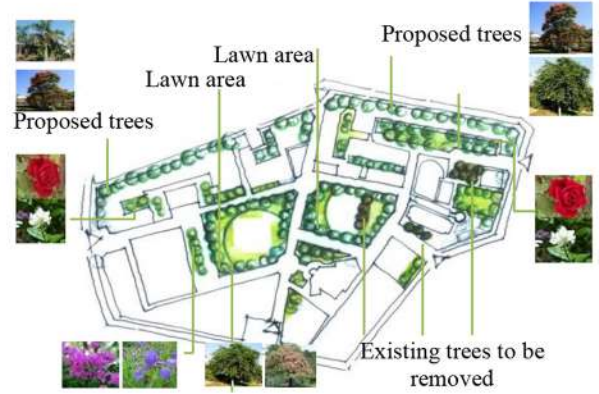


Fig. 21. Softscape Study, Source: Author



Cassia java

Cassia javanica is a small to medium-sized tree up to (25-40) m tall.



Ficus

Ficus sycamorus, a large, evergreen tree reaching a height of twenty metres, grows throughout Egypt.



Roystonea

It is a very large palm up to 20m, with a white marble column-like trunk and beautiful thick crown of leaves.



Spathodea

Spathodea campanulata is medium sized, reaching a height of 10-35 m, deciduous, with a round, heavy crown of dense, dark foliage.



Glycosides Bougainvillea Damascena Jasminum

Table 4. Softscape Study source: curvelandscape adopted by author)

8.3 Analysis of development plan according to selected Strategies:

8.3.1 North campus part-1

Part- 1



Fig. 22. North campus Development zoning, Key plan



Fig. 23. North campus development plan , part1,source: Author

After:
Before

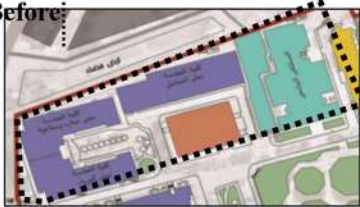


Fig24. North campus part 1(Existing condition) Google earth

Applying Selected strategies.

1 -Reducing of air, water and land pollution, through Reducing of automobile dependence between campus buildings to reduce air pollution (carbon emissions) and promote social gathering and interaction.



2 -Using the landscape to reconnect people to nature and to applying the aim of the place, through Provide relationship between campus building spaces which features, shaded setting and water feature that maintain a comfortable pedestrian scale and Develop a distinct and structured landscape pattern that addresses existing and new campus development while also including a common landscape furnishings palette for the whole campus (the Design Vocabulary).



8.3.2 North campus part-2



Fig. 25. North campus development plan , part2,source: Author

Part- 2



Fig. 26. North campus Development zoning, Key plan

After:



Fig27. North campus part 2(Existing condition) Google earth

Applying Selected strategies.

1-Reducing of air , water and land pollution.

2-Using the landscape to apply the aim of the place. These two strategies have been achieved by , create a hierarchy of circulation that effectively buffer pedestrians.

- development of automobiles and parking lots, such as establish an identifiable distinctive campus edge and transition to surrounding area neighborhoods.
- Develop comprehensive circulation, drainage and landscape improvements in perimeter .

-Increase the scale of details and complexity of planting at intersections, pedestrian entry areas, and points of interest .

3- Managing resources and materials efficiently by reducing material needs,

Through Plant native materials as part of the campus landscape design to help reduce maintenance and need for supplemental irrigation.

- Irrigation systems shall irrigate each area per the plant selected.
- low water plant zones should be irrigated less frequently to conserve water.



8.3.3 Central Campus Part-1:



Fig. 28. Central campus development plan , part1,source: Author



Fig. 29. Section A-A, source: Author.

Applying Selected strategies.

- 1-Create a functioning soil ecosystem.**
- 2-Developing plant communities that serve as a foundation for a healthy ecosystem.**

By incorporating plants that are well-adapted to the local ecosystem, this landscape requires little irrigation and attracts numerous species of birds and butterflies. The green roof of main restaurant reduces storm water runoff.

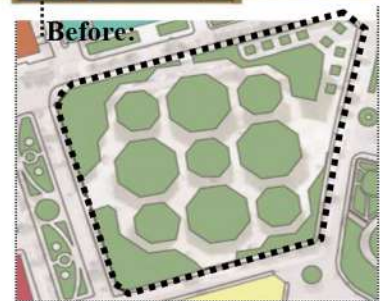


Fig.30. Central campus part 1(Existing condition) Google earth



Fig.31. Central campus Development zoning: Key plan

8.3.4 Central Campus Part-2:



Fig. 32. Central campus development plan , part2,source: Author



Fig. 33. Section B-B, source: Author.

Applying Selected Strategies.

1- Utilizing strategies to promote and change the climate to be more suitable and comfortable for users by use. Water and green spaces contribute to cooling the air as it moves upward to replace the warmer air in the center of the sanctuary.

2- Using the landscape to reconnect people to nature and to apply the aim of the place.

The design features of the entire campus efforts to show leadership in the environmental field through the sustainable use of air, soil, stones and water.

- Community members can benefit from the green campus, which features large balconies, palms and shaded gardens, and can also attend specials and cultural events to be held in the open theater.

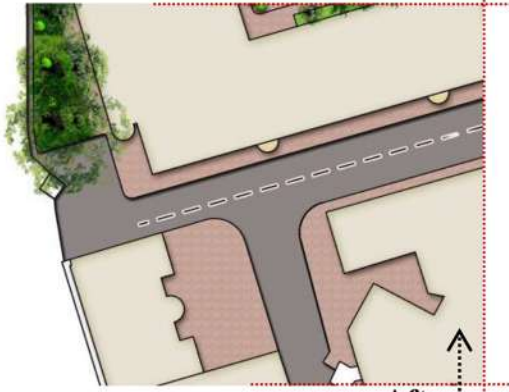


Fig.34. Central campus part 2(Existing condition)
Google earth



Fig.35. Central campus
Development zoning, Key plan

8.3.5 West & East Campus:



After:
Fig. 36. West campus development plan
Source: Author

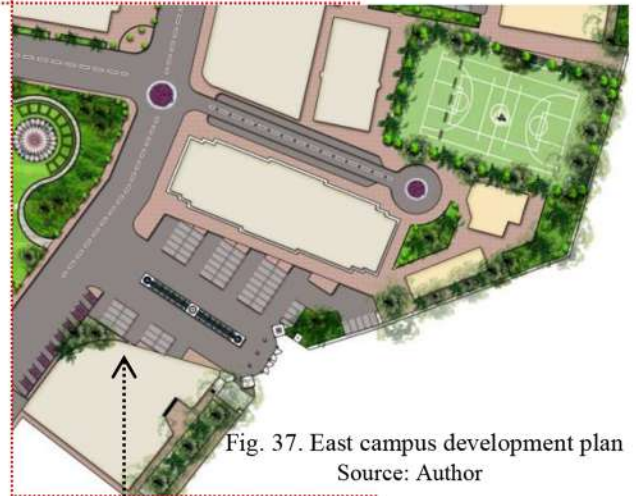


Fig. 37. East campus development plan
Source: Author

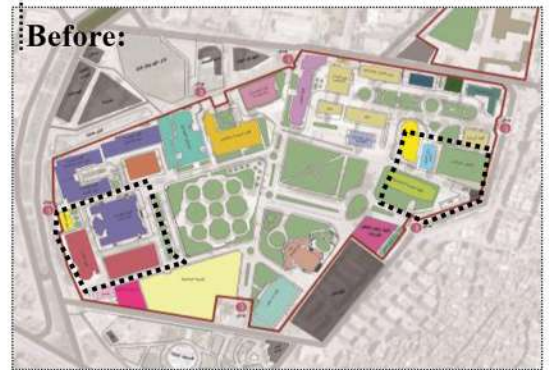
Applying Selected Strategies.

1-Reduce of air , water and land pollution,
by, Defined parking area to avoid randomly parking while Attractive land scape of main & secondary gate.

2-Manage resources and materials efficiently by reducing material needs, reusing materials generated on site, and recycling materials as much as possible,
Materials used in the campus are summarized up to: asphalt, concrete and stone in addition to other materials such as wood which are environmentally friendly attributes, including an enduring life-cycle.

- Accommodate redevelopment of the East Campus in a manner that is similar to the scale, structure, and qualities of the Central Campus.

After:



Before:

Fig.38.West &East campus (Existing condition)
Google earth

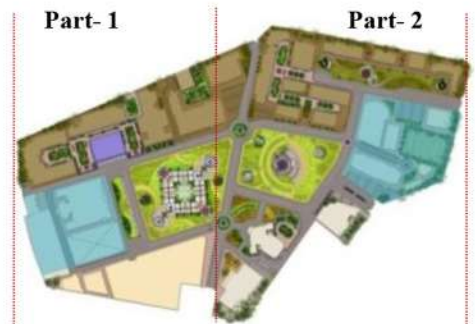


Fig.39. West and East Campus Development zoning, Key plan



Discussion and Results:

This paper examines the key issues on landscape architecture and environmental sustainability. Landscape architecture is the aspect of physical planning which deals with the improvement of the aesthetic environment. Sustainable landscape architecture takes into account environmental aspects of landscapes. There are many different approaches to landscape sustainability. It is not just about creating green spaces, but are about implementing design that can benefit both humans and ecosystems simultaneously; the paper summarized some strategies from theoretical and analytical study for applying in fayoum university campus, it has been developed in a logical sequence that leads from an examination of campus landscape and site development concerns to design concepts and solutions. This paper commences with an inventory and description of campus landscape components, and summary of key issues and opportunities for the long-term future development of the Campus environment . Next it proposes a master plan framework for future campus development.

The applied strategies have been achieved the environmental sustainability of landscape in Fayoum university campus and resulted the following :

- Improve active campus gathering spaces with site design and landscape improvements.
- Maintain and enhance larger passive courtyards, campus greens

and quads with site and landscape improvements.

- Establish new larger scale multipurpose pedestrian plazas and gathering places.
- Reinforce circulation patterns and campus spaces with the development of distinct landscaped edges.
- Establish simple and direct circulation patterns.
- Defined and improve the character and appearance of parking lots interior islands.
- Reduce the number of duplicate paths and increase the efficiency of existing pathways.
- Establish a more unified palette of materials for lighting, site furnishings, and landscape and hardscape elements.
- Improve the visual quality of the, North, Central ,West and East campus landscape.

Conclusion:

The landscape is a prerequisite to a sustainable environment. Landscape architecture is a necessary tool for environmental protection. It preserves the environment from the fierce assaults of human on the environment. It is useful for the enhancement of the aesthetic value of the environment. Accordingly, for the achievement of sustainable development through landscape architecture, environmental resources should be used in such a way as to meet the need of the present without compromising the ability

of future generations to meet their own needs.

One of the widely recognized approaches for ensuring sustainable development is landscape architecture. Sustainable development cannot be attained without due consideration to the quality and preservation of the environment. Landscape architecture has a significant role to play in the protection of the rich variety of natural biological and physical resources that are available in the environment. For the attainment of sustainable landscape architecture therefore, it is necessary to promote landscape that encourages the meaningful and purposeful use of environmental resources.

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الآثار الإيجابية والسلبية الناجمة عن مدى جودة تنسيق المواقع وقد تبين أن التأثيرات الإيجابية تفوق التأثيرات السلبية، من خلال تحليل بعض البرامج العالمية الناجحة في مشاريع متميزة ودراسة مدى تأثير تنسيق المواقع في تحقيق الإستدامة البيئية لها، ومن ثم الخروج ببعض الإستراتيجيات لتطبيقها في الدراسة التطبيقية.

الاستدامة البيئية هي القدرة على الحفاظ على جودة البيئة المادية الحالية مع الحفاظ على جودة البيئة في المستقبل، ويعتبر تنسيق المواقع من الأدوات الرئيسية في تحقيق الإستدامة البيئية ، وقد لوحظ أنه في المجتمعات العمرانية المعاصرة تم تهميش دور تنسيق المواقع واستخدامه بشكل محدود في مجال تجميل البيئة وإخفاء الدور الحقيقي وقيمه كأداة فعالة في الاستدامة البيئية. من هذا المنطلق تهدف الورقة البحثية الى إبراز العلاقات المتبادلة بين تنسيق المواقع والإستدامة البيئية، من خلال التعرف على الدراسات النظرية لتنسيق المواقع ثم تقييم حجم الآثار البيئية الناجمة عنه . وقد اظهرت الورقة البحثية أن تنسيق المواقع شرط مسبق للإستدامة البيئية، وأن الاستخدام غير المستدام لعناصر تنسيق المواقع يؤدي إلى العديد من المشاكل البيئية مثل فقدان التنوع البيولوجي ، تغير المناخ ، الاحتباس الحراري والتلوث ، كذلك تحدد الورقة البحثية

منهجية البحث هي:-

المنهج النظري :- دراسة العلاقة بين تنسيق المواقع ، البيئة والإستدامة وتحليل المشاريع المختارة وصولاً الي إستراتيجيات يمكن تطبيقها.
المنهج التطبيقي:- تحليل الوضع القائم لحرم جامعة الفيوم وتطبيق الإستراتيجيات المستخلصة من الدراسة النظرية مع تقييم النتائج.

وخلاصة الورقة البحثية أن تنسيق المواقع له دور هام ورئيسي في تحقيق التنمية البيئية المستدامة .

الكلمات المفتاحية : تنسيق المواقع ، الاستدامة البيئية ، تأثير تنسيق المواقع ، التنسيق العمراني المستدام.