The Green Areas in the city and sustainable Approach: Analytical Study of Saudi Crown Prince Mohammed bin Salman’s tree-planting Program

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Abstract. Sustainable planning has become a major topic for designers, which includes open areas and green spaces’ designs. These green designs have evolved from traditional approaches to green architecture theory and practice vision that people want to use and respect. Since 1990, the percentage of Saudi Arabia's land area covered by plantations has stayed constant at around 0.5 percent. Crown Prince Mohammed bin Salman wants to change the country's economy and society by planting 10 billion trees through a tree-planting programme, in order to boost environmental awareness, assist Saudi society reconnect with nature, and create jobs in rural areas. This project will rise the area covered by existing trees by a factor of twelve and reduce carbon emissions by more than half (4 percent). This paper aims to improve the natural and built environment by focusing on the sustainable approach that can use to upgrade the environmental quality of the city and using successful green areas designs that make more attractive cities and providing more environmental services, in addition to ensure that the green spaces are created to reflect the values and pattern of people’s life that will use them. To achieve these goals, the research depends on analytical application methodology. The study reveals the green areas in the cities and their benefits, and suggest sustainable approach for successful green spaces towards better quality of life which can be a guide for designers involved the process of sustainable growth, the research adopts Saudi Arabia case study interests in reducing its carbon footprint and placing the country against global warming.

Key words: Sustainable Approach, environmental services, quality of life, and planting program

1. Introduction

Green areas of all kinds have got importance for contemporary urban planning. Green Areas provide the important environmental and health benefits, the significance of manifestation of green areas have very diverse social, ecological and economic purposes, they can have an exceptionally positive impact on the micro-climate. (Uffelen, 2013)

Many studies conducted show the big challenges in attaining quality level of green spaces and sufficient green areas in the cities. In order to achieve contribution from green spaces, local initiatives should be focused in order to maximize green capita per city as well as its effectiveness on the environment.
1.1. Aim of research

The paper aims to suggest methodology towards implementing green areas in cities to ensure improvement of the natural and built environment by focusing on the sustainable approach.

1.2. Methodology of Research

The study depends on two main parts:
- Theoretical part: Reviews importance of green areas, sustainable approach in Architecture and urban planning
- Analytical application: Adopts case study; Crown Prince Mohammed bin Salman to plant 10 billion trees by tree-planting program, towards lowering Saudi Arabia carbon footprint and positioning the country against global warming, and finally suggest sustainable approach that can be a guide for designers to create successful places with well-designed green.

2. Green areas in Cities

Green areas spaces spreading in cities is easier than ever, due to easiness of installation, little maintenance and installation expenses, and modularity. therefore, the growth of a new urban ecosystem could be the answer to today’s cities’ environmental challenges, as green areas are spaces by which people can go for recreation, physical activity, or simply to discover some peace and quiet, but it must move toward greener urban systems in order to meet the recreational needs and to improve the quality of life for their citizens.

2.1 Importance of green areas

There are several benefits for green spaces, such as: (https://www.urbanespora.es/en/the-8-benefits-of-spreading-green-spaces-in-cities/)

![Benefits for green spaces](Figure 1: Benefits for green spaces)

Green areas are fundamental components in an ecosystem, important by providing ecosystem services like biodiversity and climate management, which improve city quality of life. The progress of every community is reliant on its urban green space ecosystem. They are essential element in urban planning of any city, hosting several activities.

Green spaces in cities are mostly vegetated public and private open spaces that promote active or passive enjoyment, sporting activities, or have a good impact on the urban environment. Open spaces, landscape areas, community parks, and gardens, among others, provide a variety of sustainable settings in a variety of forms and types. Green spaces include formal and informal green spaces, natural green spaces, children's spaces, public spaces, recreation activities, and other land management policies. Green spaces come in a variety of sorts, constructions, and shapes.

2.2. Types of green spaces

Green spaces can be designed with different scale, private or public areas, there are many different types, which can produce a widespread and prevailing recreational, cultural and community capability, efficient environmental quality and health as well as specifying varied and species – rich habits.

Types of green spaces include: Community woodlands, green roofs, landscape around buildings, street trees, urban parks and gardens, and wetlands (Figure 2)
Figure 2. Types of green space for (a) Community woodlands (b) Green roofs (c) Landscape around buildings (d) Street trees (e) Urban parks and gardens and (f) Wetlands

3. Green approach in Architecture and Urban Design

Green design is a method that minimises the negative health effects of construction projects. The idea of green architecture moreover recognised as sustainable architecture is the theory, science and style of buildings designed and confined in harmony with environmentally friendly principles. According to (Barchetta, 2018) green spaces can be recognized as public property and private property (Table 1.)

Table 1. Green space types and property regimes (Barchetta, 2018)

| Property model       | Property regime                           | Examples                                                                 | Accessibility                                                                 |
|----------------------|-------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Public property      | public green spaces                       | Greenways, grass verges, and tree alleyways; parks and woods; greenways, grass verges, and tree alley                        | Very stringent - the limits are intended to maintain the environment's quality as well as the space's public character. |
|                      | Special public green spaces               | Playgrounds for children, sports fields, pocket parks, historical parks, cemeteries, and botanical gardens are all available. | Limitations on what a person can bring into the space can be rather high.    |
|                      | Privately run public green spaces         | Intercultural gardens and community gardens                                | Various - ranging from high (quite unconstrained) to very low (access restricted to the members of an association) |
| Private property     | Simple green spaces for individual use    | Green roofs, green walls, and domestic gardens                            | Minimal, nearly entirely at the owner's discretion.                          |
|                      | Private green spaces that are complex     | Urban gardens; green places within private residential communities         | Only members of the club or organization are allowed to attend.              |
|                      | Green places that are privately owned      | Golf courses; urban teaching farms; bio-parks                              | High – can be linked to the payment of an admission price.                   |

The green approach in architecture and urban design is required to maintain the connection with environment and for people's health, a green approach in architecture and urban design is required to decrease the negative environmental effect from a built environment by many of economic advantages, health advantages, quality of life advantages, and ecological advantages that can be achieved. (Figure 3,4,5)
4. Sustainability concept approach

Sustainability is the usage of design approaches that decrease the negative environmental effect from a built environment. Figure 6 shows the concept of sustainable approach.

The Table 2. summarizes the role of urban green spaces (Karade et Al., 2017)
Table 2. the role of urban green spaces

| Role of Urban green spaces | Environmental benefits | Economic and aesthetic benefits | Social and psychological benefits |
|----------------------------|------------------------|-------------------------------|---------------------------------|
| Pollution control          | Energy savings         | Recreation and well being     |
| Ecological benefits        | Property value         | Human health                  |

4.1. Sustainability and green areas
Various studies have shown that the existence of greenness and visits to green space can lessen stress and increase renovation of the brain, and thereby develop mental health. Also, green spaces in cities contribute to climate change and adaptation, in addition to reduce natural disaster risks. Sustainable design aims to reduce buildings' negative environmental impact by maximising efficiency and moderation in the use of materials, energy, and space, as well as improving the ecosystem as a whole. In the design of the physical environment, sustainable architecture employs a methodical approach to energy and environmental conservation. Thus, many cities are starting to work to spreading green spaces in cities to develop environmental conditions. The Tree-Planting Program as an example for changing the country's economy and society will be dealt with in details.

4.2. Urban sustainability in the cities
In relation to development planning process, urban sustainability refers to the quantity of environmental quality that is achieved at a specific degree of quality of life (Alho, 2017). It is necessary to integrate aesthetic, economical, engineering and technology, natural, and ecological concerns based on sustainable development principles in order to create sustainable cities which serve its citizens (Leyzerova et al., 2016). According to (A. Leyzerova et al., 2016), suggests the fundamentals of constructing architectural solutions in urban design process, architectural and planning process, design process, and the general principles of the use of the original renewable energy (Figure 7)

![Principles of establishing architectural solutions](image)

Figure 7. Core Principles of establishing architectural solutions (A. Leyzerova et al., 2016)

4.3. Enhancing quality of life
Green areas are an important indicator to develop the quality of life and quality of environment in the city, green spaces characterized by social and spatial differences and highly valued by urban and landscape designers for contribution to the quality of life (Yilmaz et al., 2016). They provide a context for social interaction, serve as tangible reminders of childhood and memories of community life. Green spaces influence direct impact the sense of place and quality of environment in relationships of social, economic and environmental aids in these areas. (Cilliers, 2015).
The following case study shows the new Green Saudi Initiative as an example to achieve global goals in protecting the nature, being one of the solutions to recently climate change which can be applied in wider world scale, by focusing on the sustainable approach that can be used to upgrade the environmental quality of the city.

5. Application: Saudi- Arabia as a case study-The Tree-Planting Program of Crown Prince Mohammed bin Salman

Saudi Arabia is to build and develop in the direction of "Vision 2030," which was published in 2016 with the goal of achieving environmental protection, being one of the solutions to climate change. The new "Green Saudi Initiative" and the "Green Middle East Initiative" will achieve global goals in protecting the nature and it will put a clear ambitious milestone to Kingdom roadmap through the largest project of global afforestation. (Saudi press Agency Tuesday 26/10/2021, Presidential Statement of Green Middle East Initiative Summit)

![Figure 8. Saudi Green Initiative](image)

The "Green Saudi Initiative" and "Green Middle East Initiative" of Saudi Crown Prince Mohammed bin Salman to plant 50 billion additional trees is the world's largest reforestation endeavour to ensure that Saudi Arabia, as well as the rest of the Middle East, shifts to a "green policy." where "The Kingdom and the region are facing many environmental challenges, such as desertification, which poses an economic threat to the region (it is estimated that sandstorms in the region drain $13 billion annually), and air pollution from greenhouse gases is estimated to have reduced the average lifespan of the region," he said. Prince Mohammed stated, "Through the Green Saudi Initiative, I will seek to increase vegetation cover, cut carbon emissions, combat pollution and land degradation, and conserve marine life. Saudi Arabia will also join a Middle East Green Initiative with other Arab states to plant another 40 billion trees, which the prince believes will be the world's greatest reforestation project, according to The Saudi Press Agency (WAS). DUBAI (Reuters), MARCH 27, 2021 5.1. Project's vision

The project will contribute in raising the per capital’s share of green areas in the city, and increasing the proportion of the total green spaces through reforestation and tree-planting in all elements of the city and its various parts, while achieving the optimal use of water treatment in irrigation process, which contributes to the objectives of the Kingdom's Vision 2030.” in Improving air quality, lowering city temperatures, and encouraging residents to lead a more active and better lifestyle.

5.1. project's description

The Green Middle East initiative requires to conduct a tree-planting campaign for 40 billion trees and reducing carbon dioxide emissions by 60%. Saudi Arabia will achieve a big role protecting the nature, to plant a total of ten billion trees, restore 40 million hectares of land, produce 50% of energy through renewable sources, and reduce carbon dioxide emissions by 130 million tons by 2030, knowing that 1.3% of carbon dioxide emissions return to Saudi Arabia. in addition to, it is planned to reduce the waste in the garbage dumps by 94%, all of these achievements will be one of the solutions to solve the recently climate change.
5.2. Project’s challenges & solutions

Human actions can have an impact on the entire ecosystem, so it’s important to take care of the natural environment. Although the environmental campaigns require planting more trees, but it is very important to consider which part of it should survive and who will take care of those trees. It is very difficult to make long-term predictions in this area. The Institute of Atmospheric Physics at the Russian Academy of Sciences, according to the researcher Georgy Alexandrov indicated that a large part of the trees can die due to intolerance to the conditions of the ecosystems (the animals and insects that must inhabit them), as well as the peculiarities of the soil in the region.

Planting 10 billion trees in Saudi Arabia considered a big challenge, as Saudi records the third-lowest precipitation worldwide, Saudi Arabia would benefit from conducting extensive research on which trees should be planted, with local tree species being prioritised. (Ministry of Environment water & Agriculture, 2021)

They may restore existing mangroves and plant new mangrove trees, both of which provide benefits in terms of coastal protection and carbon absorption, and will help the project achieve its goals. The Saudi environment minister stated that underground water or water produced by fossil fuel-powered desalination would be used to irrigate the trees, despite the fact that the kingdom has depleted a significant amount of non-renewable water in the process of developing a water-scarce agriculture sector. The initiative will use purified water as well as renewable water sources such as precipitation, the ocean, and cloud seeding.

This initiative at the local and Middle Eastern levels for making the nature as a friend of man, to benefit from of the followings: vast lands, saving natural life, reducing disasters and storms, improving the quality of life, creation of new job opportunities, opening of new fields in industry and balance the environment and the industry of the future in all its fields (Ministry of Environment water & Agriculture, 2021)

6. Towards greater potential of green areas in cities, & sustainable approach

Creating a good green area for communities by following sustainable Approach towards better quality of life for citizens, this approach will be a guideline for designers involved the process of sustainable growth to create successful places with well-designed green. The suggested sustainable approach includes four main principles, as follows:

Principles 1: The clear understanding of the purpose of green areas

- The presence of greener urban systems in the city improves the quality of life and health, helps in reducing the stress, and the energy expenses of cooling buildings. which required regular maintenance, installation, and modularity.

- Gardens, parks, and wetlands improve a variety of benefits to urban inhabitants, health and well-being of city dwellers and workers, as well as have an unanticipated influence on a human heal and animals by improving air quality and lowering urban temperatures, they also play a big role in serving the user’ needs needed for activities and events, therefore the Green space infrastructure is essential to be designed well and distances amid green areas must be planned in order to stipulate climate cooling to communities.

- Green spaces are important ecosystems that provide ecosystem, and improve the well-being of city dwellers, the primary purpose of green spaces is improve the climate and reduce pollution by storage carbon and lessening the risk of flooding through excess rain water storage.

Principles 2: Set the main green areas’ objectives
Sustainability concept approaches decrease the negative environmental effect from a built environment by many of economic advantages, health advantages, quality of life advantages, and ecological advantages that can be achieved.

Principles 3: Suggest the solution- Sustainable approach to green areas

Sustainable architectural development to reduce buildings' negative environment towards better future, and employs a methodical approach to energy and environmental conservation. also, it is necessary to integrate aesthetic, economical, engineering and technology, natural, and ecological concerns in order to create sustainable cities, it can be achieved by:

- Using free energy and understanding the issues involved in the sustainable design: the projects' site, project's principles (Randall Thomas, 2009), the buildings' envelope using combination of recently technology and Sustainable design principles (Claudio Santini, Dafna Zilafro 2009), criteria for selecting the materials used, the air quality, water management, and guidelines to the green building designs (LEED), (Kuppaswamy lyengar, 2015)

- Green purposes must be included into the spatial planning process, as the right to develop the cities must be fulfilled to the environmental need and development for the present and for the future generation. (Osman Attman, 2006)

- Build and develop in new visions for environmental protection in order to solve recently climate change, working on world reforestation's projects in order to achieve global goals in protecting the nature, "Green Saudi Initiative’’ of Saudi Crown Prince Mohammed bin Salman as an example to build and develop in the direction of "Vision 2030," with environmental protection being one of the solutions to climate change.

Principles 4: The Importance of regular maintenance, installation, and modularity

It is also necessary to ensure that greener urban systems in the city implemented with high quality efficiency not only the quantity, as well as ensure their evaluation to improve the quality of life. all green open spaces should be cared and maintained for short and long time, using locally manufactured materials, and using the green areas with self-sufficiency uses. (Marie Helene Cntal & Jane Revein, 2009)

7. Conclusion

- The presence of greener urban systems in the city improves the quality of life and health, helps in reducing the stress, and the energy expenses of cooling buildings. which required regular maintenance, installation, and modularity. Green spaces are important ecosystems, the primary purpose of green spaces is to improve the climate and reduce pollution, it also plays a big role in serving the user' needs needed for activities and events, therefore the Green space infrastructure is essential.

- Sustainability concept approaches decrease the negative environmental effect from a built environment many of economic advantages, health advantages, quality of life advantages, and ecological advantages that by can be achieved. And Sustainable architectural development aims to reduce buildings' negative environment towards better future, it is necessary to integrate aesthetic, economical, engineering and technology, natural, and ecological concerns in order to create sustainable cities

- New "Green Saudi Initiative’’ of Saudi Crown Prince Mohammed bin Salman one of the solutions to climate change. it will achieve global goals in protecting the nature and the roadmap through the largest global afforestation’s project.
Sustainable green areas approach towards better quality of life will be a guideline for designers to create successful places with well-designed green, which includes four main principles: the clear understanding of the purpose of green areas, set the main green areas objectives, Suggest the solution, and the importance of regular maintenance, installation, and modularity.

Figure 9. Diagram for sustainable approach for green area designs’ principles

References
[1] A Brief guide to the benefits of urban green spaces, UBoC United Bank of Carbon University of Leeds, United Kingdom, www.leeds.ac.uk
[2] Al-Monitor: The Pulse of the Middle East, https://www.al-monitor.com/originals/2021/05/saudi-arabia-plans-plant-10-billion-trees-desert 3/13, g p j y g
[3] Al-Monitor: The Pulse of the Middle East, https://www.al-monitor.com/originals/2021/05/saudi-arabia-plans-plant-10-billion-trees-desert 6/14
[4] Al-Monitor: The Pulse of the Middle East, https://www.al-monitor.com/originals/2021/05/saudi-arabia-plans
[5] Carlos Alho, (2017), Towards Sustainable Architecture and Urbanism”, The International Conference on Sustainble Smart Manufacturing (S2M), 2017
[6] Christine Haaland Cecil Konijnendijkvan den Bosch, (2015), Challenges and strategies for urban green-space planning in cities undergoing densification: A review, Elsevier, 2015.
[7] Claudio Santini, Dafina Zilafro (2009), Green is beautiful, , Edit by, Beth Browne, Australia, ISBN: 9781864703252 (hbk)
[8] Giuliano Dall’o’ (2020): green planning for cities and communities: Theories, Strategies and Tools of a complex Framework, springer, 2020
[9] Integrating Green Infrastructure into Urban Planning, (2021): Developing Melbourne’s Green Factor Tool, Vol 6, No 1 (2021): Urban Planning and Green Infrastructure, 2021
[10] José G. Vargas-Hernández and Karina Pallagst, Justyna Zdunek-Wielgolaska, (2018), “Urban Green Spaces as a Component of an Ecosystem”, handbook of engaged sustainability, springer link
[11] Juan Shan,1 Zhuo Huang,2 Sibo Chen,1 Yue Li,3 and Wenli Ji, (2021), Green Space Planning and Landscape Sustainable Design in Smart Cities considering Public Green Space Demands of Different Formats, https://www.hindawi.com/journals/complexity/2021/5086636/ 2021
[12] Khoshtaria, T.K.; Chachava, N.T. (2017). The planning of urban green areas and its protective importance in resort cities (case of Georgian resorts). Annals of Agrarian Science, 15(2), 217–223. doi: 10.1016/j.aasci.2017.05.009
[13] Leyzerova A, Sharovarova E, Alekhim V (2016), International Conference on Industrial Engineering, ICIE, Procedia Engineering 150(2016) 2055-2061 Sustainable Strategies of Urban Planning
[14] Lucilla Barhetta and Francesco Chiodelli, (2018) “The variety of urban green spaces and their diverse accessibility”
[15] Elizelle Juaneé Cilliers (2015), “The importance of planning for Green Spaces”, Science Publishing.
[16] Judy Bush, Gavin Ashley, Ben Foster, Gail Hall, (2021), Integrating Green Infrastructure into Urban Planning: Developing Melbourne’s Green Factor Tool, Academic Editors: Paul Osmond (University of New South Wales, Australia) and Sara Wilkinson (University of Technology Sydney, Australia), Vol 6, No 1, 2021
[17] Marie Helene Cntal & Jane Revein, (2009), Sustainable Design- Towards a new ethic in architecture and town planning with foreword by Thomas Herzog, Basel. Boston. Berlin, Germany, ISBN 978-3-7643-9938-2
[18] Marit Jansson, (2014), Green space in compact cities: the benefits and values of urban ecosystem services in planning. Nordic Journal of Architectural Research 2, 139-160.
[19] Ministry of Environment water & Agriculture, KSA, (2021), The green initiative. A world in the colors of the banner of unification, 4 of April, 2021
[20] Osman Attman (2006), Green architecture advanced technologies and materials, Mc Graw Hill
[21] Kuppaswamy lyengar, Sustainable Architectural Design- An overview, (2015), Routledge:Tylor & Francis group, New York and London
[22] Ratnakar Karade, Venkata Satish Kuchi, Zehra Salma, (2017) “The Role of Green Space for Sustainable Landscape Development in Urban Areas”, International Archive of Applied Science and Technology: Vol 8 (2) June 2017
[23] Randall Thomas (2009), Environmental Design- An introduction for architects and engineers, Taylor& Francis group, London and New York, Third Edition, ISBN10: 0-415-36333-0(hbk)
[24] Serap Yilmaz, Sema Mumcu, (2016) Urban Green Areas and Design Principles, Environment Sustainability and Landscape Management (pp. 100-118). Chapter:6. St.Kliment Ohridski University Press.
[25] Urban Green Spaces: (2021) Combining Goals for Sustainability and Placemaking, https://www.europenowjournal.org/2021/05/10/urban-green-spaces-combining-goals-for-sustainability-and-placemaking/
[26] World Health Organization (2017), Urban green spaces: a brief for action, regional office for Europe
[27] Saudi press Agency Tuesday 26/10/2021, Presidential Statement of Green Middle East Initiative Summit, https://www.spa.gov.sa/home.php?lang=en
[28] Whitney Hopkins, Vail & New York City: Reconnecting people with nature through Architecture and Design, https://www.smartcitiesdive.com/ex/sustainablecitiescollective/nature-view-nature-design-reconnecting-people-nature-through-design/1069371/
[29] https://vid.alarabiya.net/images/2021/09/02/a20719aa-1702-41a6-9625-72c4fd6ff590/a20719aa-1702-41a6-9625-72c4fd6ff590.png?crop=1:1
[30] https://www.arabnews.com/sites/default/files/styles/n_670_395/public/2021/03/27/2544096-1578595557.jpeg?itok=V_R245vV
[31] https://www.urbanespora.es/en/the-8-benefits-of-spreading-green-spaces-in-cities/