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The Sustainable Development of Waterfronts for Coastal Cities as A solution for Green Spaces: A Case Study of Derna, Libya

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ABSTRACT

The economic and geographical locations of coastal urban developments allow them to have unique activities and growth patterns. The waterfront of a city is filled with endless opportunities to be used for various purposes, especially for recreational projects, which can increase the citizens' sense of belonging and reinforce their social and cultural values. However, some urban developments may lose such an opportunity due to various reasons. Derna is a city located at the Eastern part of Libya with a long Mediterranean waterfront. The waterfront in the city has not been fully utilized and activities were developed humbly to address the logistical and commercial sea activities. The current research aims to study urban green spaces/ urban parks in the waterfront the city of Derna, Libya in alignment with sustainability requirements and supporting the historical, social, and cultural needs of its population. An architectural analysis is carried out for the city, where the lack of sufficient parks and green spaces was apparent. The analysis also shows that the waterfront of the city is not developed to its fullest potential. Furthermore, a questionnaire was carried out on the residents of the city to understand their preferences and viewpoints on implementing a park development to the waterfront. The findings of the research on Derna's waterfront emerge from the needs and preferences of the city residents, as a proactive strategy in meeting population desires and providing a feasible solution to urban planners and developers in the city.

Keywords: Waterfronts, Green Spaces, Derna, Libya

1. INTRODUCTION

Coastal cities have high values due to their strategic locations that allow them to become economic hubs, simulating trading activities and growth. It is the reason some coastal cities miss out on great opportunities when they do not pay adequate attention to their greatest assets: their waterfronts (Hegazy, 2021). Moreover, the existence of a waterfront in a city is a unique opportunity to provide its citizens with a great deal of recreational activities, allow them to experience the full potential of their home, and develop their sense of place and belonging towards it. Waterfront also bring the natural and cultural characteristics of the location, which have positive influence on the residents' comfort, satisfaction, and pleasure levels (Turkoglu & Secmen, 2019). In urban planning, green spaces have a significant value that contributes to the residents' quality of life through allowing them to unwind and release emotional and physical destresses with a connection to natural elements. Waterfronts for urban cities have an added natural element, which is the coast, that can expand horizons by providing a unique sightseeing accompanied with enjoyable activities (Giannico, et al., 2021).

The dilemma experienced by urban cities is mainly the focus on economic growth within the city through providing residential and commercial structures. Rapidly, residents find themselves surrounded by steel and concrete block that hinders their natural connections and depreciates the value of the city's identity and residents' sense of belonging (Colding, Giusti, Haga, Walhagen, & Barthel, 2020). It is evident that populations that live in cities with more sustainable urban planning, containing sufficient green spaces and waterfront opportunities, demonstrate less aggression and violent behaviour. Furthermore, greenspaces and waterfronts increase the aesthetic value of the city to encourage new residents, better emotional and psychological tranquillity for the citizens, therefore, better economic growth and performance. The combination of greenspaces and water bodies is distinctive in meeting the physical and social needs of urban inhabitants (Callaghan, et al., 2021). This natural asset is challenged by the urban expansion that prioritises solving residential, commercial, or industrial issues without taking the historical, social, and cultural needs of the residents into consideration. Additionally, instances can be found where city developers did not consider the basic services needed by the residents and completely neglected the coastal advantages due to lack of satisfying basic urban planning requirements (Wood, et al., 2018).

The neglection of the waterfront of a coastal city, as well as its potential to enhance the residents' lives, is a significant issue that need to be highlighted. The case study adopted in this research, The Libyan city of Derna,

is an apparent example, where key recreational and natural spaces are lacking. Urban developers showed little attention to the social and cultural needs of the population, which affects interactions, development of consensus, and encouragement of positive behaviour. The impact of natural elements within the city on the health and wellbeing of its residents is another aspect of the problem. The disconnection from nature often is correlated to violent behaviour and mental fatigue. Arguments on physiological and psychological health indicators, such as lowering blood pressure and depression, have been found through data from different contexts in relationship with recreational facilities (Di Nardo, Saulle, & La Torre, 2010).

Libya is a North African country, where the majority of its population is concentrated on its coastal region. The city of Derna has been a steadily growing city, in terms of population, however, the development in the oil dependant country did not account for this growth to provide facilities that can support the social and cultural needs of the city residents. The research is a study of the problem of Derna and its need for green spaces and recreational facilities. Despite its coastal location, there have been no plans to take advantage of this asset. The proposed solution through the development of the city's waterfront is a valid and feasible approach to the urban planning problem of Derna that has accumulated over the years. The design and planning suggestions provided in the study should serve as the first step in creating a city with a better connection to its nature. Moreover, it is expected that this solution simulates better economic and strategic growth.

2. LITERATURE REVIEW

Urban Relationships

The influence of surroundings on the economic, psychological, physical, and social wellbeing of humans was early realized since ancient times. Therefore, the locations and the methods that were used to develop civilizations and cities were closely considered to leverage their opportunities and provide maximized benefits to the inhabitants. Nonetheless, it was not until fifty years ago that the extent of this influence is investigated through scientific methods in order to quantify and prioritise affecting factors. The relationship between humans and their surroundings is not limited to the things the nature does to humans, but also to the way humans affect these surroundings. Humans have the ability to establish their developments in the most efficient manners but equally can deprive themselves from using available resources in the best ways possible and extend such mistakes to harming their surroundings (Hinds & Sparks, 2011).

Research on this two-way relationship had been reviewed by Seymour (2016), who identified four types of connections in the literature: cultural, impact on nature, the conflict between surrounding and human economic benefit, and power relationship that touches on the social aspect of the problem. The author focused the study on the impact of the surroundings, in terms of nature, on human health from social, psychological, and physiological perspectives. The wellbeing of the ecosystem was considered a key part in the relationship that humans cannot ignore. The finally developed understanding of the nature identified three types of interactions that defines the relationship: biophysical, biotic, and cultural. Through the insights of the literature on the relationship, it can be comprehended that the human-surrounding relationship is more complex that it was imagined in early historic eras. The following section of the literature review focuses on studying this relationship from three dimensions: the relationships with the environment, city, and coast, in order to identify the factors that signifies the development of waterfront regions from the perspective of these relationship.

One of most fundamental and ancient human relationships is the one with the environment. The essence of the relationship is the vital need of humans for environment to survive and sustain living. The perception of man towards the relationship plays a major role in his ability to understand the required equilibrium that need to be preserved between the needs and the ecosystem. Seymour (2016) reviewed the different concepts on the human-environment relationship and developed an understanding that there are three essential human wellbeing factors: physical, mental, and social (Figure 1).

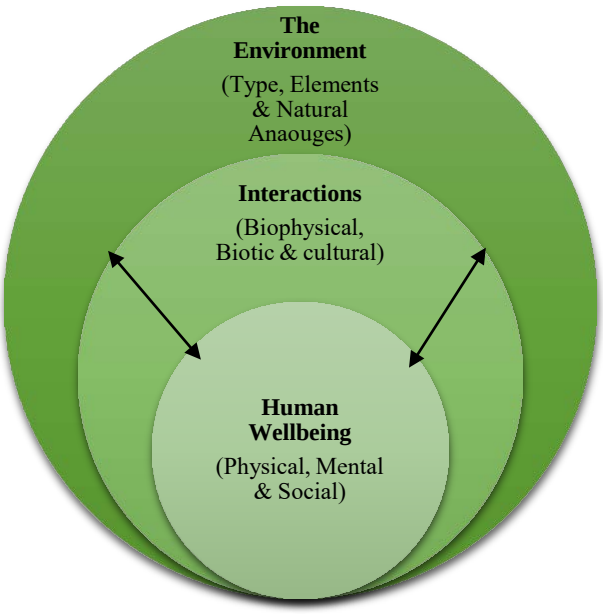

Figure 1. Relationship model for the relationship between human and environment (Seymour, 2016)

The environment in the outer circle of the model defines three elements of the environment, which are the type of environment, the elements of the environment, and the other living and non-living creatures that share the environment with humans (natural analogues) The model identifies three two-way interactions between human and the environment (Seymour, 2016):

- Biophysical: the interaction of mankind with the ecosystem and the alterations that are imposed due to their activities.
- Biotic: the interaction of mankind with the living creatures within the ecosystem and the way they affect each other.
- Cultural: the interaction of mankind with the ecosystem to get non-material benefits, such as spirituality, health, aesthetic enjoyment, and recreational advantages.

The interest of human in studying their relationship with the environment increased significantly in the second half of the century due to the noticeable impact of accelerated human activities on the ecosystem and the expansion of its problems on a global scale. Soil, water, and air are three abiotic elements in the ecosystem that all witnessed substantial changes. The impact on biotic elements is equally important, especially with increased forest fires, extinctions, and major species migration. Thus, the subject of sustainable land use is one of the most urging ones on the relationship between mankind and the environment. Exponential population increases and scarcity of vital resource add to the challenge with dilemma of increased consumption while trying to avoid environmental adverse effects, such as pollution, overgrazing, erosion, and nutrient mining. The population growth enforces another need for urban expansion that increases emissions and requires additional natural resources to be deployed (Buscardo, Forkour, Rubino, & Storozum, 2021).

Sustainable development is a bundle of solutions to issues in the relationship between mankind and their environment. The most crucial elements that are targeted by sustainable systems are the ones that are vital to human existence, including natural resources, ecosystem layers, and those that provide recreational benefits. There is no doubt that a collective human action can affect the negative effects and prevent expected ones in the future. A more comprehensive understanding of sustainable development incentivised specialists to expand its definition to include economic and social indicators, in addition to environmental indicators, as shown in Figure 2. The perception of the environmental problem was broadened through understanding that economic and social activities affect the whole environment, or parts of it, in a way or another. For instance, an enhanced educational achievement is an indication of increased human awareness towards the problems that face humanity within their environment. Hence, a better educated generation has the ability to identify problems and find solutions in a more efficiently (Kates, 2001).

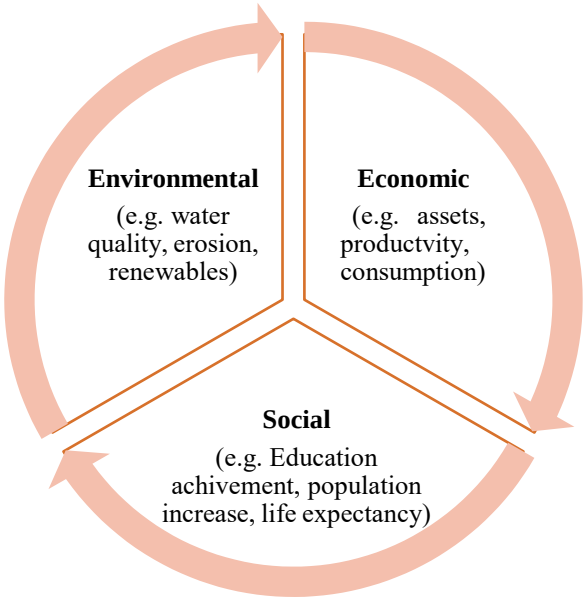

Figure 2. Elements of sustainable development determining human-environment relationship (Kates, 2001)

Dwelling is one of the most important human needs with several factors affecting decisions on location, size, and type. The location of habitat is mainly determined by the ability of a person to work and sustain a living at it, which is related to the type of economic activity it offers. The size is dependent on the population as a driver for urban activities in many perspectives. The type of dwelling depends on locally available resources and the need for protection from environmental conditions. A human civilization starts due to resource attractions and social needs, which makes economy and society the two fundamental factors in building a human community at a certain location. Moreover, the type of interactions within the community defines its structure, while the size of interaction and population defines its size of being a village, a town, or a city. Research confirms that the increase in scale in human economic and social interactions results in increasing city sizes proportionally (Schlapfer, et al., 2014).

Transportation is an important element within the city as a key factor for accessibility and mobility for its residents. The urban characteristics can change depending on the ability of the city to provide sufficient, convenient, and affordable accessibility options. Subsequently, the relationship between human and city is shaped by the latter's mobility structure, which affects several elements, such as resident satisfaction, rental prices, and comfort (Graells-Garrido, Serra-Vurriel, Rowe, Cucchietti, & Reyes, 2021). Additionally, the urban structure of the city was to affect the human behaviour and perception, which provides the connection between the city and human psychology (McCash Jr, 1976).

The natural elements within the city are key for the recreational, psychological, and social needs of its residents. While this issue was not critical in ancient eras, intensive urban development of cities to accommodate population increase and economic activities often overlooked this element. Furthermore, the type, distribution, size of natural elements deeply affects the relationship between residents and their city. Current approaches to urbanism indicate that there is an urgent need to reconciliate cities with nature as part of sustainable development and to restore the effects of city dominance that have occurred in the past (Taghvaee, Kamyar, & Moradi, 2017). The human-nature relationship was greatly affected by urbanization and opportunities for recreational activities that reinforces this relationship has been ignored for a long time. Current calls for the importance of human-nature relationship through dedicating a minimum requirement for green spaces within urban zones a governmental policy (Colding, Gren, & Barthel, The incremental demise of urban green spaces, 2020).

Interaction between City and Waterfront

The location of the city on a coastal region is mainly driven by economic activities, which imposes coastal risks, such as pollution and threats to marine ecosystem. Coastal areas provide high economic advantage mainly due to accessibility and shipping opportunities, which is signified by the existing fourteen out of the seventeen world major cities on coasts (Creel, 2003) and the concentration of around 40% of world population within coastal

regions (CIESIN, 2007). Sustainable development in coastal regions is challenged by many risks that are not present in continental regions, as shown in Figure 3. The decline in biodiversity is caused by urban expansion near the coast, which is leading to the destruction of vital natural habitat. The increase of economic activities at coastal regions caused a quick increase in population and resources overconsumption. The rapid population increase caused poorly planned urbanization that increased impermeable surfaces and lack of green surfaces. Moreover, the global issue of climate change and rising sea levels are also considered significant risks to coastal cities (Yilmaz & Terzi, 2019).

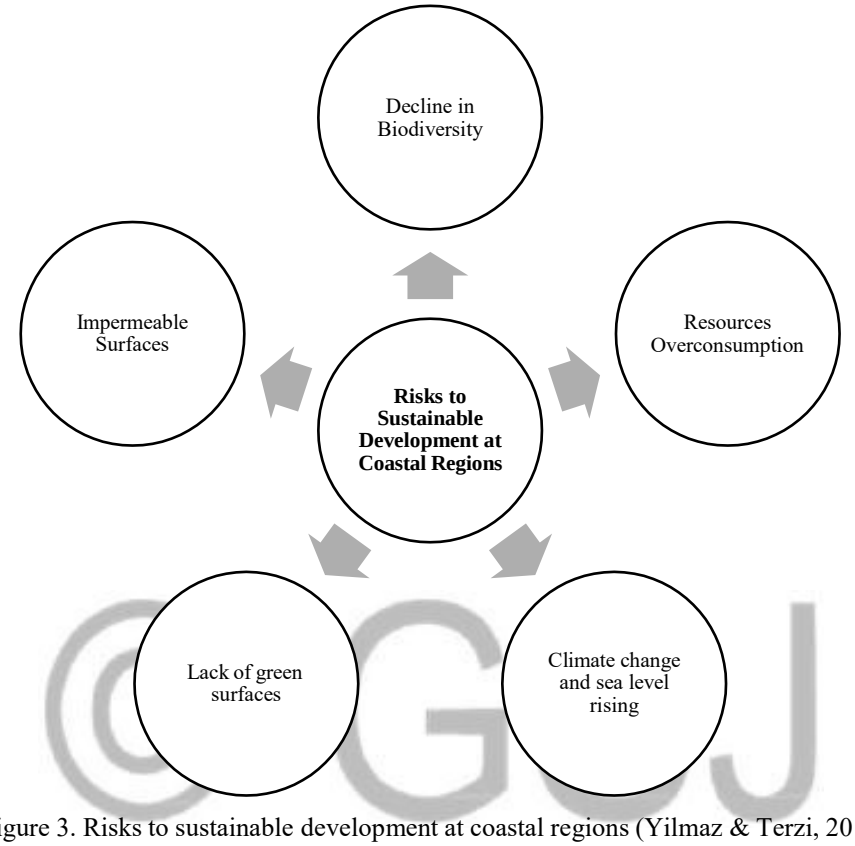

Figure 3. Risks to sustainable development at coastal regions (Yilmaz & Terzi, 2019)

Waterfront Development

There are several factors that influence city planners to develop waterfronts. The suitability of the site is an important factor in a time when sustainable development is a priority. Developers desire to ensure that their projects do not threaten the ecosystem or marine life. Apart from that, the factors of waterfront development include historic influence, cultural and social needs, economic factors, geographic and ecological factors, and strategic factors.

Historic factors

The history of the coastal region is considered in any waterfront development or rehabilitation works, in case of the existence of archaeological remains on site. Moreover, the history of the city is a strong design concept that reflects the identity of the city on its waterfront, as well as empowering the sense of belonging for its citizens. Keyvanfar et al. (2018) investigated criteria that are to be considered within the historic factor in developing a waterfront at a historic location for a city using a multi-criteria decision-making methodology. The finalized criteria were categorized under three main classifications: social and cultural, physical and environmental, and economic and functional, as shown in Figure 4 (Keyvanfar, et al., 2018):

- Social and cultural: the development should reinforce the city identity and cultural authenticity, take the safety and wellbeing of residents into consideration, create a distinctive sense of place, contain social areas, and be able to give users a sense of enjoyment.

- Physical and environmental: the development should preserve natural habitat, minimize pollution, have good accessibility, have a dynamic site design, contain facilities for walking, and provide users with sufficient facilities and amenities according to their needs.
- Economic and functional: the development should be designed for mixed-use to satisfy the desires and needs of potential users, provide employment opportunities for citizens, and have a diversified income potential.

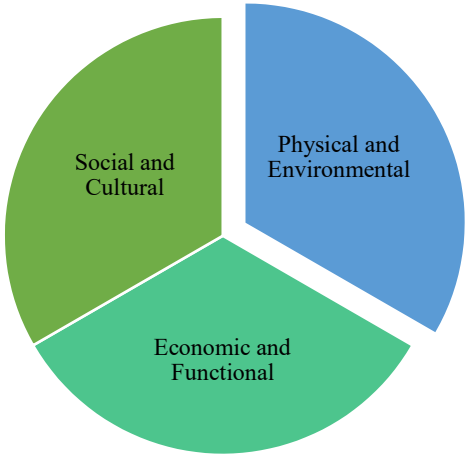

Figure 4. Criteria required for the development of historic waterfronts (Keyvanfar, et al., 2018)

The sense of place is one the key historic factors in waterfront development. The preservation of historic values becomes a priority in cities that have extended history along several eras. The term is defined as the sense of emotional attachment and perspective of what a place feels like when being at it (Mohamed & Salim, 2018). It is imperative that the development works in harmony with the history of the place in order to empower its identity, which would add to the historic value of the location and encourage local and international tourism to thrive with a new attractive historic manifestation (Hussain, Yunos, Utaberta, Ismail, & Ismail, 2015).

Cultural and social factors

The community within the city with waterfront development is a key stakeholder in decision-making and design processes. Therefore, the social and cultural values of the population affect any public project in order for it to become successful and achieve its objectives. A study performed on the state of Philadelphia indicated that changes in the cultural values of the population led to a redistribution of intensities towards waterfronts. The desire of the community to emphasize their city's unique assets, the newfound attention of citizens towards water activities, the focus of young generation on activities that can be performed in parks, the affordability of living near waterfronts, and development of desirable public spaces are all cultural changes that occurred and changed the community behaviour towards waterfronts (McGovern, 2008). In Egypt, a study on a minor city showed that social and cultural alterations can change the purpose and interests toward the usage of waterfronts. El-Minya city was developed in segments along the Nile in different historic periods, where each segment has different waterfront characteristics according to those changes. The research concluded that current waterfront development needs more focus on recreational activities based on modern cultural and social needs (Shaker, Tolba, & Fahmy, 2019).

Economic factors

Waterfronts are proposed as solutions for creative and sustainable developments from the economic perspective, especially for communities and cities that are looking to expand their land value and investment returns (Girard, Kourtit, & Nijkamp, 2014). After eras that focused on labour and production activities at the waterfronts, the current era is focused mainly on recreational and touristic activities that can attract more revenues towards coastal regions. Moreover, research and preservation of marine and ecological aspects ensures that the coastal

environment is sustained for years to come, which makes investment into waterfronts a long-term economic success (Chen, 2015).

When comparing different waterfront types, coastal waterfront developments witnessed the highest value increase among other developments located on rivers, canals, and lakes. Nonetheless, all waterfront development data showed that its value increased significantly overtime with the focus on creational activities and tourism. Furthermore, waterfront properties had significant value increase when compared with non-waterfront ones over a ten-year period (Dumm, Sirmans, & Smersh, 2016). Additionally, investment into waterfront development had been proven as one of the most successful urban planning projects from an economic perspective. This type of development has proven a stable economic growth for communities through increase of land value, additional employment opportunities, and increasing the attractiveness of the coastal regions for investment (Wah & Omran, 2012).

Waterfronts are developed not only to emphasize city identity and culture, and provide recreational facilities for its residents, but also to generate revenues from direct and indirect streams. A well-established and well-planned waterfront project would ensure the presence of private sector facilities, which can assist the project both in the funding and management stages. Private sector facilities include bank branches, shops, amusement parks, hotels, and event arenas. Private investment is important when developing big scale projects, therefore, developers should ensure to reflect the best image of the city and highlight its investment advantages and potentials in order to attract private investors (Thorning, Balch, & Essex, 2019).

The design of the waterfront is a major contributor to its economic success. Bays (2020) suggested that a seamless facility that removes barriers between its segments encourages users to navigate efficiently, hence, allowing more commercial activities. The main barrier that needs to be minimized is between recreational and touristic segments and those designated for commercial use. The goal can be achieved through minimizing and eliminating roads, redundant structures, and landscape barriers. Pedestrian connectivity is crucial for efficient navigation, while a more family-focused waterfront allows for a broadened user variety. Furthermore, public amenities can seem to be an added cost with no significant revenue. Nevertheless, the sufficiency and quality of those amenities, like toilets and parking spaces, are important increasing the attractiveness of the waterfront, which promotes economic returns. Finally, the variety of offering within the waterfront allow developers to leverage all demographic groups and their tastes in order to drive higher satisfaction levels and more returns.

Environmental and Ecological Factors

Human development has its toll on the environment, as well as its ecological components. Subsequently, it is essential to understand the factors that affect waterfront development from that perspective. Several environmental considerations were stated by Angradi et al. (2019) as benefits of developing waterfronts for coastal communities. Table 1 shows the environmental objective of waterfronts and the key indicators that fall under each one of them. The most urging objective of coastal development is preserving ecological components from pollution and degradation that are caused by human activities. Wetlands, green spaces, aquatic habitat, natural heritage, and native fauna and flora are all elements that form the environmental essence of waterfronts. Moreover, strategies that target the ecological elements of waterfronts contribute to reversing the adverse effects of climate change and natural disasters, as well as protect coastal communities.

Table 1. Environmental objectives of waterfront development (Angradi, Williams, Hoffman, & Bolgrien, 2019)

Environmental Objective	Key Indicators
Preserve wetland and storm water functions and biofiltration	Strom water solutions Natural habitat Native plants Green land cover Carbon storage

Environmental Objective	Key Indicators
Preserve waterfront green spaces	Litter removal Plant treatments Parks and trails Natural habitat Native plants Green land cover Carbon storage
Preserve aquatic habitat	Native plants Strom water solutions Birding areas Shorelines
Preserve natural heritage	Wayfinding and signage View spaces Sentinel wildlife Views Natural habitat Plant treatment
Preserve rare and native fauna and flora	Charismatic wildlife Sentinel wildlife Natural habitat
Control natural and climate disasters	Impervious surface Storm water solutions Hydrologic response
Enhance public safety and accessibility	Beach closures Water trails Views Recreational amenities Parks and trails Marine use Birding areas Access to water

Waterfront development can also become a solution for environmental and ecological issues that arose from irresponsible expansions of the past. Toomy et al. (2021) structured a framework that theorised a positive impact of waterfront development on increasing community's place attachment and meaning. It was achieved through creating activities that were absent along a polluted shoreline, which increased stewardship and encouraged community action. The framework concluded that this relationship between social-ecological sense of place and place making activities are key for waterfront protection (Toomy, et al., 2021).

A sustainable development is required to protect the environmental and ecological aspects of the location, in addition to its cultural and social aspects (Permana, Astuti, & Erianto, 2017). The environmental consideration is concerned with minimizing the footprint of the waterfront on the ecosystem, as well as seeking opportunities to enhance and support its biodiversity and hydrology (Al-Sulbi, 2018). Therefore, an environmental and ecological assessment is used to ensure that all elements of the ecosystem are considered and risks that are associated with the development is managed through effective solutions. Environmental assessments are concerned with five main domains, as shown in Figure 5: ecology, water, energy, waste, and materials (El Deeb, AbelGalil, & Sarhan, 2015).

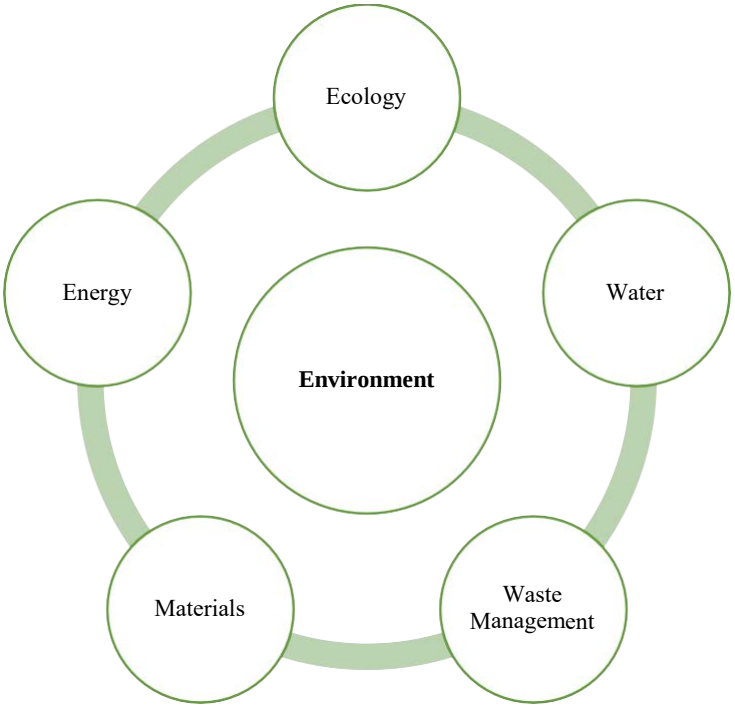

Figure 5. Domain of environmental assessment for waterfront development (El Deeb et al., 2015)

The ecological domain includes the protection of its elements at the development site and around it, such as wetlands and waterbodies, heat island reduction, site disturbance minimization, biodiversity risk assessment, native flora, land redemption, reuse of land, habitat creation and restoration, balanced food system, and reuse of land. The water domain aims to preserve water resources in terms of quality and hydrology, including stormwater management, flood risk, hazardous leakage detection, and reduction of water use in landscape and water features. The energy domain seeks dependency on sustainable energy sources and independency of external sources. Therefore, opportunities for renewable energy generation are always considered in strategic public development like waterfronts, in addition to increasing energy consumption efficiency. Waste management targets eliminating the effects of waste on the ecosystem, such as hazardous waste, as well as investigating opportunities for management and recycling. Finally, the materials domain focuses on sourcing them from local resources, elimination of environmentally hazardous materials and timber, and increasing dependency on local plantations (El Deeb et al., 2015).

3. METHODOLOGY

Aim of Study

The main aim of the research is to study urban green spaces/ urban parks in the waterfront the city of Derna, Libya in alignment with sustainability requirements and supporting the historical, social, and cultural needs of its population. The objectives of the intended waterfront emerge from the needs and preferences of the city residents, as a proactive strategy in meeting population desires and providing a feasible solution to urban planners and developers in the city.

Several objectives targeted through the course of this research, which include an assessment of the urban development status of Derna, Libya in order to create a general understanding of its needs for a sustainable development, define the main elements required for the architectural analysis of the urban waterfront of Derna, and provide practical guidelines for waterfront development at Derna, along with the required alterations and issues that demand attention throughout the project lifecycle for a sustainable development.

The Case Study

The case study is applied to the coastline of Derna, Libya. Derna is one of the most significant cities that lies on the Mediterranean within the Libyan coastal region, which extends along 1900 km from the Egyptian boarders at

East to the Tunisian boarders at West. The geography of Derna starts at Ras Alhilal to the south, which is a rocky hill that extends along 1.5 km and creates the gulf that contains the city. The geographic location of Derna is shown in Figure 6. Derna lies at the estuary of a valley that is rich with palm trees, where the city extends on both its sides. To the east side of the city, a dock was built for small boats with protection from western winds (Bulukma & Alkzeizi, 1997).

Figure 6. Geographic location of Derna

The morphology of the city is affected by the location of the site on which it extends. While the site determines the spatial relations between cities within a specific region, the location has an impact on the internal structure of the city, and the shape it takes. There are flat, plain-land cities such as Al-Marj, Ajdabiya, Misurata, and Tripoli, and there are mountainous cities that affect the heights and valleys that penetrate them in their morphology, such as Constantine in Algeria, Ifrane, Zintan, Bani Walid and others. As for the valley of Derna in the Delta Al-Deltawi plain, it affected the shape of the city, so the city was divided into two parts. And the heights in the south of the city prevented it from extending to the south, so it extended over the feet of the mountain in (Shiha) and (Eastern Coast) (Al-Qaziri S. K., 2021).

The morphology of the city of Derna suffers at the present time from an imbalance between the traditional urban fabric in the Al-Bilad neighborhood, and the accelerated leaps that accompanied the numerous developments, and the economic, social, and urban transformations that the city witnessed and coinciding with the adoption of the schemes of imported planning and design standards imported from abroad without A logical gradation, which led to a change in the general features of the urban fabric and the result of rapid and large expansion, and this is what we witness in the neighborhoods and neighborhoods of Shiha, (the eastern coast), and Bab Tobruk. The urban fabric of any city is a product of the needs and requirements of the population during a specific period of time, and in response to the influences of the cultural and natural environment, the geography of the region, its climate, building materials and others.

Darna houses are distinguished by their quality, in addition to being surrounded by gardens that produce a lot of grapes, figs, oranges and bananas, in addition to being surrounded by a fence of palm trees that give the city a special aesthetic character. A waterfall emerges from the rock higher to take its way through several streets, providing the water needed to irrigate the gardens. The streets of the city as a whole are narrow and irregular, and grape trees cover most of the walls, houses and roofed roads (Abu Luqma, 1985) (Al-Qaziri S. K., 2021).

The green areas consisted mostly of privately owned farms except for two public parks which are not enough to meet the needs of the city. Impediments to the growth of the city: The city is limited from the north by the Mediterranean Sea and from the south by the slopes, which constitute obstacles to the growth of the city and renders the need of additional areas for urban expansion, and there are also tracts of agricultural land in the western part of the city that should be maintained. There are also two valleys that limit the city from the east and the west and constitute separating lines between the areas of the proposed future city.

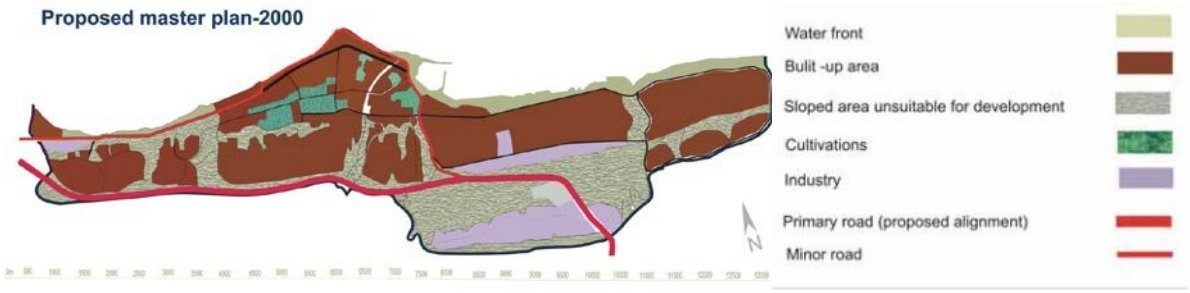

Figure 7. Derna master plan in 2000

The geographical and geological nature of Derna allows for urban expansion along the coastline rather than towards the continental depth. Thus, the city extends from the east to the west with a centre along the valley and gets denser towards the seaport, as shown in Figure 8. Commercial establishments are concentrated in the city centre; however, there is no distinction between commercial and residential zones. Away from the centre and towards the mountains, residential areas are established near the historic zones of the city. Further residential and historic areas extend beyond the main part of the city, with some commercial and industrial establishments.

Figure 8. Main zones and city planning of Derna

For recreational facilities in Derna, an investigation of city planning reveals their inadequacy in terms of their number, coverage, and quality. As shown in Figure 9, there is a single park available in the city centre zone, which is designed as a playground for children with greenery and seating areas. Nonetheless, the area of the park is humble in comparison with the city centre. Moreover, there are no other public parks in any of the city commercial or residential zones. There are few soccer courts that are available in the city, but they cannot be considered as public parks. Therefore, it is evident that Derna has an urgent need of sufficient planning for additional public parks to satisfy the recreational needs of its residents.

Figure 9. Public parks in city centre of Derna

4. ANALYSIS

Based on population, the current analysis of the city shows a density of 73 capita per hectare. The calculation is based on a total population of 131,995 capita and an approximate area of 1,800 hectares. The city is divided into eight districts as shown in Figure 10: El Jebilah, Al Maghar (Embakh), Al Maghar, Al bilad, Bu Mansur, Al Sahil, Al Sahil 400, and Al Sahil (Al Husayn). Figure 11 shows an illustration of the current city structure with the waterfront, public parks, and sea port. Figure 12 is an analysis of the main accessibility routes into the waterfront region, which is connected through two main roads from the depth of the city towards the coast.

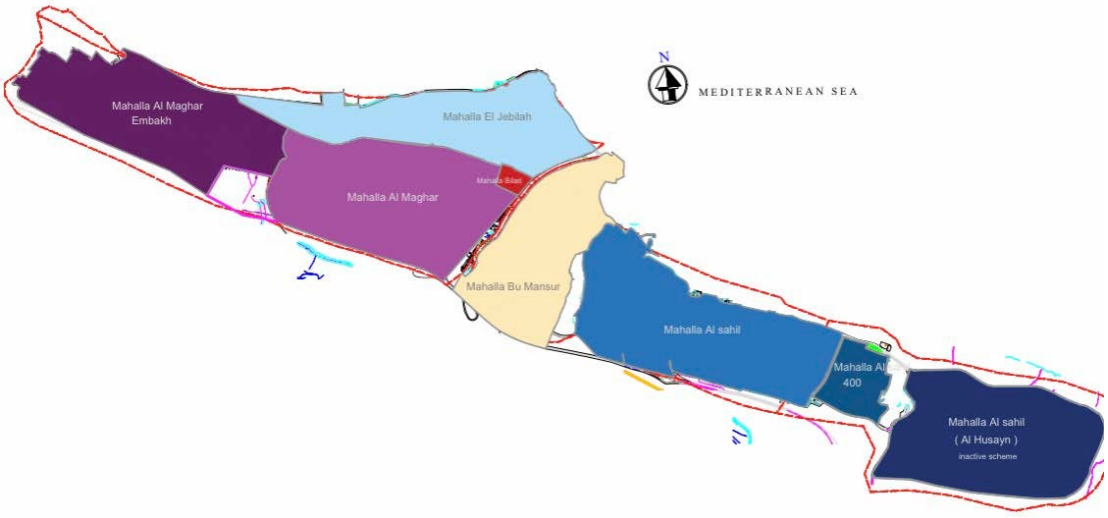

Figure 10. The districts of Derna

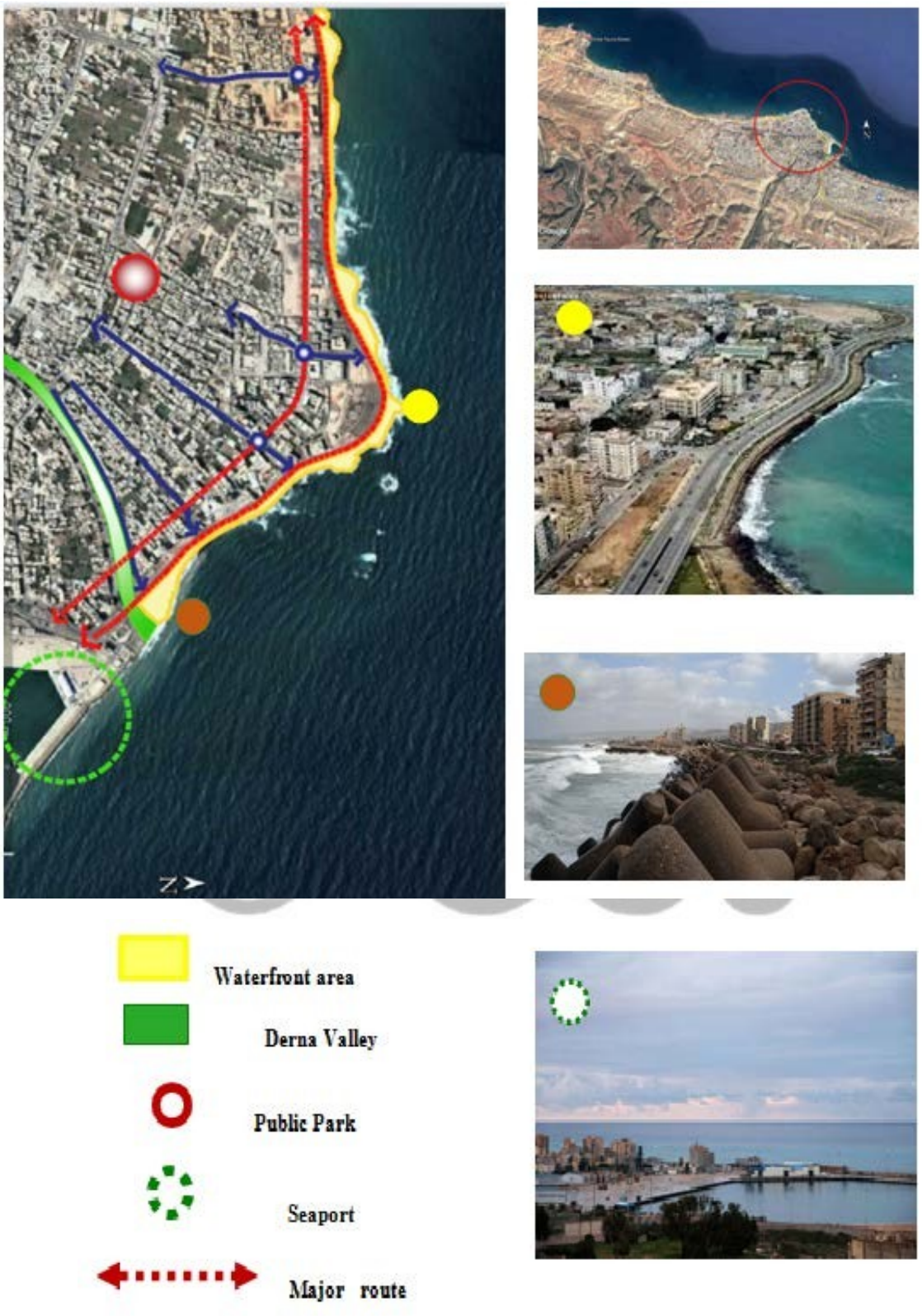

Figure 11. Current city structure of Derna

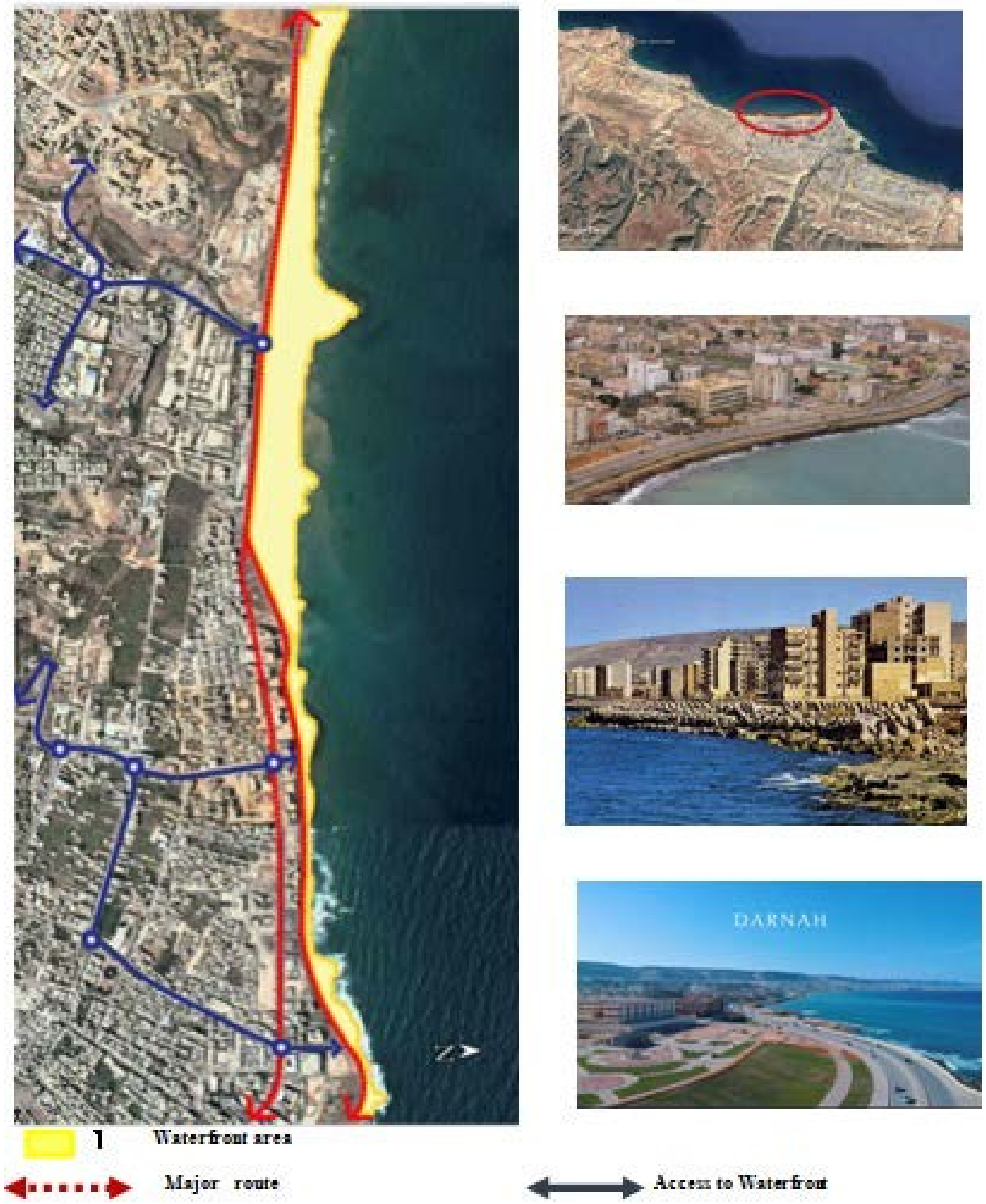

Figure 12. Accessibility of the waterfront in Derna

Understanding land ownership is critical for urban development, as it affects the decision-making process on the most appropriate regions to prioritise and the legal issues that may face city developers in negotiating reasonable deals with the owners. As shown in Figure 13, the majority of the waterfront region is owned by the government, while privately owned land is concentrated to the East and West regions from the central seaport. Figure 14 provides more information on the land use of the waterfront region in Derna to adequately address each property with individual strategies. Moreover, Table 2 summarises the land use based on different types. It can be clearly noticed that parks form 0.2% of the total city area. Figure 15 shows the current percentage of land use in the city.

Figure 16 indicates the locations of these parks and their current conditions. There are two main areas that are dedicated as public parks, which are shown in Figure 17. The Figure illustrates the minor attention paid to providing public parks in comparison to the overall area of the city.

The Performed analysis reflects the problem suffered by the city of Derna in terms of urban planning with the lack of sufficient public parks for the population. The issue of public parks in the city are indicated in both distribution and area, which leads to them failing to serve the needs of the city residents.

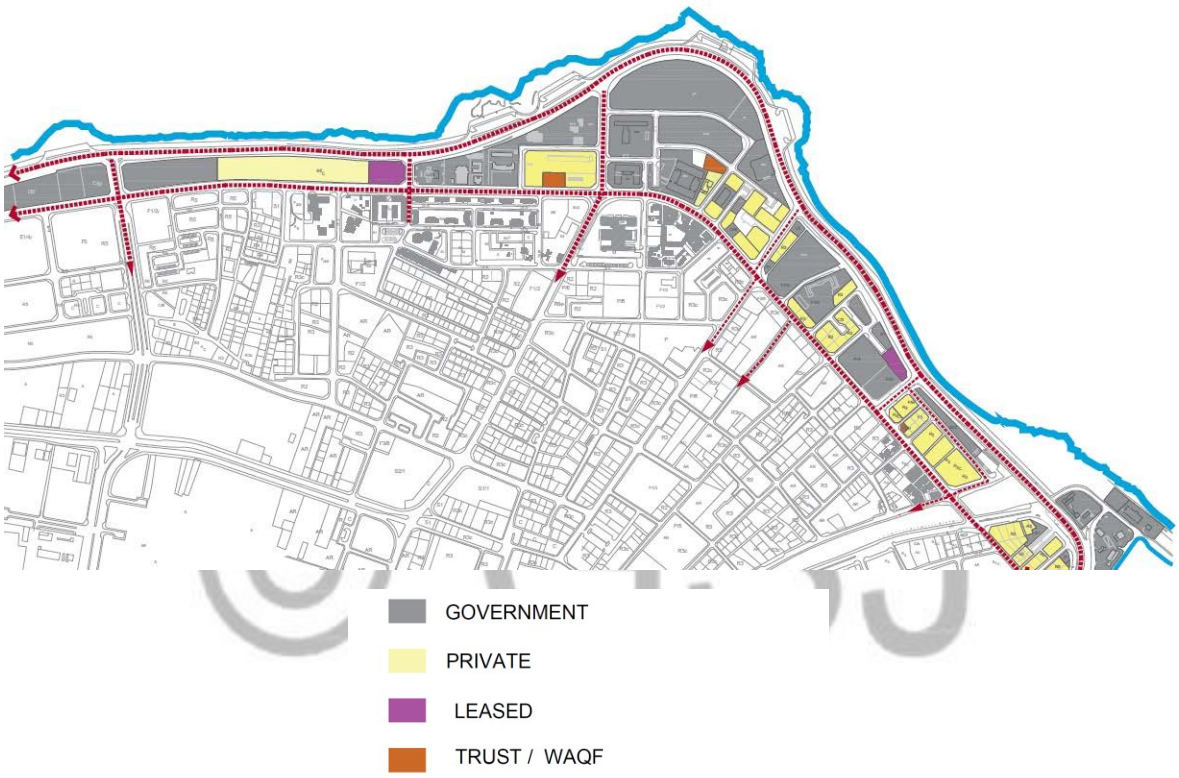

Figure 13. Land ownership of the waterfront region in Derna

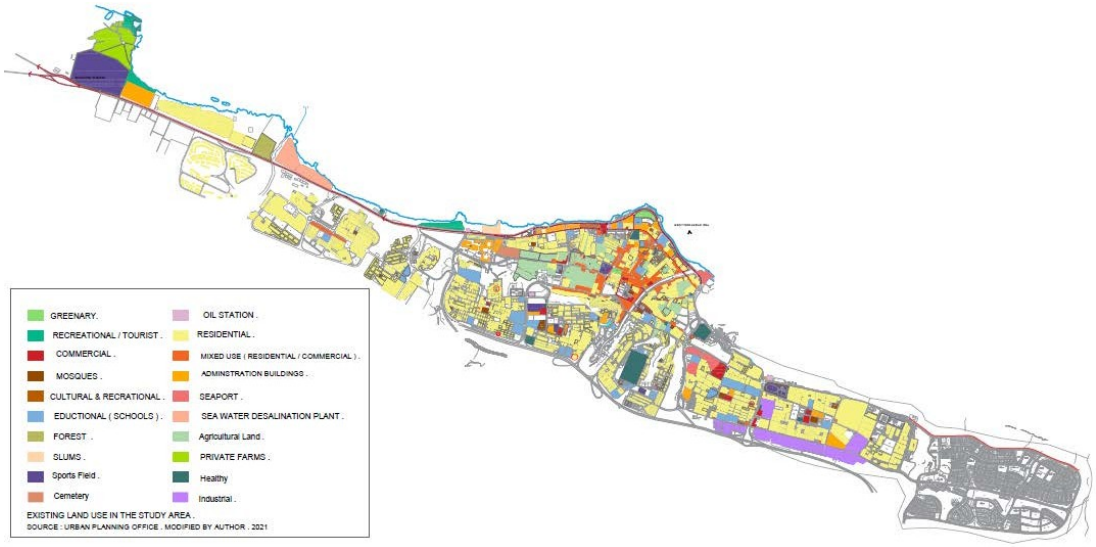

Figure 14. Land use of the waterfront region in Derna

Table 2. Land use of city area of Derna

Type of use	Area in hectares	Percentage %
Residential	**480**	**26.6 %**
Mixed use (residential / commercial)	**35**	**2 %**
Commercial	**15**	**0.8 %**
Social institutions		
_ Educational	**42**	**2 %**
_ Health	**17**	**0.9 %**
_ Cultural	**10**	**0.6 %**
Administrative	**34**	**1.9 %**
Sports fields	**47**	**2.6 %**
parks	**3**	**0.2 %**
Industrial	**30**	**1.7 %**
The road network .	**250**	**14 %**
Facilities	**30**	**1.7 %**
Agricultural land	**57**	**3 %**
Open areas and valleys	**750**	**42 %**
Total	**1800**	**100 %**

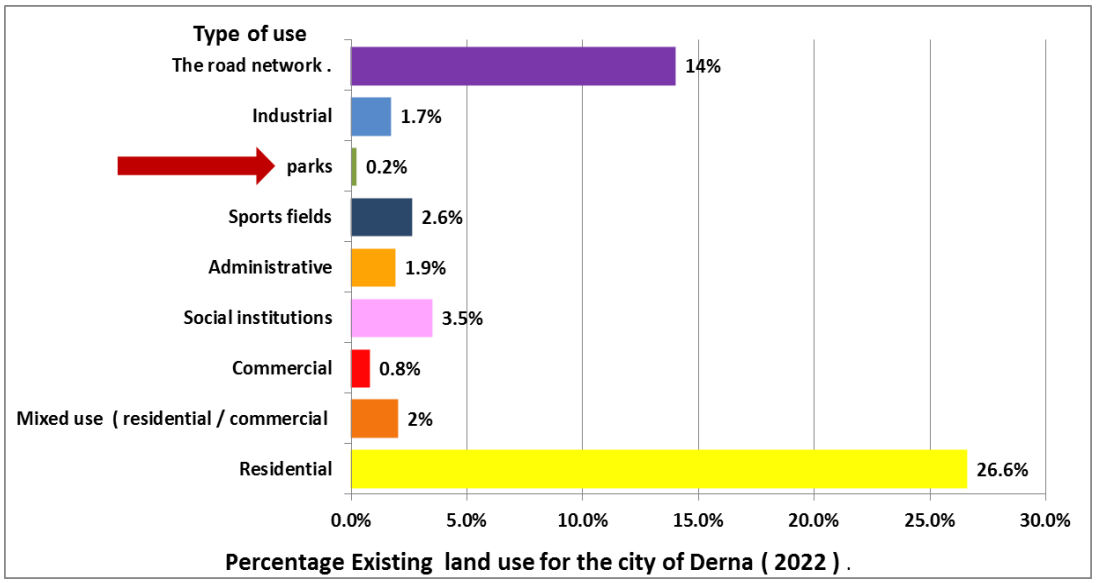

Figure 15. Current land use of Derna

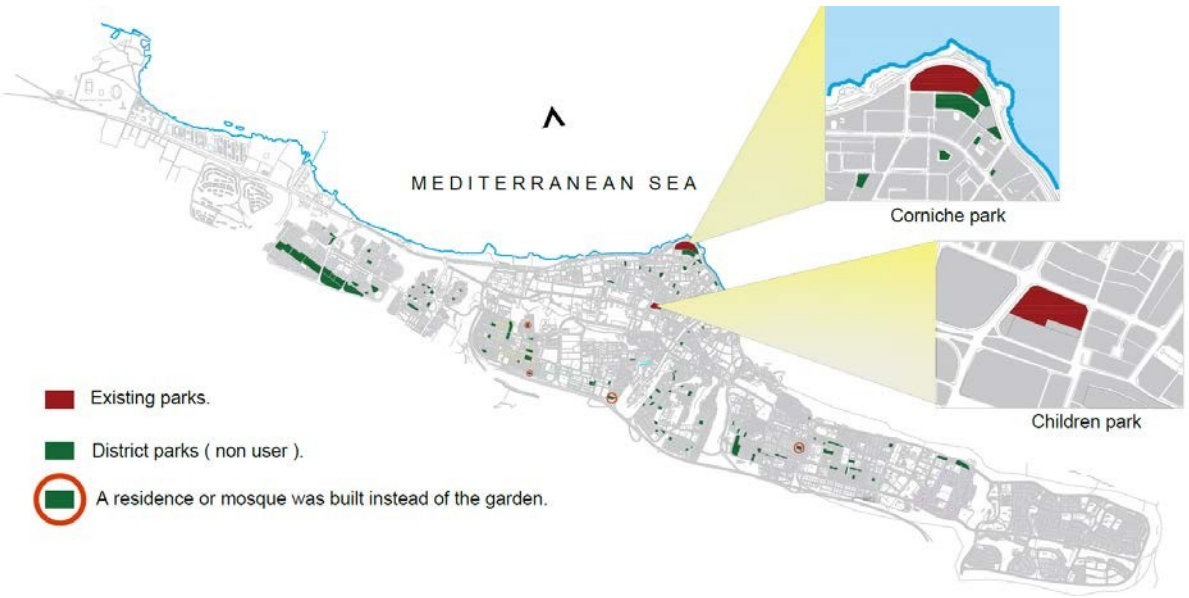

Figure 16. Current status of parks in Derna

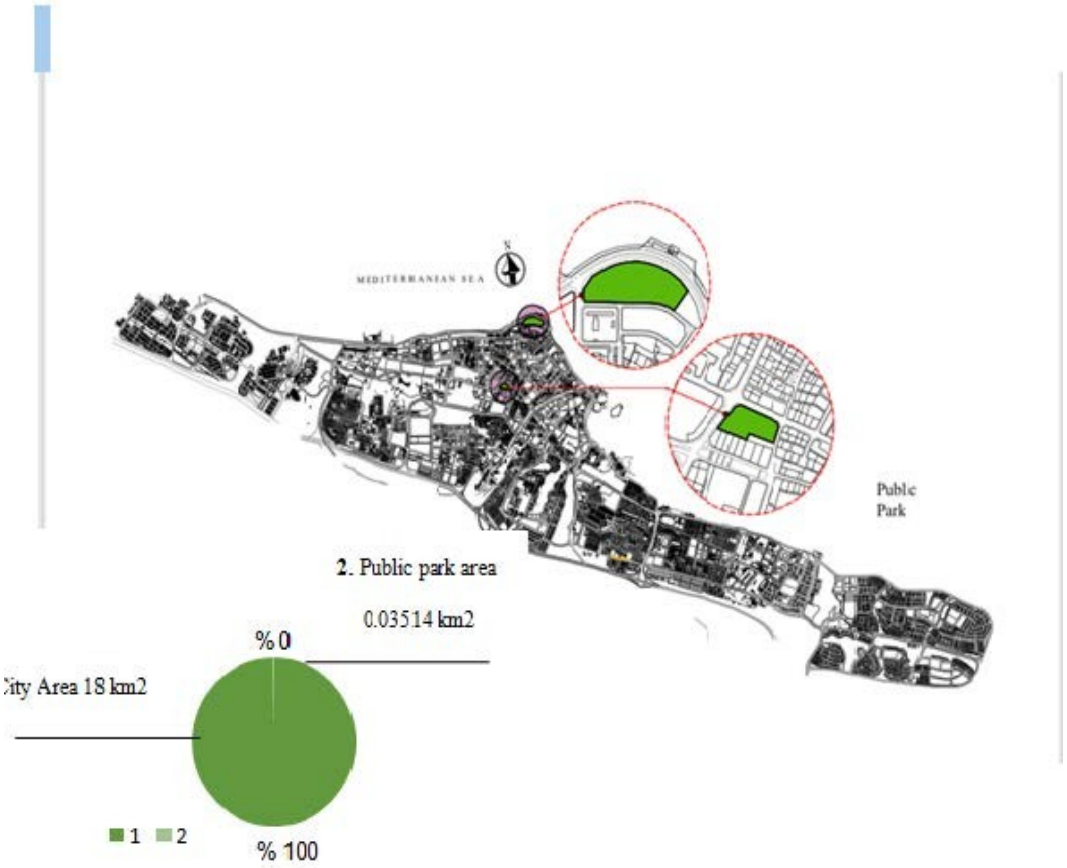

Figure 17. Areas used as public parks in Derna

5. CONCLUSION

The waterfront and the Corniche Road in Derna suffer from severe waves and the resulting spray which causes the collapse of the sidewalks and the foundation layers on which the Corniche Road was built and the consequent disintegration and continuous erosion of walls and concrete, and the spread of sea spray, which led to the erosion of all metal and concrete installations, and the sea entering many parts of the road, especially in winter.

Accordingly, a contract was made between the Public Housing and Utilities Projects Authority, and the Architecture Office for Engineering Consultations to prepare a study on this problem and propose solutions. Dr. Saad Khalil Al-Qaziri was assigned to prepare and supervise the study through his work as a consultant in the office. The scope of the study extended from the (Ras Al Mataris) at the port of Derna to the mouth of Wadi Bu Musafir along the Corniche road and its extension to the west, and the depths of the sea in front of the beach above the continental shelf or the so-called continental shelf were studied at different depths between 250 to 300 meters. The cliff in front of Darna descends a gentle slope until it reaches a depth of 60 meters at a distance of 2 km from the shore, then until it reaches a depth of 2,700 meters at a distance of 60 km from Darna.

The geomorphology of the coast of Derna has been studied, and the factors affecting it such as wave movement, sea currents, tides, rock formations, and the nature of the coastline, which is characterized by the presence of three marine heads starting from (Ras Bu Musafir) and (Ras Bu Azza) and (Ras al-Mataris), in addition to the presence of three bands in which the coast line overlaps relatively towards the land, and as a result of this meandering in the coast line was the formation of bands for carving and others for sediment, for the parts of the coast that represent areas of sedimentation in front of the coast of Derna are those that The coast line overlaps towards the land, where it represents semi-bays in which the movement of wate is relatively calm , For this reason, the sedimentation areas are identified in the beach of Derna in the port area between Ras Al-Mataris in the west, and the eastern coastal cliff in the east, as this area represents a small bay in which the sea port of Derna was established.

There was also another range of sandy sediments located in the west of the city on two parts, the first from the entrance to the city, that is, at the end of the western part of Ras Bu Azza up to Iliwa (Belroman), then from Iliwa (Belroman) to Ras Boumsafer. This part of the coast is considered the longest range of sediments, as the coastline recedes about 4 km in length, in which sea water receives its cargo of fine sandy sediments, which represent a good sandy beach.

The waterfront of the city of Derna suffers from many problems due to the attack of the high and strong waves of the installations on the Corniche Road. The marine impacts can be summarized as follows:

1. The retaining walls of the road body became in poor condition and prone to collapse due to direct exposure to the waves.
2. The continuation of the erosion of the foundation layers of the road as a result of the waves and the consequent fragmentation and continuous erosion processes.
3. Continuing erosion and fragmentation of the rocky layers on the beach in front of the retaining walls because they are incoherent sandy rocks.
4. The high waves on the road caused the accumulation of large amounts of water and the spread of this water saturated with salt, which corroded the metal and concrete installations.
5. It became clear from the study that the area between Ras Bu Azza in the east and the entrance to the city in the west is the most part of the beach and the road exposed to the influence of natural factors, due to its perpendicular position to the course of the waves.
6. It was observed that landslides consisted of gravel and crumbled soils, and erosion and deterioration of large parts of the bases on which the wall was built due to the movement of rocks and gravels by the waves and the entry of water between the rocks on which the wall was built even in good weather, due to the lack of protection from the suds of the waves and Its spray, which leads to the formation of gaps under the base, and this phenomenon increases in the case of storms, which leads to the entry of water to the bottom of the rocks and concrete bases, which leads to a movement in the rocks and sand that make up the base.

The future development of this study is understanding the preferences of the population towards the most appropriate use to the waterfront, as well as performing a deeps analysis of the specific needs of the different social and demographic groups that form the population. The researcher is continuing the study towards this direction to enrich the findings of the analysis and to propose appropriate designs that can utilize the valuable waterfront of Derna taking into consideration the different development factors of waterfronts.

6. REFERENCES

Abu Luqma, A. M. (1985). *The Bechi Brothers and the Libyan Coast (1821-1822).* Benghazi: Garyounis University Publications.

Al-Qaziri, S. K. (2021). *Darna, my city, a study in town planning.* Derna: Dar Al-Fadil for Publishing and Distribution.

Al-Sulbi, A. O. (2018). Exploration of Ecological Footprint in the Kingdom of Saudi Arabian Developed Waterfronts: The Case of King Abdullah Seafront Park (KASP) – Dammam. *The Open Environmental Research Journal, 11*, 75-85.

Angradi, T. R., Williams, K. C., Hoffman, J. C., & Bolgrien, D. W. (2019). Goals, beneficiaries, and indicators of waterfront revitalization in Great Lakes Areas of Concern and coastal communities. *Journal of Great Lakes Research, 45*(5), 851-863.

Bays, B. (2020, March 02). *Reclaiming waterfront as an economic growth strategy*. Public Square - A CNU Journal: https://www.cnu.org/publicsquare/2020/03/02/reclaiming-waterfront-economic-growth-strategy-0 adresinden alındı

Bulukma, A. M., & Alkzeizi, S. K. (1997). *The Libyan Coast.* Benghazi: Qaryounes University.

Buscardo, E., F orkour, G., Rubino, A., & Storozum, M. (2021). Land and people. *Nature: Communications Earth & Environment, 2*.

Callaghan, A., McCombe, G., Harrold, A., McMeel, C., Mills, G., Moore-Cherry, N., & Cullen, W. (2021). The impact of green spaces on mental health in urban settings: a scoping review. *Journal of Mental Health, 30*(2), 179-193.

Chen, C. H. (2015). The Analysis of Sustainable Waterfront Development Strategy - The Case of Keelung Port City. *International Journal of Environmental Protection and Policy, 3*(3).

CIESIN. (2007). *Percentage of total population living in coastal areas.* New York: The United Nations.

Colding, J., Giusti, M., Haga, A., Walhagen, M., & Barthel, S. (2020). Enabling relationships with nature in cities. *Sustainability, 12*.

Colding, J., Gren, A., & Barthel, S. (2020). The incremental demise of urban green spaces. *Land, 9*.

Creel, L. (2003, September 25). *Ripplt Effects: Population and Coastal Regions.* PRB: https://www.prb.org/resources/ripple-effects-population-and-coastal-regions/ adresinden alındı

Di Nardo, F., Saulle, R., & La Torre, G. (2010). Green areas and health outcomes: A systematic review of the scientific literature. *Italian Journal of Public Health, 7*(4), 402-413.

Dumm, R. E., Sirmans, G. S., & Smersh, G. T. (2016). Price Variation in Waterfront Properties Over the Economic Cycle. *The Journal of Real Estate Research, 38*(1), 1-26.

El Deeb, S., AbelGalil, R., & Sarhan, A. (2015). A Sustainability Assessment Framework For Waterfront Communities - Increasing the Resilience of the Abu Qir Waterfront Community in Alexandria. *Journal of Renewable Energy and Sustainable Development, 1*(1), 167-183.

Giannico, V., Spano, G., Elia, M., D'Este, M., Sanesi, G., & Lafortezza, R. (2021). Green spaces, quality of life, and citizen perception in European cities. *Environmental Research, 196*.

Girard, L. F., Kourtit, K., & Nijkamp, P. (2014). Waterfront Areas as Hotspots of Sustainable and Creative Development of Cities. *Sustainability, 6*(7), 4580-4586.

Graells-Garrido, E., Serra-Vurriel, F., Rowe, F., Cucchietti, F. M., & Reyes, P. (2021). A city of cities: Measuring how 15-minutes urban accessibility shapes human mobility in Barcelona. *PLOS ONE*.

Hegazy, I. R. (2021). Towards sustainable urbanization of coastal cities: The case of Al-Arish City, Egypt. *Ain Shams Engineering Journal, 12*(2), 2275-2284.

Hinds, J., & Sparks, P. (2011). The Affective Quality of Human-Natural Environment Relationships. *Evolutionary Psychology, 9*(3).

Hussain, M. A., Yunos, M. Y., Utaberta, N., Ismail, N. A., & Ismail, S. (2015). The role of human activities setting in cultural and heritage waterfront: the case of Venice waterfront, Amesterdam waterfront and Marsaxlokk waterfront. *International Journal of Current Research, 7*(9), 20784-20791.

Kates, R. W. (2001). Sustainability Transition: Human-Environment Relationship. N. J. Smelser, & P. B. Baltes (Dü) içinde, *International Encyclopedia of the Social and Behavioral Sciences* (s. 15325-15329). Oxford, UK: Pergamon Press.

Keyvanfar, A., Shafaghat, A., Mohamad, S., Abdullahi, M. M., Ahmad, H., Derus, N. H., & Khorami, M. (2018). A sustainable historic waterfront revitalization decision support tool for attracting tourists. *Sustainability, 10*.

McCash Jr, J. M. (1976). *The Relationship Between Urban Structure and Human Behaviour: An Exploratory Investigation.* Waterloo: Wilfrid Laurier University.

McGovern, S. J. (2008). Mobilization on the Waterfront: The Ideological/Cultural Roots of Potential Regime Change in Philadelphia. *Urban Affairs Review, 44*(5), 663-694.

Mohamed, B., & Salim, N. (2018). Preserving sense of place at historic waterfronts in malaysia. *SHS Web of Conferences, 45*(2).

Permana, A. S., Astuti, W., & Erianto. (2017). Waterfront Development Concepts in Indonesia from the Perspective of Urban Planning and Environmental Sustainability. *International Journal of Built Environment and Sustainability, 4*(3), 146-155.

Schlapfer, M., Bettencourt, L. M., Grauwin, S., Raschke, M., Claxton, R., Smoreda, Z., . . . Ratti, C. (2014). The scaling of human interactions with city size. *Journal of The Royal Society Interface, 11*(98).

Seymour, V. (2016). The Human–Nature Relationship and Its Impact on Health: A Critical Review. *Frontiers in Public Health, 4*.

Shaker, R., Tolba, O., & Fahmy, A. (2019). Socio-cultural divisions and urban waterfront activities: The case of El-Minya city, Egypt. *Journal of Engineering and Applied Science, 66*(5), 563-585.

Taghvaee, A. A., Kamyar, M., & Moradi, A. (2017). Human, Nature, City: From Oblivion to Review. *Open Journal of Ecology, 7*(7), 433-447.

Thorning, D., Balch, C., & Essex, S. (2019). The delivery of mixed communities in the regeneration of urban waterfronts: An investigation of the comparative experience of Plymouth and Bristol. *Land Use Policy, 84*, 238-251.

Toomy, A. H., Campbell, L. K., Johnson, M., Strehlau-Howay, L., Manzolillo, B., Thomas, C., . . . P alta, M. (2021). Place-making, place-disruption, and place protection of urban blue spaces: perceptions of waterfront planning of a polluted urban waterbody. *Local Environment, 26*(8), 1008-1025.

Turkoglu, H., & Secmen, S. (2019). The role of urban waterfront parks on quality of life in Istanbul. *ITU A|Z, 16*(1), 53-66.

Wah, W. S., & Omran, A. (2012). Factors Contributing To The Implementation Of Waterfront Projects In Penang Island. *Journal of Academic Research in Economics, 4*, 102-114.

Wood, E., Harsant, A., Dallimer, M., de Chavez, A. C., McEachan, R. R., & Hassall, C. (2018). Not All Green Space Is Created Equal: Biodiversity Predicts Psychological Restorative Benefits From Urban Green Space. *Frontiers in Psychology*.

Yilmaz, M., & Terzi, F. (2019). The Effects of Urban Spatial Development on Coastal Ecosystems: The Case of Mersin, Turkey. *IOP Conference Series: Materials Science and Engineering, 471*(10).