A Proposed Framework for Integrating Blue Infrastructure and Sustainable Blue Economy for Sustainable Coastal Development: Applied to Rasheed Canter, Egypt

Original Article

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ABSTRACT

This paper will describe a comprehensive blue infrastructure and sustainable blue economy integrating framework as a leading tool for a sustainable coastal development's creation, which is especially true as the current case study is set in Rasheed Canter, Egypt.

The Research Aims at solving the pressing issues of coastal regions that generally include climate change effects, habitats not thriving, and/or unsustainable development practices. The blue infrastructure and sustainable blue economy strategies are done for the purpose.

The Methodology consists of an in-depth literature review, best practices, and case studies related to coastal development, blue infrastructure, and sustainable blue economy, which form the basis for the proposed framework. The stakeholders comprising government, academia, civil society, and the private sector gather together and take part in formulating combined and inclusive strategies, keeping into consideration Rasheed Canter`s local traits.

The Research Helps them decide on how to include blue infrastructure and sustainable blue economy into the planning of the coastal area such that to ensure that Rasheed Canter and its neighboring communities benefit from rebuilding efforts, disaster resilience, fairness and environmental management. In the end, the framework proposed has a potential of being a blueprint for sustainable coastal development, which can be of a great inspiration for similar initiatives in coastal regions all over the world.

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Key Words: Blue infrastructure, rasheed center, sustainable blue economy, sustainable coastal development.

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INTRODUCTION

Coastlines are regarded by many as gifts of nature to our planet, where trade, tourism and biodiversity define their role. Nevertheless, the natural ecosystems are facing growing challenges from climate change, pollution, land degradation and unsustainable development of human practices. The understanding of the immediacy of these issues prompted a growing demand for the entire approaches to the coastal development that will emphasize the sustainability, resilience, and long-term prosperity.

With this context, it is obvious that the blue infrastructure and the sustainable blue economy philosophy can provide an effective road map for development that is sustainable on the coast. Water infrastructure provides ecosystem services by green areas such as swamps, mangroves and artificial reefs, which are crucial for distribution of water and preservation of habitats. The sustainable blue economy is a way of achieving economic growth without destroying the marine life and ecosystem, thus sustaining the coastal communities and industries.

The paper is to create an in-depth model of a blue infrastructure and the sustainable blue economy paradigm that so catalyze sustainable coastal development at Rasheed Canter, Egypt. Located in the Mediterranean coast, Rasheed Canter faces particular problems and advantages, among them the rapidly expanding city, the limited coastline, and biodiversity protection. Through this framework, which combines the advantages of blue infrastructure and sustainable blue economy approaches, the issues will be tackled comprehensively, thus, making us more resilient, fair, and environmentally conscious.

Based on a sound review of pertinent literature, the framework is a systematic unification of the sophisticated established theoretical concepts and practical insights from real-world experiences. Through using a multidisciplinary and participatory style of operation, this approach involves a collaborative effort by different stakeholders from varied field in creating distinctive solutions that are suitable for Rasheed Canter's context.

Furthermore, the framework is based on adaptive management, continuous learning and stakeholder engagement which are acknowledged as the dynamic nature of the coastal systems. This implies that the focus should be on reinforcing resiliency, increasing ecological services, and forging an inclusive economic growth to ensure that both the city and the surrounding coastline will grow and prosper sustainably.

Enabling decision-makers, the practitioners and the concerned communities to develop plans by providing a guideline that integrate blue infrastructure and sustainable blue economy concepts into coastal development is the objective of this framework. Through this, the competing of economic growth with the environment protection and social equity is balanced. Through its implementation, Rasheed Canter can serve as a beacon for sustainable coastal development, inspiring similar initiatives worldwide and paving the way for a resilient and prosperous future.

METHODOLOGY

Throughout every stage of the research, the investigator leaned on merging the Blue Infrastructure Approach with the Sustainable Blue Economy Approach to foster sustainable development in coastal regions. In the first stage, objectives and goals are formulated alongside an assessment of the current situation in the study area to precisely identify its characteristics and develop a vision for the desired objectives. In the second stage, a detailed sectoral study of the study area is conducted, identifying potential impacts in each sector (environmental, urban, economic, etc.). Following this is the financial and investment study in the study area, along with capacity-building through awareness programs, skills development, and knowledge enhancement among the population in the area or through the development of educational programs, activities, and skills related to both residents and visitors to the area, in addition to studying the resources and potentials available in the study area. Then comes the stage of solutions, where the necessary planning solutions are designed and proposed to achieve sustainable development in the study area in line with its previous specialization, while applying and considering environmental management and participatory criteria for decision-makers and stakeholders, and establishing an organizational framework that brings together all parties concerned to achieve the development goals identified and formulated in the first stage, along with the establishment of a political and organizational framework that defines the basis for cooperation and interaction among these sectors and parties. Then begins the final stage, in which a methodological framework is formulated that integrates both the Blue Infrastructure and Sustainable Blue Economy to achieve sustainable development in this area, as illustrated in the following figure 1.

Fig. 1: The research Methodology Source: By Author

LITERATURE REVIEW

Blue Infrastructure in the Context of Sustainable Coastal Development

Blue infrastructure represents a dynamic notion encompassing strategically designed and controlled natural and human-crafted aquatic elements, with the goal of bolstering ecosystem services and advancing sustainable development along coastlines.***(Arkema, K. K., et al. (2013).*** This part is a compilation of former studies focusing on blue infrastructures start-point, benefits and disadvantages.

Definition and Components

Growth of blue infrastructure includes numerous elements that we can find in nature like rivers, lakes, wetlands, and coastal waters or manmade features such as harbors, ports and artificial islands. The combination of these components in effect results in a comprehensive strategy for coastal development, emphasizing the symbiotic harmony of nature and human built structures. (***Mörtberg, U. M. , and Wallman, P. (2015)*** Blue Infrastructure is a concept that means strategically planned and managed networks of natural and human-made aquatic systems, including rivers, wetlands, and coastal areas. It applies innovative ecological approaches to water management to support biodiversity conservation and human health improvement ***(EPA, 2010; Wong, 2016).***

Blue Infrastructure Benefits

Ecosystem Services and Benefits Research has pointed out the fact that blue infrastructure is the main provider of various ecosystem services. Coastal and maritime ecosystems functioning as biodiversity conservation agents, shoreline protection, clean water purification, and offering recreation opportunities. It is necessary to take in

account the sustainable use of those services to preserve the planet health and effectively for the community. ***Barbier, E. B. , et al. (2011)***.

Coastal Protection and Resilience The importance of blue infrastructure is to protect coastal systems from the danger of hurricane and erosion. Coastal wetlands, mangroves, and reefs are are inalienable members who function as a natural buffer for coastal region against climate change impacts. ***(Temmerman et al. , 2013; Gedan et al. , 2011).***

Urban Waterfront Redevelopment Urban Blue Infrastructure is used for renewing the waterbody in the city center in particular. Introduction of the green spaces, living shorelines, and sustainable drainage systems will not only enrich urban waterfronts' visual aesthetics but also generate an ecological benefit. ***(Tratalos et al. , 2007; McMillen et al. , 2016).***

Climate Change Adaptation Blue Infrastructure is emphasized in recent times as a promising strategy for climate change adaptation. Its capacity to store carbon, moderate temperature and provide adaptive habitat for species makes the shore ecosystems more resilient towards the inevitable disruptions brought about by climate change. ***(Narayan et al. , 2016; Temmerman et al. , 2013)***.

Planning and Governance Adequate planning and good government are key factors for a successful blue infrastructure management. Coastal zone management, stakeholder participation, and incorporating blue infrastructure into city planning are fundamental components for its long-term sustainability. ***(MEA, 2005; Day et al. , 2012)***.

Challenges and Considerations Putting the Blue Infrastructure forward, we can have many benefits, but in order to balance land use, resources and the environment, we need careful management Sustainable development of Blue Infrastructure is engendered by this delicate balance between the ecosystem and human needs of the Blue Infrastructure. ***(Moomaw et al. , 2018; Arkema et al. , 2015)***.

Adaptive Management and Future Directions Recognizing the constantly changing circumstances in coastal areas, scientific work highlights the critical role of adaptive management strategies. Ongoing analysis, assessment and adaptive tactics are necessary to ensure the continued effectiveness of blue infrastructure initiatives. Future research pathways are aimed at strengthening methods, integrating economic and social factors, and expanding the usefulness of blue infrastructure across diverse environments. Annex 2 provides visual representation of the benefits associated with the blue infrastructure (Figure 2).

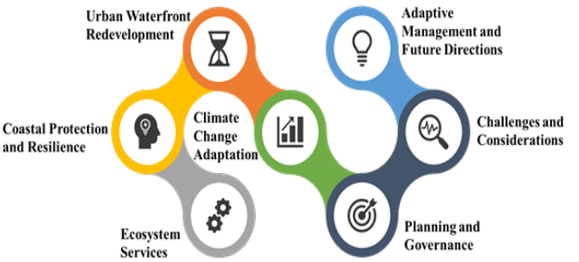


Fig. 2 : Blue Infrastructure Benefits **Source:** By Author

Blue Infrastructure Sectors

Ecological Infrastructure centers on the preservation and rehabilitation of natural ecosystems like wetlands, mangroves, and riparian zones. **Built Infrastructure** encompasses the implementation of engineered interventions, including green roofs, permeable pavements, and structures designed for flood control. **Social Infrastructure** integrates features that contribute to human well-being, including waterfront parks, recreational trails, and public spaces. **Economic Infrastructure** addresses the facilities supporting economic endeavors associated with water bodies, encompassing fisheries, tourism, and transportation. (Figure 3) illustrates the sectors of blue infrastructure. ***(Wong, 2016;) (Canning-Clode et al., 2019)***.

Fig. 3 : Blue Infrastructure Sectors **Source:** By Author

Blue Infrastructure Steps and Method

Assessment and Planning Begin by identifying the specific area of focus, which could encompass coastlines, rivers, lakes, or urban water bodies. Evaluate the ecological, social, and economic functions of these water bodies. Engage with key stakeholders and involve the community in the planning process. Integrated Planning: Embrace a collaborative approach involving various stakeholders, such as government agencies, local communities, and environmental organizations. ***(Agardy et al., 2011)***.

Mapping and Inventory Maps will be made to show the existing aquatic features, which consist of both natural habitats and man-made structures. Prepare an inventory prevailing over the ecosystems, biodiversity and current infrastructures in the particular region of study. Ecosystem-Centric Approach: Emphasize preserving natural environment and rehabilitating system of ecosystems to provide ecological services of natural origin and boost the biodiversity. In addition, climate resilience should be taken into account in the planning of Blue Infrastructure projects that are designed to withstand potential effects of this change, for example, the rising sea level and severe weather occurrences. ***(UNCTAD, 2014)***

Setting Objectives and Prioritization: Identify the main objectives of the project and integrate various components such as environmental conservation, recreation amenities, flood protection and other elements. Find highly valuable ecosystems, as well as areas that are highly vulnerable to risks, and take into account the needs of local community as the basis for planning. Multi-Objective Design: Projects with versatile features that can tackle different goals at the same time, for instance, improving the water quality, enhancing the biodiversity, and providing recreational facilities, should be developed. ***(Narayan et al. (2016) gave us a way in)***.

Design and Implementation Provide perfected schemes dedicated to exact projects, as for instance, the resuscitation of wetlands, the development of ecological parklands along waterways, or revival of urban waterfront areas. Break projects into smaller, more manageable components, following the environmental evaluations and the regulations. Research and Innovation: Endeavor to be a pioneer in this space which should drive ongoing exploration and innovation geared towards enhancing and expanding the efficacy and sustainability of Blue Infrastructure programmers. ***(Wong, 2016;)***

Monitoring and Adaptive Management Put in place regular monitoring mechanisms to assess the effectiveness of the implemented Blue Infrastructure technologies over time. Apply adaptive management techniques to make the appropriate adjustments as the data from monitoring activities and the changing conditions suggest. Community Engagement: Involve the local communities in planning for Blue infrastructure projects and decision-making processes that will guarantee the appropriateness of the endeavors culturally and to aspiration of the communities. Policy Integration: Provide satisfactory assurances that blue infrastructure initiatives are compliant with the already existing policies regarding land use, water management, environmental conservation, and sustainability. The methodology and the stages of the Blue Infrastructure are described in (Figure 4).

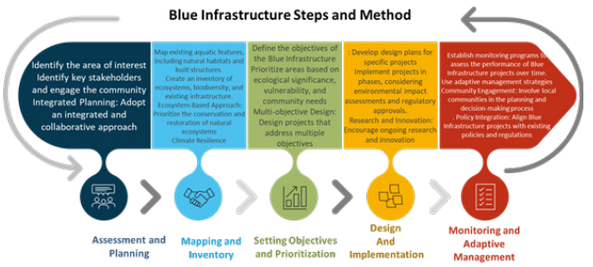


Fig. 4 : Blue Infrastructure Steps and Method **Source:** By Author

Sustainable Blue Economy in the Context of Coastal Development

Definition and Evolution The notion of the Sustainable Blue Economy, meaning the smart exploitation of ocean resources for economic development, has become the universal way to the sustainable development of coastal and marine areas ***(UN, 2014)***. The main impetus of such conceptualization behind this model was to avoid deterring people from participating in economic activities alongside protecting the coastal environment ***(Agardy et al. , 2011)***.

In the context of Blue Economy, a variety of sectors present the basis of the phenomenon ranging from fisheries, seafood, tourism, and renewable energy ***(Galgay et al. , 2019)***. Fisheries and aquaculture are capitalistic factors in creating jobs, and sustainable tourism is an economic boost ***(Douvere, 2008)***. The transition from fossil fuel-driven technology of generation with renewable energy sources complements Blue Economy approach as major the thematic of environment protection has been highlighted by World Bank ***(the World Bank, 2017)***. Besides, different initiatives have been launched slightly worldwide in the way of popularizing the ideas of the Blue Economy. The World Bank's Blue Economy Program is a program which is aimed at the promotion of the sustainable fisheries and marine conservation ***(World Bank, 2020)***. Moreover, the Global Blue Economy Coalition stands for the moves towards responsible ocean governance as well as adopting sustainable practices according to the UNFCCC and the ASEAN countries ***(GEF, 2021)***.

The promotion of green economy practices is the main script which is acted by authors in Blue Economy proceedings. The major approaches to the sustainable use of the oceans are the sustainable fisheries management and the establishment of marine protected areas ***(Sumaila et al. , 2019)***. Keeping that in mind, ecosystem "based management" is given a profound significance as a policy framework and is highly recommended by the Convention on Biological Diversity ***(CBD, 2014)***. Positive economic implications like employment creation and GDP growth are among the components touted as the result of the formulated Blue Economy initiatives ***(Galgay et al. 2019)***. Nevertheless, issues such as overfishing and Governance of fisheries emerge as the villain and the time has come to

address these issues to ensure that the economic benefits are sustained, as stated by ***Pauly et al. (2013)***.

The success of the Blue Economy is dependent, to a very large extent, on the existence of clearly defined political systems and governance structures. Integrating the coastal zone in management and using participatory approach which involve the community locals are found to be central in the successful implementation of the programs ***(Chua et al., 2020; IOC-UNESCO, 2009)***. The Blue Economy has a social dimension that includes community involvement, social justice, and theSource: By Authorl-being of coastal inhabitants. Integration strategies and social impact assessments are core components, which guarantee that Blue Economy initiatives sit well with the people that form the communities ***(Chua et al., 2020; FAO, 2015)***. Notwithstanding its numerous benefits, the blue economy also has issues that are never absent such as over-exploitation, pollution and the effects of climate change. Methods like sustainable practices, technological innovations, and international cooperation are considered to be the ways of dealing with these issues ***(Agardy et al. , 2011; Visbeck et al. , 2014***).

Sustainable Blue Economy Sectors

(Table 1) presents the major industries and their subcategories under the sustainable blue economy sector.

Table 1 Sustainable Blue Economy Sectors

Sectors	Sub sectors
Fisheries and Aquaculture (Marine living resources)	Promote sustainable fishing practices.
	Develop responsible aquaculture initiatives.
	Fish filling and packaging
	Fish-based industries
	Primary production (fish)
Tourism	Develop eco-friendly and sustainable tourism practices.
	Promote marine conservation and responsible tourism.
Renewable Energy	Explore and develop ocean-based renewable energy sources, such as offshore wind, tidal, and wave energy.
Biotechnology	Explore the potential of marine biotechnology for pharmaceuticals, agriculture, and other applications.
	Ensure ethical and sustainable practices.
Transport and Shipping	Promote sustainable shipping practices to minimize environmental impact.
	Invest in cleaner and more efficient maritime transportation.
Non-living marine resources	Fuel and natural gas
	Mineral resources
Ship maintenance and manufacturing	Ship construction
	Equipment and machinery required for maintenance
Port activities	Logistic activities
	Ports and water projects

Source: By Author

Sustainable Blue Economy Steps

Evaluation and Planning Firstly, determine the feasibility of resources from the ocean and environmental impact assessment for expected eco effects. Engage key stakeholders including local communities, businesses and agencies to seek full involvement of all parties involved from the beginning to the end of the phase. ***(Temmerman et al. , 2013;)***.

Sector Identification Exhibit regions that are sustainable, namely fisheries, aquaculture, tourism, renewable energy, and biotechnology. Evaluate the environmental and social implications of each sector and rank social concatenation as the key principle to make certain that the local communities equally benefit from these sectors and to include indigenous knowledge in decision-making.

Sustainable Strategy Development Create a complete plan which includes the goals, policies, and initiatives for sustainable ocean-based development, and then integrate it with the existing national and regional development plans. Spark blue innovation by encouraging R&D in ecological technologies and techniques as well as backing development of the new ecologically friendly tools and solutions for green resources use. ***(Canning-Clode et al. 2019)***.

Investment and Financing Seek for the investments from the public and the private sectors for the sustainable projects and explore the financing mechanisms that support the long-term sustainability. Develop Blue Finance-like financial mechanisms, which comprise those investments targeted at sustainable development goals.

Capacity Building Support the skills and knowledge development in the local communities and industries in the Blue Economy by involving them in education programs, training, and similar initiatives.

Policy and Regulatory Framework Formulate and implement policies and regulations that promote sustainable practices, monitor and change regulations based on environmental and economic changes, and adopt adaptive management strategies to respond to unanticipated challenges and changes. ***(Arkema et al., 2015; Barbier et al., 2011)***.

International Collaboration Work jointly with nearby communities and international institutions in solving common problems and sharing data and know-how for the sustainable development of a Blue Economy.

Monitoring and Evaluation Set up monitoring programmes to follow the environmental and socio-economic effects of Blue Economy activities. Figure number 5 illustrates the sustainable blue economy through its steps (Figure 5). ***(Day et al., 2012; Agardy et al., 2011)***.

Fig. 5 : Sustainable Blue Economy Steps **Source:** By Author

INTEGRATING BLUE INFRASTRUCTURE AND THE SUSTAINABLE BLUE ECONOMY FOR SUSTAINABLE COASTAL DEVELOPMENT

The blue economy, with emphasis on ecologically sustainable exploration and management of the ocean's resources to generate the necessary economic growth while keeping environmental sustainability, share similar ideals with the sustainable development agenda for coastal regions. Article Infrastructure, the core part of Blue Economy, is all water-based systems, whether natural or engineered. In fact, these technologies, together with regional economies, fisheries, and tourism, provide some form of support to ensure the survival of healthy marine habitats. Various problems in coastal areas result from urbanization, climate change, and human activities; hence, the integration of the Blue Infrastructure and the Blue Economy is the best means to solve these problems in a sustainable manner. Since there is the sea, Blue Infrastructure, giving services as a contribution to the protection of coasts from storms and biodiversity conservation, must be used in ways of reinforcement of coastal resilience and sustainable development. As there is the sea, ***(Agardy et al., 2014)***; ***(Barbier, 2012); (World Ocean Initiative, 2021)***. Effective integration requires authoritative governance frameworks, dynamic management strategies, and stakeholder participation to overcome the intricacy of socio-environmental interactions. Tying fiscal *value* to ecosystem services appraisal is an essential tool to comprehend the monetary worth of Blue Infrastructure, helping policymakers to develop plans for growth that will propel sustainable coastal economies. Notwithstanding that, the torch has just been lit, and overcoming the challenges like in-line interests and competition for resources is the vital component to effect an effective integration of Blue Infrastructure and the Blue Economy for the benefit of the coasts. ***(Barbier, 2012);(Uyarra et al., 2018.)***

INTEGRATING BLUE INFRASTRUCTURE AND THE SUSTAINABLE BLUE ECONOMY APPLIED TO RASHEED CENTER

Assessment and Planning

The urban scene of Rashid Center, situated on Egypt's Mediterranean coast, has a special status as a core city, combining ancient historical landmarks with societal crosses and opportunities of nowadays. Rasheed Center is well-known for the city's maritime heritage and strategic placement. However, it has also served as a gateway for trade, cultural interaction, and environmental occurrences like migration of sea animals. Nevertheless, the increasing challenges of urban growth, together with the vulnerability of the coastal ecosystems, demand for a holistic and sustainable way to deal with the destiny of this city. The purpose of the research is to introduce an originated approach that is specifically developed for Rasheed Center thereby accommodating Blue Infrastructure with Sustainable Blue Economy principles as suitable strategies to promote sustainable coastal improvement. Addressing the uniqueness of Rasheed Center, the outlined framework is aimed at providing an essential route to sustain the community's cultural heritage, crafting a prosperous economy, and conserving the natural coastal environment. The process of making a detailed blueprint for the Blue Infrastructure integration which is customized to the Rasheed Center's coastal dynamics is a complex task that requires an in-depth understanding of the region's ecological, economic, and social characteristics. Such process is based on the step-by-step procedure of discovery and creation that includes waters of natural as well as artificial aquatic system. It will be purposeful to preserve the gifts of mother nature which are elements like mangroves, wetlands, and coastal vegetation to help support the retention abilities of the coast, protecting them from storms and also building the biodiversity. Moreover, the addition of engineered solutions, like green infrastructure, permeable surfaces, and sustainable coastal structures aims to complement and strengthen natural systems while creating sustainable economic activities. This holistic strategy endeavors to strike a harmonious equilibrium between environmental preservation and socio-economic advancement, ensuring Rasheed Center's coastal expanse flourishes in a resilient and sustainable manner. (Figures 6 ,7) illustrate Rasheed Center's location relative to Alexandria and its layout, respectively.

Fig. 6 : The location of Rashid Center from the city of Alexandria

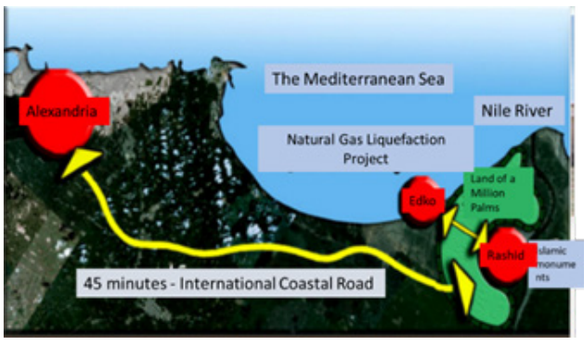


Fig. 7 : The layout of Rashid Center

Setting Objectives and Prioritization

The primary challenge facing Rasheed Center lies in the underutilization of its water resources, resulting in various problems that impact both the city and the broader Rasheed Center area. These issues include the inadequate use of coastal and Nile interface areas, declining aquatic life in the Rasheed branch, inefficiencies in water resource management, urban environment degradation in Al-Bogaz due to ongoing encroachment, and coastal erosion exacerbated by rising sea levels. The core aim of the research is to foster a sustainable economic environment within Rasheed Center by employing the Integrated Blue Infrastructure and Sustainable Blue Economy approach. This goal is further elaborated through specific sub-sectorial objectives tailored to Rasheed Center, as depicted in the accompanying (Figure 8).

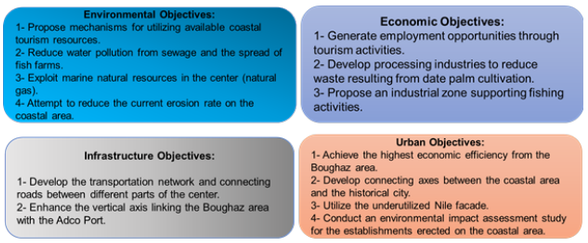


Fig. 8 : The main objective and the sub-sectorial objectives in Rasheed Center. **Source:** By Author

RESULTS

Sustainable Blue Economic Sectors

(Table 2) illustrates Sustainable Blue Economic Sectors and Sub sectors in Rasheed Center.

Table 2 Sustainable Blue Economic Sectors and Sub sectors in Rasheed Center

Sectors	Sub sectors	Sub sectors in Rasheed Center
Fisheries and Aquaculture (Marine living resources)	Promote sustainable fishing practices.	.Establishing a new fishing port
	Develop responsible aquaculture initiatives.	Establishing fish farms in the Bu Ghazal region.
	Fish filling and packaging	Establishing an industrial zone for fish packaging and processing.
	Fish-based industries	
	Primary production (fish)	
Tourism	Develop eco-friendly and sustainable tourism practices.	Rasheed New City - Road Network - Railway Network -
	Promote marine conservation and responsible tourism.	Lake Adco - Qaitbay Castle - Islamic Antiquities.
Renewable Energy	Explore and develop ocean-based renewable energy sources, such as offshore wind, tidal, and wave energy.	Wind and Solar energy
Biotechnology	Explore the potential of marine biotechnology for pharmaceuticals, agriculture, and other applications.	Utilizing the Million Palm Area for agriculture and food .industries
	Ensure ethical and sustainable practices.	
Transport and Shipping	Promote sustainable shipping practices to minimize environmental impact.	The International Coastal Road
	Invest in cleaner and more efficient maritime transportation.	Adco Port.
Non-living marine resources	Fuel and natural gas	The presence of gas wells with a production capacity of 100 million cubic meters.
	Mineral resources	
Ship maintenance and manufacturing	Ship construction	The presence of a new industrial zone in New Rasheed City.
	Equipment and machinery required for maintenance	The existence of 5 factories for building boats and fishing tools.
Port activities	Logistic activities	The presence of Rasheed Old Port and Adco Port.
	Ports and water projects	

Source: The Author

Stakeholder Engagement and Collaboration

stakeholder engagement and collaboration play a pivotal role in ensuring the relevance, effectiveness, and acceptance of the framework. Stakeholder engagement begins with a comprehensive assessment to identify and map the diverse range of stakeholders involved in coastal development, including government agencies, local communities, environmental groups, businesses, and academic institutions. This first stage serves as the basis for the generation of the framework that is intended to promote inclusive and cooperative processes by allowing the stakeholders to add their knowledge, expertise and views in order to influence the development and application of the framework. Stakeholders are allowed to express their worries, hopes, and thoughts through the way of talking, conversations, and engagement during the entire process and the outcomes of this engagement are incorporated into the decision-making process. Collaboration among stakeholders is facilitated through the establishment of formal and informal partnerships, networks, and platforms for cooperation. By fostering a collaborative environment, the framework harnesses the collective efforts and resources of stakeholders, leading to innovative solutions, shared responsibilities, and mutual benefits. Ultimately, stakeholder engagement and collaboration are essential elements of the proposed framework, enabling the co-creation of sustainable coastal development pathways that are responsive to the needs and aspirations of all stakeholders in Rasheed Canter, Egypt.

Mapping and Inventory

By studying the environmental characteristics of Rasheed Center and City, it is possible to divide the center into several homogeneous areas in terms of environmental features, as illustrated in the following diagram and in the following descriptive table, which specifies the environmental characteristics of each area (Figure 9, Table 3).

Fig. 9: Map of environmentally homogeneous areas in Rashid Center. Source: By Author

Table 3 The environmental characteristics of each zone in Rashid Center

Zone	A	B-E	C	D
Topography	0-3	0-2	1-2	3-5
Soil	Marine river deposits	Marine river deposits	Nile clay soil	Nile clay soil
Geology	Plasmodic deposits	Plasmodic deposits	Black sand	Black sand
Water	Overlooking the Nile River - the sea, rainfall 200 mm/year	Overlooking the Nile River - the sea, rainfall 200 mm/year	Overlooking the Nile River , rainfall 150-200 mm/year	Overlooking the Nile River , rainfall 75 150- mm/year
The built environment	A proposed tourist service area	A proposed area for tourism development	It has existing areas - Ezbet El-Borg - agricultural lands	Rosetta Historical List
Resources	A distinctive area where the sea meets the river	Area overlooking the sea	An area overlooking the Nile River and characterized by the availability of fish wealth.	An area overlooking the Nile River and characterized by distinctive archaeological resources (Pharaonic, Islamic, Greek).
Risks	“Encroachment”	Erosion - Sea level rise	Rising groundwater levels - Spread of brick factories - Pollution from fishing activities	Rising groundwater levels - Spread of brick factories - Pollution from fishing activities

Source: The Author

SWOT Analysis

In this analysis, the strengths of Rasheed Canter, such as its strategic coastal location, natural resources, and existing infrastructure, can be identified as advantageous factors that could support the integration of blue infrastructure and sustainable blue economy principles. Conversely, weaknesses such as inadequate infrastructure, limited financial resources, and regulatory barriers may pose challenges to implementation. Opportunities may arise from technological advancements, international collaborations, and community engagement initiatives, which could enhance the effectiveness and sustainability of coastal development efforts. However, threats such as climate change impacts, political instability, and competing interests for coastal resources need to be carefully addressed to mitigate risks and ensure the success of the proposed framework in Rasheed Canter, Egypt. (Figure 10) illustrates the SWOT Analysis for Rashid Center.

Fig. 10: SWOT Analysis for Rashid Center Source: By Author

Sectoral Indicators (Determinants - Potentials - Issues and Problems) at the Level of Each Sector in Rashid Center

(Table,4) illustrates Sectoral Indicators (Determinants - Potentials - Issues and Problems) at the Level of Each Sector in Rashid Center

(Figure 11) illustrates Sectoral Indicators (Determinants - Potentials - Issues and Problems) at the Level of Each Sector in Rashid Center

Fig. 11: Sectoral Indicators (Determinants - Potentials - Issues and Problems) at the Level of Each Sector in Rashid Center

CONCLUSION AND FUTURE DIRECTIONS

Implementing the proposed framework for integrating Blue Infrastructure and the Sustainable Blue Economy in Rasheed City, Egypt, demands strategic measures to overcome anticipated challenges. The first challenge, financial constraints, can be mitigated by establishing a dedicated fund sourced from public-private partnerships and international collaborations. A comprehensive financial strategy that aligns with sustainable financing mechanisms will ensure the adequate resourcing of Blue Economy initiatives.

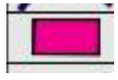
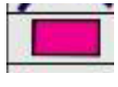
Overcoming regulatory obstacles entails proactive engagement with governmental bodies to streamline regulations and establish a supportive policy environment. Efforts toward the institutionalization of the Blue Economy principles into the current legal systems will ease flexible governance structures, therefore making the framework more effective. Also, the participation of stakeholders has to be promoted. An all-inclusive awareness campaign, decision-making processes, and partnerships with local businesses and NGOs will instigate active engagements and help solve the issue of low stakeholder participation.

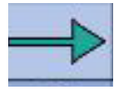
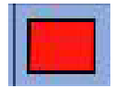
This would be improved through strategic investments in capacity-building initiatives and technology transfer programs. Innovative solutions shall be introduced through collaboration with research institutions and technology specialists to ensure that local communities benefit from technological advancements. Resistance may be reduced through appropriate communication of positive results from the framework and through the involvement of local opinion leaders to promote trust. These are some of the challenges that must be overcome together if the proposed framework is to be a success and sustainable in Rasheed City, where economic growth is coupled with the preservation of the coastal environment.

In this regard, to make it sustainable in the long term, the framework should have an appropriate monitoring and evaluation system that makes effective utilization of current technologies in gathering correct data in real time. Education and training will also help to redress the shortage of educational facilities and prepare the local workforce skillfully so that they can work in all the sectors of the Blue Economy.

The framework must also incorporate climate-resilient practices, addressing potential climate change impacts and ensuring adaptability. By fostering a culture of innovation within institutions, overcoming social equity concerns, and prioritizing ecosystem integrity, Rasheed City can position itself as a beacon of sustainable coastal development.

The proposed framework for integrating the Blue Infrastructure approach with sustainable Blue Economy in achieving the highest development rates in Rashid Center, by maximizing the utilization of available resources in the center. This also contributes to finding sustainable developmental alternatives and solutions to the issues and challenges facing the center. This is evident through:

sector	Issues	key	Problems	Determinants	Potentials
Environmental protection of water resources	Deterioration of coastal environment		Increase in drowning rate	Increasing rates of erosion	The potential to exploit the available water resources in the center for its development, such as the Nile River branch in Rasheed and the coastal shoreline, in addition to the Boqaz.
			Increase in the rate of neglect in the Bougaz area		
			Increase in pollutant levels in the water due to discharge in the drainage area	Rising sea levels	
			Deterioration of marine life		
Tourism development	Decline in tourism activity.		Deterioration of the archaeological area due to neglect and lack of utilization.	Private ownership of land along the Nile and coastal fronts	The potential to elevate the historical buildings in the center and transform them into an open-air museum
			Underutilization of the Nile and coastal fronts, and the spread of garbage on them.		The potential to utilize the Nile and coastal fronts for tourism development
			Deterioration of the coastal area	High levels of pollution in the Nile in the Bughaz area	The potential to utilize and develop the Bougaz area.
			Underutilization of the Boughaz area.		
Sector of living water resources	Economic activities deterioration		Rise in pollution levels in Rasheed branch due to the increase in the number of fish farms	Rising sea levels	The possibility of exploiting existing natural gas wells in the center -
			Migration of a large number of fishermen.		

sector	Issues	key	Problems	Determinants	Potentials
Infrastructure sector	Weakness in infrastructure networks		Direct sewage and industrial discharge into the Nile	Rising groundwater levels along with an increase in its salinity percentage.	The potential to utilize available groundwater resources
			Deterioration of infrastructure networks due to rising groundwater levels		
			Dependence of the population on groundwater use without treatment, leading to health problems		The possibility of exploiting existing natural gas wells in the center -
			Lack of connectivity for nearly 40% of buildings to sewage networks.		
Transportation sector	Weakness in land and maritime transportation networks		Pollution of sea water due to the discharge of drainage basins at Rasheed Port	Weak connectivity between urban clusters in Rasheed Center.	. The possibility of utilizing the international coastal road and the marine railway line in Rasheed Center to enhance connectivity between the settlements within the center.
			Increased air pollution rates due to transportation means		
			Weakness in the connectivity between historic Rasheed City and Azbet Al Burj.		
Energy sector			Deterioration of electricity networks in areas where a large proportion of buildings are not served by electricity grids.	Increased cost of supplying the entire center with electricity networks.	Availability of renewable energy sources in the center that can be utilized, such as solar energy and tidal energy in some locations.

- Optimal utilization of the Buqaz area, characterized by unique natural features where the Nile River meets the Mediterranean Sea, making it one of the development triangles in the northern region of Rashid Center. The industrial area located in the New Rashid City represents the second corner of the development triangle, while the historical city of Rashid, which includes many Islamic monuments, is the third corner of the development triangle in Rashid Center.
- Maximizing the utilization of the palm area in the center and establishing several industries based on the palm resource for which Rashid Center is famous.
- Maximizing the utilization of the proposed new drainage area in Rashid Center, which can provide various activities and contribute to job opportunities.
- Developing fishing and fish production activities in the center and maximizing its role so that Rashid Center becomes one of the most important sites for fish production in the region.
- Focusing on and developing the tourism sector in Rashid Center in all its forms (historical and archaeological tourism in the old city of Rashid, coastal tourism on the Mediterranean Sea coast, and Nile Riverfront tourism).

The research concludes by summarizing key findings and emphasizing the transformative potential of the proposed framework for Rasheed City. It provides recommendations for future research and outlines policy implications, contributing to the advancement of sustainable coastal development practices in Egypt and beyond.

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الملخص العربي

إطار مقترح لدمج مدخل البنية التحتية الزرقاء والإقتصاد الأزرق المستدام من أجل التنمية الساحلية المستدامة: بالتطبيق على مركز رشيد، مصر

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تناقش هذه الورقة البحثية إطارًا شاملاً لدمج البنية التحتية الزرقاء والاقتصاد الأزرق المستدام كأداة رائدة لإنشاء تنمية ساحلية مستدامة، وهو ما ينطبق بشكل خاص على حالة الدراسة الحالية التي تركز على مركز رشيد في مصر. يهدف البحث إلى حل القضايا الملحة التي تواجه المناطق الساحلية، والتي تشمل بشكل عام تأثيرات تغير المناخ، وتدهور المواطن الطبيعية، أو الممارسات التنموية غير المستدامة. تم تطوير استراتيجيات البنية التحتية الزرقاء والاقتصاد الأزرق المستدام لهذا الغرض. تتكون المنهجية من مراجعة متعمقة للأدبيات، وأفضل الممارسات، ودراسات الحالة المتعلقة بالتنمية الساحلية، والبنية التحتية الزرقاء، والاقتصاد الأزرق المستدام، والتي تشكل الأساس للإطار المقترح. يجتمع أصحاب المصلحة، بما في ذلك الحكومة والأكاديميا والمجتمع المدني والقطاع الخاص، للمشاركة في صياغة استراتيجيات شاملة ومشتركة تأخذ بعين الاعتبار الخصائص المحلية لمركز رشيد. يساعد البحث على اتخاذ قرارات حول كيفية دمج البنية التحتية الزرقاء والاقتصاد الأزرق المستدام في التخطيط للمناطق الساحلية، لضمان استفادة مركز رشيد والمجتمعات المجاورة من جهود إعادة البناء، ومقاومة الكوارث، والعدالة، وإدارة البيئة. في النهاية، يتمتع الإطار المقترح بإمكانية أن يكون نموذجًا يُحتذى به لتحقيق التنمية الساحلية المستدامة، مما قد يكون مصدر إلهام لمبادرات مماثلة في المناطق الساحلية حول العالم.