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REGIONAL COASTAL TOURISM DEVELOPMENT FROM THE BLUE ECONOMY PERSPECTIVE: CASE STUDY OF SOUTHERN RED SEA COAST, EGYPT

The Thesis of the PhD Dissertation

by

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CHAPTER 1: INTRODUCTION

1-1 Introduction and Background

1-1-1 Blue Economy

Generally, the blue economy approach is a novel term, and its concept focus on the importance of water resources on the Earth's surface (oceans, seas, rivers, etc.), which cannot be denied. Oceans cover two-thirds of the Earth's surface, produce about 50% of the world’s oxygen, shape more than 95% of the biosphere, control Earth’s surface temperature, provide people with food, and host various economic activities such as fishing, shipping, maritime, and tourism (Bigg et al., 2003; Kabil et al., 2021; OECD, 2016; UNCTAD, 2014).

"Blue Economy", as a term, appeared for the first time after the UN Conference on Sustainable Development (UNCSD) in 2012, also known as Rio +20 or the Earth Summit (Doyle, 2018; UN, 2012; Upadhyay & Mishra, 2020). Blue economy aims to achieve good management of the water resources and sustainably deal with oceans to preserve them, as major natural resources for current and future generations (Kabil et al., 2021). Blue economy is also considered a catalyst for developing mechanisms and procedures that support the sustainable development of water resources (Bari, 2017; Smith-Godfrey, 2016).

The blue economy roots back to the continuous international community's endeavour to implement the green economy approach at the international and regional levels (UN, 2012; UNCTAD, 2014). After the global economic crisis in 2008, the international community and its institutional entities focused on activating mechanisms to boost the economic growth in a way that does not conflict with the environmental factors, thus the idea of a green economy appeared (Bina, 2013). At the same time, the coastal states such as Small Island Developing States (SIDS) called for the necessity of paying attention to the role of oceans and their resources in enhancing economic growth. Hence was the actual appearance of the blue economy term for the first time in a report entitled "Green Economy in a Blue World" (UN, 2012). Therefore, it can be said that the blue economy concept is similar, to some extent, to the green economy, with the difference in focusing on ocean resources and achieving optimal exploitation of them in consideration of sustainability principles (Kabil et al., 2022).

As a result of this diversity in the overall perspective of defining the blue economy, it consists of several economic sectors which collectively represent its comprehensive concept. These various economic blue economy sectors are classified into three main groups, namely: (a) Established Sectors: which have a long-term contribution to the blue economy such as aquaculture, fish processing industry, fisheries, shipbuilding & repair, water projects, coastal tourism, maritime transport, and marine extraction of oil and gas, (b) Emerging Sectors: which represent the sectors with high future potentials such as desalination, ocean energy, bioeconomy, offshore wind energy, and coastal & environmental protection, and (c) Enabler Sectors: such as shared infrastructure, sustainable use of the sea, maritime spatial planning, maritime security marine data, and common skills (European Commission, 2018, 2020; UN, 2012). According to this classification of blue economy sectors, coastal tourism was selected as the study area in this research, and its linkage and importance in the blue economy will be presented in the next section.

1-1-2 Importance of the Blue Economy Approach

The importance of blue economy term is achieved from its conceptual kernel which is, enhancing the sustainability concept. Blue economy is also linked with the Sustainable Development Goals (SDGs), which are also known as the Global Agenda 2030. SDG-14 entitled "life below water," strives for the sustainable utilization and advancement of oceans, seas, marine resources, and ecosystems. These elements form the foundation of the blue economy approach and its diverse economic sectors (Lee et al., 2020a).

The concept of blue economy presented a new perspective of sustainable economic development in different countries or geographical areas (e.g., coastal areas), by using the oceans and marine resources at the various levels of development, regional, national, and international. The development of blue economy depends on the development of industries and activities based on marine and ocean resources such as fisheries, shipping, ports, marine logistics, coastal, and recreational tourism. Furthermore, there are many emerging sectors in blue economy such as renewable ocean and seas energy (wind, tides, waves, etc.), extraction of gas and oil from the seas and oceans, mining, aquaculture and marine, blue biotechnology, monitoring and controlling seas and oceans, conducting marine research, and other sectors that are characterized by using the latest technologies (Garland et al., 2019).

1-1-3 Relation Between the Blue Economy and Coastal Tourism

This research focuses on analyzing the coastal tourism sector as a part of blue economy. According to the EU Blue Economy Report, in 2018, blue economy sectors provided nearly 5 million job opportunities and contributed €218 billion in the gross value added (GVA) (UNCTAD, 2014). Among the great economic value of blue economy and its various economic sectors, coastal tourism comes at the forefront of these sectors, as the most BE sectors participate in providing job opportunities or sharing in the gross value added (GVA). The following Figure (2) shows the participation percentage of the different blue economy sectors in providing job opportunities and GVA, where the coastal tourism sector appears as the largest valuable economic sector in BE (European Commission, 2018).

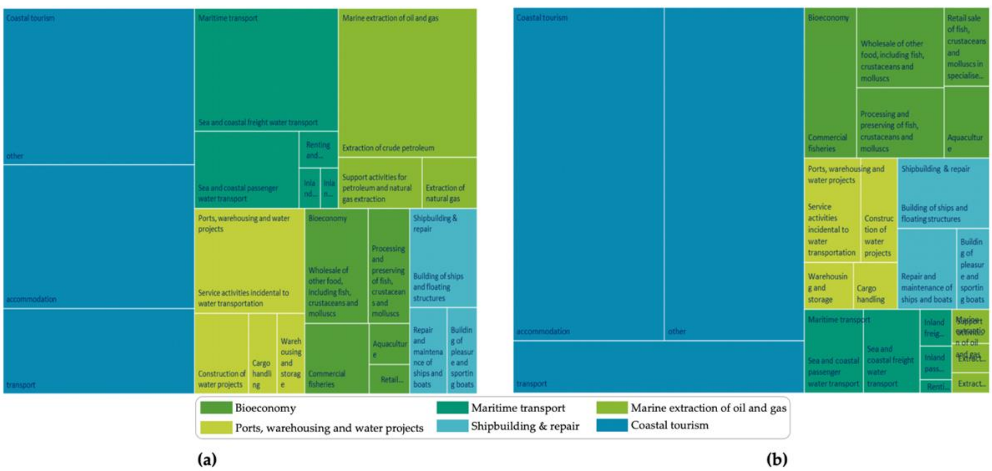


Figure 1. Blue economy (BE) sectors contribute to the EU economy; (a) Blue economy sectors contribute to providing job opportunities; (b) BE sectors contribute to the Gross Value Added (GVA). Source: (European Commission, 2018).

Coastal tourism was chosen as one of the two main focused scientific fields in this research, not only because its importance as an economic sector of blue economy, but also because its contribution in the global tourism industry. Coastal tourism consists of many various activities, patterns, and infrastructure, which makes it the hotspot scientific research area when analyzing and studying the different patterns of the tourism industry. It includes a large number of tourism, recreation, and entertainment-oriented activities such as swimming, snorkelling, diving, beaches, recreational fishing, various water sports, cruises, sports competitions, recreational, sailing boats, etc. Simultaneously, there is a strong potential infrastructure that serves the coastal tourism sector, such as accommodation, restaurants, tourist villages, hotels, ports, trade and shopping centers, logistic zones, and transportation hubs (Karani & Failler, 2020).

1-2 Research Importance

The importance of this research emerges from the urgent need to apply different sustainable approaches to improve the sustainable development of the tourism sector. Especially with the fact that the tourism sector is a fragile and seasonal sector that has recently been affected by global political and economic crises such as the Russo-Ukrainian war and the Coronavirus pandemic. Additionally, the importance of this research is reflected in finding practical ways to apply the blue economy approach in real-life practices at local and national levels instead of just setting national and international principles, indicators, reports, and initiatives. Finally, the importance of any academic research comes from its ability to help decision-makers identify the best possible development decisions. Choosing Egypt as a case of study and trying to determine the efficiency of tourism centres to apply the blue economy approach on the Red Sea coast may pave the way for solving many of the economic challenges facing the Egyptian tourism sector recently, as well as optimizing the available resources and creating new and sustainable tourism development patterns.

1-3 Research Justifications/Problem

The research justifications arose from two major issues which could be classified into the following two perspectives: The content perspective and the scholarly perspective. From the content perspective, the research problems can be summarized in the following points:

- Knowledge gaps and recovery challenges: There is a need for more scientific knowledge of applying the blue economy approach in real-life practices. Despite the great international and regional attention paid to the blue economy as an approach seeking to achieve sustainable development using ocean resources, most of the academic production in this scientific area was merely initiatives and policies at the international or national levels, with limited strategies and implementation plans which has impeded the actual viability of applying the blue economy approach. Especially in the coastal tourism sector, which not only represents the largest sector of the blue economy in terms of size, but also happens to be the sector most severely impacted by recent global crises such as COVID-19, and its recovery path is described as "very lagged" (European Commission, 2020).

- Absence of adequate local and regional implementation: Applying the blue economy approach at the local and regional levels needs more procedures. Several national, regional and global indicators have appeared to measure the blue economy approach to move towards the actual implementation of this approach into practice (Colgan, 2016). These indicators were developed by various local and regional authorities and were based on different statistics and ways of calculation (Reinertsen & Asdal, 2019). For example, Ocean Health Index (OHI) (Halpern et al., 2012), European Commission blue economy reports (European Commission, 2020), DG MARE's initiative, maritime policy indicators by Eurostat, maritime economy statistics by Eurostat, French Marine Economic Data (FMED) (Girard & Kalaydjian, 2014), Ecorys (Ecorys, 2012), and others. These indicators can be divided into three main groups: (a) 1st group, indictors used the two basic blue economy measurements GVA and employment. (b) 2nd group, indicators focused on the economic and social impact of the blue economy such as investments, turnovers, revenues, or SMEs number, and (c) 3rd group, indicators used labour market characteristics to figure the blue economy size (Charalambous, 2016). Despite the diversity of these measurements/indicators focusing on calculating the blue economy size, most of them are applied on wide scales such as regional or international levels, with limited attempts to apply on local levels or at the economic sub-sectors of the blue economy such as the coastal tourism sector. Additionally, there is a lack of transparency regarding the transferability of lessons learned from these measurement procedures and the applicability of these indicators across different contexts and geographical areas (Lowndes et al., 2015). Furthermore, these previously mentioned blue economy indicators aimed mainly to measure the size of the blue economy regardless of the readiness of the selected measured units (i.e., countries or regions) to implement the ideas of this development approach.

- Implementation challenges between spatial development units and administrative ones: The possibility of relying on spatial developmental units (e.g., tourism centres) to apply the blue economy approach in the coastal tourism sector remains an area of doubt, not the same as relying on government administrative units (e.g., governorates).
- Untapped vs. occupied coastal tourism areas for maximizing benefits: In the coastal tourism field, the application of the blue economy approach remains ambiguous. Specifically, there exists an ongoing dilemma regarding whether to implement the blue economy approach in untapped or pristine coastal tourism areas versus areas already occupied with tourism activities. This situation presents a constant trade-off, raising questions about where and how the approach yields the most favourable outcomes.
- The geographical case study: The final research justification is related to the selected case study, Egypt. Although the Egyptian tourism sector is one of the main contributors to gross domestic product (GDP), it has recently suffered due to the swinging economic conditions and the Coronavirus pandemic. Therefore, selecting Egypt as the case study in this research is justified by the need to assess the readiness of coastal tourism centers to adopt the blue economy approach. This, in turn, facilitates the examination of how coastal tourism can implement the principles of the blue economy approach, raise tourism development rates, and help the Egyptian government find alternative solutions to sustainable development in this sector.

Regarding the content perspective, the main research problem was as follows:

- Scientific gaps: Scientific research on coastal tourism, despite its significant contribution to gross value added (GVA) and employment opportunities, appears to be lacking compared to other sectors of the blue economy. Coastal tourism holds a prominent position among the key sectors of the blue economy, yet it has received relatively less attention in scientific literature (Kabil et al., 2021).

1-4 Research Questions

Based on the previous research justifications, the research adopts the answer to the following five key questions:

- How can the blue economy approach be applied in real-life/pragmatic practices?
- Can the blue economy approach be applied at local and regional levels practices (e.g., development of tourism centres) and get useful outcomes for decision-makers?
- Can spatial development units, such as tourism centers, be considered more suitable for implementing the blue economy approach in the coastal tourism sector compared to administrative units like governorates?
- Is it effective to apply the blue economy approach in the untapped/raw coastal tourism areas rather than the occupied ones?
- What are the economic sectors that have the most significant impact on the implementation of blue economy principles in the Red Sea region of Egypt?

1-5 Research Hypotheses

Based on the previous research questions extracted from the research justification and problem statement, this study aims to test four core hypotheses:

- **H1:** Implementing the blue economy approach in local coastal tourism will yield valuable feedback beneficial for decision-makers.
- **H2:** The utilization of spatial units (e.g., tourism centers) instead of administrative units (e.g., governorates) enhances the effectiveness and clarity of applying the blue economy approach.
- **H3:** The application of the blue economy approach is more efficient in untapped/raw coastal tourism centers rather than occupied ones in the Red Sea region of Egypt.
- **H4:** All economic sectors exert the same significant impact on the implementation of blue economy principles in the Red Sea region of Egypt.

1-6 Research Objectives

The main objective of this research is to identify the readiness of coastal tourism centres in the southern Red Sea region of Egypt to apply the blue economy approach. Additionally, there are some sub-objectives as described below:

- Defining the roadmap for applying the blue economy approach in real-life practices.
- Testing the ability of some economic measurements such as efficiency analysis (e.g., DEA and FDH) in paving the way for applying the blue economy at local and regional levels.
- Enriching the scientific and academic content linking the tourism sector to the blue economy.
- Providing insights into the readiness of coastal areas to embrace the blue economy approach in the Southern Red Sea region of Egypt. These insights aim to help decision-makers in making informed and effective development decisions regarding the development of this unique coastal region.

CHAPTER 2: LITERATURE REVIEW

2-1 Bibliometric Analysis: Mapping Academic Endeavors in Blue Economy and Coastal Tourism Research

Bibliometric analysis is the chosen quantitative method for analyzing the literature review related to the scientific topic of this study which is the blue economy in general and coastal tourism in particular. Recently bibliometrics analysis is considered one of the most objective and reliable literature reviewing approaches. Although it is not a new technique and has been used since the 1890s (Osareh, 1996), it appears to be a trendy literature review technique nowadays. The main idea of this method is to collect, describe, analyze, evaluate and monitor published academic papers in a particular research topic (Osareh, 1996).

The literature review using bibliometric analysis was based on two main analyzing levels: basic information of the extracted literature, and basic contents of the extracted literature. Each level has different sub-levels of the analyzing process. Moreover, at each level, the two main focused scientific fields in this research (blue economy & coastal tourism) will be compared.

The imported dataset of this research was extracted from Scopus (Elsevier's abstract and citation database). Selected Scopus as a research engine instead of Web of Science (WOS) in this study was based on several logical reasons, the most important one is that Scopus has a wider variety of scientific materials than WOS (Lahsen Ababouch, 2015), and this corresponds with the focused scientific field (blue economy) as it is a novel topic. To collect the required raw data, I used the following two basic terminology and Boolean operators, for each of the two focused scientific fields in this research (blue economy & coastal tourism): "*BLUE ECONOMY*" OR "*OCEAN ECONOMY*" AND "*TOURIS**".

2-1-1 Scientific Production Analysis

The quantity of published papers in any academic research filed is considered a key indicator of bibliometric analysis. According to the published BE articles, over the 11-years, there was a rapid growth in BE scientific production, about 60.48% annual growth rate (Figure 4). The least productive year was 2012 with just three papers, as it was the appearance year of BE term, while the highest number of BE articles was published in 2023 (101 papers). The total number of citations for BE articles was 2420 with 5.084 average citations per documents, which reflect the trend of this research area in recent years.

On the other hand, compared to BE, scientific production in the coastal tourism sector was a different story. With just a total of 49 published papers, the production volume in this sector did not reflect the importance of this sector in comparison with the other seven BE sectors regarding job opportunities or sharing in the gross value added (GVA). According to (Figure 4), applying BE concept in coastal tourism development was not great, especially from 2012 to 2020, where the scientific production in this sector stuck on a kind of plateau with about between 2 to 5 articles per year. In 2021, 2022 and 2023 the situation improved and the number of published papers in the coastal tourism sector jumped significantly to 8, 9 and 11, respectively.

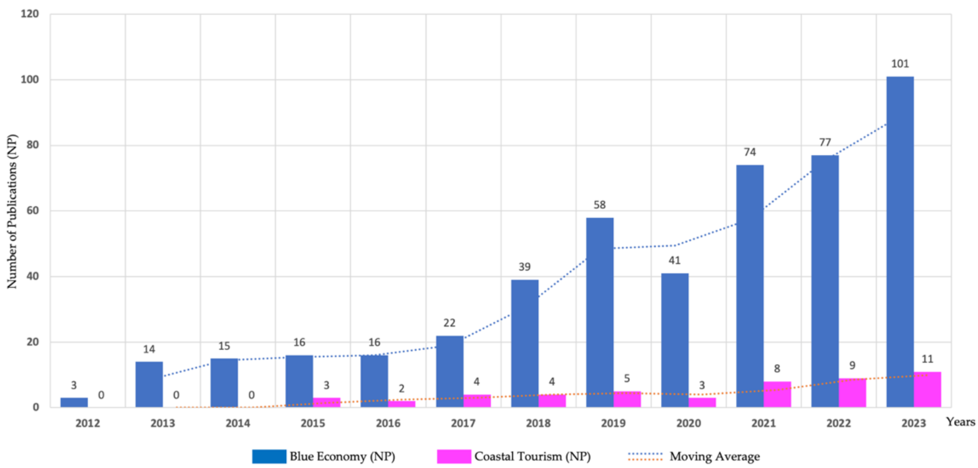


Figure 2. The Annual Scientific Production in BE and Coastal Tourism. Note: NP: Number of Publications. Source: Researcher, 2023, derived from R Programming Language (bibliometrix package).

2-1-2 Sources Analysis

With regards to sources analysis in BE, the extracted 476 articles were published in 249 sources. Although the broad range of the published articles sources in BE scientific field during the 11-years, only 55% (n=12) sources had published more than 5 articles. The same manner can be vividly shown in the coastal tourism publications, where from 39 sources only one journal published four papers, named, “Frontiers in Marine Science”, while other sources only published between one to three articles.

The most productive sources in BE research area were: “Marine Policy”, “Journal of the Indian Ocean Region”, “Journal of Coastal Research”, “Ocean and Coastal Management”, and “Sea Technology” with a number of publications 42, 21, 12, 10 and 10, respectively. While the most productive sources in the coastal tourism sector were: “Frontiers in Marine Science” (4), “Marine Policy” (3), “Journal of Coastal Research” (2), “Journal of the Indian Ocean Region” (2), and “Ocean and Coastal Management” (2).

Figure (5) depicted the relationship between the sources’ number of publications (NP) and the number of total citations (TC) for sources in the two scientific fields (BE & coastal tourism). The sources total citation numbers did not match the same order in the most productive sources list, either for BE or coastal tourism. For example, in the BE scientific field, the “Journal of Environment and Development” received 109 citations which were obtained from only one published article and ranked third in terms of the total number of citations for sources (Figure 5a).

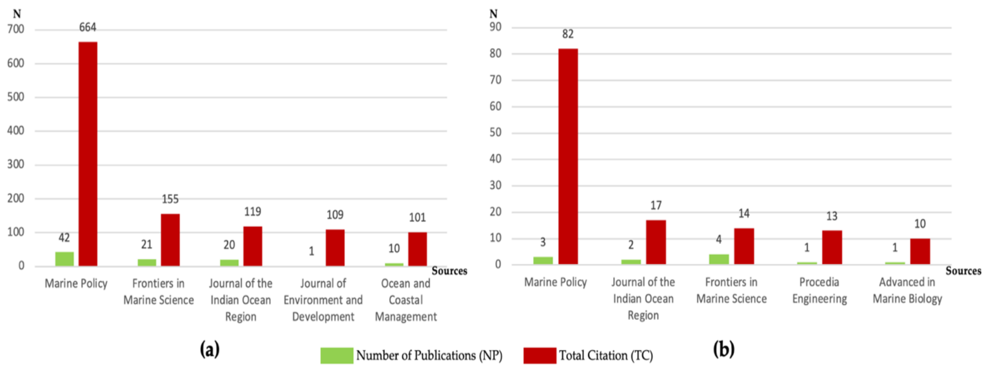


Figure 3. The Relation Between the Sources Number of Publications (NP) and Total Citations (TC); (a) BE Scientific Field; (b) Coastal Tourism Scientific Field. Source: Researcher, 2023, derived from R Programming Language (bibliometrix package).

2-1-3 Authors Analysis

In the authors analysis, the research discussed three bibliometric techniques for each of the two focused research fields (BE & coastal tourism). Firstly, the most relevant authors. Secondly, the authors' co-citation network. Thirdly, the authors production over the years is based on the number of publications and total citations.

According to BE scientific production, the total numbers of authors were 1584 authors. The most 5 relevant authors based on the number of publications were Na Na (n=13), Failler P (n=7), Voyer M (n=7), Bennett Nj (n=6) and Morrissey K (n=6), (see Table 4). The author co-citation network presents a vivid fact that the authors' number of publications did not reflect their number of citations. In other words, you can find an author who has a large number of publications but received fewer citations than another author with fewer published articles. Looking at Figures 6a & 6b, the top 5 authors in the citations number index, did not appear in the publication production list. Authors such as Pauly D, Halpern Bs, and Campbell Im received more than 100 citations for their articles and achieved the most link strength values in the author co-citation network map. Moving to the top authors production over time, we can highlight that in the second half of the focused timespan, exactly from 2017 to 2020, the majority of authors achieved their high production volume, whether in the number of published articles or the number of total citations. Also, Na Na and Morrissey K were the earliest scholars who published about BE after the release of the term in 2012, although they did not achieve great citations for these publications (Figure 6a).

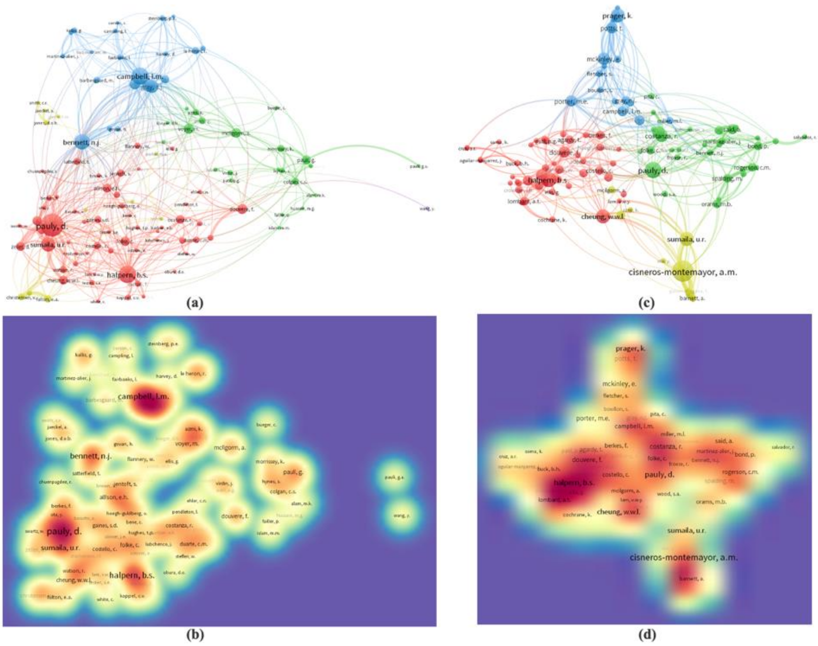


Figure 4. Author collaboration network; (a) BE author collaboration network visualization; (b) BE author collaboration density visualization; (c) coastal tourism author collaboration network visualization; (d) coastal tourism author collaboration density visualization. Source: Researcher, 2023, derived from VOSviewer.

By comparing the authors analysis between the blue economy and the coastal tourism sector, some interesting notes can be mentioned. Firstly, by examining the top relevant authors in these two research areas, it is clearly seen that the scientific production is not monopolized or controlled by specific scholars, and the total scientific production has an unequal distribution among the authors, despite a large number of authors in both studied research areas. Secondly, in the most relevant authors' analysis, the two lists for the two research areas (BE & coastal tourism) were different, although the scientific production of the coastal tourism is a part of BE one, and this reflects the specialization in the tourism sector when it related to authors. Thirdly, in the two research areas, there was a vivid difference between the authors names appearing in the most relevant authors list, either based on the number of publications or the number of citations. Fourthly, 2022 and 2023 were the most productive years in both two scientific fields, either in the total number of publications or the total number of citations.

2-1-4 Countries and Institutions Analysis

With regards to the country's collaboration network, BE literature was published by 124 countries. This diversity in the countries participating in the scientific production of BE (55% countries of the world), indicates the extended prosperity of BE term as a trendy academic research field in the recent years, specifically from 2012 to the present day. Figure (10) represents the most contributed countries in the literature of the two focused scientific fields (BE & coastal tourism), where the circle size represents the country's scientific production and lines represent the country's collaborations.

Turning to the countries contributing to coastal tourism output, as shown in Figure (10b), the most collaborative country was the United Kingdom with 12 publications, followed by South Africa (5), Australia (5), Portugal (4), Italy (4), and the United States of America (3).

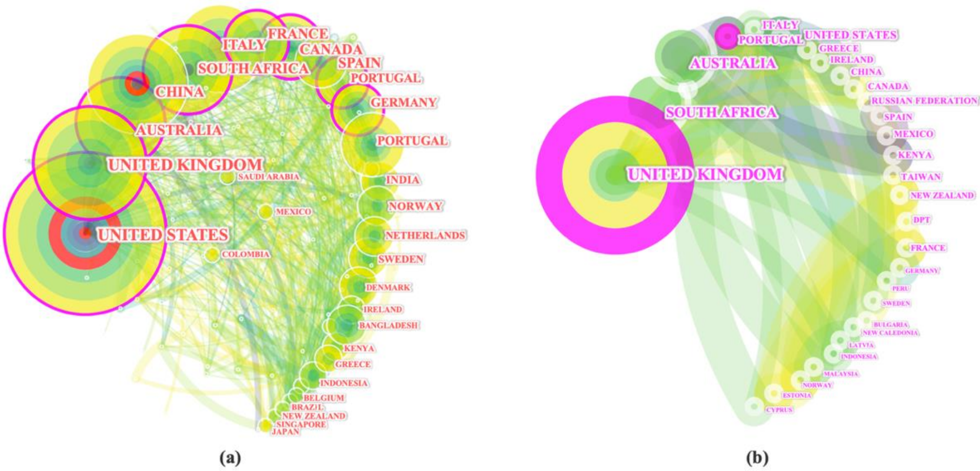


Figure 5. Country Collaboration Network. (a) BE Scientific Field; (b) Coastal Tourism Scientific Field. Source: Researcher, 2023, derived from CiteSpace.

The total number of institutions involved in the scientific production of BE and coastal tourism were 747 and 90 articles, respectively. In BE literature, “The Ocean University of China” and “University of British Columbia” were the two most productive academic institutions with 17 articles each, followed by “Kenya Marine and Fisheries Research Institute” (16), “The University of Washington” (13) and “University of Wollongong” (11), respectively, as shown in Table 3. By comparing the most productive institutions and countries in BE scientific field, we find that these two listed are corresponded, where the United States, United Kingdom, Australia, China and South Africa, either countries or institutions, placed at the top of these lists.

According to the coastal tourism scientific production, “Nelson Mandela University” was the most productive institution with 5 publications, followed by “Heriot WATT University”, “Independent Researcher”, “Kenya Marine and Fisheries Research Institute”, “Rhodes University”, and “Rhodes University” with 2 articles each, as shown in Table 3.

Table 1. The Most 10 Productive Institutions in BE & Coastal Tourism Literature

Affiliations / Institutions (Blue Economy)	TP	Affiliations / Institutions (Coastal Tourism)	TP
Ocean University of China	17	Nelson Mandela University	5
University of British Columbia	17	Heriot Watt University	2
Kenya Marine and Fisheries Research Institute	16	Independent Researcher	2
University of Washington	13	Kenya Marine and Fisheries Research Institute	2
University of Wollongong	11	Rhodes University	2
Duke University	9	Universidad Autnoma De Baja California SUR	2
Nelson Mandela University	9	Universiti Malaysia Terengganu	2
University of California	9	University of Aberdeen	2
University of Tasmania	8	University of Extremadura	2
Lancaster University	7	University of Glasgow	2

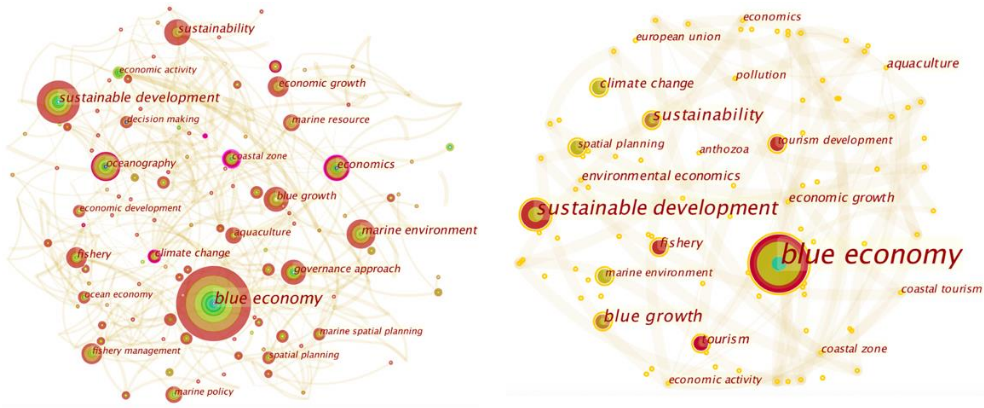
Source: Researcher, 2023, derived from R Programming Language (bibliometrix package). Note: TP: total publications number.

2-1-5 Keywords and Burst Analysis

Using CiteSpace software, the co-word analysis networks were mapped based on keywords frequency in the two studied research areas (BE & coastal tourism). In Figure (11a), which shows the co-word analysis of BE literature, we find that the most frequent keywords were the blue economy (n=197), sustainable development (n=78), sustainability (n=44), marine environment (n=44), economics (n=38), oceanography (n=32), fishery (31) and blue growth (n=30). This network also shows that the keywords which form the main conceptual kernel of BE such as economy and sustainability, are ranked on the top of the most frequented keywords. And this emphasises the novelty of BE scientific area which has been under research since the term's appearance in 2012. It also appears in this network that there is a clear absence of keywords that refer to coastal tourism, despite its importance as one of the most economic-valuable BE sectors, as was previously mentioned and proved.

While in Figure (11b), which shows the co-word analysis of the coastal tourism scientific production, we find that blue economy, sustainable development, blue growth, sustainability, fishery, environmental economics and tourism were the most frequent keywords with frequent numbers 27, 10, 7, 6, 4, 4, 4, respectively. Moreover, by conducting further examination and scrutiny of this network, we find that, although it represents the most frequented keywords of the research papers published in the coastal tourism scientific field, the top listed keywords still refer to BE and sustainability concept, which seems logical because coastal tourism is an integral part of BE sectors and it cannot be discussed in isolation from the general idea of BE.

Also, it is worth noting that terms related to tourism appear directly and clearly in this network, such as tourism, tourism development and coastal tourism.



(a) (b)

Figure 6. Co-Word Analysis. (a) BE Scientific Field; (b) Coastal Tourism Scientific Field. Source: Researcher, 2023, derived from CiteSpace.

2-2 Exploring Theoretical Foundations in Blue Economy and Coastal Tourism: Content Literature Review

2-2-1 Interwoven Horizons of Blue Economy, Coastal Tourism, and SDGs

In addition to the previously highlighted aspects underscoring the importance of coastal tourism within the blue economy concerning job creation and gross value added (GVA), this relationship extends beyond that. The blue economy presents substantial opportunities for local communities in coastal tourism areas (Evans et al., 2023). For example, the blue economy approach underscores the importance of inclusive and community-driven development. In the context of coastal tourism, this translates into empowering local communities to actively participate and benefit from tourism activities. By establishing inclusive tourism systems, coastal areas can ensure equitable distribution of the tourism economic benefits among the locals, thereby fostering community development and poverty alleviation (Farmery et al., 2021). Another example is the emphasis placed by the blue economy on responsible tourism practices that prioritize social well-being. This includes the minimization of adverse social impacts, the respect for local cultures, and the assurance that tourism activities contribute positively to community life. Social responsibility in coastal tourism, aligned with the principles of the blue economy, advocates for ethical tourism practices, highlights the new approach to tourism development such as regenerative tourism, and encourages responsible behaviour among visitors (Cummings & Greenberg, 2022).

Moreover, a strong bond between coastal tourism and the blue economy approach involves the formidable issue of climate change. On a global scale, coastal tourism stands out as a rapidly growing sector within the tourism industry, facing heightened susceptibility to climate variability due to its heavy reliance on weather and climate conditions (Karani & Failler, 2020). These factors influence tourists' decision to visit a specific tourism destination, which impacts the success of tourism destinations, activities and businesses. Almost all coastal tourism activities are affected by climate change, further influencing the number of tourists visiting coastal destinations (Lam et al., 2012). The challenge of climate change is particularly significant in coastal tourism destinations, exemplified by the fact that approximately 60% of U.S. tourists favour beach vacations and coastal tourism regions (Karani & Failler, 2020). Additionally, coral reefs, which attract millions of tourists annually for activities such as snorkelling and diving, are highly sensitive to climate change. The significance of coral reefs extends beyond their attraction to tourists; they also contribute significantly to the global tourism industry, generating around US$11.5 billion (Burke et al., 2011).

Furthermore, as stated by the United Nations World Tourism Organization (UNWTO), the tourism sector's carbon footprint accounts for 8% of worldwide greenhouse gas emissions, signifying a substantial share at the global level (UNWTO, 2014). In this context, the concept of "blue carbon" emerges as a fundamental element associated with the blue economy approach. Within the framework of the blue economy, the concept of "blue carbon" holds significant relevance, representing a crucial intersection between marine conservation efforts and sustainable economic development. Blue carbon refers to the carbon storage in vegetated coastal ecosystems such as mangroves, salt marshes, and seagrass." (Feng et al., 2023, p. 1). These ecosystems have the remarkable ability to sequester and store large amounts of carbon dioxide from the atmosphere, thus playing a vital role in mitigating climate change.

Exploring the intricate relationship between the blue economy and the Sustainable Development Goals (SDGs) reveals a profound connection that extends beyond mere alignment. The blue economy, characterized by its sustainable use of ocean resources for economic growth, aligns with several SDGs, offering a comprehensive framework for fostering sustainable development (Lee et al., 2020b). One key aspect of this relationship lies in SDG 1: No Poverty. The blue economy holds immense potential to alleviate poverty by creating significant job opportunities, particularly within local coastal communities (Chaturvedi, 2023). For example, initiatives such as community-based ecotourism projects in coastal regions have not only generated employment but also empowered local communities economically and socially. In my opinion, fostering inclusive growth through such initiatives is vital for achieving sustainable development objectives and reducing poverty levels in our way to apply the blue economy approach.

2-2-2 Navigating Blue Economy Implementation Misconceptions

While the conceptual essence of the blue economy approach underscores its importance as a sustainable development direction, operating within the vital environment of oceans and seas—a core component of our daily existence on Earth—and receiving backing from national and international initiatives, there persists a degree of misunderstanding in its implementation. This is underscored by the absence of a specific and universally accepted definition of the blue economy. Definitions tend to vary among institutions and are influenced by the desired objectives of applying this approach. Therefore, it can be said that the blue economy is still considered almost a conceptual framework, with limited practical implementations and practices. Furthermore, there is no unified framework or mechanism for setting out a precise road map for implementing the blue approach and achieving the desired sustainable development outcomes. Consequently, this vaguest and unclear image of the blue economy concept, paved the way for the emergence of various concerns that highlighted the possibility of the blue economy practices causing risk to resources, as well as incurring consequences that are difficult to remedy in the future such as destruction of ecosystems.

While the blue economy practices might appear to be well-intentioned ones, especially with their ability to offer many contributions that improve our lives (e.g. providing jobs, improving the living standards of coastal areas' locals, and helping in the local economic growth), the academic society should focus on investigating, asking about the necessity entails, and assessing these intentions. In this context, there is a critical need for future research that seeks to find principles to transfer the blue economy from a theoretical perspective to a pragmatic one, with an emphasis on achieving a green, prosperous, and equitable blue economy approach.

2-2-3 Blue Economy and Coastal Tourism from the Ecotourism Perspective

In examining the interwoven concepts of the blue economy and coastal tourism, it becomes pertinent to incorporate the foundational concept of ecotourism into the analysis. Ecotourism, characterized by responsible travel to natural areas that conserve the environment and improve the well-being of local communities, offers valuable insights into sustainable tourism practices within coastal regions. Many studies have highlighted the potential synergies between ecotourism and the blue economy, emphasizing the importance of integrating ecotourism principles into coastal tourism development strategies. For example, a study conducted by Andrés M. Cisneros-Montemayor et al. identified ecotourism as one of the high-resource availability subsectors for the blue economy approach. The research highlights the importance of ecotourism features such as emphasizing education, conservation efforts, and local benefits to achieve an equitable and sustainable blue economy, thereby promoting social equity and community well-being (Cisneros-Montemayor et al., 2021).

2-2-4 Blue Economy Landscape in Egypt

Generally, the Egyptian government shows keen interest in the blue economy approach due to its potential to effectively implement various practices across different economic sectors in the country. The country is equipped with 53 seaports, including 15 commercial and 38 specialized ones. In 2021, the volume of imports and exports reached an estimated 162.8 million tons, facilitated by 11.59 thousand vessels, according to (Egyptian Authority for Maritime Safety, 2023). Egypt's coastal tourism sector, encompassing yacht tourism, diving, and fishing, constituting over 90% of the country's total tourism. The tourism sector contributes significantly to Egypt's economy, accounting for 11.9% of the gross domestic product (GDP) and employing approximately 12.6% of the workforce. Moreover, it represents 21% of total non-commodity exports and generates 19.3% of foreign exchange earnings. In 2019, the coastal tourism sector experienced a remarkable growth of 16.5%, before the coronavirus pandemic disrupted this momentum (Ministry of Tourism and Antiquities, 2023).

At the global level, Egypt participated in the “Sustainable Blue Economy” conference held in the Kenyan capital, Nairobi, from November 26 to 28, 2018. The event attracted approximately 18,000 delegates from 184 states. The conference projected that the blue economy would double in growth compared to the traditional economy by 2030, with the potential for further increases if the reliance on seas and oceans for energy generation and desalination continued. Emphasizing the establishment of a blue economy, the conference highlighted the need for the sustainable long-term use of oceans and marine resources. It underscored the enormous potential that could be harnessed in the service of coastal and marine resources, not only in Egypt but globally (IISD, 2018).

Additionally, Egypt had the privilege of hosting the International Conference of the Blue Economy Forum in 2002, in its first participation in a blue economy international event. The conference, funded by the European Union, centred around the theme 'Blue Economy and Sustainable Development.' It aimed to explore challenges, opportunities, and partnerships in the domains of seas, oceans, rivers, and lakes, with a specific focus on new technologies and innovation. The event provided a platform to assess progress in various areas, including fishing, coastal tourism, maritime transport, offshore exploration, and themes related to the Sustainable Development Agenda. These themes were particularly intertwined with the climate change agenda, pollution control, production acceleration, economic growth, employment, poverty alleviation, and the sustenance of marine life. This underscores the Egyptian government’s recognition of the significance of the blue economy and its integral connection to the attainment of sustainable development goals, as evidenced by its unwavering commitment.

CHAPTER 3: MATERIALS AND METHODS

3-1 Study Area

The main objective of this study is to identify the readiness of coastal tourism centres to apply the blue economy approach. The selection of a robust case study is crucial to achieve this objective. Egypt, in general, and the Southern Red Sea region, in particular, appeared as suitable spatial areas for this purpose. In the subsequent subsections, the main justifications for selecting these case studies (Egypt & the Southern Red Sea region) will be presented.

3-1-1 Egyptian Coastal Tourism Sector

At the national level, Egypt serves the broader geographical context for the specific study area, the Red Sea region. The coastal tourism sector in Egypt exhibits rich features, rendering the country a compelling geographical area for investigating this tourism pattern. These features can be summarized in the following main areas of SWOT analysis. The primary aim of the SWOT analysis presented for the coastal tourism sector in Egypt within this subsection is to confirm the richness of this sector, thereby justifying the selection of Egypt (specifically, the Southern Red Sea region) as a robust case study for this research.

The following points from the SWOT analysis serve as the main justifications for focusing on Egypt as the main case study in this research, which seeks to apply the blue economy approach in the coastal tourism sector. The following Figure (23) provides a summary of the diverse features identified in the SWOT analysis discussed earlier.

Figure 7. SWOT Analysis for the Coastal Tourism Sector in Egypt. Source: Researcher, 2023.

3-1-2 The Southern Red Sea Region, Egypt

The Southern Red Sea region, also referred to as Ganoub Bahr al Ahmar in Arabic, is the central focus of this study, boasting a diverse landscape that epitomizes the essence of coastal tourism. Spanning approximately 612 kilometers in length and with a maximum width of 355 kilometers, this semi-enclosed body of warm water covers an expansive surface area of roughly 78,510 square kilometers. Stretching from the northern city of Gouna to the southernmost point of South Ras Benas, the region encompasses a wealth of tourist attractions, natural wonders, and vibrant communities, including six major cities: Gouna, Hurghada, Safaga, El-Quseir, Marsa Alam, and Ras Benas. The following Figure (24) illustrates the Southern Red Sea region, the primary case study area in this research.

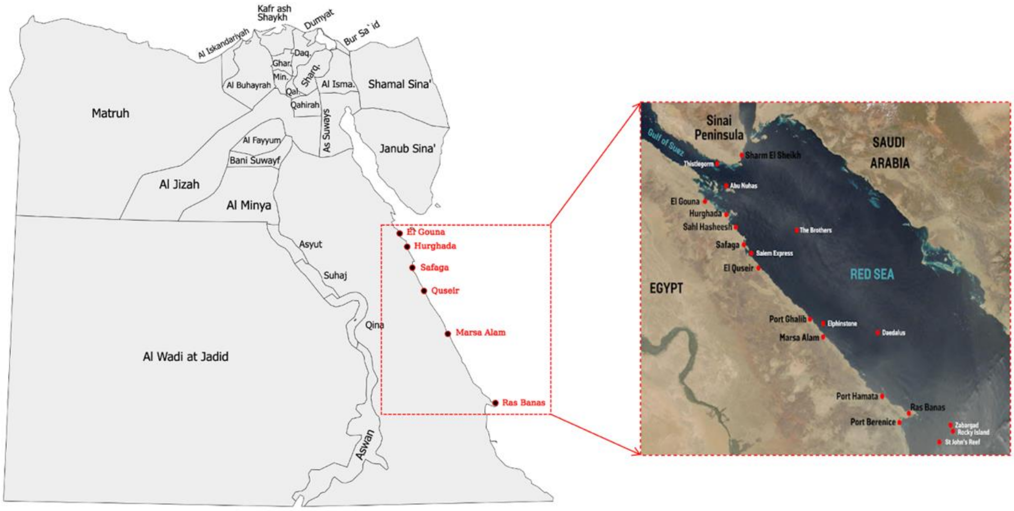


Figure 8. The Southern Red Sea Region, Egypt. Source: Researcher, 2023.

3-2 Research Methodology

3-2-1 Efficiency Analysis as a Main Research Method

Technical efficiency (TE) is an economic analytical method applied across various industries. It revolves around the utilization of resources within an economic unit to achieve specific output levels. The concept of technical efficiency (TE) finds its origins in the 1950s, notably when Koopmans and Debreu, in 1959, defined TE as a state where a firm operates on the efficiency frontier, with all associated slacks being zero (Debreu, 1959; Koopmans, 1959). Additionally, in 1957, Farrell described TE as “the success of firm in producing as large as possible an output from a given set of inputs” (Farrell, 1957, p. 254). The following Figure (25) elucidates the notion of the frontier and the concept of efficiency units operating on this frontier, along with the idea of radial technical efficiency. The frontier serves as the boundary or limit representing the maximum achievable level of outputs given the existing inputs or resources (Ahn et al., 2023). Economic units, such as the coastal tourism centres within the context of this study, positioned on the frontier illustrate their efficiency by optimizing their available resources. Conversely, economic units falling below or above this frontier line indicate their inefficiencies. Illustrated in Figure (25), A, B, C, D, E, and F denote economic units or decision making units (DMUs). The red line signifies the efficiency frontier. Based on this representation, economic units C, B, and F are considered efficient units, while economic units A, D, and E are categorized as inefficient units. In pursuit of efficiency, these inefficient units endeavour to move towards the frontier using the radial concept of technical efficiency. For example, to enhance its efficiency, the inefficient unit A must follow its radial direction (as indicated by the dotted grey line) originating from the origin to align with the frontier and attain efficiency. This transformation occurs through the judicious utilization of its resources, presenting an input-oriented technique/approach as depicted in Figure (26).

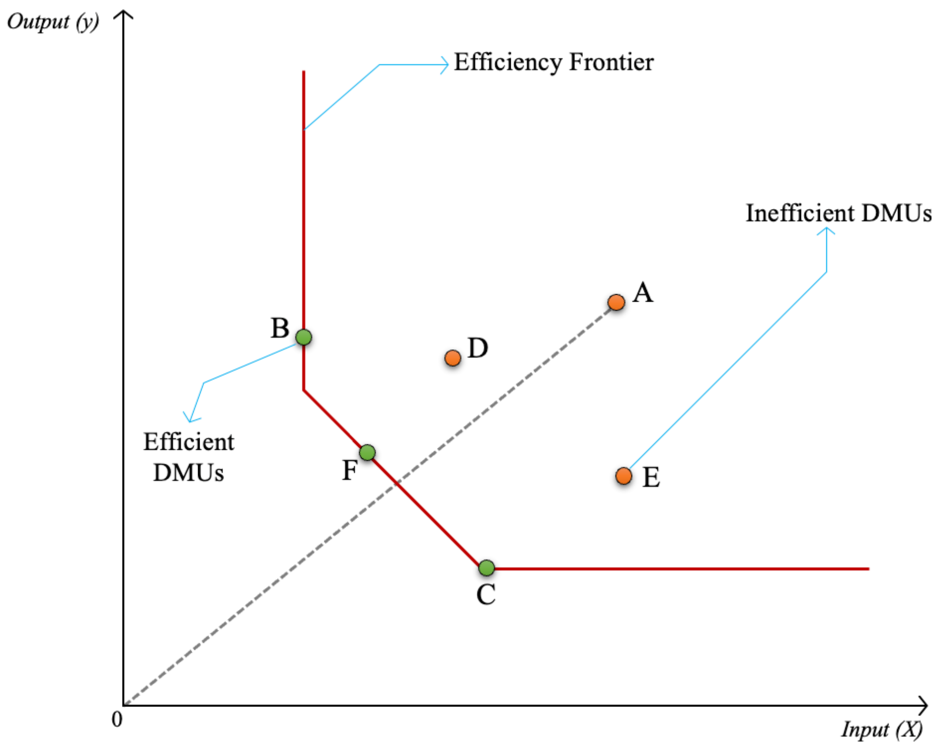


Figure 9. Illustration of the Efficient Frontier as a Fundamental Element of Technical Efficiency (TE) Measurements. Source: Researcher, 2023.

Three possible versions of the previous Figure (25) exist. Although they all centre around the concept of the frontier, each version differs. Their differentiation stems from the specific research objectives. These techniques are known as the input-oriented technique, output-oriented technique, and input-output-oriented technique. Further explanation of these techniques and their underlying principles will be provided in the subsequent subsection, alongside an exploration of the conceptual kernel of Data Envelopment Analysis (DEA).

3-2-2 Technical Efficiency Using Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH)

Having selected technical efficiency (TE) as the primary efficiency type, the subsequent step was to determine the specific technical efficiency measurement to be employed. This study opts for Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) as the main measurements for evaluating the technical efficiency of tourism centres in the southern Red Sea region within the context of implementing the blue economy approach.

3-2-2-1 Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric envelopment frontier measurement, was initially propounded by the three professors Abraham Charnes, William Cooper, and Edwardo Rhodes (CCR) in 1978 (Rhodes, 1978), and extended by Banker, Charnes, and Cooper (BCC) in 1984 (Banker et al., 1984). DEA is a linear programming frontier optimization efficiency measurement. The conceptual kernel of DEA is to estimate the relative efficiency of homogenized decision-making units, known as DMUs, that use multiple inputs which represent the resources and produce some outputs (Pedraja-Chaparro et al., 1999). Efficiency value using DEA is represented with a single number (θ) on a scale from zero to 1, with the rule that ($0 < \theta < 1$), where the value of 1.0 represents an efficient DMU (Adler et al., 2002). The efficiency or inefficiency of a particular DUM is assessed by the distance of how far this DMU is from the constructed frontier (Bhat et al., 2001). Also, it is worth mentioning that the efficiency numbers are not on a linear scale, so it cannot be said that the DMU with a 0.5 efficiency score is half as efficient as one at 1.0. Additionally, DEA not only calculates DMUs' efficiency, but also identifies the inefficiency causes and then ranks the DMUs according to their efficiency, as well as pinpoints how to improve the efficiency of these inefficient DMUs.

Data Envelopment Analysis (DEA) can be applied to assess efficiency on two scales: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). Constant Returns to Scale (CRS) within the context of Data Envelopment Analysis (DEA) implies that a decision-making unit (DMU) (i.e., a coastal tourism centre), exhibits a linear and consistent production process. In other words, if the tourism centre (DMU) were to double all its inputs (e.g., investments, number of hotels, accommodation capacity), the outputs (e.g., tourists number and employees number) would also double while maintaining the same level of technical efficiency. CRS assumes that scaling up or down, proportionally increasing or decreasing inputs and outputs, doesn't significantly affect the tourism centre's efficiency (Bogetoft & Otto, 2020). It essentially portrays a scenario where the coastal tourism centre's efficiency remains steady across different scales of operation. Conversely, Variable Returns to Scale (VRS) recognizes the dynamic nature of efficiency concerning scale. In the case of coastal tourism centres, VRS accommodates the idea that increasing or decreasing inputs may lead to varying outcomes in terms of outputs and efficiency. It acknowledges that as a centre scales up, it might experience increasing returns to scale (IRS) if it becomes more efficient with growth, delivering proportionally more output per unit of input. Conversely, it allows for the possibility of decreasing returns to scale (DRS) if, as the centre expands, its efficiency decreases, and it produces less output relative to its inputs. VRS provides a flexible approach, considering that different centres may respond differently to changes in scale (Cooper et al., 2011). It allows for a more nuanced assessment of efficiency, especially in scenarios where coastal tourism centres may have diverse scales of operation and efficiency characteristics.

The VRS output-oriented model (primal equation) is as follows:

$$\text{Minimize} \quad \sum_{i=1}^{m} v_i x_{ik} - c_k \qquad (1)$$

Subjected to:

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} - c_k \geq 0 \quad j = 1, \ldots, n \qquad (2)$$

$$\sum_{r=1}^{s} u_r y_{rk} = 1 \qquad (3)$$

$$u_r, v_i > 0 \quad \forall r = 1, \ldots, s; i = 1, \ldots, m \qquad (4)$$

While the VRS intput-oriented model (primal equation) is as follows:

$$\text{Maximize} \quad \sum_{r=1}^{s} u_r y_{rk} + c_k \tag{5}$$

Subjected to:

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} - c_k \geq 0 \quad j = 1, \ldots, n \tag{6}$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \tag{7}$$

$$u_r, v_i > 0 \quad \forall r = 1, \ldots, s; i = 1, \ldots, m \tag{8}$$

In this context, "*k*" denotes the specific coastal tourism centre that is the focus of this study, and "*n*" represents the total number of coastal tourism centres being assessed. The various inputs and outputs used by these coastal tourism centres (DMUs) are denoted by "*m*" and "*s*", respectively. Additionally, "y_{rk}" signifies the quantity of output "r" generated by coastal tourism centre "*k*". Conversely, "x_{ik}" represents the quantity of input "*i*" consumed by coastal tourism centre "*k*". The weights of outputs and inputs are expressed as "u_r" and "v_i", respectively, with "c_k" indicating the measure of returns to scale concerning the variables involved (Shao & Lin, 2002; Wei, 2001).

3-2-2-2 Free Disposal Hull (FDH)

The second efficiency measurement method employed in this study, alongside Data Envelopment Analysis (DEA), is the Free Disposal Hull (FDH). It is developed by Deprins, Simar, and Tulkens in 1984 (Deprins et al., 1984), and extended by Lovell in 1993 (Lovell & Vanden Eeckaut, 1993). FDH provides a unique approach to evaluating efficiency, characterized by its lack of distinction between input-oriented and output-oriented assessments. Instead, it adheres to the principle of "non-oriented" or "undirected" efficiency. In contrast to DEA's oriented techniques, FDH takes a different approach by evaluating efficiency without a predefined orientation. This distinct feature, aligned with the study's objectives, enables FDH to identify any underperforming coastal tourism centres regardless of their unique resource allocation structures.

The linear programming equation for the Free Disposal Hull (FDH) is as follows (Borger et al., 1994):

$$\text{Maximize } \rho \quad (9)$$

$$\rho \cdot yr_k + \sum_{s=1}^{S} ur_s \cdot y_s \leq \sum_{m=1}^{M} vi_m \cdot xi_m, \quad \forall k \quad (10)$$

Subjected to:

$$ur_s \geq 0,\ s = 1, 2, ..., S \quad (11)$$

$$vi_m \geq 0,\ m = 1, 2, ..., M \quad (12)$$

It is important to note that the final step in the series of efficiency analysis methods used to evaluate the efficiency of coastal tourism centers in the Southern Red Sea region of Egypt involves calculating the Scale Efficiency (SE). SE as a critical indicator for assessing how a Decision Making Unit (DMU), such as a coastal tourism center in this study's context, performs under different scales of operation. It takes into account whether the DMU can maintain or even improve its performance as it adjusts the scale of its operations. The idea behind calculating SE is to compare the efficiency of a Decision-Making Unit (DMU) under Variable Returns to Scale (VRS) conditions to its efficiency when assuming Constant Returns to Scale (CRS). In detail, the SE value for any DMU can fall into one of three categories: 1, >1, or <1. A SE value of 1 indicates optimal scale operation. A SE value of <1 suggests there is room for improvement in scaling for that DMU. Conversely, a SE value of >1 implies that the DMU is operating below its optimal scale (Balk, 2001; Chen & Zhu, 2019; Zelenyuk, 2015). The following equation represents the calculation of SE:

SE = Efficiency Score under VRS / Efficiency Score under CRS (13)

As evident from the previous equation, to calculate SE, DEA must be assessed using the Constant Returns to Scale (CRS). Therefore, the subsequent linear programming problems are employed to compute DEA-CRS (Shao & Lin, 2002; Wei, 2001).

The CRS input-oriented model (primal equation) is as follows:

$$\text{Maximize} \quad \sum_{r=1}^{s} u_r y_{rk} \qquad (14)$$

Subjected to:

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} \geq 0 \quad j = 1,\ldots,n \qquad (15)$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \qquad (16)$$

$$u_r, v_i > 0 \quad \forall r = 1,\ldots,s; i = 1,\ldots,m \qquad (17)$$

While the CRS output-oriented model (primal equation) is as follows:

$$\text{Minimize} \quad \sum_{i=1}^{m} v_i x_{ik} \qquad (18)$$

Subjected to:

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} \geq 0 \quad j = 1,\ldots,n \qquad (19)$$

$$\sum_{r=1}^{s} u_r y_{rk} = 1 \qquad (20)$$

$$u_r, v_i > 0 \quad \forall r = 1,\ldots,s; i = 1,\ldots,m \qquad (21)$$

To compute the array of efficiency measurements in this study (DEA-VRS-Output, DEA-VRS-Input, DEA-CRS-Output, DEA-CRS-Input, FDH, SE-VRS, and SE-CRS), several software tools were employed, including the Benchmarking package from the R programming language, the web interactive interface (deaR-Shiny), and the PIM-DEA software.

3-3 Data Collection

3-3-1 Decision Making Units (DMUs)

Despite the existence of various administrative levels defining geographic and spatial areas in Egypt, resulting in diverse spatial units and easy data collection due to their use in gathering official government statistics, this study chose not to rely on them for tourism development. Instead, the study focused on developmental spatial units (functional spatial units) known as coastal tourism centres to implement the blue economy approach, rather than any of the previously established official government administrative units. Although this choice may complicate data collection, it is justified for several reasons. Firstly, these administrative boundaries do not consider the spatial distribution of development resources; they primarily serve political and administrative purposes at the national, governmental, and institutional levels, such as elections, legislative rights, and internal civil status. Moreover, the coastal tourism sector is delicate, seasonal, and resilient, making it susceptible to various changes. Therefore, it is essential to base spatial divisions on realistic and developmental criteria rather than administrative orientations. Additionally, administrative boundaries fail to account for the presence of sufficient infrastructure needed for developing the tourism sector. Lastly, since the primary goal of this research is coastal tourism development, it requires a specific spatial division tailored to the tourism sector, unlike administrative boundaries that encompass all dimensions and economic sectors, including industry, trade, agriculture, politics, governance, and others.

Consequently, the southern Red Sea region will be subdivided into spatial Tourism Development Centers (TDCs), followed by assessing these TDCs efficacy regarding applying the conceptual foundations of the blue economy. A Tourism Development Center (TDC) represents a spatial geographical area formed by a combination of several tourism projects, including tourist villages, hotels, tourist resorts, public or private beaches, restaurants, coastal tourist activity centers (recreational or sports), and various other tourism resources. The lands for these projects are designated by the Egyptian Tourism Authority (ETA), which oversees the proposed coastal land acquisition for tourism development. This classification yielded 29 tourism centers grouped into five tourism sectors; Figure (31) illustrates the concept of establishing these spatial tourism development centres.

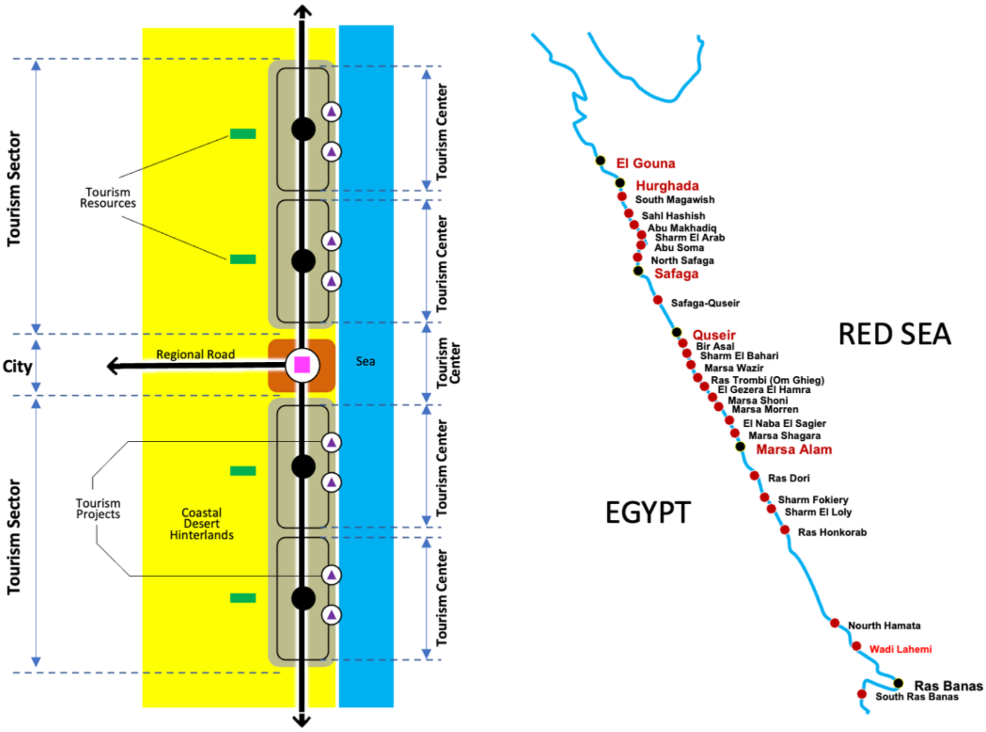


Figure 10. Conceptualization of Tourism Center Establishment. Source: Researcher based on (JICA, 2000).

3-3-2 Operational Variables (Inputs and Outputs)

The operational variables discussed here are an essential element of the data collecting procedure required for conducting different technical efficiency assessments, such as DEA and FDH, as described in this work. These variables form the foundation for calculating the technical efficiency scores/values for each coastal tourism centre in the Southern Red Sea Region in Egypt. In order to establish a strong academic and scientific basis for collecting these variables, as well as enhancing the reliability and robustness of the study's outcomes, the Delphi technique was utilized to gather both input and output variables. The following Figure (32) depicts the Delphi technique process with its four rounds.

CHAPTER 4: RESULTS AND DISCUSSION

4-1 The Data Envelopment Analysis Inputs and Outputs Variables

Table 2. Summary of Statistical Information for Input and Output Variables of Coastal Tourism Centers Used to Conduct DEA, FDH and SE.

No.	Variable	Code	Min	Max	Mean	Range	Std.[b]
			INPUTS				
1	**Length of Shoreline**	EN1	2.21	73.07	19.78	70.86	15.17
2	**Quality of Coral Reefs**	EN2	4	10	7.9	6	1.8
3	**Sea Current**	EN3	0.15	2.12	0.91	1.97	0.57
4	**Beach Slope**	EN4	3.7	22.2	10.02	18.5	4.24
5	**Seabed Slope**	EN5	15	25	18.68	10	2.76
6	**Beach Soil Type**	EN6	1	4	2.93	3	0.59
7	**Turbidity**	EN7	1	28	13.31	27	7.86
8	**Percentage of Coral Cover**	EN8	11	48	24.31	37	11.18
9	**Marine Fish Diversity**	EN9	1	3	2.28	2	0.65
10	**Coastal Geomorphology Landforms**	EN10	1	4	2.66	3	1.08
11	**Presence of Aquatic Plants (Mangroves)**	EN11	0	1	0.28	1	0.45
12	**Investments**	EC1	7	4473	725.91	4466	1000.03
13	**Number of Hotels**	EC2	0	67	6.34	67	12.56
14	**Accommodation Capacity**	EC3	1828	69510	26786.41	67682	21291.69
15	**Tourism Housing Capacity**	EC4	0	54921	7118.52	54921	12449.56
16	**Number of Tourism Projects**	EC5	0	178	42.38	178	44.84
17	**Number of Tourist Villages**	EC6	0	24	2.38	24	4.79
18	**Average Length of Stay**	EC7	1.5	7.6	6.66	6.1	1.52
19	**Number of Tourist Nights**	EC8	870	377032	72601.72	376162	83083.65
20	**Tourism Density**	EC9	15.57	9052.39	1475.19	9036.81	1898.44
21	**Area**	UR1	10.3	92.56	56.6	82.26	26.35

No.	Variable	Code	Min	Max	Mean	Range	Std.[b]
22	**Total of Allotments Areas**	UR2	0	37.68	9.26	37.68	10.13
23	**Total of Developed Areas**	UR3	0.38	94.32	27.8	93.94	29.14
24	**Coastal Hinterland Width**	UR4	1	4	1.48	3	0.95
25	**Surrounding Land Uses**	UR5	2	4	3.21	2	0.9
26	**Proximity to Urban Centers**	UR6	1	3	2.31	2	0.81
27	**Accessibility**	IN1	1	3	2.9	2	0.41
28	**Proximity to Airports/Ports**	IN2	1	2	1.83	1	0.38
29	**Number of Tourism Companies**	GO1	0	44	7.34	44	9.24
30	**Supply Chain Capabilities**	GO2	1	3	1.66	2	0.9
			OUTPUTS				
1	**Total Employees Numbers (Direct and Indirect)**	OUT1	1428	58096	10709.28	56668	11494.84
2	**Total Future Job Opportunities**	OUT2	0	74232	19800.69	74232	17291.48
3	**Total Tourists Numbers**	OUT3	0	600000	112481.34	600000	143682.94

Source: Researcher, 2023. Note: [b] Std: represent the standard deviation.

4-2 Integrated Technical Efficiency Analysis Considering the Entire Input Spectrum

As mentioned earlier in the research methodology chapter, this study will perform a technical efficiency analysis to assess the efficiency and preparedness of coastal tourism centres in the Southern Red Sea region to apply the blue economy approach. Three types of measurements will be employed: Data Envelopment Analysis (DEA) with its two scales, Variable Returns to Scale (VRS-Input and VRS-Output), and Constant Returns to Scale (CRS-Input and CRS-Output), Free Disposal Hull (FDH), and Scale Efficiency (SE). These different models will be conducted at two levels of analysis. The first level will present an integrated approach, utilizing all the previously mentioned input groups with their 30 variables alongside the main three outputs. The second level will delve into details by conducting the technical efficiency measurement for each group of input variables separately, while maintaining the same main three outputs. The following Table (8) presents the efficiency results for the first level of analysis, focusing on the use of all 30 input variables collectively.

Table 3. Results of the Different Technical Efficiency Measurements (DEA, FDH and SE) for the coastal tourism centres in the Southern Red Sea region, Egypt.

No.	DMUs (Tourism Centres)	Tourism Sector	DEA (VRS-I)	DEA (VRS-O)	DEA (CRS-I)	DEA (CRS-O)	FDH	SE [b]
DMU1	**Gouna**	Hurghada-Safaga	1.00	1.00	1.00	1.00	1.00	1.00
DMU2	**Hurghada**		1.00	1.00	1.00	1.00	1.00	1.00
DMU3	**South Magawish**		1.00	1.00	1.00	1.00	1.00	1.00
DMU4	**Sahl Hashish**		1.00	1.00	1.00	1.00	1.00	1.00
DMU5	**Abu Makhadiq**		1.00	1.00	1.00	1.00	1.00	1.00
DMU6	**Sharm El Arab**		1.00	1.00	1.00	1.00	1.00	1.00
DMU7	**Abu Soma**		1.00	1.00	**0.83**	**0.83**	1.00	**0.83**
DMU8	**North Safaga**		1.00	1.00	1.00	1.00	1.00	1.00
DMU9	**Safaga**	Safaga-Quseir	1.00	1.00	1.00	1.00	1.00	1.00
DMU10	**Safaga-Quseir**		1.00	1.00	1.00	1.00	1.00	1.00
DMU11	**Quseir**		1.00	1.00	1.00	1.00	1.00	1.00
DMU12	**Bir Asal**	Quseir-Marsa Alam	1.00	1.00	1.00	1.00	1.00	1.00
DMU13	**Sharm El Bahari**		1.00	1.00	1.00	1.00	1.00	1.00
DMU14	**Marsa Wazir**		1.00	1.00	1.00	1.00	1.00	1.00
DMU15	**Ras Trombi (Om Ghieg)**		1.00	1.00	1.00	1.00	1.00	1.00
DMU16	**El Gezera El Hamra**		1.00	1.00	1.00	1.00	1.00	1.00
DMU17	**Marsa Shoni**		1.00	1.00	1.00	1.00	1.00	1.00
DMU18	**Marsa Morren**		1.00	1.00	1.00	1.00	1.00	1.00
DMU19	**El Naba El Sagier**		1.00	1.00	1.00	1.00	1.00	1.00
DMU20	**Marsa Shagara**		1.00	1.00	1.00	1.00	1.00	1.00
DMU21	**Marsa Alam**	Marsa Alam-Ras Benas	1.00	1.00	1.00	1.00	1.00	1.00
DMU22	**Ras Dori**		1.00	1.00	1.00	1.00	1.00	1.00
DMU23	**Sharm Fokiery**		1.00	1.00	1.00	1.00	1.00	1.00
DMU24	**Sharm El Loly**		1.00	1.00	1.00	1.00	1.00	1.00
DMU25	**Ras Honkorab**		1.00	1.00	1.00	1.00	1.00	1.00
DMU26	**North Hamata**		1.00	1.00	1.00	1.00	1.00	1.00
DMU27	**Wadi Lahemi**		1.00	1.00	1.00	1.00	1.00	1.00
DMU28	**Ras Benas**	Ras Benas	1.00	1.00	1.00	1.00	**0.63**	1.00
DMU29	**South Ras Benas**		1.00	1.00	1.00	1.00	**0.72**	1.00
	Average		1.00	1.00	1.00	1.00	1.00	1.00

Source: Researcher, 2023. Note: Bold results represent the inefficient tourism centres (DMUs), [b] SE: represents Scale Efficiency.

Upon investigating the results of the various technical efficiency analyses conducted, it becomes evident that almost all coastal tourism centres (DMUs) in the Southern Red Sea region of Egypt were efficient and ready for implementing the blue economy approach in coastal tourism development, as demonstrated in Table (8). Specifically, in the Variable Returns to Scale DEA (VRS-I) and DEA (VRS-O) models, all the 29 coastal tourism centres (DMUs) were efficient. Additionally, for the Constant Returns to Scale DEA (VRS-I) and DEA (VRS-O) models, all DMUs except DMU7 (Abu Soma) were efficient. DMU7 showed inefficiency with a score of 0.83. This pattern is consistent across other technical efficiency measurements. For example, in the FDH model, only two out of the 29 DMUs—Ras Benas (DMU28) and South Ras Benas (DMU29)—were inefficient, scoring 0.63 and 0.72, respectively. Furthermore, in the Scale Efficiency (SE) results, only Abu Soma (DMU7) displayed inefficiency with a score of 0.83.

The results presented in the previous Table (8) can be interpreted from two perspectives. The first perspective suggests that all coastal tourism centres (DMUs) in the Southern Red Sea region are efficient and possess significant potential for applying the principles of the blue economy approach. This interpretation seems compelling at first glance, given the unique characteristics of the Red Sea region in general, and particularly its southern part. The region has distinctive natural tourism resources (e.g., unique coral reefs, sea grass beds, mangroves, and marine ecosystems), strategic geographical location, affordable tourism activities, and varied coastal urban system network contribute to its suitability for adopting the blue economy approach and confirm the logic behind supporting this perspective.

However, despite these undoubtedly promising potentials in the Red Sea region, the SWOT analysis conducted earlier has revealed certain challenges that hinder the seamless application of the blue economy approach in coastal tourism development. These challenges include issues related to climate change, administrative hurdles, degradation of some tourism resources, intense competition from neighboring countries, and the fragility and seasonality of the coastal tourism sector. Consequently, the second perspective arises when interpreting and justifying these results: the notion that these results may not fully reflect the efficient status of coastal tourism centres in the Southern Red Sea region. To explore this perspective and either confirm or rebut it, the study conducted another type of technical efficiency analysis named Super Efficiency analysis. This analysis, specifically the Simple Super Efficiency (SSE) model, in its two orientations, VRS-I and VRS-O. Super Efficiency Analysis is an extension of the traditional Data Envelopment Analysis (DEA) method used to assess the relative efficiency of

Decision Making Units (DMUs). While standard DEA evaluates the efficiency of DMUs relative to their peers, Super Efficiency Analysis goes a step further by identifying the most efficient DMUs that set the benchmark for others. Super Efficiency Analysis provides a more stringent evaluation, helping to distinguish top performers more clearly and offering valuable insights for benchmarking and improvement strategies.

4-3 Technical Efficiency Analysis Using a Grouped Input Approach

4-3-1 Environmental Inputs Group

Initiating the various technical efficiency analyses (DEA, FDH, and SE) using only the pertinent input variables from the environmental group and the three main output variables (Total Employees Numbers, Total Future Job Opportunities, and Total Tourists Numbers), Figure (36) presents the results of DEA analysis using Variable Returns to Scale (VRS-Input). Upon examining the figure, it is evident that all coastal tourism centres (DMUs) were efficient, except for Marsa Alam (DMU21). These findings align closely with the results obtained from conducting DEA using all input variables (as presented in Table 8). The efficiency of the majority of tourism centers to apply the blue economy approach underscores the favorable environmental conditions that characterize the region. These include pristine shorelines, rich coral reefs, and diverse marine biodiversity, which provide a solid basis for sustainable tourism practices. Efficient utilization of these environmental assets is indicative of the potential for implementing blue economy principles such as sustainable resource management, eco-friendly infrastructure development, and responsible tourism practices.

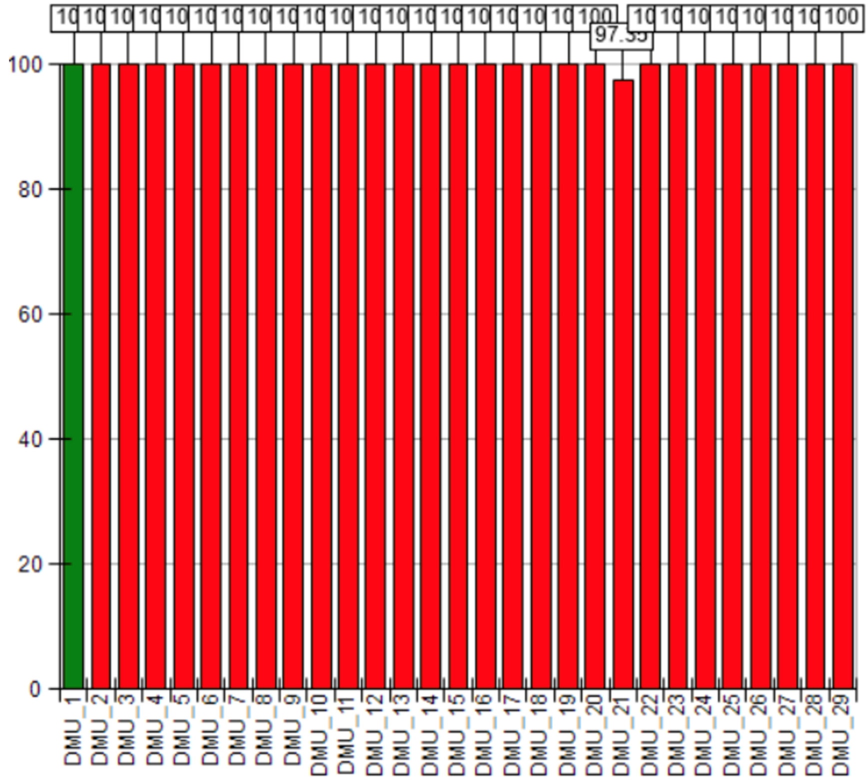


Figure 11. DEA Analysis with Variable Returns to Scale (VRS-Input) Utilizing Environmental Input Variables Group. Source: Researcher, 2023.

Additionally, by comparing each environmental input with one of the targeted outputs a more detailed examination of the diversity in efficiency among coastal tourism centres (DMUs) becomes apparent. This is achieved through the PPS (Production Possibility Set) graph, which illustrates the efficiency of Decision Making Units (DMUs) in terms of specific input and output. The PPS graph typically displays the efficiency frontier, acting as a boundary that distinguishes efficient DMUs from inefficient ones based on the relationship between these selected inputs and outputs. For example, the following Figure (37) presents a PPS graph depicting the situation of the 29 DMUs used in DEA analysis in relation to the environmental input, Coastal Geomorphology Landforms (EN10), and the desired output, Total Employees Numbers (OUT1). Using this individual input variable, we observe that not all DMUs are efficient. This underscores the importance of conducting detailed DEA models at different scales.

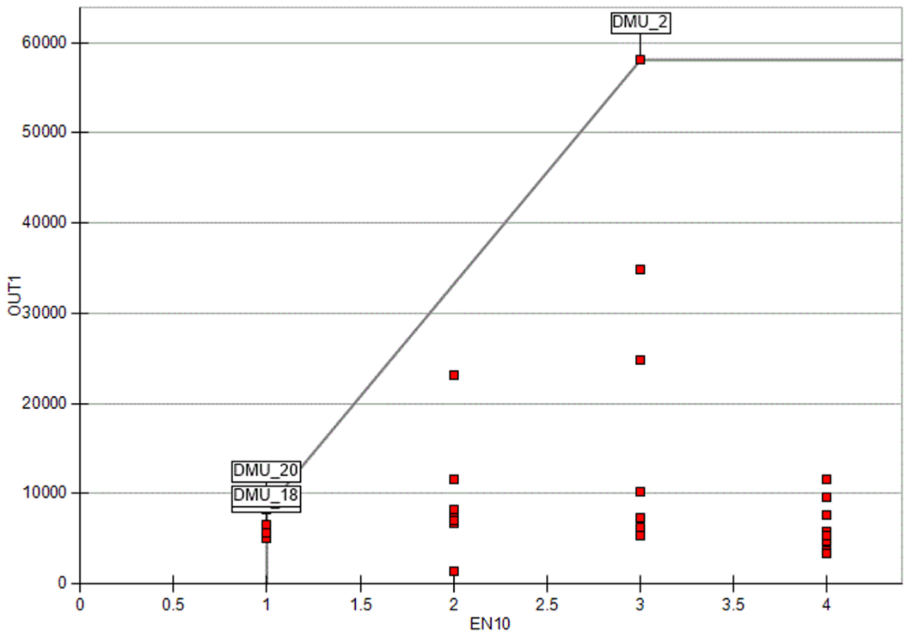


Figure 12. Production Possibility Set (PPS) Graph Depicting the Relationship between Coastal Geomorphology Landforms as Input and Total Employees Numbers as Output. Source: Researcher, 2023.

For a more detailed understanding of the DEA analysis and insights into the relationships between efficient and inefficient coastal tourism centres (DMUs), the study conducted a benchmarking analysis with a focus on identifying benchmark or peer units for inefficient DMUs. This process guides decision-makers on where to concentrate their efforts for improvement. In the following Figure (38), the benchmarking graph is presented, where the inefficient unit, Marsa Alam (DMU21), discovers that Sharm El Loly (DMU24) appears as the relative peer. Marsa Alam should align its environmental variable values with those of Sharm El Loly to transition toward efficiency. For example, Sharm El Loly excels in environmental conservation measures, particularly in preserving the quality of coral reefs within its tourism center. By emulating these practices, Marsa Alam can bolster its environmental sustainability efforts, thereby advancing its readiness to apply the blue economy approach. This could involve implementing robust coral reef protection initiatives, enhancing waste management systems, or promoting eco-friendly tourism practices to mitigate environmental impacts.

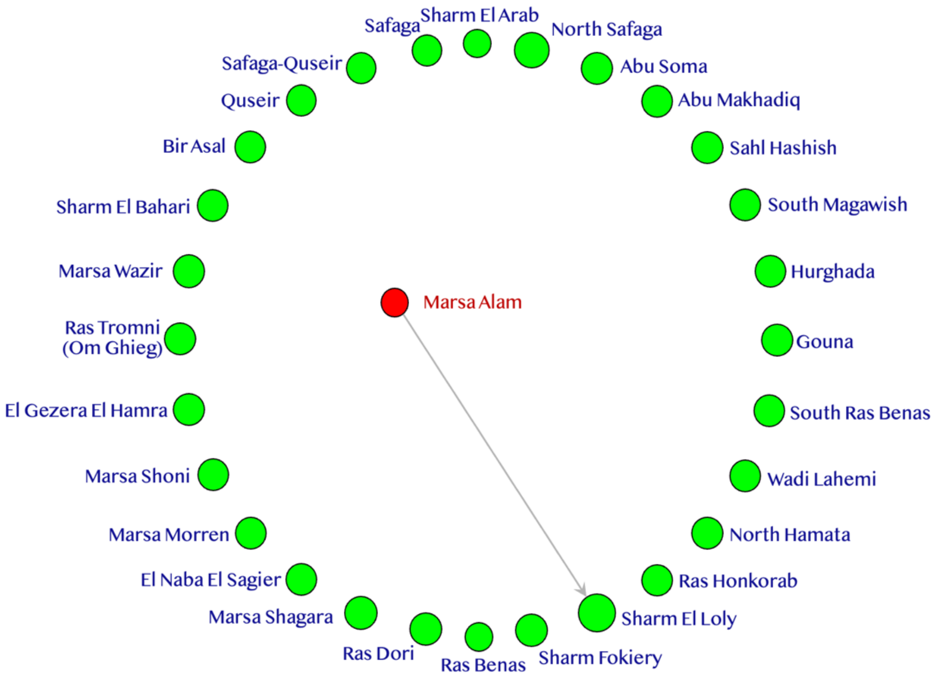


Figure 13. Benchmarking Graph illustrating DEA VRS-Input efficiency based on Environmental Input Group. Source: Researcher, 2023. Note: Red circles denote Inefficient DMUs, while Green circles represent Efficient DMUs.

4-3-2 Economic Inputs Group

The economic input variables group constituted the second phase of running the DEA analysis using Variable Returns to Scale (VRS-Input). This group comprised nine inputs, and the results of the DEA (VRS-Input) model based solely on these inputs are presented in Figure (39). Upon analysis, it is evident that four out of 29 coastal tourism centres (DMUs) were inefficient. These DMUs were Gouna (DMU1), Sahl Hashish (DMU4), Abu Soma (DMU7), and El Naba El Sagier (DMU19) with efficiency scores of 0.79, 0.8, 0.71, and 0.9, respectively. In this model run, changes in the number of efficient and inefficient DMUs, as well as efficiency scores, are observable compared to the comprehensive run of the DEA model that considers all input variables. This emphasizes the importance of conducting a detailed efficiency analysis (DEA) for each input group separately.

Figure 14. DEA Analysis with Variable Returns to Scale (VRS-Input) Utilizing Economic Input Variables Group. Source: Researcher, 2023.

Delving into more details of the economic input variables, the following Production Possibility Set (PPS) figure illustrates efficient and inefficient coastal tourism centres (DMUs) along with the frontier border based on Investments as an economic input and Total Tourists Numbers as an output. This underscores the significance of investments in coastal tourism development to attract more tourists to the Red Sea region. Investments play an important role in creating and enhancing tourism-related infrastructure (e.g., hotels, resorts, and recreational facilities), which ensures a comfortable and enjoyable experience for tourists. Additionally, investment in sustainable practices and environmental conservation ensures that the natural beauty of the Red Sea is preserved, contributing to its allure for tourists seeking pristine coastal environments. Furthermore, investments support marketing campaigns that promote the destination, reaching a wider audience and establishing the region as a competitive and sought-after tourist destination.

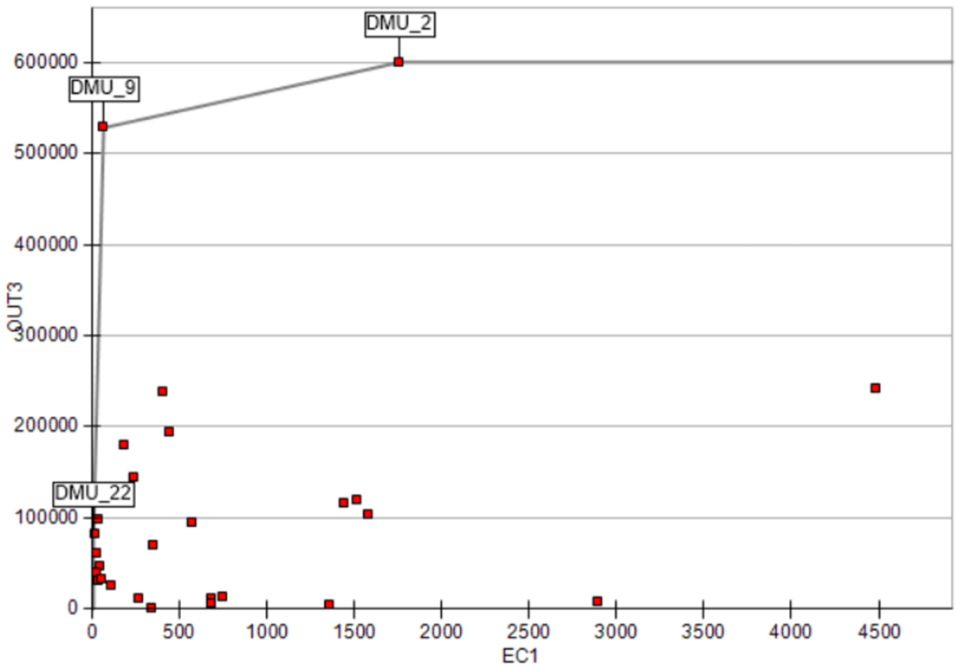


Figure 15. Production Possibility Set (PPS) Graph Depicting the Relationship between Investments as Input and Total Tourists Numbers as Output. Source: Researcher, 2023.

The following benchmarking graph, designed as a guide for policymakers to enhance the efficiency of inefficient coastal tourism centres (DMUs) based on economic features, illustrates the nearest relevant efficient DMUs to the inefficient ones. For example, the inefficient coastal tourism centre, Abu Soma (DMU7), needs to improve its economic variables to align with other efficient coastal tourism centres such as Safaga-Quseir (DMU10), Ras Trombi (DMU15), and Sharm Fokiery (DMU23). Other examples of these efficiency direction paths for inefficient coastal tourism centres (e.g., Gouna, El Naba El Sagier, and Sahl Hashish) are also presented in the following Figure (41). This graph underscores the necessity of adopting specific tailored strategies and policies for each tourism center based on its unique characteristics to enhance efficiency in applying the blue economy approach. It challenges the notion of a one-size-fits-all approach, emphasizing that such a strategy may not yield optimal results. Particularly in developing countries like Egypt, decentralization in managing the tourism sector can significantly contribute to improving the efficiency of tourism centers and regions in applying new sustainable and regenerative approaches such as the blue economy approach.

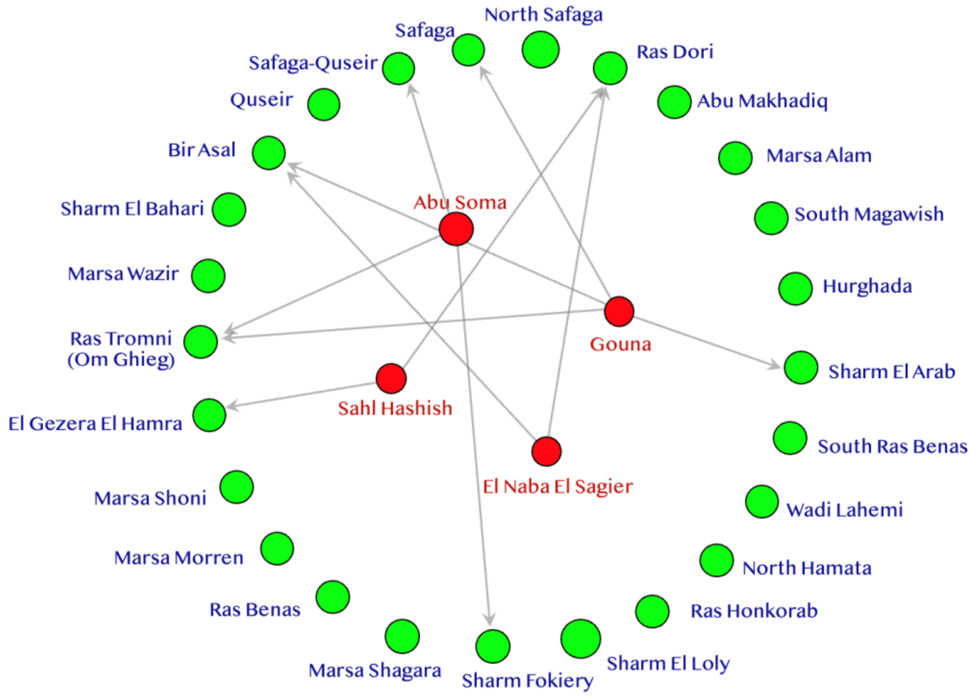


Figure 16. Benchmarking Graph illustrating DEA VRS-Input efficiency based on Economic Input Group. Source: Researcher, 2023. Note: Red circles denote Inefficient DMUs, while Green circles represent Efficient DMUs.

4-3-3 Urban Inputs Group

Regarding using the urban input variables separately in the efficiency analysis DEA (VRS-Input), the following Figure (42) presents the results of efficient and inefficient coastal tourism centres (DMUs). According to this figure, only two DMUs were inefficient, namely Gouna (DMU1) and Abu Soma (DMU7). Again, these results almost match the results gained from the overall DEA model, which used all the inputs, as well as the results obtained from using the environmental group of input variables. All these results confirm the favourable urban characteristics related to the coastal tourism centres in the Red Sea region, which, in turn, will aid in implementing the blue economy approach. These unique urban features can be summarized in the distinctive coastal urban system and network, containing various types of urban and local areas, including urban hubs such as Hurghada. Additionally, this coastal urban system is the habitat of 27% of the Egyptian population. To enhance the efficiency of inefficient coastal tourism centers, Gouna and Abu Soma, and facilitate their transition towards implementing the blue economy, policymakers should prioritize community engagement and stakeholder collaboration in urban planning processes.

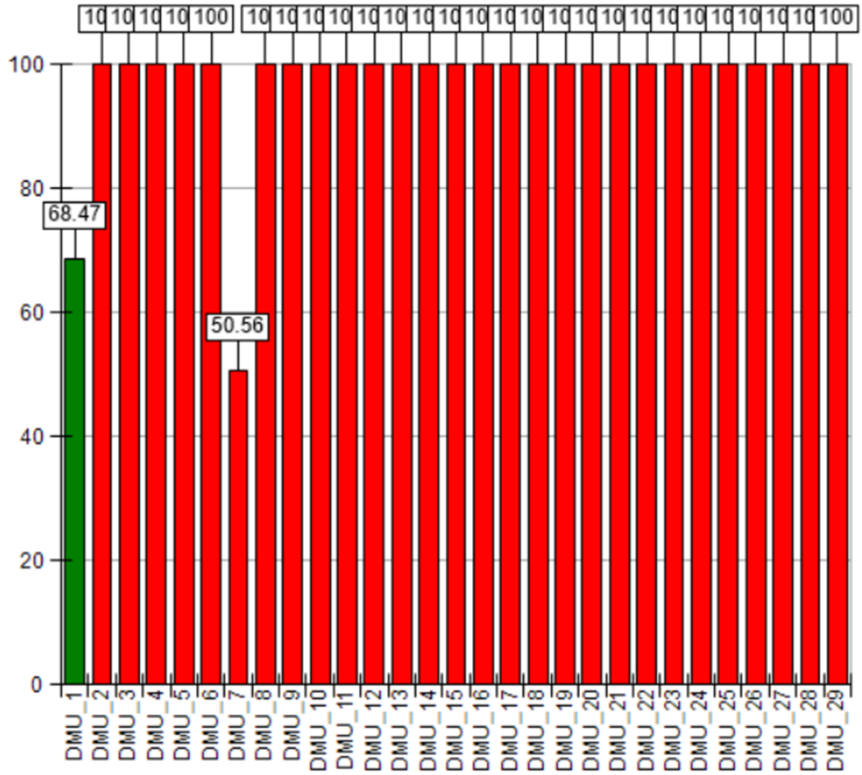


Figure 17. DEA Analysis with Variable Returns to Scale (VRS-Input) Utilizing Urban Input Variables Group. Source: Researcher, 2023.

The following Production Possibility Set (PPS) graph illustrates the relationship between one of the most important urban input variables, Surrounding Land Uses (UR5), and the Total Tourists Numbers (OUT3) as output. We can observe that around 45% of the coastal tourism centers (DMUs) are located on the frontier border, indicating their efficiency. This reflects the unique urban land uses surrounding the coastal tourism centers, such as land and sea reserves, agricultural and grazing areas, and urban settlements. These land uses provide a unique hinterland for the coastal tourism centers, facilitating the provision of services for tourists as well as the local communities in these coastal areas, thus contributing to the achievement of sustainable coastal tourism development and the principles of the blue economy approach.

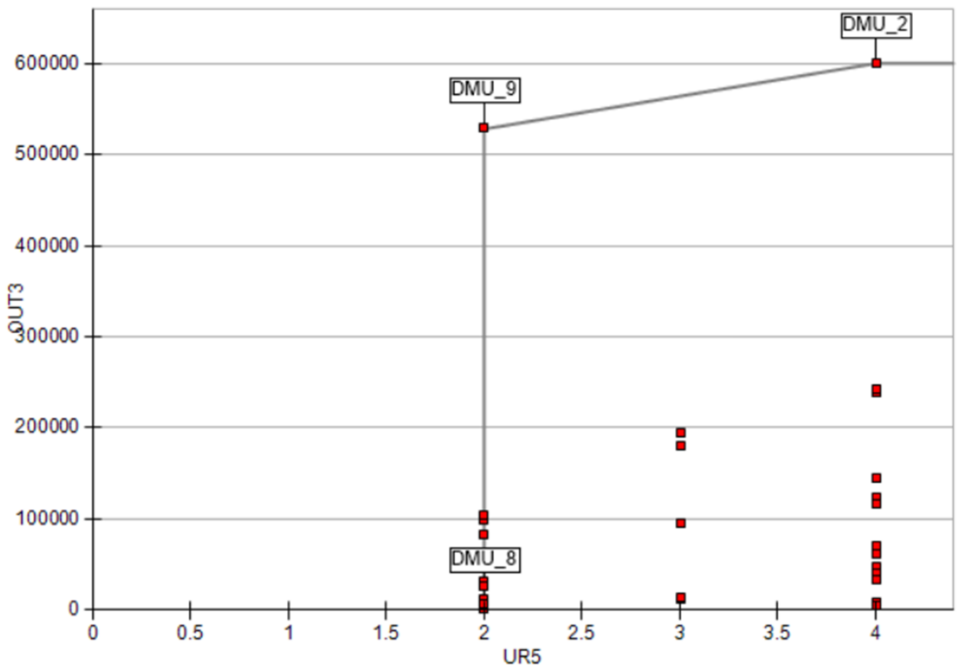


Figure 18. Production Possibility Set (PPS) Graph Depicting the Relationship between Surrounding Land Uses as Input and Total Tourists Numbers as Output. Source: Researcher, 2023.

The following benchmarking graph illustrates the efficiency paths for the two inefficient coastal tourism centers, Gouna (DMU1) and Abu Soma (DMU7). The significance of such graphs lies in their ability to visually represent the trajectory these centres could follow to improve their efficiency. For example, Gouna coastal tourism centre can enhance its efficiency based on urban features by aligning its values with other efficient DMUs, such as Sahl Hashish (DMU4), South Ras Benas (DMU29), Sharm El Loly (DMU24), and Quseir (DMU11). This benchmarking graph is not merely a diagnostic tool but an actionable instrument that empowers coastal tourism centres to undertake informed and effective measures for performance enhancement. By analyzing these efficiency paths, policymakers can identify specific areas where interventions are required to boost the performance of inefficient centers. For example, Gouna could focus on upgrading its urban infrastructure, enhancing transportation networks, and optimizing land use planning to create a more conducive environment for tourism development. This could involve investing in sustainable urban design, promoting mixed-use development, and preserving natural habitats to enhance the overall attractiveness of the destination.

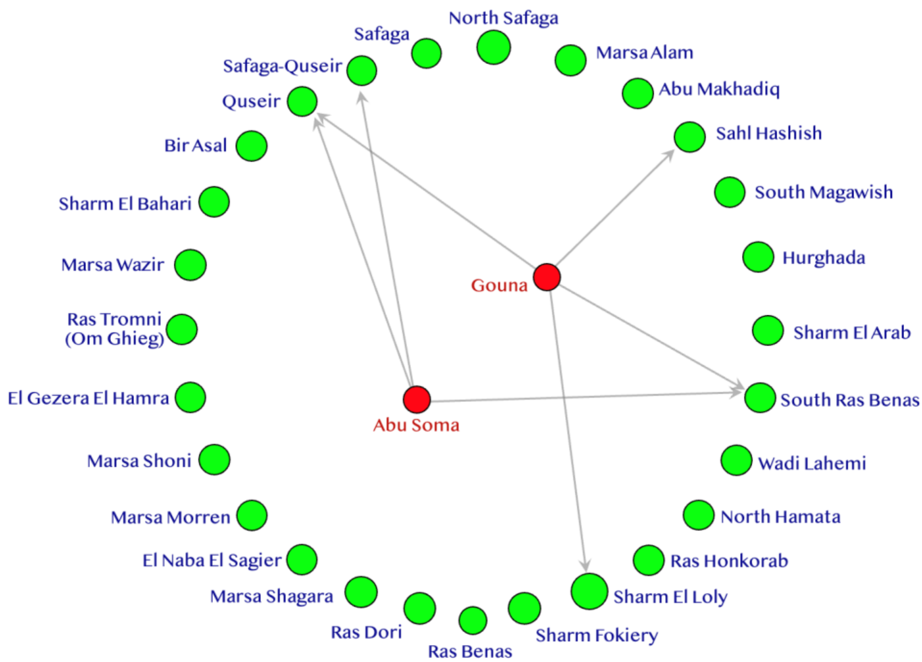


Figure 19. Benchmarking Graph illustrating DEA VRS-Input efficiency based on Urban Input Group. Source: Researcher, 2023. Note: Red circles denote Inefficient DMUs, while Green circles represent Efficient DMUs.

4-3-4 Infrastructure Inputs Group

The outcomes of the Data Envelopment Analysis (DEA) VRS-Input model, focusing exclusively on infrastructure input variables, are summarized in the following Figure (45). Despite the study's limited exploration of the infrastructure sector, with a concentration on only two input variables—Accessibility (IN1) and Proximity to Airports/Ports (IN2)—the results starkly differ from those obtained through the comprehensive model that considered all input variables. Notably, this figure reveals inefficiencies in 22 out of the 29 coastal tourism centres (DMUs), highlighting the imperative to address infrastructure concerns in the Red Sea region's coastal tourism development. Infrastructure serves as the backbone of coastal tourism development, influencing accessibility and connectivity. This finding emphasizes the need for strategic investments and meticulous planning in the infrastructure domain to enhance the overall efficiency of coastal tourism centres. To address these inefficiencies, policymakers should upgrading transportation networks, expanding airport and port facilities, and improving road and rail connectivity to enhance accessibility to coastal tourism centers.

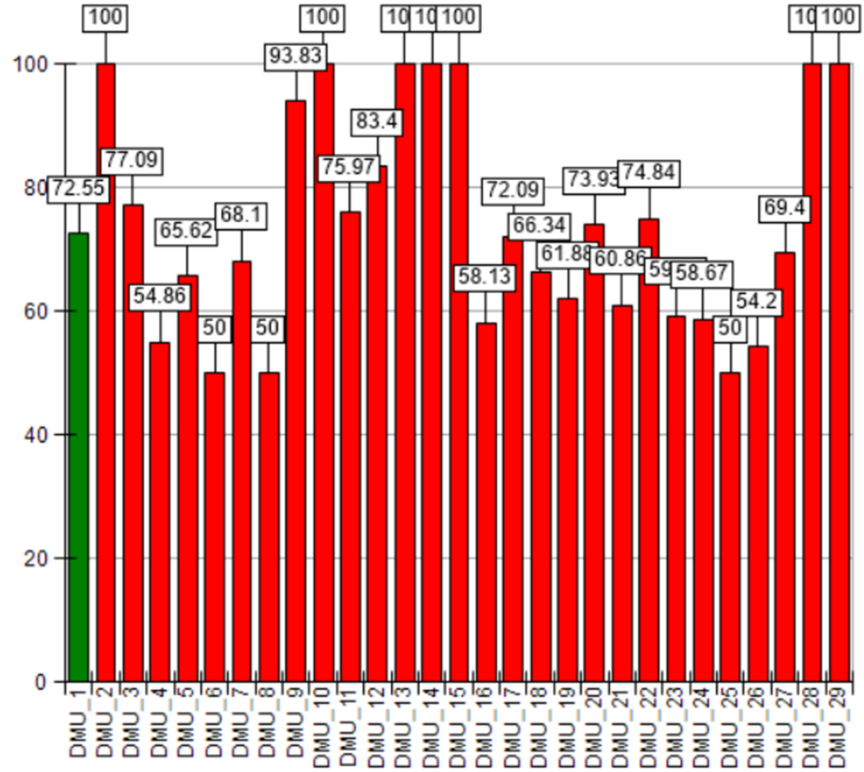


Figure 20. DEA Analysis with Variable Returns to Scale (VRS-Input) Utilizing Infrastructure Input Variables Group. Source: Researcher, 2023.

The impact of infrastructure inputs on the efficiency of Decision Making Units (DMUs) and the attainment of specific outputs is illustrated in the following figure. This Production Possibility Set (PPS) graph showcases the efficient DMUs concerning the role of one infrastructure input, Accessibility (IN1), and a desired output, Total Tourist Numbers (OUT3). As depicted, only two DMUs, namely Hurghada (DMU2) and Ras Benas (DMU28), were efficient. This reflected the poor accessibility of the remaining 27 DMUs as well as highlighted the importance of accessibility as input in controlling the number of tourists as output. Accessibility, including factors such as transportation infrastructure and connectivity, plays an important role in determining how easily tourists can reach and explore a destination. Challenges in accessibility, such as insufficient transportation options or poorly developed infrastructure, can discourage potential tourists by creating barriers to reaching or navigating within the destination, resulting in a decline in tourist numbers. To address these challenges, policymakers should prioritize investments in infrastructure projects aimed at enhancing accessibility.

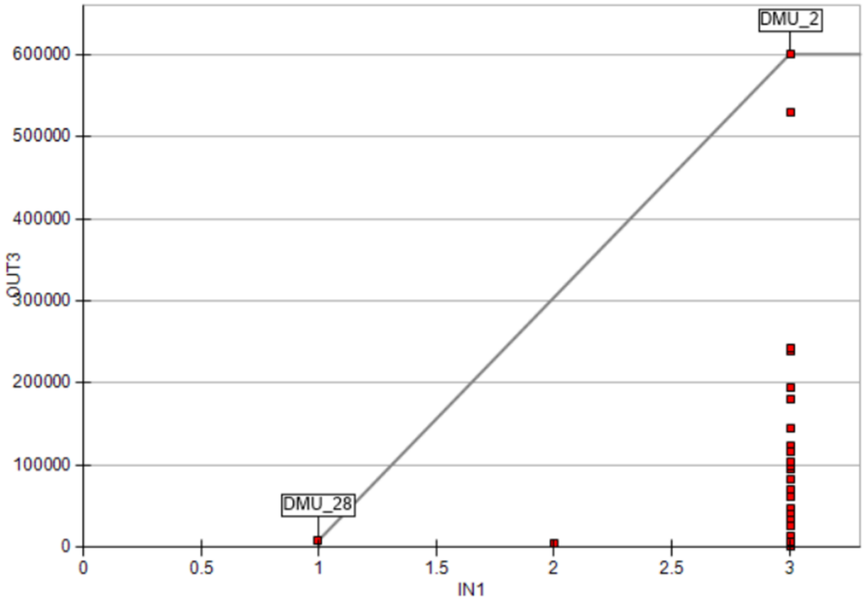


Figure 21. Production Possibility Set (PPS) Graph Depicting the Relationship between Accessibility as Input and Total Tourists Numbers as Output. Source: Researcher, 2023.

The following benchmarking Figure (47) conclusively underscores the primary aim of conducting a meticulous efficiency analysis by examining each group of inputs independently. While the integrated model, considering all inputs, yields results indicating that all DMUs are efficient, a closer examination of individual input groups reveals variations in efficiency. This nuanced understanding suggests that certain inputs require more development attention than others, which is crucial for policymakers to prioritize resource allocation and strategic planning efforts effectively. For example, inputs related to infrastructure, such as Accessibility and Proximity to Airports/Ports, emerge as key areas requiring targeted development interventions to enhance the efficiency of coastal tourism centers. To address these findings, policymakers should consider implementing targeted strategies tailored to the specific needs of each input group. For instance, investments in infrastructure development projects, such as improving transportation networks and upgrading airport facilities, can significantly enhance accessibility and connectivity, thereby attracting more tourists and improving the overall efficiency of coastal tourism centers. Moreover, the delineation of distinct trajectories for each unit in the benchmarking graph provides valuable guidance for policymakers, enabling them to formulate informed policies and strategies to enhance efficiency and facilitate the application of the blue economy approach in the Red Sea region.

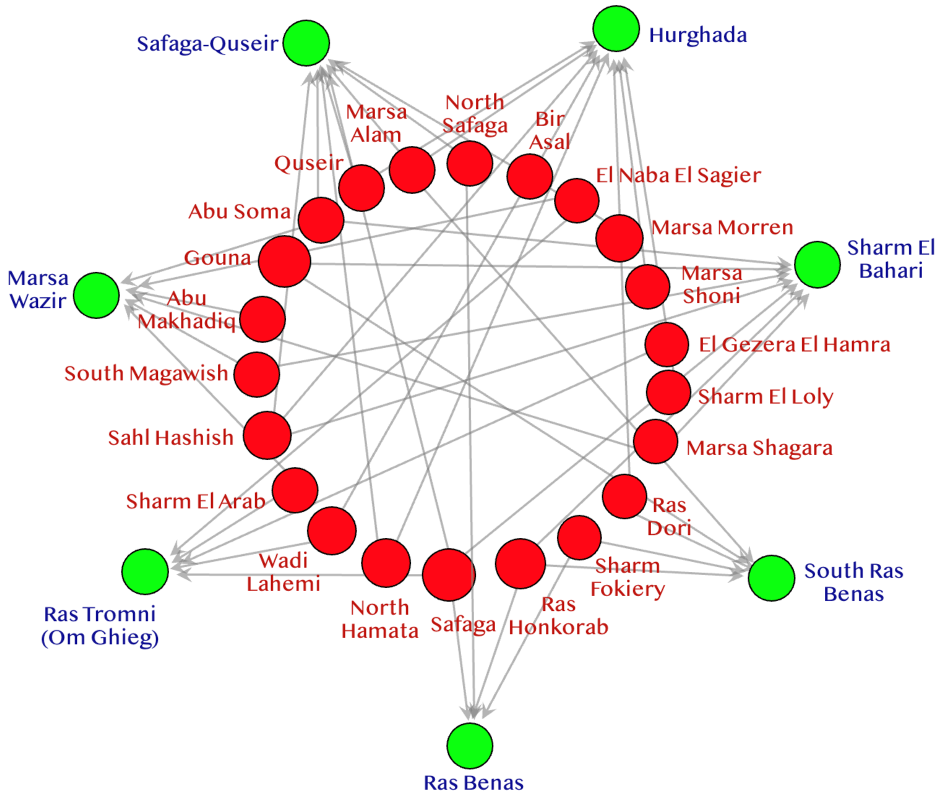


Figure 22. Benchmarking Graph illustrating DEA VRS-Input efficiency based on Infrastructure Input Group. Source: Researcher, 2023. Note: Red circles denote Inefficient DMUs, while Green circles represent Efficient DMUs.

4-3-5 Governance Inputs Group

The efficiency results illustrated in the subsequent Figure (48), pertaining to the application of DEA VRS-Input analysis using only governance input variables, exhibit a degree of equilibrium concerning efficiency values and the count of efficient and inefficient DMUs. However, these model results are far from perfect, as they do not portray all DMUs as efficient and, conversely, indicate that most DMUs are inefficient. The figure reveals that out of the 29 investigated coastal tourism centres, seven of them were inefficient: South Magawish (DMU3), Sahl Hashish (DMU4), Sharm El Arab (DMU6), Abu Soma (DMU7), Marsa Alam (DMU21), and Ras Honkorab (DMU25) with efficiency scores of 0.55, 0.42, 0.5, 0.33, 0.45, 0.33, and 0.5, respectively.

These inefficient DMUs lack the governance structures necessary for implementing the blue economy approach effectively.

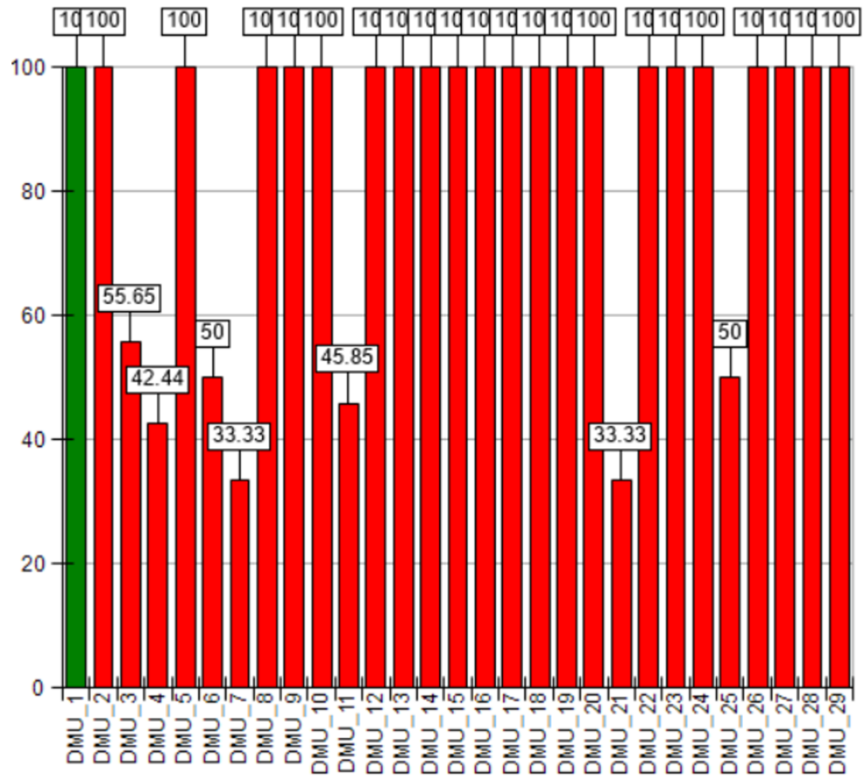


Figure 23. DEA Analysis with Variable Returns to Scale (VRS-Input) Utilizing Governance Input Variables Group. Source: Researcher, 2023.

The subsequent figure illustrates the Production Possibility Set (PPS) graph, showcasing the relationship between the Number of Tourism Companies (GO1) as an input and the Total Tourists Numbers (OUT3) as an output. According to this figure, six coastal tourism centres stand out as efficient, positioned on the frontier: Gouna (DMU1), Hurghada (DMU2), North Safaga (DMU8), Safaga (DMU9), Quseir (DMU11), and Marsa Alam (DMU21). In the context the efficient of these previously mentioned DMUs is effected by the multifaceted and dynamic relationship between the Number of Tourism Companies (GO1) as an input and the Total Tourists Numbers (OUT3) as an output in coastal tourism centers. For example, an increase in the number of tourism companies operating within a coastal tourism center can directly influence the total number of tourists visiting the area.

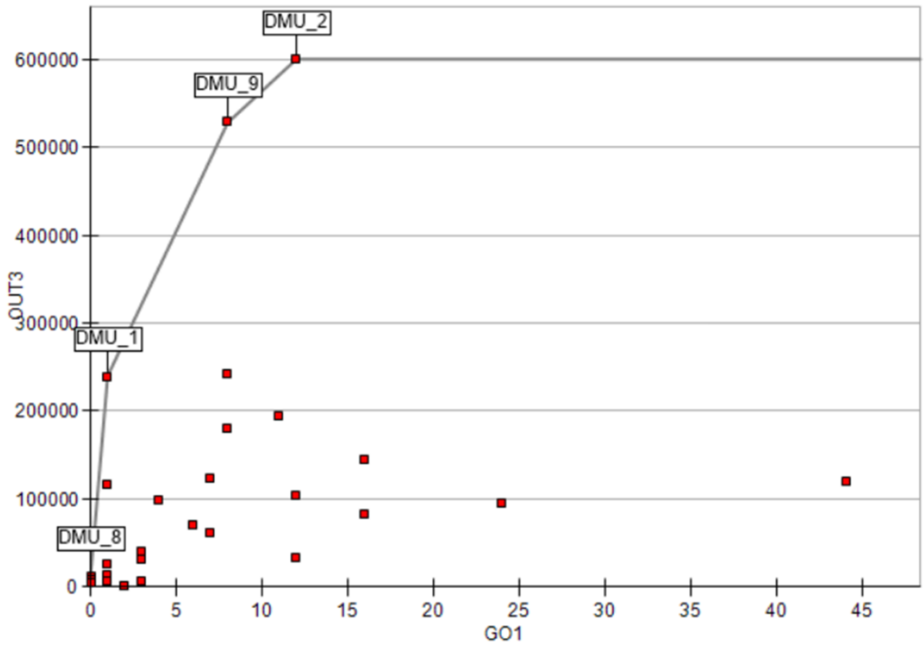


Figure 24. Production Possibility Set (PPS) Graph Depicting the Relationship between Number of Tourism Companies as Input and Total Tourists Numbers as Output. Source: Researcher, 2023.

As previously highlighted, the DEA analysis focused solely on the governance input variables revealed inefficiencies in seven coastal tourism centres (DMUs), evident in their scores falling below 1, indicating a deficiency in their readiness to apply the blue economy approach. The subsequent benchmarking graph plays an important role in pinpointing these inefficient DMUs and provides a directional guide for each of them to transition from inefficiency to readiness for applying the blue economy approach. Taking Sahl Hashish (DMU4) as an example, the graph identifies four efficient peers whose governance variable values can serve as a model for the inefficient DMU to emulate. These four efficient peers are Sharm Fokiery (DMU23), Ras Dori (DMU22), El Gezera El Hamra (DMU16), and North Safaga (DMU8). By studying the governance practices of these efficient peers, Sahl Hashish can gain valuable insights into improving its governance structures and processes. This could involve measures such as enhancing transparency, stakeholder engagement, regulatory frameworks, and capacity-building initiatives aimed at fostering sustainable coastal tourism development aligned with the principles of the blue economy approach.

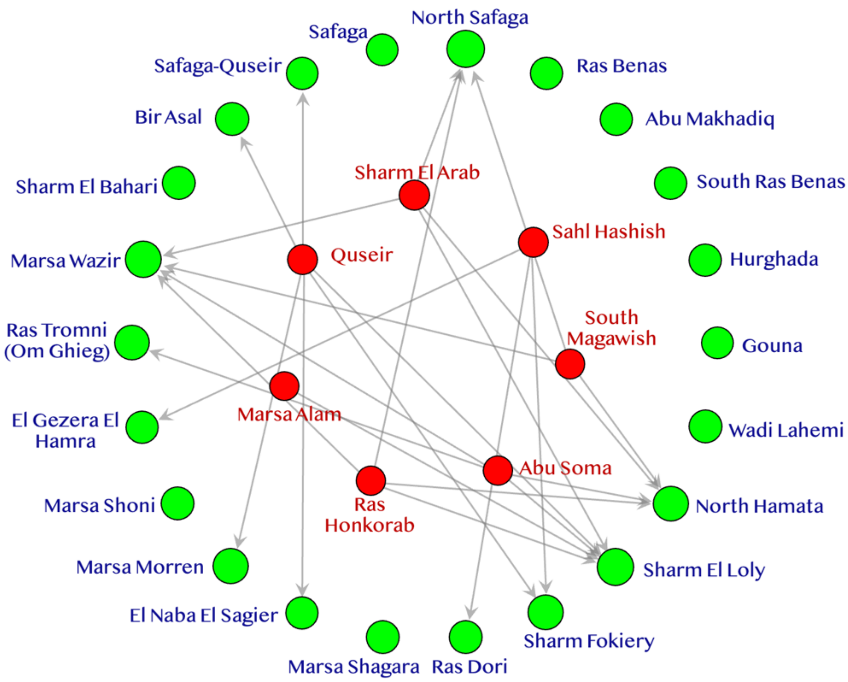


Figure 25. Benchmarking Graph illustrating DEA VRS-Input efficiency based on Governance Input Group. Source: Researcher, 2023. Note: Red circles denote Inefficient DMUs, while Green circles represent Efficient DMUs.

In conclusion, the analysis of efficient and inefficient Decision Making Units (DMUs) based on the DEA VRS-Input method, conducted for each group of inputs separately, underscores the critical need for substantial improvements in the infrastructure variables group to facilitate the readiness of coastal tourism centres for the application of the blue economy approach. The following figure presented the number of the efficient and inefficient tourism centers in each inputs group.

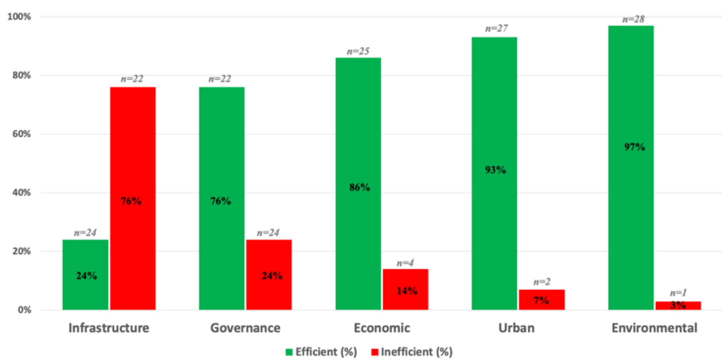


Figure 26. Efficiency Analysis of Tourism Centers (DMUs) Across Input Groups. Source: Researcher, 2023.

CHAPTER 5: RESEARCH CONCLUSION

5-1 Conclusion

5-1-1 Revisiting Research Objectives

As mentioned at the beginning of this study, the primary objective was to identify the readiness of coastal tourism centres to apply the blue economy approach, along with four other secondary objectives. Regarding the main objective of this research, the study discussed the pathways for applying the blue economy in coastal tourism development by assessing the readiness of coastal tourism centers in the southern Red Sea region based on various features relevant to the coastal tourism sector in this region. The main findings of this study illuminate which coastal tourism centers exhibit greater efficiency in adopting the blue economy approach, effectively fulfilling the primary objective of this research.

Concerning the secondary objectives of this study, the first one is centered on presenting the road map for applying the blue economy approach in real-life practices. This study is conceived as a significant step toward fulfilling this objective. Given that the concept of the blue economy first emerged in 2012, which is still relatively new in scientific terms, comprehending the entire process of applying the blue economy in coastal tourism development, from initial ideas to practical implementation with projects, takes time and involves entities and organizations rather than individuals. Therefore, this study focuses on guiding policymakers on how to begin by assessing the efficiency of spatial units to implement the blue economy approach. This transition from theoretical foundations to actionable application represents a crucial real-world practice in advancing the adoption of the blue economy approach.

5-1-2 Recapitulating Findings

This study presents various findings pertaining to the relationship between the blue economy approach and coastal tourism, which can be categorized and summarized into four key findings:

- <u>Local and Regional Application:</u> One fundamental finding of this research is the viability of applying the blue economy approach at the local and regional levels in a practical manner, in contrast to international and theoretical practices. Relying on spatial coastal tourism areas in a developing country like Egypt has yielded robust and precise outcomes, effectively conveying the importance of the blue economy approach at lower levels of development, particularly at the local and regional levels.

- <u>Effectiveness of Spatial Development Boundaries:</u> The second main finding indicates that relying on spatial development boundaries (e.g., tourism centers) rather than administrative ones (e.g., governorates) proves more effective in implementing the blue economy approach on the ground. Tourism centers, such as those studied in the southern Red Sea region, provide a more realistic depiction of tourism resources and their distributions, addressing a core issue in achieving equitable blue economy outcomes that benefit local communities.
- <u>Application in Untapped vs. Occupied Coastal Tourism Areas:</u> Responding to the research question regarding the effectiveness of applying the blue economy approach in untapped/raw coastal tourism areas versus occupied ones, the study findings reveal no preference for either. Whether the coastal tourism areas were untapped or occupied with activities, efficiency scores were fluctuated. For example, in the DEA (VRS-Input) analysis, all coastal tourism centers (DMUs) demonstrated efficiency with a score of 1, regardless of whether these centers were occupied with tourism activities or not. While in the Free Disposal Hull (FDH) analysis, some coastal tourism centers (DMUs) were inefficient, such as Ras Benas ($\theta = 0.63$) and South Ras Benas ($\theta = 0.72$), considered untapped coastal tourism centers. At the same time, coastal tourism centers like Hurghada and Gouna ($\theta =1$) were efficient, categorized as occupied tourism centers. Another example is evident in the analysis of the Scale Efficiency model (SE), where occupied coastal tourism centers such as Abu Soma were inefficient ($\theta = 0.83$), while other untapped ones like Ras Benas were efficient ($\theta = 1$).
- <u>Sectors Influencing Efficiency and Readiness:</u> The fourth core finding pertains to the sectors that significantly impact the efficiency and readiness of coastal tourism centers in applying the blue economy approach. The infrastructure sector in the southern Red Sea region's coastal tourism centers emerged as the least prepared, with approximately 76% of DMUs identified as inefficient. The governance

sector followed, with 24% of the total 29 DMUs found to be inefficient. The economic sector exhibited a 14% inefficiency rate among the total 29 DMUs. Finally, the urban environmental sectors ranked fourth and fifth in readiness for applying the blue economy approach, with 7% and 3% of DMUs identified as inefficient, respectively.

5-1-3 Evaluating Research Hypotheses

In this section, we revisit the hypotheses proposed at the outset of the study and assess their validity based on the findings obtained.

- **H1:** Implementing the blue economy approach in local coastal tourism will yield valuable feedback beneficial for decision-makers.

  This hypothesis is confirmed as the study has identified efficient tourism centers suitable for applying the blue economy approach. By doing so, valuable feedback is provided to decision-makers, aiding in informed policymaking, sustainable development initiatives, and applaying the blue economy approach.

- **H2:** The utilization of spatial units (e.g., tourism centers) instead of administrative units (e.g., governorates) enhances the effectiveness and clarity of applying the blue economy approach.

  This hypothesis is confirmed by the study findings. Utilizing tourism centers as spatial units for analysis has proven to be effective in providing clear insights into the applicability of the blue economy approach. This approach offers a more practical and focused perspective for policymakers, facilitating targeted interventions and strategic planning efforts for applying the blue economy approach.

- **H3:** The application of the blue economy approach is more efficient in untapped/raw coastal tourism centers rather than occupied ones in the Red Sea region of Egypt.

  This hypothesis is not supported by the study findings. Contrary to the hypothesis, the study results indicate that the status of tourism centers (untapped/raw or occupied) does not significantly impact their efficiency in applying the blue economy approach. Efficient and inefficient centers were found across both categories, suggesting that other factors play a more decisive role in determining readiness for the blue economy.

- **H4:** All economic sectors exert the same significant impact on the implementation of blue economy principles in the Red Sea region of Egypt.

  This hypothesis is <u>not supported</u> by the study findings. The analysis reveals variations in the impact of different economic sectors on the efficiency of tourism centers in applying the blue economy approach. While some sectors, such as infrastructure and governance, contribute significantly to inefficiencies, others, like environmental and urban sectors, have a lesser impact. This underscores the importance of targeted interventions tailored to specific economic sectors to enhance efficiency in implementing blue economy principles.

CHAPTER 6: NEW AND NOVEL SCIENTIFIC RESULTS

This chapter summarizes the new and novel scientific results derived from this study endeavor, uncovering unexplored dimensions in the implementation of the blue economy approach into the coastal tourism centres in the Southern Red Sea region, Egypt.

- Integration at Local and Regional Levels: This study presents a novel perspective by showcasing the practical implementation of the blue economy concept at both local and regional scales. In contrast to prior methodologies that mostly emphasized international and theoretical contexts, the present study sheds light on a practical and effective adoption of the blue economy approach principles inside developing countries, as demonstrated by the case study of Egypt. This observation presents novel opportunities for the formulation of sustainable development strategies that are tailored to the distinct circumstances of local and regional coastal tourism.
- Spatial Development Boundaries as Focal Points: One notable feature of this study is the focus on spatial development boundaries (coastal tourism centres) over traditional administrative demarcations. The importance of these spatial development units has frequently been disregarded in previous academic literature, with a preference for administrative divisions such as governorates. By highlighting the efficiency of these tourism centers in reflecting the blue economy approach principles, this study pioneers a more refined and precise concept in understanding the complexities associated with tourism resources and their distribution. This shift in focus signifies a new methodological contribution to the field of coastal tourist research.
- Dynamic Efficiency Regardless of Coastal Status: The outcomes that the effectiveness of implementing the blue economy approach remains dynamic, regardless of whether the coastal areas are untapped/raw or occupied with activities challenges pre-existing assumptions. The use of several analytical methods, such as Data Envelopment Analysis (VRS-Input), Free Disposal Hull (FDH), and Scale Efficiency models (SE), enables a more intricate comprehension of efficiency dynamics. This

motivate calls for a reevaluation of conventional viewpoints and establishes the groundwork for a more flexible and situation-dependent implementation of the blue economy approach.

- Sectoral Influence on Blue Economy Implementation: In the application of the blue economy approach to coastal tourism centers, a multitude of variables and features from various economic sectors, including environmental, economic, urban, infrastructure, and governance, come into play. The novel scientific findings of this research reveal that these sectors collectively influence the efficiency or inefficiency of coastal tourism centers in adopting the blue economy approach. The study uncovered that each of these sectors does not have an equal impact on the effectiveness of blue economy implementation. Instead, certain sectors exert a more significant influence than others. These findings provide valuable insights for policymakers, guiding them on which sectors to prioritize and where to direct their efforts in order to successfully implement the blue economy approach in coastal tourism centers. By understanding the varying impacts of different economic sectors, policymakers can tailor strategies and interventions to address specific sectoral challenges and maximize the effectiveness of blue economy initiativ

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