

TOWARDS A BLUE ECONOMY IN EGYPT: ECONOMIC ASSESSMENT OF ENVIRONMENTAL DEGRADATION OF MARINE AND COASTAL RESOURCES

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ABSTRACT

Egypt has coastlines on both the Mediterranean Sea and the Red Sea which have been providing the country with a wealth of marine resources, livelihoods, and food and minerals. However, due to several factors related to pollution, unsustainable practices and use of marine resources, etc. Egypt's marine and coastal ecosystems have been subjected to environmental degradation in recent years. Moreover, the potential climate change impacts will lead to further environmental damages and deterioration of Egypt's marine and coastal resources. This, in turn, will represent a challenge for the country to ensure the sustainable use of its resources and ecosystems and in achieving the Sustainable Development Goals (SDGs) especially as pertain to the sustainable use of marine and coastal resources (i.e., SDG 14). This paper sets out to discuss Egypt's marine and coastal resources within the context of the country's aspirations to implement a blue economy approach as means of achieving the sustainable use of its marine and coastal resources to support livelihoods as well as continue to provide food and resources in a sustainable manner. The discussion on the blue economy will be presented by first providing a qualitative assessment of the marine and coastal ecosystem. Then, a valuation assessment will attempt to provide estimates of the costs of damages and environmental degradation for marine and coastal ecosystems in Egypt in 2020.

Keywords: Blue economy, marine and coastal resources and ecosystems, damages to coral reefs, sustainable fisheries, ballast water, damage costs of environmental impacts, climate change impacts on marine ecosystems, SDG 14.

INTRODUCTION

Egypt has a coastline of around 3,000 Kms; 1,150 Kms on the Mediterranean Sea and around 1,850 Kms on the Red Sea, including those

in the Gulf of Suez and the Gulf of Aqaba. While such coastal areas have provided Egypt with a very rich source of marine and natural resources, they have been increasingly subjected to much stress. This is primarily due to a multitude of factors including untreated wastewater and industrial effluents, fish farms, release of unchecked ballast water and risk of oil spills.

EGYPT AND THE BLUE ECONOMY

Since 2016, Egypt has recognized the concept of the blue economy as one of the main drivers for achieving sustainable development (EEAA, 2016). The blue economy can be defined as the sustainable use of ocean resources (including seas and coastal areas) for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem (World Bank, 2017). With regard to the Sustainable Development Goals (SDGs), the blue economy supports the implementation of SDG 14 “conserve and sustainably use the oceans, seas and marine resources for sustainable development.” However, one of the main challenges in adopting the concept and principles of the blue economy is to understand and better manage the different aspects of oceanic and coastal sustainability including sustainable fisheries, ecosystem health, pollution, etc. That is, the potential of the oceans, seas and coastal areas to meet sustainable development needs is enormous only if they can be maintained in or brought back to a healthy, and productive state.

A fundamental premise of the blue economy concept is the decoupling of socioeconomic development from environmental degradation. Subsequently, an assessment and incorporation of the real value of the natural/blue capital (including the cost of environmental degradation) into all aspects of economic activity (e.g., planning, infrastructure development, trade, travel, etc.) needs to be carried out as a necessary pre-requisite for implementing the blue economy concept.

Within the above context, this paper sets out to estimate the costs of damages in the marine sector and coastal areas of Egypt. A qualitative assessment of the coastal and marine ecosystems in Egypt will be presented. A valuation of the environmental degradation in the marine ecosystems will follow the assessment. The paper will provide a discussion of the results, conclusions and recommendations in line with Egypt's aspirations and efforts to pursue a blue economy path as part of its overall effort to achieve sustainable development.

QUALITATIVE ASSESSMENT

The degradation and loss of habitat of coastal and marine ecosystems in Egypt can be attributed to the following main sources as cited in several references (Burke at al., 2011, Cesar, 2003, EEAA, 2014, El-Askary et al., 2014 and PERSGA, 2002):

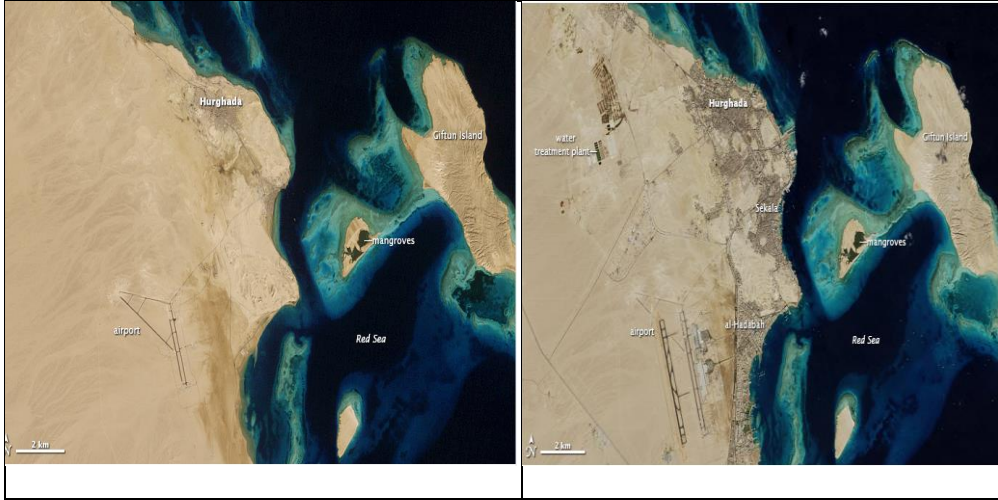
- Poor urban planning, rapid development and artificialization of the northern coast and the center of the Suez Canal that is also leading to coastal erosion. Coral reefs in Egypt are under threat from high siltation and sedimentation rates due to poorly planned and implemented construction of buildings, especially hotels and resorts facilities associated with the tourism industry. The construction of hotels, touristic facilities and other infrastructure has often led to the destruction of fringing reefs, which grow seaward directly from the coastlines, caused by the dredging or dumping of large amounts of sediment. While this appears to be an issue related to construction in the past, the impacts of such activities continue to the present day, nonetheless. For instance, Hurghada's coral reefs are damaged, displaced, polluted, and stepped on. In fact, as Figure 1 indicates, Corals near Hurghada have declined by as much as 50% over three decades.

- Oil production in general as well as both reported and unreported oil spills are making the Red Sea coral reefs more fragile and vulnerable to destruction.
- Unsustainable practices (e.g., deep-water overfishing) with regard to the use of marine resources. There are reports of some unsustainable fishing practices along the Egyptian Red Sea coastline, including the use of closed mesh nets, catching fingerlings and even blast fishing. Shark finning and sea cucumber collection have appeared as major additional threats to Egyptian reefs. Removal of sea cucumbers could lead to increases in algae and bacteria in coral reef ecosystems with possibly disastrous consequences.
- Deterioration and loss of spawning sites and the proliferation of algae, especially in the Mediterranean and to lesser extent in the Red Sea despite the existing protected areas along the coasts and islands.
- Mining of coastal sand mainly used for construction activities in coastal areas.
- Thermal stress: power plants usually release large quantities of hot water, from cooling towers, into the marine environment and the planned construction of the nuclear power plant on the Mediterranean coast may make matter worse as the Mediterranean Sea temperature is gradually increasing unless there are mitigation measures in place to curb the release of hot water into the sea
- Unsustainable tourism (activities and practices) that could also be a threat to coral reef. A great deal of offshore coral reefs has suffered considerable damage from careless snorkelers and scuba divers in the Red Sea. Visitor numbers in diving areas have ranged from 10,000 to 60,000 divers annually. PERSGA (2002) suggests a number of 10,000 dives per year as carrying capacity. This is higher than the number of 4-6,000 that Dixon et al. (1993) established for Bonaire in the Caribbean but lower than the 10-15,000 dives per site established under the Coral

Monitoring Program in Hurghada, which is used by EEAA as a guideline for ensuring coral health and sustainability.

- Rate of discharge of sewage, industrial effluents, and agricultural runoff in the Mediterranean and coastal lakes. Sewage and phosphate ore washing are the main sources of nutrient enrichment in the Egyptian Red Sea. Sewage, high in nitrogen and phosphorous affect the marine environment by driving algal blooms that subsequently die off, reducing the amount of oxygen in the water causing eutrophication and threatening marine organisms.
- Deterioration of seagrass and corals due to maritime traffic (including the use of anchor, etc.). The Suez Canal brings with it a large amount of international trade to be transported through the Red Sea. As a consequence, important coral reef ecosystems are under threat from ship groundings. Also, cruise ships and dive boats in reef areas have caused major damage.
- As regards climate change impacts, corals are particularly sensitive to elevated sea surface temperatures, which can lead to coral bleaching. The Red Sea appears to have suffered less from coral bleaching than other major reef regions. However, thermal stress and ocean acidification in the Middle East region are projected to increase threat levels to nearly 90% by 2030, while by 2050 these climate change impacts, combined with current local impacts, will push all reefs to threatened status, with 65% at high, very high, or critical risk.

Figure 1: Hurghada Artificialization - Satellite Image in 1985 and 2014
1985 **2014**



Source: El-Askary et al., (2014).

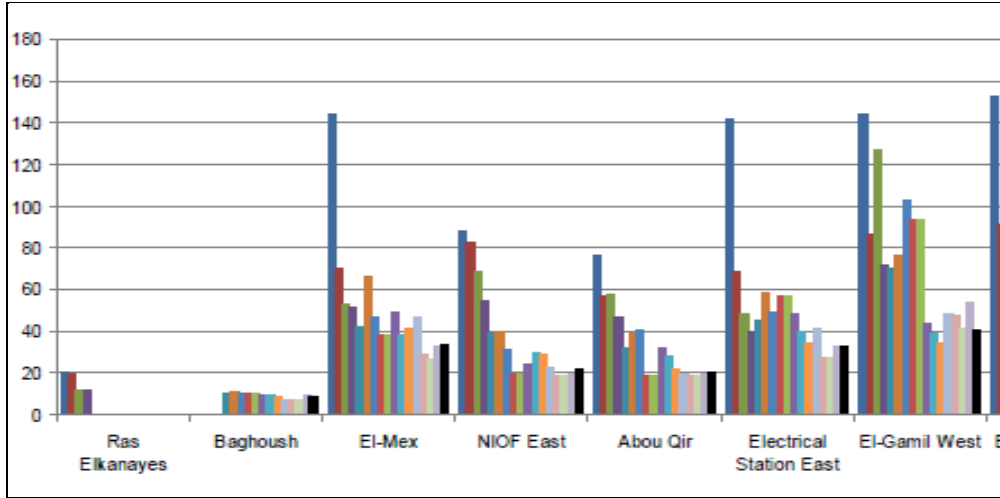
In addition to the main factors mentioned above that led to the degradation and loss of habitat of coastal and marine ecosystems in Egypt, social pressure on the government to meet the population needs represent an additional challenge. Examples of such pressure include unemployment, the introduction of new patterns of development, and competition for the utilization of available resources, and the lack of public awareness regarding resource use and depletion.

Marine Water Quality

Monitoring activities carried out by the Egyptian Environmental Affairs Agency (EEAA) along the Mediterranean (15 stations) and Red Sea (8 stations) coasts indicate (EEAA, 2016) that the results are above or just within the allowed limits in terms of physical, biological and chemical measurements. Figure 2 indicates that while a significant progress was achieved in reducing marine pollution, the composite index remains high in certain areas of the Mediterranean.

Figure 2: Mediterranean Marine Pollution Composite Index, 1998, 2014





Source: EEAA (2016).

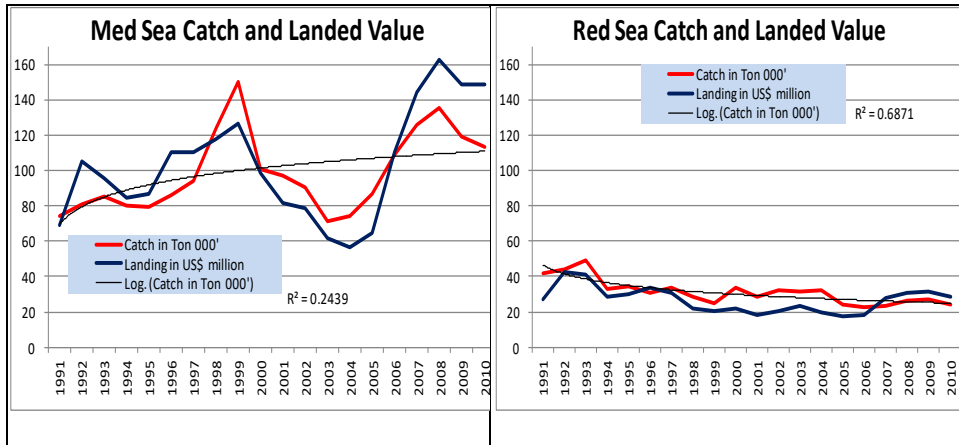
Fish Catch, Coral Impact and Bioaccumulators

In addition to fish farming, the violation of fishing laws (by increasing the number of motorboats and using illegal nets) is leading to overfishing although fish catch is increasing along the Mediterranean Sea from 74,067 tons in 1991 to 113,433 tons in 2010 due to deeper fishing but decreasing along the Red Sea from 41,520 tons in 1991 to 24,279 tons in 2010 (Sea Around the World website; Figure 3). However, the Mediterranean Sea fish catch and landed value show a boom-and-bust trend over 20 years whereas the Red Sea fish catch and landed value trend is decreasing and steadily negative. One possible explanation for such a decline could be attributed to the overfishing of *L. nebulosus*, which is a slow-growing and long-lived species with a longevity of up to 18 years, which is a predator feeding mainly on large Echinoderm species, especially the acanthasters and sea urchins. Due to the decline in the *L. nebulosus* population, the acanthasters and sea urchins have multiplied and started attacking coral polyps, hence affecting the coral reef health as already observed around the world (Sabrah and Al-Ghanaini, 2012).

Several studies were conducted on the contamination of the food chain in both the Mediterranean and Red Sea. One study conducted along the Mediterranean Sea indicated that the concentration of heavy metals in

edible bivalve and fish were below the documented toxic levels for human consumption (Shreadah et al., 2015). However, another study along the Mediterranean Sea revealed that the concentrations of Cd and Pb in the soft tissues of the edible bivalve were above the maximum acceptable concentrations for human consumption proposed by FAO/WHO, EU, and recorded high accumulation rates of Cd and Cu. Also, water and bottom sediments showed apparent seasonal variations of metals accumulation with maximum concentrations during summer and winter, respectively but the area of the present study was in general not considered a metal polluted area according to USEPA classification criteria (El-Serehy et al., 2012). On the other hand, a bioaccumulator study along the Red Sea found that the concentration of metals in the present fish muscles were acceptable by international standards and were safe for human consumption (El Moselhy et al., 2014).

Figure 3: Mediterranean and Red Sea Wild Fish Catch and Value Landing Trend, 1991-2010



Source: Compiled by Author and based on Sea Around the World website: <www.seaaroundus.org>.

Coral Reefs and Mangroves

Coral reefs provide economic benefits through tourism and fisheries. However, human activities, including development in coastal areas, over-fishing, and pollution have contributed to a global loss of over 10% of these

valuable ecosystems. An additional 15% have been lost due to warming of the surface oceans and seas, and it is expected that climate change will further contribute to bleaching and coral reef degradation in the decades ahead (EEAA, 2010).

Several factors can be attributed to the destruction of coral reefs in many sites including activities by hotels and other touristic establishments, ships and even individuals. Likewise, wetlands are facing serious hazards from land reclamation and urban development and expansion activities. They are also exposed to natural phenomena like sedimentation, floods and sandstorms as well as coastal erosion shrinking the barriers separating the Northern lakes from the Mediterranean Sea. This, in fact, will be exacerbated by sea level rise in the future due to climate change (EEAA, 2009). A study using satellite imagery comparing the year 2000 with 2013 revealed increases in sand subtidal and macro-algae classes by 14% and 19%, respectively, while major decreases of 49%, 46% and 74% were observed in the sand intertidal, coral, and seagrass classes, respectively (El-Askary et al., 2014).

Since 2001, Egypt has been systematically monitoring the status of coral reefs in more than 120 sites in the Red Sea and Gulf of Aqaba. Such monitoring has revealed that coral reefs' status inside protected areas is better than elsewhere. However, a global survey conducted by the World Resources Institute (WRI) estimated that 61% of the coral reefs of Egypt were seriously at risk from human impacts (Burke et al., 2011). By contrast, the areas that do not accommodate any human activities have witnessed increase in coral reefs (14%) compared with those with human activities (5-7%). Furthermore, coral reef coverage showed a decrease of 4% - 5% in some of the northern marine areas that attract considerable number of divers (EEAA, 2009).

ECONOMIC ASSESSMENT

For the economic assessment of damages in the marine sector of Egypt, we shall focus on fisheries, coral reefs, and ballast waters to estimate the damages to the associated environmental services:

1. Fisheries

The pressure on the fisheries in the Mediterranean needs additional analysis as the fish catch and landing have been increasing. However, the pressure on fish resources in Red Sea from all the littoral states has grown substantially since 1991 and catches of a number of species, such as grouper, barracudas, sardines, Indian mackerels, snapper, lethrinus, and shrimp have declined. The fishing is made up mainly of subsistence, artisanal, recreational and industrial fishers. Considering the Egyptian effort, the total catch was estimated at 18,455 tons in 2014, with the largest share being scads, followed by pompanos (Sea Around the World, www.seaaroundus.org/). However, these figures provide a strong indication of the extent to which environmental pollution and other pressures have been responsible for the reduction in the value of the catch. The evidence on the fish stock in the Red Sea indicates a decline of about 71% due to environmental pressures between 1991 and 2010. However, it is not known whether the decline is equal across species or just specific to certain ones (Sea Around the World). Assuming this to be the case, the catch would be correspondingly higher at the current fishing rate (the approximation used herewith is $Catch = Fishing\ Rate \times Biomass$ (DFID, 2005). The current net income from the catch is based on averages prices for the different species times the quantities, net of the cost of making the catch. A local informal survey carried out among local fishers concluded that net income is about one-fourth (i.e., 25%) of the gross value of the catch. Based on that, the latest catch had a net income of US\$ 4.96 million but in the absence of the loss of stocks it would have been as high as US\$ 7.81, indicating a cost of degradation of US\$ 4 million. This figure should be taken as a first approximation only (Table 1). The rate of loss of

different stocks is required to make a better estimate. Further, the estimated catch with the full stock may not be sustainable, in which case the estimated loss would be lower. However, these figures give an idea of the extent to which environmental pollution and other pressures have reduced the value of the catch.

In order to estimate the costs of one year's loss of fish stock, we have to make some further assumptions. First, the above losses are the result of many years of overfishing and pollution (possibly for 23 years), so one year's damages would be one-twenty-third of the above figures. However, once the loss has occurred, it affects the catch rates into the indefinite future. Subsequently, we would need to take the discounted present value of that loss. Given that, we will use a long-term discount rate of 3% in our calculations in this paper.

2. Aquaculture

There has been a big increase in the amount of aquaculture activity in Egyptian waters in recent years as wild fisheries production of an estimated 142,536 tons in 2014 represents a little more than a third (36%) of total fish while a staggering 64% comes from aquaculture/aquafarming, a process of raising fish in controlled environments of ponds and containers. Initially it was concentrated on the freshwater of the Nile close to coastal areas, but this has been overtaken by different kinds of shrimps in marine waters. The increase in this activity has had an impact on the marine environment through the discharge of nutrients of nitrogen (N) and phosphorous (P) as well as bacterial wastes from the cultivated fish. It has been argued that this is part responsible for the loss of wild fish stocks as well as to eutrophication (that is, the blooms of harmful phytoplankton and unwanted microalgae), and to the development of hypoxic and anoxic conditions. Unfortunately, we do not have adequate data to estimate the additional costs of environmental degradation caused by these pollutants; the effects

on fish stocks, however, have been accounted for in the losses estimated above.

3. Coral Reefs, Mangroves, Sea Grasses, other Marine Flora and Fauna

There is wide variation in the degree of damage to coral reefs as they can range from minor injuries to the severe degradation of its structural complexity and to irreversible damage leading to its death. Furthermore, the natural recovery of coral reefs from severe groundings can occur over a period of many years or even decades. Due to an increase in tourism, coral reefs in Egypt are a primary source of national income and employment and are also a major impetus for international investment. On the one hand, there are no recent studies to gauge the status of coral reefs in Egypt. On the other hand, the 2014 State of the Environment Report (SOER: EEAA, 2016) provides a constant coral reef area of 1,800 km² in 2007 over the years without mentioning the relative status of the coral reefs. However, one study (Cesar, 2003), cited an area of 4,000 km² quoting a biodiversity expert, Dr. M. Fouda, which is more than twice the area reported by EEAA. Similarly, the 2014 SOER (EEAA, 2016) provides figures for mangrove areas (700 ha) that are on the rise over the years but also omits to gauge the mangrove status.

Coral Reefs Damage and Compensation

Damages to coral reefs are subject to compensation and fines that is another method of valuing the losses. The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) provides some data that is specific to this marine zone. The maximum fine for dropping anchor over a reef was only US\$ 6,000 in the late 1990s, which is a very small figure given the damage to ecosystem services that it could potentially cause. In the 1990s, however, Egypt adopted a compensation value of US\$ 120/m² of coral (US\$ 1,200,000/ha) which was subsequently increased to US\$ 300/m² (US\$ 3,000,000/ha)

when corals are in protected areas. Egyptian official records show that there have been 170 coral reef damage incidents till 2013 (<http://emicsegypt.com/>) and EEAA is mandated with the right to issue compensation claims against the culprits.

Nearly two-thirds of the reefs in the Red Sea region are at risk from local threats (Burke et al., 2011). However, a slightly better situation (61%) prevails around Egypt Red Sea coast, which has a reef area covering 1,800 km² (EEAA, 2013). A 5% equivalent to 9,000 ha of the total coral was considered dead. In addition, we can assume some damage to the other coral in the area as studies from neighboring countries reveal this to be the case. As it is difficult to produce coral reef category of degradation, the 5% losses of the 1,800 km² with a value derived by De Groot et al., 2012 will be used after adjusting the value for 2020 prices (EEAA, 2009).

With regard to the monetary valuation of the losses, a major global review of all studies of the values of ecosystems has been published and it gives unit values (US\$/ha/year at 2007 price levels) for the different biomes (De Groot R. et al., 2012). These are derived from a set of 94 value estimates across a range of countries. The mean value of a whole live coral in terms of ecosystem services has been valued in this study at US\$ 453,333/ha/year in 2020 prices. The values cover the following services: provisioning (i.e., food, raw materials and genetic resources); regulating (i.e., climate regulation, erosion prevention and disturbance moderation); habitat services of genetic diversity; cultural services of recreation and aesthetic information. Accordingly, the mean coral reef degradation is estimated at US\$ 3.92 billion in 2020.

4. Ballast Water

The disposal of ballast water in coastal areas is undertaken when the tankers reach the shipping ports. This is a source for oil residues that can pollute the waters of the marine environment as well as invasive species

that damage local ecosystems. According to World Wildlife Fund (WWF) Silent Invasion report (WWF, 2009), the cost of not treating ballast waters imposes direct costs equivalent to about US\$ 0.72 per ton of untreated water in 2020 prices – or US\$ 7.2 billion per year for the ten billion tons of water transported globally each year.

As an indication of the magnitude of the problem, it is estimated that there are around 10 billion tons of ballast water globally that are released into the seas annually (IMO, 2012). Assuming that the responsibility for these is proportional to the volume of trade (almost 90% of globally traded goods are by sea) then Egypt would account for about 0.21% of the total; in 2020, global exports were around US\$ 22.4 trillion of which Egypt's total exports accounted for US\$ 47.9 billion (WDI, 2021). Based on the WWF estimate of damages, this would result in releases of 16.6 million tons of ballast water and thus, the annual cost would amount to US\$ 26.9 million.

Summary of Marine Damages

Damages in the marine sector have been estimated to the following environmental services and from the following sources:

- Damages to fisheries from overfishing and pollution
- Damages to coral from coastal development
- Damages caused to ecosystems generally from ballast waters.

The last category is partly responsible for damages to the other three categories and so there is an element of double counting. But ballast waters have an impact on ecosystems more widely and it would be a mistake to ignore them completely.

RESULTS

The damages representing the costs of one year's pollution and other misuse of resources for marine and coastal areas in Egypt are summarized in Table 1. Ranges are provided where possible and a brief explanation of the methodology and its limitations is also included in the comment's section.

Table 1: Egypt Marine & Coastal Areas: Annual Damage Costs - mean estimate, 2020

Source/ Area	Lower Bound	Upper Bound	Mean Value	Comment
	US\$ billion			
Fisheries	0.004	0.004	0.004	Based on loss of catch. Assumed losses are very rough and further work is needed.
Coral Reefs	2.938	4.897	3.918	Loss of coral areas utilized in this paper is based on EEEA figures. Damage costs per hectare are based on international studies.
Ballast Water	0.027	0.027	0.027	Ballast water released is based on Egypt's share in global trade and on damage per ton provided by WWF.
Total	2.968	4.928	3.948	
GDP ₂₀₂₀		365.25		
	0.8	1.4	1.1	% of GDP ₂₀₂₀

Source: Author.

From Table 1, the biggest source of damage is coral reefs followed by ballast water then fisheries. In total, damages of this size amount to only 1.1% of the country's GDP in 2020. Nevertheless, they are important because of the impact these damages have on vulnerable groups (e.g., fishermen and pastoralists). Moreover, some of these damages, such as those to coral areas, can make the country more exposed and vulnerable to the dire impacts of climate change and extreme weather events. It is important, however, to note that these estimates are only first approximations and considerable work is needed to refine them and to confirm the orders of magnitude provided here.

CONCLUSIONS AND RECOMMENDATIONS

The challenges that Egypt is currently facing in terms of ensuring the sustainable use of its sea and marine resources are increasing especially with the emerging impacts of climate change. Despite that the damages of the marine and coastal ecosystems in Egypt, as estimated in this paper, may not be significant in terms of the country's GDP, they are nonetheless important and need to be addressed. That is, marine and coastal ecosystems contribute to poverty eradication by creating sustainable livelihoods and decent work especially for those vulnerable groups in Egypt that are most affected by such damages. It is therefore imperative that Egypt embarks on a blue economy path as means of pursuing its sustainable development goals and targets, and 2030 Vision, in general.

For Egypt to fully implement the concept of the blue economy, it has to develop a long-term strategy aimed at supporting sustainable economic growth through the sectors and activities directly related to its seas, marine and coastal ecosystems. This strategy will need to consider economic development and the health of its seas and marine ecosystems as compatible propositions. Furthermore, the blue economy strategy must accommodate and fully mainstream the potential impacts of climate change on its marine and coastal ecosystems. More notably, the strategy will not only anticipate the potential impacts, it will also need to include the means and actions needed for its marine and coastal ecosystems to adapt and become more resilient to such impacts.

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نمو اقتصاد أزرق في مصر: التقييم الاقتصادي للتدهور البيئي للموارد البحرية والساحلية

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المستخلص

تعد مصر من بين دول العالم التي تواجه تحديات بيئية واقتصادية كبيرة، خاصة في ظل التدهور المستمر للموارد البحرية والساحلية. يهدف هذا البحث إلى تقييم الأضرار الاقتصادية الناتجة عن تدهور هذه الموارد، وذلك من خلال تحليل البيانات المتاحة عن الإنتاجية البيئية للمناطق الساحلية والبحرية. كما سيقدم البحث مقترحات لتقليل الأضرار وتعزيز التنمية المستدامة في القطاع الاقتصادي. وتتماشى هذه الدراسة مع أهداف التنمية المستدامة (SDGs) خاصة الهدف 14 (الحياة تحت الماء) والهدف 15 (الحياة البرية). وتعد هذه الدراسة خطوة مهمة في فهم الأبعاد الاقتصادية للتدهور البيئي، وذلك من أجل اتخاذ قرارات مستنيرة بشأن السياسات البيئية والاقتصادية. وتتميز الدراسة باستخدام منهجية تحليلية دقيقة، وذلك من خلال الاعتماد على بيانات اقتصادية وبيئية موثوقة. وتتميز النتائج بتوضيح الأضرار الاقتصادية الناتجة عن تدهور الموارد البحرية والساحلية، وذلك من خلال تحليل البيانات المتاحة عن الإنتاجية البيئية للمناطق الساحلية والبحرية. كما سيقدم البحث مقترحات لتقليل الأضرار وتعزيز التنمية المستدامة في القطاع الاقتصادي. وتتماشى هذه الدراسة مع أهداف التنمية المستدامة (SDGs) خاصة الهدف 14 (الحياة تحت الماء) والهدف 15 (الحياة البرية).

تعد مصر من بين دول العالم التي تواجه تحديات بيئية واقتصادية كبيرة، خاصة في ظل التدهور المستمر للموارد البحرية والساحلية. يهدف هذا البحث إلى تقييم الأضرار الاقتصادية الناتجة عن تدهور هذه الموارد، وذلك من خلال تحليل البيانات المتاحة عن الإنتاجية البيئية للمناطق الساحلية والبحرية. كما سيقدم البحث مقترحات لتقليل الأضرار وتعزيز التنمية المستدامة في القطاع الاقتصادي. وتتماشى هذه الدراسة مع أهداف التنمية المستدامة (SDGs) خاصة الهدف 14 (الحياة تحت الماء) والهدف 15 (الحياة البرية). وتعد هذه الدراسة خطوة مهمة في فهم الأبعاد الاقتصادية للتدهور البيئي، وذلك من أجل اتخاذ قرارات مستنيرة بشأن السياسات البيئية والاقتصادية. وتتميز الدراسة باستخدام منهجية تحليلية دقيقة، وذلك من خلال الاعتماد على بيانات اقتصادية وبيئية موثوقة. وتتميز النتائج بتوضيح الأضرار الاقتصادية الناتجة عن تدهور الموارد البحرية والساحلية، وذلك من خلال تحليل البيانات المتاحة عن الإنتاجية البيئية للمناطق الساحلية والبحرية. كما سيقدم البحث مقترحات لتقليل الأضرار وتعزيز التنمية المستدامة في القطاع الاقتصادي. وتتماشى هذه الدراسة مع أهداف التنمية المستدامة (SDGs) خاصة الهدف 14 (الحياة تحت الماء) والهدف 15 (الحياة البرية).