Report on the baseline situation for IMAP common indicator 16 “Length of coastline subject to physical disturbance due to the influence of human-made structures” in Libya

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1 - Introduction:

At the fifth meeting of the Conference of (COP 15/2008), the Contracting Parties decided to apply (EcAp) in accordance decision (IG.17/5) to the Human Activities Management System in the Mediterranean Basin with the aim of achieving (GES). This is within the framework of what was approved for the contracting parties to the Barcelona Convention through the (MAP) in order to help Mediterranean countries protect and improve the coastal environment and sea and pollution control through protocols that address specific aspects of the Mediterranean Sea and complement the legal framework of (MAP). It is the protocol of the Integrated Coastal Zone Management (ICZAM) strategy.

In order to implement the ecosystem (EcAp) as a strategy for the integrated management of negative activities on the ecosystem of the Mediterranean coast, by defining and implementing the integrated assessment and monitoring program with regard to the ecological objectives related to the coast, EO 8 which is our subject in this report.

Through the PAP RAC, the contracting parties defined the mission of the center through their decision, which is to provide support to the Mediterranean countries for the ratification and implementation of (ICZM). As such the mission and scope of work positions(PAP/RAC)as an active lead partner in the EcAp MED III project, to ensure additional support for IMAP national implementation and to provide reliable data for IMAP indicators on the coast through the Common Indicator (IC 16) along The coastal strip of the Mediterranean countries “the length of the coastline subject to physical disturbance due to the influence of man-made structure” in order to determine each country’s Good Environmental Status (GES), targets and measures (CI 16) cannot expressed quantified (as a threshold value) but are left For the countries themselves because of the specificity of each country in terms of (social, economic, cultural, historical).

The objective of this report is to provide data for the preparation of a report on the state of the Mediterranean coastal strip of the Libyan state to monitor the common indicator (16) the length of the coastline subject to

physical disturbance due to the influence of man-made structures. To assess the environmental objective (8) so that the results of the spatial assessment of man-made structures along the Libyan coast can be presented, to contribute to the assessment and monitoring program and to prepare for the preparation of an assessment of the good environmental status (GES) of the coastal area and to evaluate the reported data variables for this indicator.

The following reference documents should be taken into account that are integral part of the contract:

a. Indicator Guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 “Length of coastline subject to physical disturbance due to the influence of manmade structures”. (Annex 1)
b. Information standards for the Common Indicator 16. (Annex 2)

General description of Libyan coast:

The Libyan state, according to any standards, is considered a large country, with an area of 1.78 million square kilometers, it is bordered on the north by the Mediterranean Sea, and its coast length is about 1,970 km. 85% of the population lives in the eastern and western coastal areas and plains(Source (LIB/96/001) National Tourism Development Plan (1999-2018))

The land area forms part of the continental group (Gondwanaland) and consists mainly of basal rocks, and this is the basis of the southern and central parts of the country. It led to the emergence of a wide surface plateau and an area characterized by volcanic influences.

The coastal strip leads to a series of gradients, reaching a height of 600 meters above sea level in the Jabal Al-Akhdar (north of Eastern Region) it is covered with shrubs and at the higher elevations, the plants change to a comprehensive green covering.

Central coastal strip surrounding the Gulf of Sirte is about 60 km long and is semi-desert in general, and to the south of the central coastal region lies the Great Desert, which includes most of the country’s lands.

The coastal zone is located within the coastal ecological zone with an area of 970 km2 (National Natural Plan 2000 -2025). This zone covers the following:

a- The coastal strip with a width of 1-30 km

b - Coastal sabkhas (wetland)

c - Coastal waters and the sea floor

The coastal ecological domain is considered one of the most fragile domains compared to other domains, and the United Nations Human Settlements Project (LIP 96/X01) worked to provide assistance to the relevant sectors in preparing a digital map on the coastal strip (Figure. 1) on the sites of nature reserves and the historical and archaeological sites Sea turtle nesting sites, pollution areas, and marine areas with natural potential.

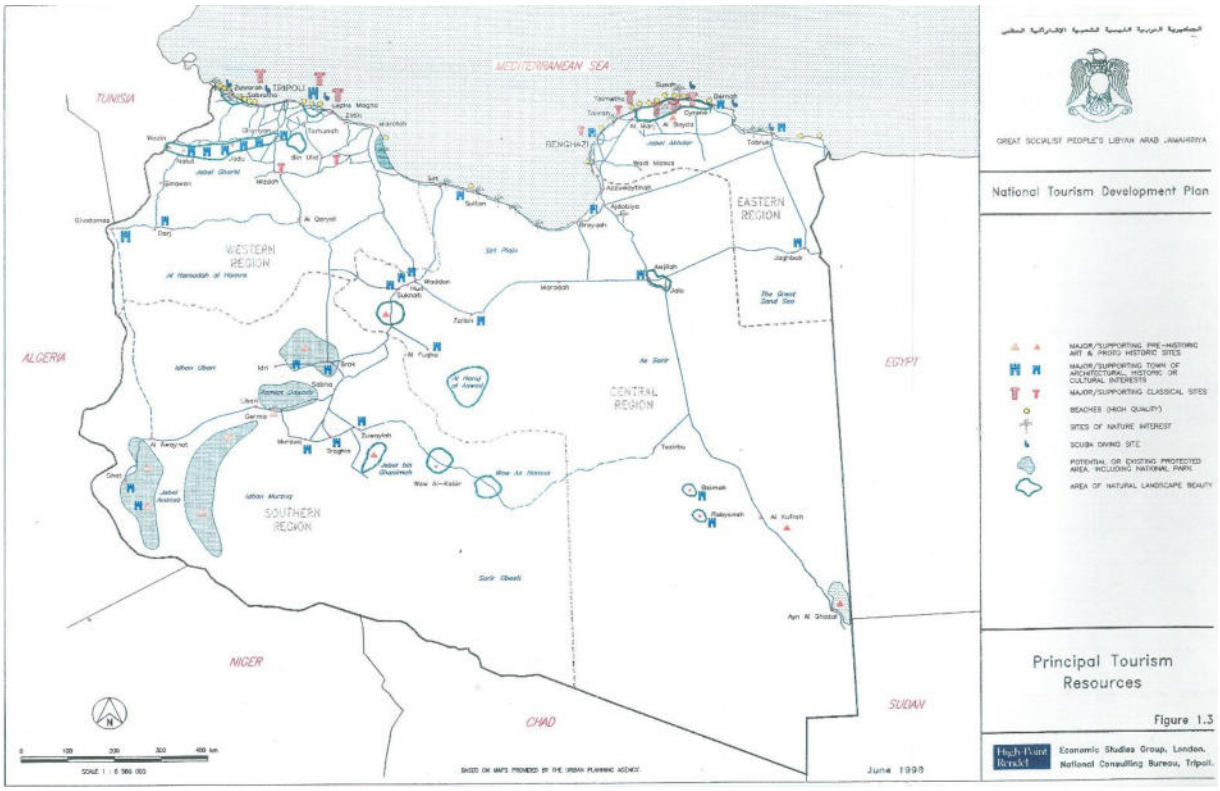


Figure No. (1) A map of the coastal zone environment, showing most of the economic and vital activities along the Libyan coast

Along the coastal strip, a wide variety of natural and tourist resources are available, including landmarks and landscapes such as sandy beach and rocky beaches, lakes, sea caves, wet areas, and historical cities that include all periods and eras from the prehistoric era to the modern era and a vital

diversity of plants and animals Which gives privacy in the Landscape of Natural ecosystem, especially the Green Mountain area.

Studies indicate that about 50% of the number of endemic plants in Libya are found in this area, figures (No.2,3,4,5,6,7) examples from different regions that illustrate the specificity and diversity of the coastline , knowing that there are areas in the coastline, especially in the central and eastern regions, that no human foot has set foot in , because it is difficult to reach it .

Figure No.(2)Al-Athrun,Beach,west of city of Derna

Figure No.(3)Siline Beach,Homiss city

Figure No. (4): Sirt City Beach

Figure No. (5): Green Mountain

Figure No.6: Zwara city beach

Figure No.7: The ancient city of Sousse

2 - METHOD AND INPUT DATA

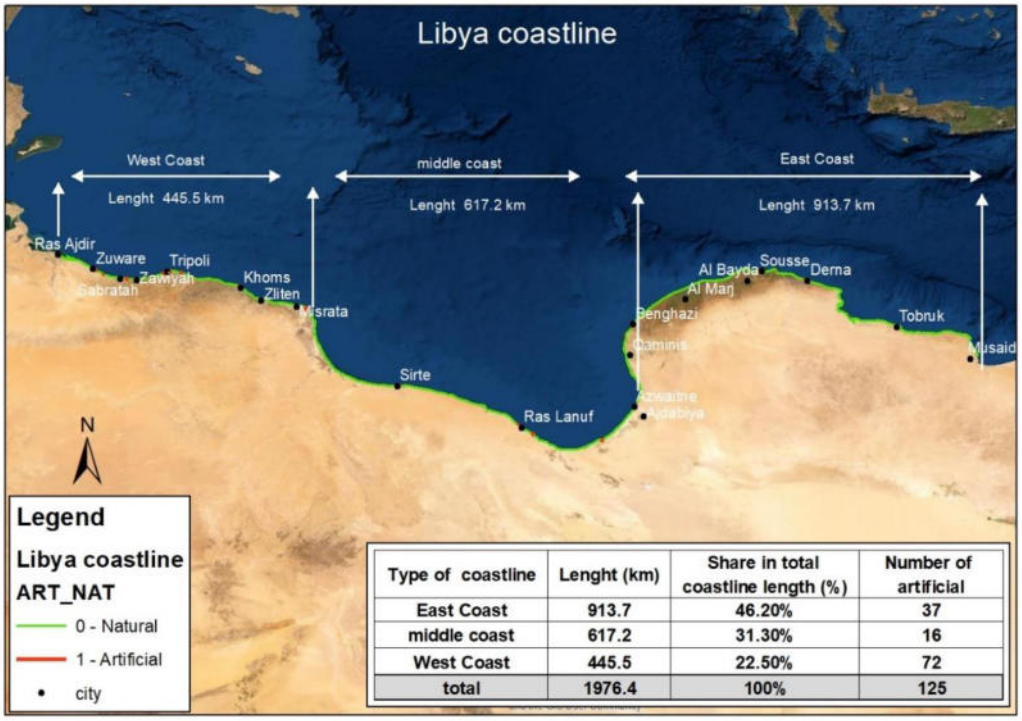
The monitoring of this Common Indicator entails an inventory of the length and locations of human-made and it's share in total Natural coastline of the Libyan country ,the location of the segments was determined using Digitalizar of an SPOT6 satellite images of coastline dated (2020), the length of the coastline Calculated by using (ArcGIS) , spatial resolution (1.5 meters) is provided by Libyan Center for Remote Sensing and Space Sciences.

The coastal line approved by the Survey Authority, which it adopted as a reference, is a line sourced from the 1956 topographic maps of the Libyan coast, scale 1: 50,000 backed by only 64 basis points along the coast for course correction, but as a result of old maps and a rather large scale The drawn coast does not match reality when placed on the satellite image , (there was an attempt to draw the coast line using the aerial photograph in 2006, but due to circumstances during that period, the project was not completed.)

As a result of the above, we have drawn the coast line and industrial facilities using the satellite image of the SPOT6 satellite, with a Resolution of 1.5 meters for the year 2020, and Pleiade satellite images with a Resolution of 0.50 meters for cities for the year 2020 , also we used as required Coordinate Reference System (WGS 84) , our reference was the coastline drawn by the Libyan Center for Remote Sensing (a government institution) in year 2010 from SPOT5 image, discriminatory capacity is 5 meters,(but it has not been officially approved from Survey Authority) we used the ArcGIS 10.8 program in the drawing and created a file of type Feature Class Geodatabase.

The length of artificial coastline has been calculated as the sum of segments on reference coastline identified as the intersection of polylines representing human-made structures with reference coastline ignoring polylines representing human-made structures with no intersection with reference coastline. The minimum distance between coastal defence structures should be set to 10 m in order to classify such segments as natural, i.e. if the distance between two adjacent coastal defence structures is less than 10 m, all the segment including both coastal defence structures is classified as artificial.

In these report, we adopted the methodology of dividing the Libyan coastline into three regions as shown in (Figure No. 8).



Type of coastline	Lenght (km)	Share in total coastline length (%)	Number of artificial
East Coast	913.7	46.20%	37
middle coast	617.2	31.30%	16
West Coast	445.5	22.50%	72
total	1976.4	100%	125

Figure No. (8): divided Libyan coastline into 3 region

The information required in the attribute table associated with the GIS information layer, according to the information standards for the Common indicator 16, for the coastline of Libyan are:

- CPCODE: (Two-letter code of Country) LY
- ART_NAT: Code for type of segment of coastline.
- 0 Natural coastline
- 1 Artificial coastline

- ASCODE: Code of type of artificial infrastructure.
- 1 Breakwaters
- 2 Seawall /REVETMENTS
- 3 Jetties
- 12 Port and marinas
- ASDES : Description of type of artificial infrastructures
- Year: Year of production of the information layer.(2021)
- Ref_ year: Year of the reference coastline used to represent natural and artificial segments. (2010)

3 – Results

The results are prepared according to Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 “Length of coastline to physical disturbance due to the influence of manmade structures“.

The total length of coastline of the Libyan state is 1976.41 km, length of the natural coastline is 1891.39 km which represents 95.60% of total length , while the total length for artificial coast is 85.02 km which represents 4.4% of total length. (Table 1) and (Figure 9)

Type of coastline	Length (km)	Share in total coastline length (%)
Natural	1891.39	95.60%
Artificial	85.02	4.40%
Total	1976.41	100.00%

Table No. (1): length and type of coastline

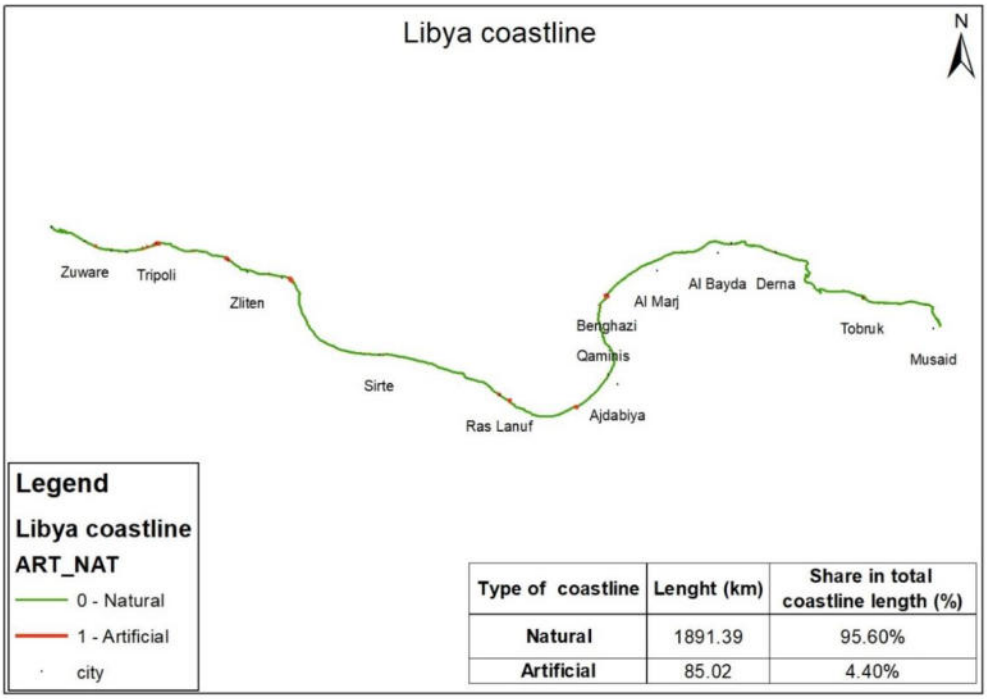
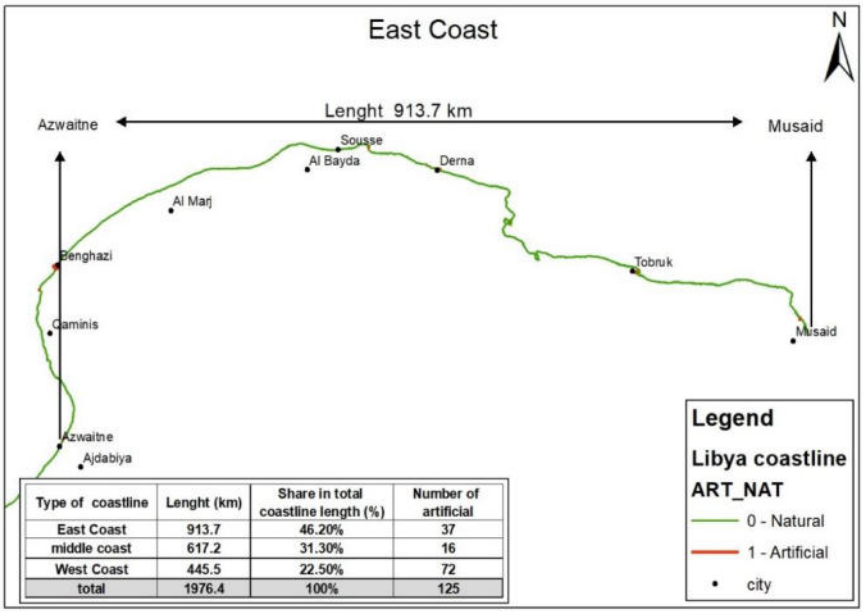


Figure No (9): coastline delineation Natural – Artificial of LIBYA

Based on the methodology we followed in preparing the report on the division of the Libyan coast into three regions, we conclude the following:

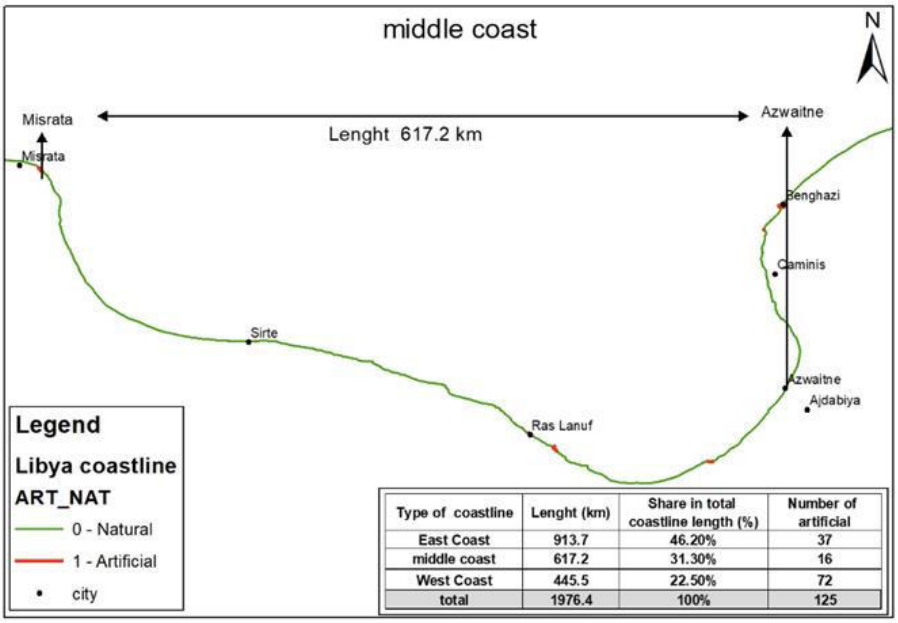
a) **The Eastern coast** (Eastern Region) extends from Musaid city to Azwaitne, its length is 913.7 km, constituting 46.2% of the length of the coast. The region contains 37 industrial facilities, 13 sea ports, 2 port for exporting oil, Al-Hariqa and Zueitina, 4 commercial ports (Figure10).



Type of coastline	Lenght (km)	Share in total coastline length (%)	Number of artificial
East Coast	913.7	46.20%	37
middle coast	617.2	31.30%	16
West Coast	445.5	22.50%	72
total	1976.4	100%	125

Figure No. (10): East Coastline

b) **The middle coast** (the middle region) and extends from Azwaitne to the city of Misrata. The length of the coast is 617.18 km, which constitutes 31.2% of the length of the coast, it contains 16 industrial facilities 3 oil ports (Sidra port, Ras Al Anouf, Al Buriqa), 1 cargo port. (Figure 11)



Type of coastline	Lenght (km)	Share in total coastline length (%)	Number of artificial
East Coast	913.7	46.20%	37
middle coast	617.2	31.30%	16
West Coast	445.5	22.50%	72
total	1976.4	100%	125

Figure No. 11: Middle Coast

c) **The West coast** (the western region) extends from Misrata to Ras Ajdir, a length of 445.4 km, which constitutes 22.5% of the length of the coast. It contains 72 industrial facilities, including 3 oil ports (Zawiya port, Melita port for gas export, Melita port for export oil) and 7 commercial ports .(Figure12)

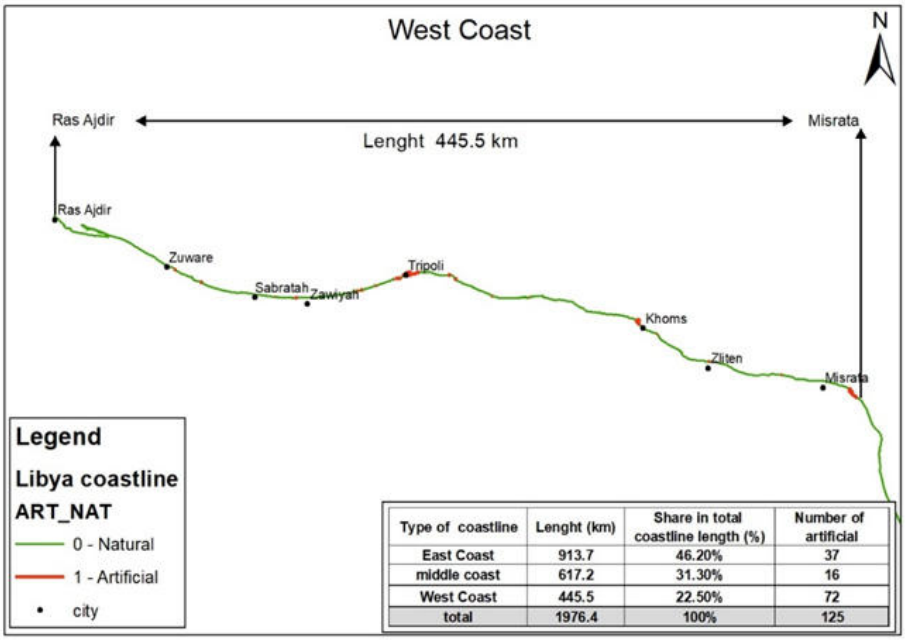


Figure No. (12): West Coastline

The following table shows (Table 2) the type of coastline in each region share in total coastline and number of artificial structure.

Type of coastline	Length (km)	Share in total coastline length (%)	Number of artificial	Length of artificial (km)	Share in total artificial coastline length (%)
East Coast	**913.7**	**46.20%**	**37**	**27.7**	**3.0%**
middle coast	**617.2**	**31.30%**	**16**	**14.3**	**3.5%**
West Coast	**445.5**	**22.50%**	**72**	**43.0**	**9.6%**
total	**1976.4**	**100%**	**125**	**85.0**	

Table No. 2: Regions share in total coastline

The total length of the artificial structure is 200.45 km and the number is 125 artificial. Most of the artificial structure are located in the western coastal region, where there are (72) artificial structure in an area estimated at 22% of the total length of the coast. This is due to the presence of the capital in this region and the increase in population and economic activity generally.

Through the survey, we determined the length and extent of the coastline defined by the type of artificial structures. The natural coast represents about 95.60%, breakwaters represents about 23.68%, Seawall/Revetments represents about 10.27%, Jetties represents about 9.00 % and Port/Marinas represents about 56.97 %. (Table 3)

ASDES code	Type of artificial coastline	Number of artificial	Length (km)	Share in artificial coastline length (%)
1	Breakwaters	22	47.47	23.68%
2	Seawall/Revetments	28	20.6	10.27%
3	Jetties	29	18.1	9.00%
12	Port and marinas	46	114.2	56.97%
total		125	200.45	100.00%

Table No (3): Length and type of artificial coastline in LIBYA

Additional a table No. (4) We explain in detail the types and number of the artificial structure Sharing in total Ports and marinas length.

Type of artificial	Number	Length (km)	Share in total Port and marinas length (%)
port	12	62.6	54.90%
marinas	23	20.35	17.80%
oil export port	8	26.7	23.40%
Tourist port	3	4.4	3.90%
Total	**46**	**114.2**	**100.00%**

Table No. (4): type and numbers of ports & marinas

There are several examples related artificial structure along coastline. Break water (ASCODE = 1), found in seaports, sea tourism ports and sea fishing ports, designated as a "port and marines". (Figure, 13, 14)

Figure No. (13): Dila marina – Zawiya city

Figure No. (14) Zuware marina - Zuwara City

(ASCODE = 2) these are features in most coastal cities, especially in the design of the waterfront of cities , Those manmade structures are defence against the sea waves and serve mainly as promenades . (Figure15, 16)

Figure No. (15): Benghazi Juliana lake Road Revetments

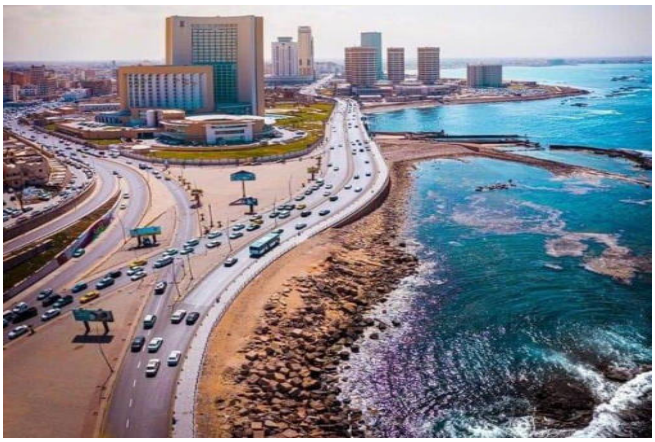


Figure No. (16): Tripoli Sea Road Revetments

Since the Libyan state is one of the oil-exporting countries, there are many oil ports along the coastline (ASCODE = 12) , there are many ports with long docks and breakwater structures . (Figure 17, 18)

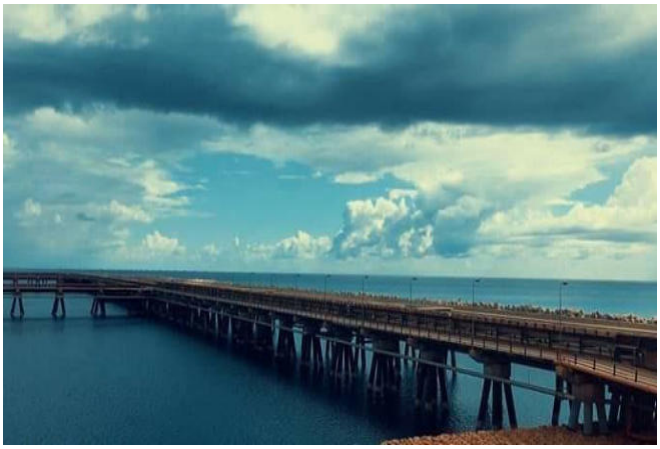


Figure No. (17): Ras Lanuf oil export port

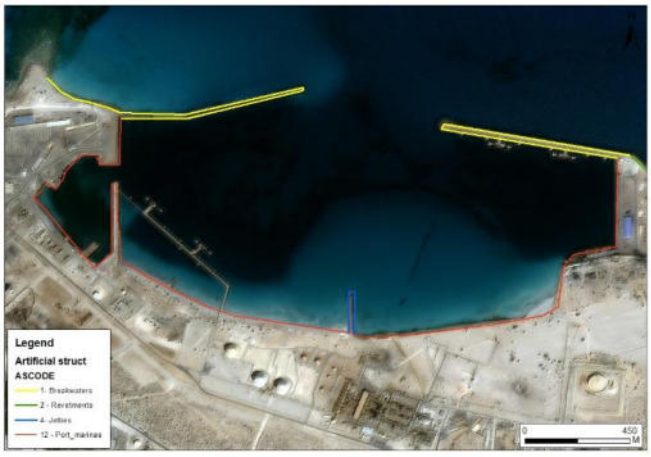


Figure No. (18): Brega oil export port

Although the legislation and laws prohibit the exploitation or construction near the coastline (Law No. 3 of 2001 Article (25) of the law stipulates that building not be permitted on the lands closed to the seashore and Article (57) of the Executive Regulations of Law No. 3 of 2001 Concerning Urban Planning - The protection of the beaches of the sea shall be at least 100 meters " law of 100 meters "). However, there are man-made bad practices in coastal areas.

One of the most important issues facing the Libyan coast is the process of cutting the sedimentary rocks on the coast and transforming them into bricks used in construction (quarries), especially in the Maya, Jadam , Al-Zawiya, Al-Harsha and Abu Kamash (west of Tripoli), which caused the erosion of the rocky layer, damage in the coastline Which causes the sea water intrusion and change of landscape . (Figure19, 20)

Figure No.(19) : Harsh area quarry 2021

Figure No. (20): Harsha area Quarry 2004

The other issue that threatens the Libyan coast is sand mining quarries, as a result of the high quality of sand in the Zliten city, it is used in construction with cement. Although there are decisions prohibiting the use of this type of sandy soil in the construction process, addition to its non-compliance with the specifications of use this type of soil in construction, but it is commonly used. See (Figure 21, 22, 23)

Figure No. (21): Sand quarry Zliten area 2019

Figure No. (22) : Sand quarry Zliten area 2021

Figure No . (23): Construction sandy soil cargo trucks

4 - CONCLUSIONS

The objective of this report is to produce information for a common indicator "16" the length of the coastline is physically disturbed due to the influence of man-made structures in Libya, through the data and information obtained changes on the coastline can be regularly monitored and recorded within the monitoring programs.

Monitoring and assessment plan will provide early warning of potential, significant impacts, inform future operations and contribute to continuous improvement in the management of environmental and social issues related to the Project.

The natural coastline is 1891.39 km which represents 95.6% of total length while the total length for artificial coast is 85.02 km which represents 4.4% of total length, breakwaters represents about 47.47 km or 23.80 %, Seawater/Revetments represents about 19 km or 9.60 %, Jetties represents about 18.1 km or 9.20 % and Port/Marinas represents about 114.2 km or 57.40 %.

Through the survey and reports obtained on coastline, we drew our attention to bad practices by human - made impact, which have negative impact on the environment, landscape and habitats, and we suggest considering it in the future.

Digital data (shape file format with required attributes) is an integral part of this report.

5 – REFERENCES

- Annual Reports – EGA
- The third generation (National Long-Term Natural Plan 2000-2025)
- Tourism Development Master Plan, 1999-2018 (National Tourism Development Plan (VOULUME 1)
- Reference was the coastline drawn by the Libyan Center for Remote Sensing (a government institution) in year 2010

6 – Annexes

6.1 - Information standards for the Common Indicator 16'' GIS information standards;

- Artificial structures
- Coastline artificial/natural

Name of GIS layer: Artificial structures

Type of GIS Layer: polyline

Geographical Reference Systems: WGS 84 decimal degree

Attribute table:

Content	Description
Ecological Objective	**EO8. Coastal ecosystem and landscape**
IMAP Common Indicator	**CI16. Length of coastline subject to physical disturbance due to the influence of manmade structures**
Parameter	**Location and extend of artificial structures**
Attribute table	Specify the following information in the attribute table associated with the GIS information layer: • CPCODE: Two-letter code of Country • ASCODE: Mandatory. Integer. Code of type of artificial • Infrastructure. The following code list should be used: ○ 1 Breakwaters ○ 2 Seawall/Revetments/Sea dike ○ 3 Groins ○ 4 Jetties ○ 5 River mouth structures ○ 12 Port and marinas • ASDES: Optional. Text. Description of type of artificial infrastructures • Municipal: Optional. Text. Name of municipality or local administrative region where the polygon of impervious surface is located • Year: Mandatory. Text. Year of production of the information layer
Variables	Border on the sea side of coastal artificial structures
Spatial resolution	10 m or higher as produced by photo digitalization or CAD (Computer Aided Design) software
Vertical coverage	1 level at sea surface
Coordinate Reference System	WGS 84 or ETRS 89 decimal degrees
Temporal coverage	Every 6 years
Data format	GIS Layer: polyline or polygon

Name of GIS layer: Coastline_AN

Type of GIS Layer: polyline

Geographical Reference Systems: WGS 84 decimal degree

Attribute table:

Content	Description
Ecological Objective	**EO8. Coastal ecosystem and landscape**
IMAP Common Indicator	**CI16. Length of coastline subject to physical disturbance due to the influence of manmade structures**
Parameter	**Artificial/Natural coastline**

Attribute table	Specify the following information in the attribute table associated with the GIS information layer:
	• CPCODE: Two-letter code of Country
	• ART_NAT: Mandatory. Integer. Code for type of segment of coastline. Use the following code list
	  ○ 0 Natural coastline
	  ○ 1 Artificial coastline
	• Municipal: Optional. Text. Name of municipality or local administrative region where the polygon/polyline of segment of coastline is located
	• Year: Mandatory. Text. Year of production of the information layer
	• Ref_Year: Mandatory. Year of the reference coastline used to represent natural and artificial segments

Variables	Segment of artificial/natural of coastline
Spatial resolution	10 m or higher as produced by photo digitalization and interpretation
Vertical coverage	1 level at sea surface
Coordinate Reference System	WGS 84 or ETRS 89 decimal degrees
Temporal coverage	Every 6 years
Data format	GIS Layer: polyline

6.2-Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 “Length of coastline subject to physical disturbance due to the influence of manmade structures

Ecological Objective 8:	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved	
Indicator Title	Length of coastline subject to physical disturbance due to the influence of human-made structures	
Relevant GES definition	Related Operational Objective	Proposed Target(s)
Physical disturbance to coastal areas induced by human activities should be minimized.	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved.	Negative impacts of human activities on coastal areas are minimized through appropriate management measures.
GES, targets and measures cannot be expressed quantitatively (as a threshold value) but due to country specific circumstances (socio-economic, cultural, historical) should be defined by the countries themselves. In doing so the CPs should take their spatial development and planning policies into account, as well as the legal obligations of the Barcelona Convention, in particular the ICZM Protocol. The above GES definition and Proposed target(s) are just examples.		
Rationale		
Justification for indicator selection Mediterranean coastal areas are particularity threatened by coastal development that modifies the coastline through the construction of buildings and infrastructure needed to sustain residential, commercial, transport and tourist activities. The land, intertidal zone and near-shore estuarine and marine waters are increasingly altered by the loss and fragmentation of natural habitats and by the proliferation of a variety of built structures, such as ports, marinas, breakwaters, seawalls, jetties and pilings. These coastal human-made infrastructures cause irreversible damage to landscapes, losses in habitat and biodiversity, and strong influence on the configuration of the shoreline. Indeed, physical disturbance due to the development of artificial structures in the coastal fringe can disrupt the sediment transport, reduce the ability of the shoreline to respond to natural forcing factors, and fragment the coastal space. The modification of emerged beach and elimination of dune system contribute to coastal erosion phenomena by lessening the beach resilience to sea storms. Coastal defence infrastructures have been implemented to solve the problem together with beach nourishment but preserving the natural shoreline system with adequate sediment transport from river has proved to be the best solution. Monitoring the length of coastline subject to physical disturbance due to the influence of human-made structures and its trend is of paramount importance to preserve habitat, biodiversity and prevent coastal erosion phenomena, as well as for its importance in land-sea interactions. Until now there has not been systematic monitoring in Mediterranean regarding this, in particular not quantitatively based monitoring or any major attempt to homogenously characterize coastal ecosystems on a wider Mediterranean basis. The status assessment of EO8 aims to fill this gap.		
Scientific References Boak, E., H. & Turner I., L. (2005), Shoreline definition and detection: a review. Journal of Coastal Research 21(4), 688-703. Deichmann, U., Ehrlich, E., Small, E., and Zeug, G. (2011). Using high resolution satellite data for the identification of urban natural disaster risk (GFDRR (Global Facility for Disaster Reduction and Recovery)).		

Ecological Objective 8:	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved
Indicator Title	Length of coastline subject to physical disturbance due to the influence of human-made structures

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Rochette, J., Puy-Montbrun, G., Wemaëre, M., and Billé, R. (2010). Coastal setback zones in the Mediterranean: a study on Article 8-2 of the Mediterranean ICZM Protocol. n°05/10 December 2010, IDDRI

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UNEP/MAP/PAP (2001). White paper: coastal zone management in the Mediterranean. (Split).
UNEP/MAP (2013). Approaches for definition of Good Environmental Status (GES) and setting targets for the Ecological Objective (EO) 7 “Hydrography” and EO8 “Coastal ecosystems and landscape” in the framework of the Ecosystem Approach.

Policy Context and targets

Policy context description

ICZM Protocol (Article 8, point 3):

The Parties shall also endeavour to ensure that their national legal instruments include criteria for sustainable use of the coastal zone. Such criteria, taking into account specific local conditions, shall include, inter alia, the following:

identifying and delimiting, outside protected areas, open areas in which urban development and other activities are restricted or, where necessary, prohibited;

limiting the linear extension of urban development and the creation of new transport infrastructure along the coast;

ensuring that environmental concerns are integrated into the rules for the management and use of the public maritime domain;

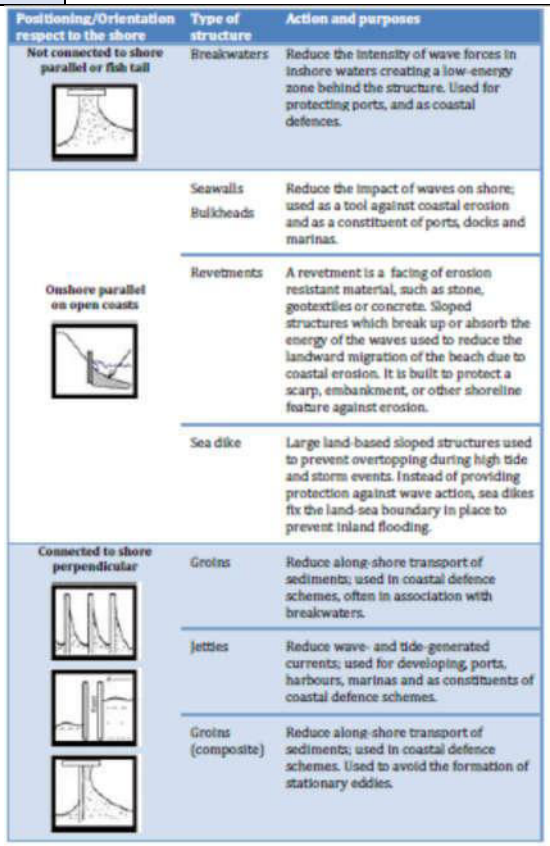
providing for freedom of access by the public to the sea and along the shore;

restricting or, where necessary, prohibiting the movement and parking of land vehicles, as well as the movement and anchoring of marine vessels, in fragile natural areas on land or at sea, including beaches and dunes.

Targets

Ecological Objective 8:	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved
Indicator Title	Length of coastline subject to physical disturbance due to the influence of human-made structures
Negative impacts of human activities on coastal areas are minimized through appropriate management measures. Additional country-specific criteria should be taken into account for definition of targets, measures and interpretation of results regarding this indicator due to strong socio-economic, historic and cultural dimensions in addition to characteristic geomorphological and geographical conditions in each respective country (reflected in policy documents, strategies and other country-specific documents). Interpretation of results should be left to the countries taking above criteria into account.	
Policy documents Protocol on the ICZM in the Mediterranean - http://www.pap-thecoastcentre.org/pdfs/Protocol_publikacija_May09.pdf	
Indicator analysis methods	
Indicator Definition The monitoring aim of the EO8 common indicator is twofold: (i) to quantify the rate and the spatial distribution of the Mediterranean coastline artificialitsation and (ii) to provide a better understanding of the impact of those structures to the shoreline dynamics. It has an operational target on impact, thus it is associated to concrete implementation measures related to specific human activities (i.e. appropriate management measures) to minimize negative impacts and to inform about progress towards GES.	
Methodology for indicator calculation The monitoring of this Common Indicator entails an inventory of the length and location of human- made coastline (hard coastal defence structures, ports, marinas (see Figure 1). Soft techniques e.g. beach nourishment are not included. With regard to the coastline to be considered: the fixed reference official coastline as defined by responsible Contracting Party should be considered. The optimal resolution should be 5 m or 1: 2000 spatial scale. Once a proper geographic scale has been established, monitoring should focus, in particular, on the location, the spatial extent and the types of coastal structures taking into account the minimum coastal length that can be classified as artificial or natural. The identification procedure of human-made structures should be carried on based on typical situations added to the indicator guidance factsheet, including the minimum size (length, width of human-made structures) to be taken into account. As monitoring should be done every 6 years, every CP should fix a reference year in the time interval 2000-2012 in order to eliminate the bias due to old or past human-made infrastructures.	

Ecological Objective 8:	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved
Indicator Title	Length of coastline subject to physical disturbance due to the influence of human-made structures



Positioning/Orientation respect to the shore	Type of structure	Action and purposes
Not connected to shore parallel or fish tail	Breakwaters	Reduce the intensity of wave forces in inshore waters creating a low-energy zone behind the structure. Used for protecting ports, and as coastal defences.
Onshore parallel on open coasts	Seawalls Bulkheads	Reduce the impact of waves on shore; used as a tool against coastal erosion and as a constituent of ports, docks and marinas.
	Revetments	A revetment is a facing of erosion resistant material, such as stone, geotextiles or concrete. Sloped structures which break up or absorb the energy of the waves used to reduce the landward migration of the beach due to coastal erosion. It is built to protect a scarp, embankment, or other shoreline feature against erosion.
	Sea dike	Large land-based sloped structures used to prevent overtopping during high tide and storm events. Instead of providing protection against wave action, sea dikes fix the land-sea boundary in place to prevent inland flooding.
Connected to shore perpendicular	Groins	Reduce along-shore transport of sediments; used in coastal defence schemes, often in association with breakwaters.
	Jetties	Reduce wave- and tide-generated currents; used for developing, ports, harbours, marinas and as constituents of coastal defence schemes.
	Groins (composite)	Reduce along-shore transport of sediments; used in coastal defence schemes. Used to avoid the formation of stationary eddies.

Figure 1. Hard coastal defence structures, modified from the EUROSION Shoreline Management Guide, EU, 2004. Taken from IMAP guidelines, page 134, Table 1.

Indicator units

Km of artificial coastline and % of total length of coastline.

Percentage (%) of natural coastline on the total coastline length.

The length of artificial coastline should be calculated as the sum of segments on reference coastline identified as the intersection of polylines representing human-made structures with reference coastline ignoring polylines representing human-made structures with no intersection with reference coastline. The minimum distance between coastal defence structures should be set to 10 m in order to classify such segments as natural, i.e. if the distance between two adjacent coastal defence structures is less than 10 m, all the segment including both coastal defence structures is classified as artificial.

List of Guidance documents and protocols available

Monitoring and assessment methodological guidance on EO8: coastal ecosystems and landscapes (within IMAP guidelines)

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EUROSION Shoreline Management Guide (European Commission and Directorate General Environment, 2004, Annex 2)	
Data Confidence and uncertainties Regarding data confidence, both geographic scale and resolution of images have to be properly selected depending on type and density of coastal human-made structures. A specific cost/benefit analysis has to be carried on to choose the right balance among resolution, an acceptable level of uncertainties and the necessity to assure comparability of results at Mediterranean level.	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols Space and airborne earth observation systems are the most suitable tool to conduct the monitoring strategy of the EO8 common indicator, i.e. very high resolution (VHR) satellite imagery, aerial photographs, laser scanners etc. Beyond earth observation data, identification techniques and procedures used through GIS tools also have to be described	
Available data sources CORINE land cover, national spatial plans, World Imagery Basemap feature (in ArcGIS 10.1), Landsat satellite imagery, Google earth, aerial photographs surveys.	
Spatial scope guidance and selection of monitoring stations The exact territorial extent of the monitoring should be presented. The optimum spatial scale for a proper identification of human-made structures should be 5 m by satellite imagery or aerial photographs.	
Temporal Scope guidance Monitoring human-made structures data should be updated at least every 6 years, while shoreline survey of sandy coastline under anthropogenic pressure should be, if possible, repeated annually (at the same time of the year)	
Data analysis and assessment outputs	
Statistical analysis and basis for aggregation The total length of coastline estimated as being subjected to physical disturbance due to the influence of human-made structures should be summed. In addition, the share of this coastline in total country's coastline should be determined. If an official coastline is available, i.e. an institutional body provides a GIS polyline, then such coastline can be used to “project” the identified human-made structures in order to classify parts of the coastline as being subjected to physical disturbance due to the influence of human-made structures. Geographic scale of maps and cartography used to identify human-made structures could be different but not too much form the ones used for the official coastline. In case if such official coastline is not available or its geographic scale is too coarse with respect to one needed to properly identify human-made structures, then coastline will be defined by the same maps/cartography used for human-made structures identification.	
Expected assessments outputs	

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The total length of coastline influenced by human-made structures and the share of this coastline in total country's coastal length should be provided on a map showing the coastline subject to physical disturbance due to human-made structures (artificial segments) in red line and the rest (natural segments) in green line.
The assessment output should be reported as a common shape file format with GRS as WGS84. Shape file with other GRS will also be accepted if provided with a complete .prj file that allows GRS transformations by standard GIS tools.

Known gaps and uncertainties in the Mediterranean
In order to implement EO8 indicator with an acceptable level of accuracy, recent data sources with proper spatial resolution and complete coastline coverage should be used jointly with adequate GIS tools and expert team.
Capacity building can be readily assessed for each CP as such resources are generally available for the Mediterranean Region also taking into account the increasing efforts on satellite imagery products (ESA Sentinels constellation). So, once a common framework of data sources, GIS procedures and way of representing the output of EO8 indicator are agreed, a common implementation work for all CPs could be in principle settle down.

Contacts and version Date

Key contacts within UNEP/MAP for further information

Version No	Date	Author
V.1	27/6/16	PAP/RAC & Giordano Giorgi
V.2	27/7/16	Giordano Giorgi
v.3	23 March 2018	PAP/RAC