

Experience Note



Photo: L.-M. Preau / Initiative PIM

Assessment of climate variability and change impacts and evaluation of response options (Case study of Tunisia)

AT A GLANCE

The "*Integration of climatic variability and change into national strategies to implement the ICZM Protocol in the Mediterranean*" ("*ClimVar & ICZM*" project) is a collective effort to promote the use of Integrated Coastal Zone Management (ICZM) in countries sharing the Mediterranean as an effective tool to deal with the impacts of climate variability and change in coastal zones, by mainstreaming them into the ICZM process. It was adopted in January 2012 and will be completed in late 2015. The project is led by UNEP/MAP, within the framework of the MedPartnership project. Its executing partners are PAP/RAC, Plan Bleu/ RAC and GWP-Med.

Participating countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Libya, Morocco, Montenegro, Palestine, Syria and Tunisia.

Total budget: USD 9.2 million.

USD 2.2 million: Global Environment

Facility; USD 7 million: Participating

countries, executing agencies, and donors.

ABSTRACT

The coastline of Tunisia is more than 1,700 km long, including the continental part and the islands, with a variety of coastal types. Tunisia is considered as one of the Mediterranean countries most vulnerable to climate variability and change, and particularly to sea-level rise and storm surges. Its coastal wetlands, which are located at a very low elevation, are of particular concern.

This activity will help evaluate the future impacts expected to occur in coastal zones, in terms of assets and persons impacted, if the current practices in coastal management remain unchanged and under different development scenarios. The Dynamic Integrated Vulnerability Assessment (DIVA) modelling framework is used to assess the increased coastal flood risk in terms of the expected annual damage from extreme sea-level events and dry land loss due to sea-level rise. DIVA is intended to highlight the need for and support decision making on future adaptation policies in coastal management.

The first results of the assessment are in good agreement with the vulnerability trends identified by the Tunisian experts studying the impacts of the sea-level rise in the country. Sea-level rise is expected to have significant impacts in the course of the century, and adaptation measures are required. Results show that hard defence construction and continuous beach nourishment would be economically beneficial compared to "do-nothing" approaches but this does not mean that dikes and nourishment are the only available options. Actual coastal adaptation will need to take into account the wider objectives of coastal management and development.

ACTIVITY DESCRIPTION

The DIVA modelling framework is largely recognised in climate science as a key tool for assessing the economic costs of climate variability and change (CV&C) in the coastal zone. The model was applied in two selected countries – Croatia and Tunisia. All partner countries were invited to apply if they could guarantee the necessary input data. In Tunisia, preliminary results were presented in 2014, while the final results will be published in 2015.

THE EXPERIENCE

The DIVA model was downscaled at the national level for the Tunisian case study. Since the democratic uprising in 2012 the institutional and political background has been constantly evolving. However, data and information exchange between the DIVA team and its Tunisian counterparts, under the Tunisian Coastal Agency (APAL), has been continuous and productive.



Photo: APAL

Addressing the Issue/mMthodology

DIVA is an integrated, global research framework for assessing the biophysical and socio-economic consequences of sea-level rise and associated extreme water levels under different physical and socio-economic scenarios, also considering various adaptation strategies. The approach of the DIVA segmentation was applied to the Tunisian coasts and was based on:

- elements of the coastline, such as coastal types, plain, river mouth and lagoon;
- population density; and
- administrative units.

The Tunisian DIVA segmentation of the coast constitutes the data model for a spatial data base that includes more than 80 physical, ecological and socio-economic parameters. The initial global DIVA segmentation represented Tunisia with 35 segments; with the downscaled Tunisian DIVA segmentation a total of 563 segments were defined.

The preliminary results provided by the Global Climate Forum and the University of Kiel were based on the processing of open source and online available data (i.e., coastal type, coastal plain, river mouth, population, administration unit, lagoon). The following key information summarises the input data of DIVA for Tunisia:

Coast length: 2,104 km; erodible coast length: 484 km

Current (2010) exposure below 2 m:

- People: 258,283
- Assets: USD 5.6 billion
- Area: 5,370 km²

Current (2010) exposure below 100-year flood:

- Average height of 100-year flood: 1.53 m
- People: 186,416
- Assets: USD 4047 million
- Area: 1,107 km²

Coastal administrative Units: 78

The final results provided by the Global Climate Forum and the University of Kiel combine preliminary results and inputs from the Tunisian partners, essentially GIS data provided by APAL.

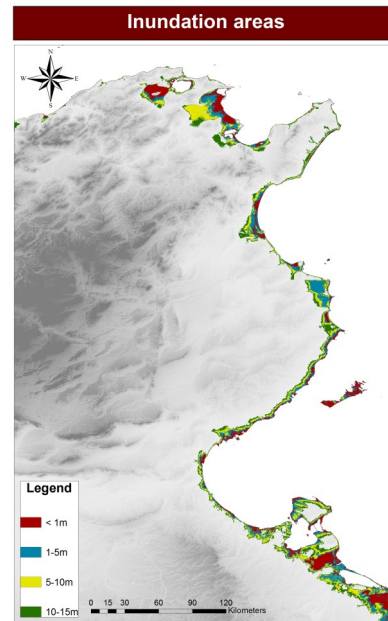
RESULTS

Flooding is an issue in Tunisia (exposure):

- 1,124 km² of the Tunisian coastal zone is currently exposed to the 1-in-100 year coastal extreme water level;
- 21st century sea-level rise (RCP 8.5) would increase this area to 1,666 km²;
- Médenine is the municipality with the biggest potential 100-year floodplain, followed by Bizerte and Sfax;
- Tunis, Ben Arous and Sfax have the highest asset values and population in the potential 100-year floodplain;
- Worst case in 2100: up to 436,000 people flooded annually, annual cost of up to USD 45.5 billion;
- Damages are mainly concentrated in Sfax, Tunis and Ben Arous;
- Impacts can be reduced significantly when applying appropriate adaptation measures (Avoided annual flood damages in 2100: US\$ 19,00 – 49,428 million due to adaptation *via* dikes);
- Up-front investments of US\$ 18.8 billion to build initial dikes for about 86% of Tunisia’s coastline plus annual investment and maintenance costs increasing from US\$ 169 million per year in 2100 to US\$ 220-300 million at the end of the century would be required. Protection by dikes will not be very attractive for tourism.

Erosion is an issue in Tunisia:

- Without adaptation: annual land loss of up to 5,200 km² in 2100 (around 1/3 of the Tunisian coastline consists of erodible beaches);
- Municipalities most affected by erosion are Nabeul, Sousse, Médenine and Bizerte;
- Adaptation (beach nourishment) in 2100 would cost about USD 43.82 million annually and up to 7,2 km² of sand;
- Keeping the beaches used for tourism is relatively expensive.



Inundaion areas in Tunisia



Sfax region, areas <15 m

LESSONS LEARNED

Replication: After presenting the preliminary results, the partners agreed to push forward with the DIVA Tunisia modelling. Further analysis will be based on the integration of more specific data forwarded by the Tunisian partners. A list of comments can be used to illustrate (i) the value of data provided (e.g. more details on the coastal types, etc.), (ii) steps beyond the final results, and (iii) guidelines for future cooperation.

Effectiveness/efficiency: Greater involvement of Tunisian partners in the early stages of the socio-economic evaluation of CV&C impacts would guarantee a better adaptation of the model as a decision-making tool suited to local needs and capacity improvement. Further involvement in the process of evaluation of the results will provide useful insights on the extent and drivers of impacts of sea-level rise in the Tunisian coasts.

Sustainability: It will be important to enhance local expertise (i.e. inundation modelling, harbour development analysis, etc.). Other areas for further cooperation are also identified. Brief recommendations should provide insight into what can be done and will provide “material” to sustain the discussion with the Tunisian partners on further cooperation.

IMPACTS

First results of the DIVA model were presented in 2014 to 30 senior Tunisian experts in coastal zone management and representatives of national research institutions and organisations, such as the National Institute for Marine Studies, the National Institute of Meteorology, and the National Coastal Agency. Great interest was shown in the technical aspects of the DIVA model.

After the meeting, it was decided to work on a more detailed analysis using available Tunisian data. The latest findings of DIVA Tunisia were presented at the MedPartnership Final Conference on ICZM in Split on 12-13 May 2015. A study on CV&C impacts per sector in Tunisia was launched in cooperation with Mr. A. Markandya, Scientific Director of the Basque Centre for Climate Change, for which a Tunisian expert was hired to gather and analyse the data. The results were presented in Kiel, on September 8 2015, during a Regional conference on the evaluation of socio-economic impact of CV&C. Because of the interest shown in Tunisia and by partners in the project countries, a regional DIVA training session was also organised. This meeting was an opportunity to discuss the methodologies and results of the evaluation of socio-economic CV&C impacts on coastal zones.



Photos: APAL

REFERENCES

Priority Actions Programme/Regional Activity Centre (PAP/RAC)
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KEYWORDS

climate change; sea level rise; coastal flooding; coastal management; adaptation; resilience; mitigation

EXECUTING PARTNER

PAP/RAC is established in 1977 in Split, Croatia, as a part of the Mediterranean Action Plan (MAP) of the United Nations Environment Programme (UNEP). PAP/RAC's mandate is to provide support to Mediterranean countries in the implementation of the Barcelona Convention and its Protocols, and in particular of the Protocol on Integrated Coastal Zone Management. PAP/RAC is oriented towards carrying out of the activities contributing to sustainable development of coastal zones and strengthening capacities for their implementation. Thereby, it cooperates with the national, regional and local authorities, as well as with a large number of international organisations and institutions.

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Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem

Together for the Mediterranean Sea

MedPartnership



Executing partners: FAO, UNESCO/IHP, UNIDO, GWP-Med, MIO-ECSDE, WWF MedPO, UNEP/MAP's MEDPOL programme and Regional Activity Centres (SCP/RAC, SPA/RAC and PAP/RAC).

Participating countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Lebanon, Libya, Morocco, Montenegro, Palestine, Syria, Tunisia and Turkey.

Partner countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Lebanon, Libya, Morocco, Montenegro, Palestine, Syria, Tunisia and Turkey.