13 THE COASTAL SYSTEM

A. THE PHYSICAL COMPONENT

13A.1. GOALS

Coastal erosion is a widespread phenomenon along the Mediterranean shorelines, especially those where human interference has been continuous for thousands of years like Lebanon. Coastal land subsidence, the frequently severe climatic regime and low-lying shoreline segments mean a high rate of coastal deterioration, notably with the expected Relative Rise in Sea Level (RRSL) resultant from climate change. The vulnerability of the coastal community and the quality of coastal fresh water are serious issues affecting more than 70% of Lebanon's population.

Accordingly, this study aims to assess the impacts of climate change on the physical aspects of the coastal system, and vulnerability of components affecting the quality of life of the coastal community. It identifies adaptation measures for proper management through a variety of technical, administrative and policy options.

13A.2. SCOPE

The exposure units used to reflect the vulnerability of the coastal physical component are the coastal stretch, the community and coastal water. They are exposed at different fragile coastal segments along Lebanon's shoreline through a time frame defined by on-going trends, as well as the years 2015 (like water resource of Chapter 2), 2050 and 2080 the benchmark years of climate change.

13A.3. METHODS AND UNCERTAINTIES

Different approaches are followed including analogues to learn from past or similar conditions; field surveys where data are missing or where new techniques are applied; and modeling because some data are predictive in nature and there is an obvious need in themes related to climate change to resort to future projections. Indeed, there are uncertainties in all the above methods because data in Lebanon and the scope of scientific research are quite lacking. This is why evaluations are done for the predictive capabilities of the mentioned methods. Thus, sensitivity analysis, scientific feasibility and data needs are employed for valuation and a summary matrix gives the overall picture of appropriateness of the methodology. This leads to establish a set of useful data on coastal storms and their impacts especially on the community, physical parameters of the shoreline as they are crucial indicators for calculating land loss using the famous Bruun Rule, estimates of rates of annual RRSL, study cases of coastal erosion, climatic modeling, and the status of the shoreline including its geoidal elevation, therefore, where it is at most risk.

13A.4. VULNERABILITY AND IMPACT ASSESSMENT

This is where first the climate change scenario is introduced and then impacts are analyzed. To be meaningful, the expected future has to be compared to the present. Current estimates and calculations show a RRSL of about 4mm, and land loss varying between 7 and 16mm. The coastal stretch was classified into three categories: very critical, critical and less critical. Thus, existing conditions and plans in terms of expected incurred economic losses due to an increase in coastal flooding and resource deterioration are shown as a baseline to the year 2015 (this is in line with the water sector-see Chapter2- as water is a vulnerable unit), and projected further to 2050 and 2080. It shows an estimated financial annual losses between $55-60 million. Then, with climate change impact reflected by a higher level of the sea, it means that low-lying areas are flooded more and financial losses could increase to $75 million annually (Fig. 19).

13A.5. ADAPTATION MEASURES

These are identified at three levels as the impacts are expected to affect the whole social structure: the strategic, the population and the individual levels. A total of 33 options are given falling under 4 opportunities: prevention, sharing, changing, and control technology. The options are further recommended, after being screened with respect to their priorities, into 3 phases: the immediate within the year 2001, the medium term within 2005, and the long term within the year 2010 (see attached list).

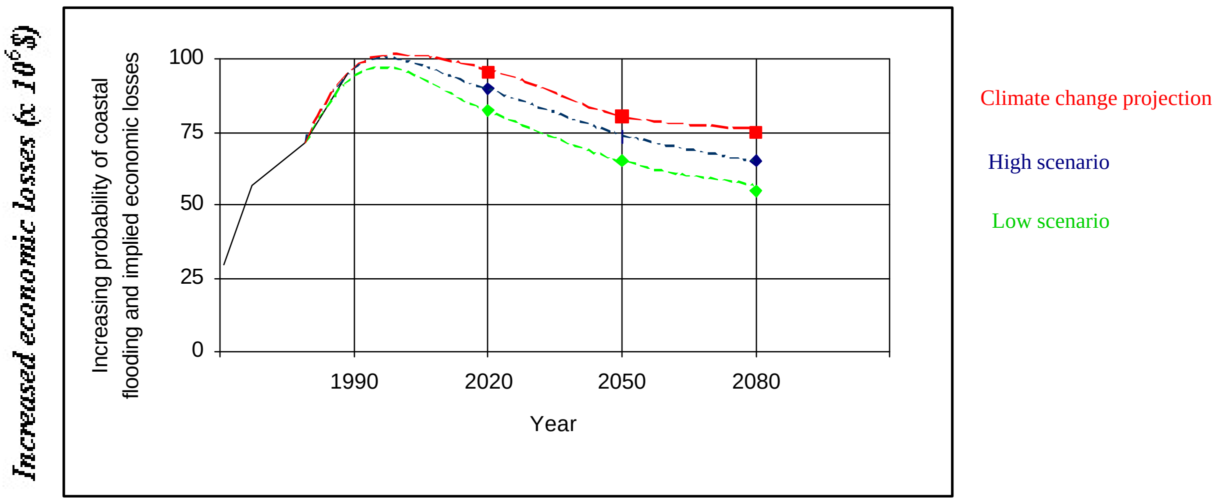

Fig. 19. Climate change projection, probability of coastal flooding and implied increase in financial losses

Proposal concepts on selected themes relating to the physical component of the coastal system

Theme	Justification	**Methodology, Workplan and Duration**	**Budget $**
4. Assessing environmental indicators at "very critical" low-lying shorelines in Lebanon for coastal protection	Heavy financial losses will be incurred as studies have indicated an estimated 4mm of coastal land subsidence, a land loss varying between 7 & 16mm annually, and the presence of low-lying shorelines. With expected relative rise in sea level due to climate change, those losses will increase	Phase I: 1-2 months • Documentation • Preparation • Pilot area • Stake holders Phase II: 8-10 months • Shoreline parameters • Defining climate coastal regime • Defining human interference • Geoenvironmental stresses • Satellite-borne data Phase III: 6-8 months • Monitoring parameters-indicators • Data analysis including GIS • Defining control mechanisms • Protection measures Phase IV: 4-6 months • Projected limits and constraints • Optimum protection parameters • Feedback testing • Reporting & dissemination	85000
5 Effects of sea level rise on salt-water intrusion along selected coastal segments	As sea water is expected to rise, and because the land is karstic and/or fractured with sea water intrusion occurring, this intrusion will increase and affect further the quality of coastal fresh groundwater	Phase I: 1-2 months • Documentation • Preparation • Pilot area • Stake holders Phase II: 10-12 months • Geological delineation • Hydrological regime • Human interference and water use • Relative rise in sea level Phase III: 8-10 months • Monitoring coastal regime • Monitoring groundwater • Data analysis including	145000

		GIS • Defining intrusion boundaries Phase IV: 4-6 months • Model construction • Model validation • Reporting & dissemination	