

ADAPTATION TO THE IMPACTS OF SEA LEVEL RISE IN EGYPT

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Abstract. Assessment of the vulnerability and expected socioeconomic losses over the Nile delta coast due to the impact of sea level rise is carried out in details. Impacts of sea level rise over the Governorates of Alexandria and Port Said in particular, are evaluated quantitatively. Analysis of the results at Alexandria Governorate indicate that, if no action is taken, an area of about 30% of the city will be lost due to inundation. Almost 2 million people will have to abandon their homeland; 195,000 jobs will be lost and an economic loss of over \$3.5 Billion is expected over the next century. At Port Said Governorate results indicate that beach areas are most severely affected (hence tourism), followed by urban areas. The agriculture sector is the least affected sector. It is estimated that the economic loss is over \$ 2.0 Billion for 0.50 m SLR and may exceed \$ 4.4 Billion for 1.25 m SLR.

Options and costs of adaptation are analyzed and presented. Multi-criteria and decision matrix approaches, based on questionnaire surveys are carried out to identify priorities for the two cases. Analysis of these techniques of two options; the current policy (hard protection measures on some vulnerable areas) and no action (stopping these activities) have the lowest scores. Beach nourishment and integrated coastal zone management (ICZM) have the highest scores, however ICZM has high cost measures. The most cost-effective option is the land-use change, however with relatively very high cost measure. It is recommended that an ICZM approach be adopted since it provides a reasonable trade off between costs and cost effectiveness.

Key words: adaptation, climate change, socioeconomic impacts, Egypt.

1. Introduction

It has been well established that climate change is expected to take place over the next century in spite of the international effort for mitigation of greenhouse gas emissions. It is expected to exacerbate already existing environmental problems in many countries. In particular coastal areas all over the world are expected to suffer from impacts of sea level rise (SLR) as well as other impacts, in addition to already existing problems of coastal erosion, subsidence, pollution, land use pressures and deterioration of ecosystems. In Egypt, the most fertile land of the Nile Delta coast is vulnerable to the impacts of SLR (e.g., Sestini, 1989). A detailed vulnerability assessment of the most important cities along the Mediterranean coast was studied. Cases of the cities Alexandria, Rosetta and



Port Said have revealed serious potential impacts of SLR on various socio-economic sectors (El-Raey *et al.*, 1995, 1997, and 1998).

If this is the case, then an anticipatory adaptation strategy must be developed in spite of the large uncertainty involved. The foundations, upon which this strategy is built, are the “precautionary principle” and the “no regrets policy”. Smith (1994) has illustrated the importance of setting up priorities in spite of uncertainties of climate change. The objective of this paper is to present the results of a study carried out at Alexandria and Port Said Governorates to identify, assess and prioritize options for adaptation to sea level rise, and to carry out an economic evaluation of the required adaptation measures.

2. Adaptation Assessment Methodology

The steps followed for implementation of the adaptation strategy follows the guidelines published by Carter *et al.* (1994). A broad framework for the evaluation of adaptation strategies to cope with climate change can be identified. This comprises the following steps:

- Defining the objectives.
- Specifying the climatic impacts of importance.
- Identifying the adaptation options.
- Examining the constraints.
- Quantifying measures and formulating alternative strategies.
- Weighting objectives and evaluating trade-offs.
- Recommending adaptation measures.

2.1. DEFINING OBJECTS

Some overall goals and evaluation principles must guide any analysis of adaptation. Two examples of general goals commonly propounded are (i) the promotion of sustainable development, and (ii) the reduction of vulnerability. These are open to various interpretations, however, so specific objectives need to be defined that complement the goals. Objectives are usually derived either from public involvement, from stated public preferences, by legislation, through an interpretation of goals such as those stated above, or any combination of these.

2.2. SPECIFYING THE CLIMATIC IMPACTS OF IMPORTANCE

This step involves an assessment, following the methods outlined elsewhere above, of the possible impacts of climate variability or change on the exposure unit. Where climatic events are expected that will cause damage, these need to be specified in detail so that the most appropriate adaptation options can be identified. A complete vulnerability assessment must be carried out so as to identify as accurately as possible the extent of the damage expected.