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Implications of Expected Climate Change in the Eastern African Coastal Region: an Overview

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PREFACE

In spite of uncertainties surrounding the predicted climate change, greenhouse gases appear to have accumulated in the atmosphere to such a level that the changes may have started already and their continuation may now be inevitable.

The environmental problems associated with the potential impact of expected climate change may prove to be among the major environmental problems facing the marine environment and adjacent coastal areas in the near future. Therefore, in line with UNEP Governing Council decision 14/20 on "Global Climate Change", the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of the United Nations Environment Programme (UNEP) launched and supported a number of activities designed to assess the potential impact of climate change and to assist the Governments concerned in identification and implementation of suitable response measures which may mitigate the negative consequences of the impact.

Since 1987 to date, Task Teams on Implications of Climate Change were established for ten regions covered by the UNEP Regional Seas Programme (Mediterranean, Wider Caribbean, South Pacific, East Asian Seas, South Asian Seas , South-East Pacific, Eastern Africa, West and Central Africa, the Kuwait Action Plan Region and the Red Sea and Gulf of Aden). The Task Team for the Eastern African Region was sponsored by UNEP.

The initial objective of the Task Teams was to prepare regional overviews and site-specific case studies on the possible impact of predicted climate change on the ecological systems, as well as on the socio-economic activities and structures of their respective regions. The overviews and case studies were expected to:

- examine the possible effects of the sea-level changes on the coastal ecosystems (deltas, estuaries, wetlands, coastal plains, coral reefs, mangroves, lagoons, etc.);
- examine the possible effects of temperature elevations on the terrestrial and aquatic ecosystems, including the possible effects on economically important species;
- examine the possible effects of climatic, physiographic and ecological changes on the socio-economic structures and activities; and
- determine areas or systems which appear to be most vulnerable to the above.

The regional overviews were intended to cover the marine environment and adjacent coastal areas influenced by, or influencing, the marine environment. They are to be presented to intergovernmental meetings convened in the framework of the relevant Regional Seas Action Plans, in order to draw the countries' attention to the problems associated with expected climate change and to prompt their involvement in development of policy options and response measures suitable for their region.

Following the completion of the regional overviews, and based on their findings, site-specific case studies are developed by the Task Teams and are planned to be presented and discussed at national seminars. The results of these case studies and the discussions at the national seminars should provide expert advice to national authorities in defining specific policy options and suitable response measures.

The Task Team on the Implications of Climate Change in the Eastern African Region was established and met in its first meeting in Nairobi between 21-23 June 1989, and in its second meeting jointly with the Task Team for the West and Central African Region in Nairobi between 18-21 December 1989. Each member of the Task Team was assigned a specific subject to address in detail, and the present overview is largely based on the contributions by the individual members of the Task Team as given in Annex I. The Task Team consisted of:

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This publication was prepared by A.L. Alusa and L.J. Ogallo on the basis of work carried out by the Eastern African Task Team, edited by John C. Pernetta, and finalized for publication by M. Gerges (Deputy Director) and M. Kh. El-Sayed (Consultant) of OCA/PAC.

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1. INTRODUCTION

Anticipated global warming as a result of the emission of greenhouse gases into the atmosphere was the most important subject discussed during the fifteenth session of the Governing Council of UNEP and at the Second World Climate Conference. The so-called greenhouse effect is a most pressing environmental problem to the extent that it involves many scientific disciplines and hence presents major challenges. The greenhouse gases (CO_2, CFCs, CH_4, N_2O, O_3, etc.) have the effect of changing the atmosphere's radiative balance by trapping more heat near the earth's surface resulting in a rise in global mean surface temperature. It is now clear that if the burning of fossil fuel continues at the present rate, global warming is a virtual certainty.

General circulation models estimate that by the year 2030 the mean global temperature will increase within the range 0.5-4.5°C, (Bolin *et al*, 1986, IPCC, 1990). This may appear small, but even the lower end of this range, if achieved, would cause major changes in regional climate. Specifically, such regional climate change, when coupled with an increase in frequency and intensity of extreme weather events such as floods, droughts and cyclones, will have considerable impact on communities and their socio-economic well-being. The regional impacts of changes in greenhouse gas concentrations are, however, not well understood.

Present planning activities, to the extent that they are climate-sensitive, assume that past climate provides a reliable basis for future climate. With the known effects of greenhouse gases, this assumption is no longer valid. A forecast of future climate must now take cognizance of the greenhouse effect and the anticipated global climate warming. Specifically, the expected melting of ice-sheets and thermal expansion of the oceans is expected to lead to sea-level rise in the range of 20-140 cm by the end of the next century. In 1990, the Intergovernmental Panel on Climate Change (IPCC) estimated that the global mean sea-level will rise by 20 cm by the year 2030. These expected changes are important additions to the planning process in view of the increasing population and the subsequent increase in use of coastal areas for various activities such as tourism, agriculture, fishing, harbours and industries. For the Eastern African Region, the sea-level rise forecasts necessitate a serious examination of efforts towards the amelioration of the adverse effects of global warming.

Obviously, serious environmental problems are likely to arise in association with potential impacts of expected climate change in coastal areas of East Africa, and the objectives of the Task Team were as follows:

Long Term Objectives

(a) Assess the potential impact of climate change on the coastal and marine environment as well as on the socio-economic structures and activities; and

(b) Assist Governments in the identification and implementation of suitable policy options and response measures which may mitigate the negative consequences of the impacts.

Short Term Objectives

(a) Analyze the possible impact of expected climate change on the coastal and marine ecological system, as well as on the socio-economic structures and activities; and

(b) Prepare overviews and selected case studies relevant to the Eastern African Region.

This overview is expected to specifically address the following:

(a) Possible effects of the sea-level changes on the coastal ecosystems (deltas, estuaries, wetlands, coastal plains, coral reefs, mangroves, lagoons, etc.);

(b) Possible effects of the temperature elevations on terrestrial and aquatic ecosystems, including the possible effects on economically important species;

(c) Possible effects of climate, physiographic and ecological changes on the socio-economic structures and activities; and

(d) Areas or systems which appear to be most vulnerable to the expected impacts.

The overviews were further expected to be based on:

(a) Best available existing knowledge and insight into the problems relevant to the objectives of the study;

(b) Assumptions accepted at the UNEP/ICSU/WMO International Conference in Villach, 9-15 October 1985, i.e., an increase in temperature of 1.5-4.5°C and a sea-level rise of 20-140 cm before the end of the twenty-first century. For the purpose of this overview and the various studies by members of the Task Team, a temperature elevation of 1.5°C and a sea-level rise of 20 cm by the year 2025 were accepted (with the understanding that these estimates may have to be revised on the basis of new scientific evidence). An IPCC (1990) scenario, for example, estimates the mean global sea-level rise to be between 10-30 cm by the year 2030, and 20-100 cm by the end of the next century; and

(c) Several detailed case studies, which would constitute the substantive annexes of the studies.

This paper reviews the results of a series of papers prepared by members of the Task Team on Implications of Climate Changes in the Eastern African Region, in cooperation with the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of UNEP, these are listed in Annex I of this report.

2. PHYSICAL CHARACTERISTICS OF THE REGION

2.1 CLIMATE

The Eastern African Region straddles latitudes 18°N - 27°S and has large spatial variations in climate, which range from arid and semi-arid to humid tropical. Specifically, rainfall is one climate parameter with the highest spatial and temporal variability in the region. These large variations are due, in part, to the complex topographical features and thermally induced meso-scale circulations. Figure 1 gives some examples of the typical seasonal rainfall characteristics over the region. Most of the areas near the equator have two distinct rainfall seasons centered around March-May and September-November. These seasons are related to the double passage of the Inter Tropical Convergence Zone (ITCZ) which follows the seasonal movement of the sun. Away from the equator, most of the rain is concentrated within the summer seasons as is evident in Figure 1. The peaks in the northern and southern hemisphere are centered around June-August and December-February respectively. It should be noted that the seasonal rainfall patterns are significantly modified in some areas by meso-scale systems. For example, some of the coastal areas receive their rainfall throughout the year as a result of the land/sea breeze effects while those lying on the leeward sides are permanently dry. Apart from the ITCZ, the intensity, location and orientation of the monsoonal wind systems, tropical cyclones, sub-tropical anticyclones, jet streams, extra-tropical weather systems, easterly/westerly waves, global teleconnections, etc., are among the other systems which affect the climate of the area. These, together with the dominant regional features such as the Mozambique channel trough, the dynamic low running across the African Continent in a north-easterly/south-westerly direction and the other thermally induced meso-scale circulations, significantly affect the local climates of some areas. If these features are shifted, changed or modified by the expected greenhouse gas induced climate change, the climate of the region will be changed.

Further away from the equator, temperature becomes a significant variable with a clear distinction between the cold winter and hot summer seasons. Additionally, the highlands have a marked temperature differential, and these differentials determine the local environmental humidity. A description of the climate of the region is provided by Griffith (1972) and Ogallo (1985).

2.2 GEOGRAPHY

The geography of the coastal areas of the Eastern African Region will, in this context, be delimited to latitudes 18°N-27°S to include Comoros, Kenya, Madagascar, Mauritius, Mozambique, Reunion, Seychelles, Somalia and Tanzania. The mainland coastal plain lies less than 100m above sea-level and is narrowest (10km or less) in northern and north-eastern Somalia and from south-eastern Kenya to northern Mozambique. It becomes wider (around 20km) southward and in areas traversed by large rivers such as the Juba, Limpopo, Pangani, Rio Save, Rufiji, Ruvu, Ruvuma, Tana and Zambezi (Figure 2). Immediately inland, the topography is interrupted by a range of mountains and escarpments before rising to inland plateaux (UNEP 1982).