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FLORIDA

IFAS EXTENSION

Impact of Climate Change on Water Resources¹

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THE RELEVANCE OF CHAPTER 18 OF THE AGENDA 21 FOR STATE GOVERNMENTS

PROTECTION OF THE QUALITY AND
SUPPLY OF FRESHWATER RESOURCES:
APPLICATION OF INTEGRATED APPROACHES
TO THE DEVELOPMENT, MANAGEMENT AND
USE OF WATER RESOURCES

INTRODUCTION

In 1987, the UN World Commission on Environment and Development linked the issue of environmental protection to global environmental economic growth and development. Headed by Norwegian Prime Minister Gro Harlem Brundtland, this commission published the report *Our Common Future*. The Brundtland Commission report concluded that the world was threatened by extraordinarily serious global environmental problems, caused in large part by development patterns that were leaving increasing numbers of people poor. Scientific evidence demonstrated rapid destruction of air, water, species of flora and fauna, deserts, forests, and other ecosystems as well as overuse of natural resources.

It is predicted that the world population will more than double during the next century. As a result, a new development pattern is required for the entire planet that would "sustain" human development. The Brundtland Commission report thrust the concept of "sustainable development" into the mainstream of world debate, as the only manner to confront the twin problems of environmental degradation and necessary economic development.

The need for sustainable development applies to both developing as well as developed nations of the earth. The developing world needs sustainable development to avoid the environmental destruction entailed by moving billions of the poorest people on earth to basic levels of human health and dignity. The developed nations must move to sustainable development to avoid environmental catastrophe entailed by the developed world's depletion of natural resources and its destruction of air, water, and the natural environment.

In December 1989, the General Assembly of the United Nations called for a meeting of all the nations of the Earth to confront the twin problems of environmental destruction and the necessity for

1. This document is AE250, one of a series of the Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date April, 1994. Reviewed July, 2002. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.

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sustainable development. The United Nations Conference on Environment and Development was set for June of 1992 in Rio de Janeiro, Brazil.

The Rio Earth Summit was the largest international meeting in history. During the meeting five documents were signed. The first two, the Conventions on Climate change and biodiversity, received most of the publicity in the United States, largely because of the role played by the United States in perceived weakening of the first and the refusal to sign the second. Other documents signed at Rio were the Rio Declaration, a nonbinding set of 27 principles that deal with the rights and responsibilities of nations relating to environment and development, and Forest Principles Agreement, a nonbinding statement of principles for the sustainable management of global forests. Not widely publicized in the United States was the main substantive work of the Earth Summit, Agenda 21, the fifth document signed at Rio.

Agenda 21 is a comprehensive blueprint for global action into the 21st century designed to solve the twin problems of environmental destruction and the necessity for sustainable development. It is an 800 page document comprising four sections and 40 chapters. Agenda 21 is based on the notion that humanity has reached a defining moment in its history. The nations of the earth cannot continue present policies that deepen economic divisions between rich and poor and that are causing the continued deterioration of the ecosystems on which we depend for life on earth. If the peoples of the world are to avoid environmental catastrophe they must move to implement policies and practices of sustainable development.

Even though Agenda 21 is not binding on the signatory nations, it is expected to work as a set of normative principles that will determine appropriate international behavior in the next century. A new commission on sustainable development has been set up in the United Nations to review the efforts of the nations of the world to implement Agenda 21. In agreeing to Agenda 21, the nations of the earth have agreed to develop plans implementing Agenda 21 at the national, state, and local level. Agenda 21 calls for 2,500 specific actions.

Agenda 21 addresses the pressing problems of today and also aims at preparing the world for the challenges of the next century. It reflects a global consensus and political commitment at the highest level on development and environment cooperation. Its successful implementation is first and foremost the responsibility of governments. National strategies, plans, policies, and processes, are crucial in achieving this. International cooperation should support and supplement such national efforts. In this context, the United Nations systems has a key role to play. Other international, regional, and subregional organizations are also called upon to contribute to this effort. The broadest public participation and the active involvement of the non-governmental organizations and other groups should also be encouraged.

The program areas that constitute Agenda 21 are described in terms of the basis for action, objectives, activities, and means of implementation. Agenda 21 is a dynamic program. It will be carried out by the various actors according to the different situations, capacities, and priorities of countries and in full respect of all the principles contained in the Rio Declaration on Environment and Development. It could evolve over time in the light of changing needs and circumstances. This process marks the beginning of a new global partnership for sustainable development.

Freshwater resources are an essential component **of the earth's** hydrosphere and an indispensable part of all **terrestrial** ecosystems. The freshwater environment is characterized by the hydrological cycle, including floods, and droughts, which in some regions have become more extreme and dramatic in their consequences. Global climatic change and atmospheric pollution could also have an impact on freshwater resources and their availability and, through sea-level rise, threaten low-lying coastal areas and small **island** ecosystems.

Water is needed in all aspects of life. The general objective is to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological, and chemical functions of ecosystems, adapting human activities within the capacity **limits** of nature and combating vectors of

water-related diseases. Innovative technologies, including the improvement of indigenous technologies, are needed to fully **utilize** limited water resources and to safeguard those resources against pollution.

The widespread scarcity, gradual destruction, and **aggravated pollution** of freshwater resources in many world regions, along with the progressive encroachment of incompatible activities, demand integrated water resources **planning** and management. Such integration must cover all types of interrelated freshwater bodies, including both surface water and groundwater, and duly consider water quantity and quality aspects. The multisectoral nature of water resources development in the context of socio-economic development must be recognized, as well as the multi-interest utilization of water resources for water supply and sanitation, agriculture, industry, urban development, hydropower generation, inland fisheries, transportation, recreation, low and flat lands management, and other activities. Rational water utilization schemes for the development of surface and underground water supply sources and other potential sources have to be supported by concurrent water conservation and wastage minimization measures. Priority, however, must be accorded to flood prevention and control measures, as well as sedimentation control, where required.

Transboundary water resources and their use are of great importance to riparian states. In this connection, cooperation among those states may be desirable in conformity with existing agreements and/or other relevant arrangements, taking into account the interests of all riparian states concerned.

The following program areas are proposed for the freshwater sector: (a) Integrated water resources development and management; (b) Water resources assessment; (c) Protection of water resources, water quality and aquatic ecosystems; (d) Drinking-water supply and sanitation; (e) Water and sustainable urban development; (f) Water for sustainable food production and rural development; (g) Impacts of climate change on water resources.

This publication lists only those sections of Chapter 18 that deal with impacts of climate change on water resources. It addresses planning

responsibilities at the state level. The sections which deal only with national or international responsibilities or problems are not addressed in this publication.

The original numbering system of Agenda 21 has been retained so that anyone wishing to compare this document with the full Agenda 21 may easily refer to numbered paragraphs.

IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

Basis For Action

18.82. There is uncertainty with respect to the prediction of climate change at the global level. Although the uncertainties increase greatly at the regional, national, and local levels, it is at the national level that the most important decisions would need to be made. Higher temperatures and decreased precipitation would lead to decreased water-supplies and increased water demands; they might cause deterioration in the quality of freshwater bodies, putting strains on the already fragile balance between supply and demand in many countries. Even where precipitation might increase, there is no guarantee that it would occur at the time of year when it could be used; in addition, there might be a likelihood of increased flooding. Any rise in sea level will often cause the intrusion of salt water into estuaries, small islands and coastal aquifers and the flooding of low-lying coastal areas; this puts low-lying countries at great risk.

18.83. The Ministerial Declaration of the Second World Climate Conference states that "the potential impact of such climate change could pose an environmental threat of an up to now unknown magnitude ... and could even threaten **survival in** some small island states and in low-lying coastal, arid and semi-arid areas" (A/45/696/Add.1, annex III, preamble, para. 2). The Conference recognized that among the most important impacts of climate change were its **effects on** the hydrologic cycle and on water management systems and, through these, on socio-economic systems. Increase in incidence of extremes, such as floods and droughts, would cause increased frequency and severity of disasters. The Conference therefore called for a strengthening of the

necessary research and monitoring programs and the exchange of relevant data and **information**, these actions to be undertaken at the national, regional, and international levels.

Objectives

18.84. The very nature of this topic calls first and foremost for more information about and greater **understanding** of the threat being faced. This topic may be **translated** into the following objectives, consistent with the United Nations Framework Convention on Climate Change: (a) To understand and quantify the threat of the impact of climate change on freshwater resources; (b) To facilitate the implementation of effective national countermeasures, when the action is justified.

(c) To study the potential impacts of climate change on areas prone to droughts and floods.

Activities

18.85. All states, according to their capacity and available resources, and through bilateral or multilateral cooperation, including the United Nations and other relevant organizations as appropriate, could implement the **following** activities: (a) Monitor the hydrologic regime, including soil moisture, groundwater balance, penetration and transpiration of water-quality, and related climate factors, especially in the regions and countries most likely to suffer from the adverse effects of climate change and where the localities vulnerable to these effects should therefore be defined; (b) Develop and apply techniques and methodologies for assessing the potential adverse effects **of climate** change, through changes in temperature, precipitation, and sea level rise, on freshwater resources and the flood risk; (c) Initiate case-studies to establish whether **there** are linkages between climate changes and the occurrence of droughts and floods in certain regions; (d) Assess the resulting social, economic, and environmental impacts; (e) Develop and initiate response strategies to counter the adverse effects that are identified, including changing groundwater levels and to mitigate saline intrusion into aquifers; (f) Develop agricultural activities based on brackish-water use;

(g) Contribute to the research activities under way within the framework of current international programs.

Means of Implementation

Scientific and technological means

18.87. Monitoring of climate change and its impact on freshwater bodies must be closely integrated with national and international programs for monitoring the environment, in particular those concerned with the atmosphere, as discussed under other sections of Agenda 21, and the hydrosphere, as discussed under program area B above. The analysis of data for indication of climate change as a basis for developing remedial measures is a complex task. Extensive research is necessary in this area and due account has to be taken of the work of the Intergovernmental Panel on Climate Change (IPCC), the World Climate Program, the International Geosphere-Biosphere Program (IGBP) and other relevant international programs.

18.88. The development and implementation of response strategies requires innovative use of technological means and engineering solutions, including the installation of **flood and** drought warning systems and the construction of new water resource development projects such as dams, **aqueducts**, well fields, waste-water treatment plants, desalination works, levees, banks, and drainage channels. **There is also** a need for coordinated research networks such as the International Geosphere-Biosphere Program/Global Change System for Analysis, Research and Training (IGBP/START) network.

Human Resource Development

18.89. The developmental work and innovation depend for their success on good academic training and staff motivation. International projects can help by enumerating alternatives, but each country needs to establish and implement the necessary policies and to develop its own expertise in the scientific and engineering challenges to be faced, as well as a body of dedicated individuals who **are able** to interpret the complex issues concerned for those required to make policy decisions. Such specialized personnel need to

be trained, hired, and retained in **service**, so that they may serve their countries in these tasks.

Capacity-Building

18.90. There is a need, however, to build a capacity at the national level to develop, review, and implement response strategies. Construction of major engineering **works and** installation of forecasting systems will require **significant** strengthening of the agencies responsible, whether in the public or the private sector. Most critical is the requirement for a socio-economic mechanism that can **review** predictions of the impact of climate change and possible response strategies and make the necessary judgments and decisions.