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M. A. Lange

PROSPECTS OF CLIMATE CHANGE AND IMPLICATIONS FOR WATER AVAILABILITY ON CYPRUS AND IN THE EASTERN MEDITERRANEAN

Cyprus Institute, Cyprus

The study is a survey of climate change on Cyprus and in the Eastern Mediterranean leading to enhanced water scarcity in the region. Diminishing precipitation rates and rising water demand are analysed. In the article the problem solving is proposed.

Key words: climate change, water scarcity, precipitation rates.

М. А. Лейндж

Інститут Кіпру, Кіпр

ДОСЛІДЖЕННЯ КЛІМАТИЧНИХ ЗМІН ТА ЇХ ВПЛИВ НА ВОДОЗАБЕЗПЕЧЕНІСТЬ КІПРУ ТА СХІДНОГО СЕРЕДЗЕМНОМОР'Я

Робота присвячена дослідженню кліматичних змін на Кіпрі та у східному Середземномор'ї, які призводять до зменшення водних ресурсів на цих територіях. Вивчаються показники атмосферної води, що зменшуються, та показники водоспоживання, які збільшуються. Пропонуються шляхи вирішення даної проблеми.

Ключові слова: кліматичні зміни, скорочення водних ресурсів, показники атмосферної води.

М. А. Лэйндж

Институт Кипра, Кипр

ИССЛЕДОВАНИЯ КЛИМАТИЧЕСКИХ ИЗМЕНЕНИЙ И ИХ ВЛИЯНИЕ НА ВОДООБЕСПЕЧЕНИЕ КИПРА И ВОСТОЧНОГО СРЕДИЗЕМНОМОРЬЯ

Работа посвящена исследованию климатических изменений на Кипре и в восточном Средиземноморье, которые приводят к уменьшению водных ресурсов на этих территориях. Изучаются уменьшающиеся показатели атмосферной воды и все увеличивающиеся показатели водопотребления. Предлагаются пути решения данной проблемы.

Ключевые слова: климатические изменения, сокращение водных ресурсов, показатели атмосферной воды.

It is anticipated that the Eastern Mediterranean and Cyprus will be disproportionally and adversely affected by future climate change. This will have consequences for summer temperatures and the amount of annual precipitation and will most likely lead to enhanced water scarcity in the region. The water balance on Cyprus is already strained by rising temperatures, diminishing precipitation rates and rising demand, resulting in the highest Water Stress Index among European countries (fig. 1).

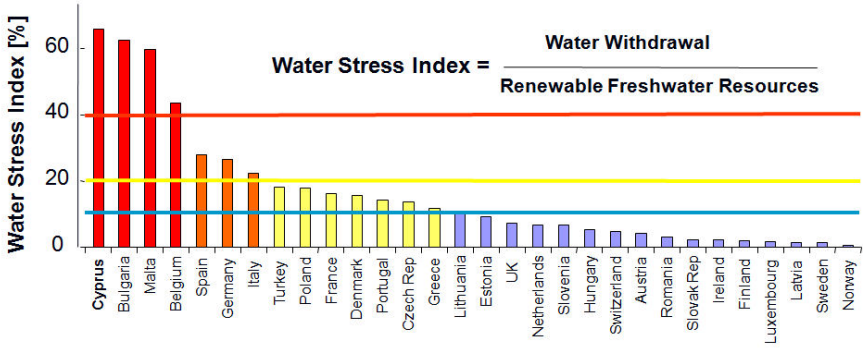

Fig. 1. **Water Stress Index for various European countries; source: EEA**

The average amount of precipitation during most of the 20th century has been 4600 Mill. m^3, 80% of which evaporated to the atmosphere. From the remaining 900 Mill. m^3, 600 Mill. m^3 has been surface water and about 300 Mill. m^3 replenished the aquifers. The total water demand on Cyprus has been estimated at 266 Mill. m^3 including 15% of conveyance and distribution losses. 69% of the water is used for agricultural purposes, 20% by domestic consumers, 5% by the tourism sector, 5% for environmental needs and 1% for industry. However, values for precipitation over successive 30 year periods have been steadily decreasing (fig. 2).

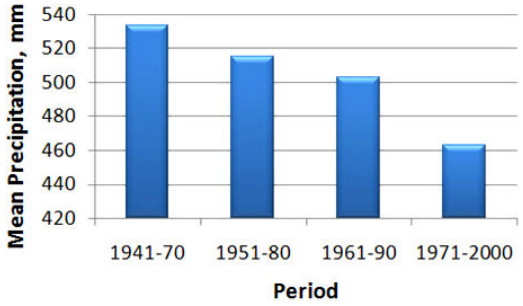

Fig. 2. **Mean precipitation over Cyprus for 30-year periods between 1941 to 2000; derived from data by the Water Development Department, Cyprus**

To satisfy the increasing demand and to minimize the losses of surface water to the sea, the Government of Cyprus embarked on an ambitious programme of water development works with the construction of many dams and conveyors and irrigation networks in the 1980s and 1990s. Despite an increase in storage capacity of the reservoirs from 6 Mill. m^3 in 1960 to 304 Mill. m^3 today, decreasing winter and spring precipitation values have lead to reduced water levels in the reservoirs. The winter 2007/08 has seen record lows in rainfall resulting in vanishing groundwater resources and in water volumes of less than 10% reservoir capacities of the existing dams. In this situation, the Cyprus government has decided to upgrade existing desalination plants to higher production rates, to build new plants and to immediately ferry in about 8 Mill. m^3 from Greece.

As already mentioned, current climate projections indicate an increase in summer temperatures as well as a decrease in precipitation throughout the year. Fig. 3 illustrates the results of a downscaling experiment employing RACMO2 regional climate model developed at KNMI, Netherlands in the framework of EU-ENSEMBLES project and based on the ECHAM 5 global climate model driven by the A1B SRES emission scenario. Shown are projections of total winter precipitation (ΔP_w) for a 2021–2050 and a 2071–2100 time window relative to values for the reference period 1961–1990. As can be seen, the anticipated reductions during the main precipitation periods for the two time windows are substantial and underline the already mentioned notion of enhanced water scarcity under conditions of climate change.

Given this situation, the import of water from neighbouring countries as carried out during 2008 clearly represents only a short-term remedy. Increasing the capacity for seawater desalination based on current technologies will result in enlarged consumptions of conventionally generated energy, derived mainly from hydrocarbon sources (i.e., oil). Thus, the resultant enhanced CO_2 emissions from power plants will add to the already disproportionally high emission record of Cyprus. In addition, rising oil prices and the dependence on imported energy sources imply economic and political constraints for the country. Thus, the employment of renewable energies for the operation of desalination plants and enhancements in energy efficiency represent more promising remedies for increasing water scarcity under conditions of climate change.

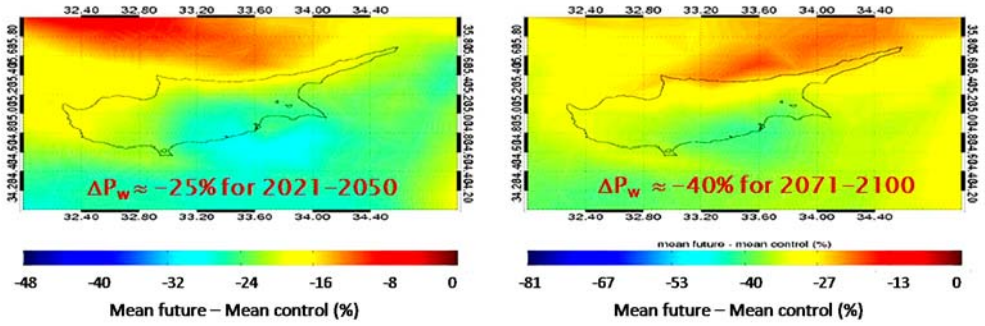

Fig. 3. **Average total winter precipitation (ΔP_w) relative to reference; source: Hadjinicolaou , pers. comm**

A technology that holds particular promise lies in the employment of concentrated solar power (CSP) for the co-generation of electricity and desalinated water. The present paper will present first assessments as to the technical and economical feasibility of such a technology and its consequences for the provision of potable water to Cyprus and its inhabitants. While concentrating on the situation in Cyprus, the conclusions drawn will be relevant for neighbouring countries in the entire (eastern) Mediterranean.

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