

NAME: PHOTINI PHOTIOU

GLOBAL CLIMATE CHANGE:

The Science, Social Dimensions and

Public Health Impact of a World

Environmental Crisis

Research Paper



Prepared for: Prof. Timothy C. Weiskel (Research Director)

&

Prof. Zachery Zevitas (Course Administrator)

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TITLE

What is the status of water scarcity in Cyprus and what plans does the island have for the provision of water if drought in Greece makes it impossible to supply water by ships? What is the role of desalination in order to minimize the water problem?

BACKGROUND

Water scarcity is an important issue and an escalating problem that exists all over the world including Europe. The key solution to the problem is that the correct management of water resources is required all over the continent. The water shortage is remarkable in zones of semi-arid climate and the availability problems occur mainly when demand goes above the amount is available during a certain period of time. According to EEA (2007), water availability problems occur mainly when demand goes above the amount that is available during a certain period of time. These circumstances normally take place in areas that experience low rainfall, overpopulation and high agricultural or industrial activity. The Mediterranean countries are characterized by water scarcity mainly during summer months. Cyprus, which is an island located in the eastern basin of the Mediterranean, its neighboring countries are Greece, Turkey, Syria and Egypt possesses a serious water problem especially apparent in the last 30 years.

WATER DEVELOPMENT IN CYPRUS

Until the 1970s groundwater was the main source for the provision of water for drinking and irrigation purposes. However, throughout time almost all of the aquifers became depleted due to over-pumping. For the protection of groundwater sources and sustainable aquifer management the allowance of water extraction from these sources should not exceed 81.3MCM per year.

The water problem was recognized quite quickly by the relevant authorities: the Ministry of Agriculture, Natural Resources and Environment and Water Development Department, which co-operated with international organizations and focused on the issue to construct long-term programs in order to deal with the water shortage effectively (Themistocleous, 2005). The motto, **‘Not a drop of water into the Sea’** determines the Water Policy of the Government and the need for proper management to control water shortage. The first stage involved the construction of large dams. Currently in Cyprus there are 103 dams and ponds and their storage capacity has reached 304.7MCM in 2004. There are 35 dams¹ that account for 286.1MCM, 42 other ones with capacity 16.1MCM and 26 ponds with average storage 2.5MCM (Socratous, 2003).

The relevant water authorities have promoted the recycling of water to be used in agriculture and landscape irrigation.

The number of urban waste water treatment plants (UWWTP) has increased exponentially in Cyprus the last five years. At present there are five UWWTP operating in the south-eastern corner of the island (Fig 1).

¹ 81% of the dams in Cyprus are earth fill or rock fill and the rest 19% are concrete

In 2002, around 3MCM of treated sewage was used for agriculture and irrigation. It is estimated that by 2012 an amount of around 30MCM of treated sewage effluent will be available for the irrigation of crops such as citrus and olives from recycled water. But subsequently with the continuous increase in water demand and the reduction in rainfall, the amount of water stored in the dams and water treatment plants was insufficient and new measures had to be implemented by the Government to manage water accordingly.



Fig.1. Distribution of urban waste water treatment facilities in Cyprus.

(Source: Omorphos, 2005)²

CLIMATIC CONDITIONS IN CYPRUS

Climatic conditions have a significant role on the problem of water scarcity in Cyprus. It is one of the countries that is experiencing the typical Mediterranean climate with semi-arid conditions, mild winters, long dry summers, and short autumns and spring seasons. In the beginning of the 21st century a reduction in the annual precipitation has been observed accounting for a total decrease of 14-18% which caused the reduction of river flows by 35-50% (Fessas, 2001).

According to long-term observations from the Meteorology Department (2007) the mean annual precipitation of Cyprus is 500mm but during the last three decades (1971-2000) this amount has decreased to 460mm. Figure 2 below, shows recent annual and ten-year average precipitation values all over Cyprus.

² Note: Map not to scale

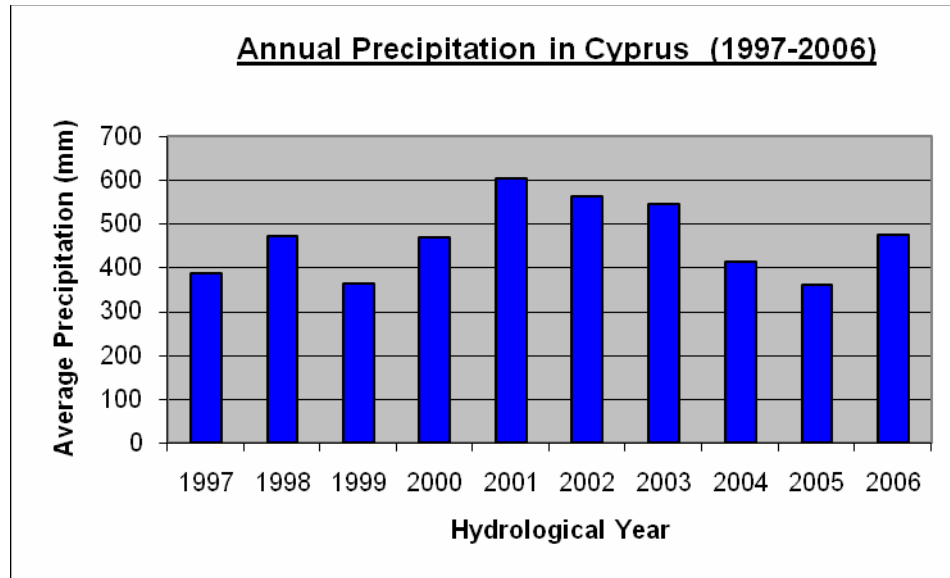


Fig. 2. Cyprus: Annual Precipitation. (Source: Meteorology Department, 2007)

As shown in Figure 2 above, the hydrological value of precipitation was higher from 2001-2003 and was recorded to be 603.7mm, 561.7mm and 544.8 mm respectively. However, during the next years that followed, 2004- 2006, the precipitation was reduced which shows that the island began to suffer from droughts. For example, in 2005 the average precipitation was 360.1mm accounting for a total decrease of 24.4% when compared with 2004 when 412.1mm was received. It is not only precipitation reduction that influences the water shortage in Cyprus but also the fact that the temperature has been rising yearly and as a result the country came very close to desertification³.

As weather conditions are unpredictable and there is an irregular pattern of precipitation in Cyprus that is diachronic with prolonged periods of droughts and water shortage, the country has to be fully prepared to withstand all the climatic changes that are more likely to worsen the water problem.

RESEARCH / Aims/ Objectives

All of the above sections have provided an overview of the water sector in Cyprus. But since demand increases due to the rising of standards of living, the need to diversify tourism products such as the construction of golf courses and generally all goods and services that people use every day rely on water. This leads to unsustainable water management and as a result this natural resource becomes scarce. Last summer Cyprus had to face a severe situation.

After four years with limited rain during the winter months the demand has exceeded supply. The island then decided to buy water from Greece.

³ Desertification is one of the serious environmental problems which refers to the destruction of lands in dry areas and their conversion to desert-like conditions (Johnston, 2000).

The first tanker which arrived contained 40,000 cubic meters of water. An undersea pipeline was placed to transport the water to the island's distribution network where it would then be distributed to the households. But some problems have arisen with the water delivery from the first tanker. The pipeline was 3.5m short from connecting with the land pipeline. During that time approximately 16million cubic meters were needed in order to bring Cyprus' water supplies to the acceptable levels. The plan with the tankers was that Greece would have provided half of this amount in the next months. In order to meet 50% of the island's demand the Greek initiative had a cost of US\$60million. A second tanker had then arrived to Cyprus after that the problem with the first tanker was fixed. But in the mean time Cyprus has turned towards other alternatives options such as desalination in order to mitigate the water problem in the near future.

Aim

The primary aim of this work is to assess the role of the desalination plants in Cyprus and emphasize whether or not the desalination process is the only alternative solution to reduce water scarcity in the country.

Objectives

To achieve the main aim of this paper the concrete objectives are the following:

- Introduce the water problem in Cyprus and the development of the desalination sector.
- Assess the policies on from the Cyprus' government and the European Directives for the sustainable management of water resources.
- Use questionnaires to highlight public awareness on the water problem and their perception about the expansion of the desalination sector in Cyprus.

METHODOLOGY

In order to provide the necessary information to meet the objectives and aims of the research, primary data and secondary statistical data were collected and analyzed. Secondary statistical data should include average water consumption on households. The amount of water needed for agriculture, tourism and industrial sector. It can also include statistical data about the output of Dhekelia and Larnaca desalination (current operating plans in Cyprus).

The main sources of secondary data include:

- Documents from Water Development Department
- Documents from Audit Office of the Republic of Cyprus
- Reports from World Wildlife Fund (WWF) and World Health Organization (WHO)
- Articles from newspapers that relate to the desalination sector in Cyprus
- Articles from Science Direct, New Scientist, European Desalination Society

Qualitative interviewing and questionnaire design are also other sources but mainly these techniques will be used for the collection of primary data.

DESALINATION PLANTS IN CYPRUS

In view of the increasing water demand as described above, the Government of Cyprus decided to proceed with the installation of sea water desalination plants utilizing reverse osmosis desalination processes to help solve the severe water shortage problem. Cyprus presently has two major seawater desalination facilities. The first one built was the Dhekelia desalination facility that started its operation on 1st April, 1997. The previous President of the Cyprus Republic stated that the 'new era has begun for Cyprus' to tackle water scarcity with the completion of the second desalination plant in Larnaca during 2001 (Cyprus Mail, 2001).

Dhekelia Desalination Plant

The desalination plants in Cyprus are located in the south east corner of Cyprus in the Larnaca District. The first desalination plant is situated next to the Dhekelia power station. It is in a coastal region, 15km away from Larnaca city centre and around 40km from Nicosia and Famagusta⁴. The towns mentioned are the ones that suffer most from severe water shortage and the plant supplies each year a considerable amount of water to satisfy people's growing demand. Its operation started in April, 1997 with an initial capacity of 20,000m³/d and in May, 1998 its capacity was increased to 40,000m³/d due to the prevailing water scarcity (Sallangos, 2001). It is important to point out that the plant has operated continuously and mainly successfully during the last nine years and its production did not stop until September 2006. Since then, the plant was refurbished until April 2007, and its operation restarted in 2nd May, 2007.

Larnaca Desalination Plant

The Larnaca Desalination Plant is the largest one in Cyprus and is located in the south-east coast of the country. Its operation began in 2001 with nominal water capacity of 54,000m³/d. The Larnaca plant during its 6th year of operation has been providing potable water to approximately 200,000 citizens of Nicosia, Larnaca and Famagusta Districts (Bartels, 2007).

Role of desalination plants in the water problem in Cyprus

It is clear that both of the desalination plants more or less cover the water demand for Larnaca, Nicosia and Famagusta. According to recent estimations the three towns require around

40, 000,000m³ per year. The desalination plants are able to manage and provide sufficient amount of potable water because, based on their current capacity, Dhekelia Desalination Plant produces **14,600,00m³** per year and Larnaca Desalination Plant produces **19,700,000m³** per annum. The total amount of water coming from desalination in Cyprus is **34,300,000m³**. (Cyprus Annual Report, 2005). The rest **6,000,000 m³** are obtained from the water treatment plant.

However, since last year it was decided that the production of both plants will increase in the forthcoming years by roughly 10,000 cubic meters. Also the developers have proceeded with their applications to gain the permission and install their own small-scale desalination units. Information collected from the Environment Service demonstrates that the following developers claimed for permission from May – September 2008.

⁴ Note: part of Famagusta is occupied by the Turkish Military.

- Amathus Beach Hotel, Limassol: desalination plant – daily production 230 cubic meters
- Le Meridien Limassol Spa and Resort: desalination plant-daily production 500 cubic meters
- Thalassa Hotel, Paphos: desalination plant- daily production 100-200 cubic meters
- GlideCom Ltd, Protaras: desalination plant- daily production 100 cubic meters
- Aristo Developers PLC: desalination plant- daily production 500 cubic meters
- Lanitis Development, Aphrodite Hills: desalination plant- daily production 500 cubic meters

Recommendations for Research

This research paper is based upon a recent and a serious problem in Cyprus. The contribution of public is very important and all must contribute in order to eliminate the water problem in Cyprus. There should be a regular monitoring from authorities for the correct implementation of policies for drought management. One aspect that can help to reduce water scarcity is through the setting of several restrictions using water-saving techniques. For example government, especially the Ministry of Finance must provide some funding for households to replace their old washing machines and dishwashers with more efficient for instance that use less water. Technological developments play a role with several improvements in appliances. At the same time changes in lifestyle and habits such as the desire for a green lawn during the summer can boost water usage in households. The tourists must be aware as well and the cost of water can be more expensive for them for example because typically they use between two and five times more water than the locals. Furthermore, since the desalination sector is expected to expand even more in the near future, there should be some precautionary measures to be taken to minimize environmental impacts as well as to control the emissions of carbon dioxide into the atmosphere for their operation. Therefore, on my personal view Cyprus needs to convert to solar energy as soon as possible. Other recommendations for further research that will add up to this research paper include that designers must recommend for outdoor decoration species like cactus (as shown in Figure 3 below) which require less water. There should be restrictions in gaining permission for swimming pools because currently in Cyprus huge amounts of water are wasted pools and some of them are illegal as well.



Fig. 3: Cactus (Source: Theopemptou, 2009).

LISTS

a) The people and institutions that are currently working on the problem are the following:

- ✓ **Water Development Department**
- ✓ **Water Boards in all cities**
- ✓ **Environment Service**
- ✓ **Ministry of Agriculture, Natural Resources and Environment**
- ✓ **Meteorology Department**
- ✓ **Waste Water Sewage Board**
- ✓ **Commissioner of the Environment**
- ✓ **Green Party**
- ✓ **Audit Office of the Republic of Cyprus**
- ✓ **European Union**

b) The government authorities, academic departments or civil society organizations that should be working on these questions but who may not yet be doing so

- ✓ **Cyprus Tourism Organization**
- ✓ **Property Developers**
- ✓ **Designers (interior and outdoor decoration)**
- ✓ **Ministry of Finance**
- ✓ **Professors from Cyprus University**
- ✓ **Volunteering campaigns**

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