

### **3. CYPRUS**

This country fiche provides a comprehensive overview and assessment of climate change adaptation in Cyprus. After detailing the vulnerability of Cyprus' coastal zones, the responsibility and financing for coastal protection is explained. Next, the fiche presents the relevant research activities, the coastal defence, risk reduction and adaptation plans available in Cyprus as well as the current and future protection and adaptation expenditure. The persons contacted and sources of information used are listed at the end.

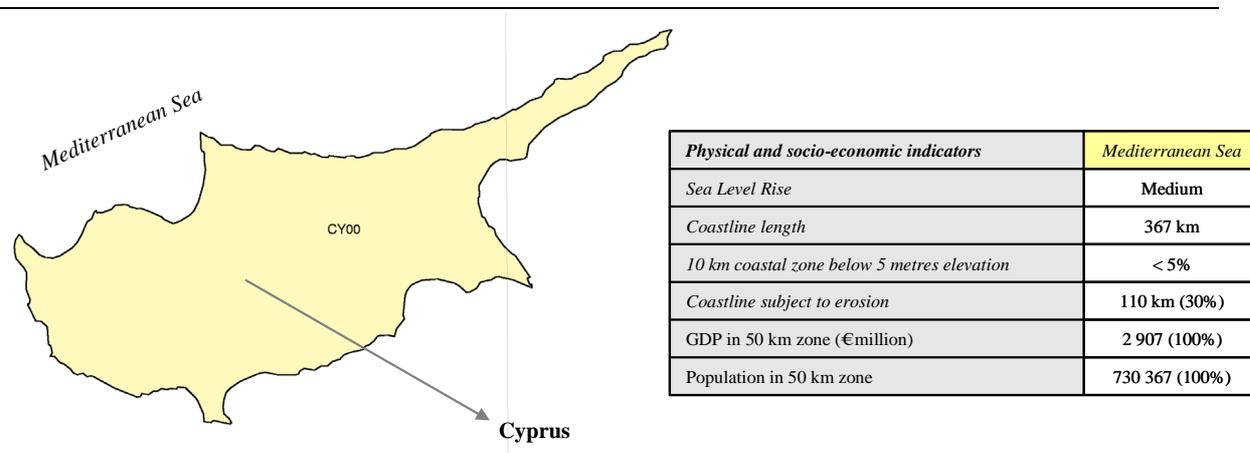
#### **3.1. VULNERABILITY OF CYPRUS' COASTAL ZONES TO CLIMATE CHANGE**

Cyprus is the third largest Mediterranean island, situated east of Greece. The coastline measures about 735 km<sup>1</sup> of which 50% is under the control of the Republic of Cyprus and 50% under Turkish occupation. The coastline is characterised by sand, gravel and rock formations. *Figure 3-1* illustrates the coastline of Cyprus and its main physical and socio-economic indicators.

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<sup>1</sup> Coastline length provided by ISOTECH Ltd Environmental Research and Consultancy; the coastline length taken into account in the EuroSION project is some 20% of the government controlled coastal zones of Cyprus.

Figure 3-1: Coastline of Cyprus and its main physical and socio-economic indicators<sup>2</sup>



Source: Policy Research based on EEA, 2006, *The changing faces of Europe's coastal areas* (for Sea Level Rise and 10 km coastal zone below 5 metres elevation); European Commission (EuroSION study), 2004, *Living with coastal erosion in Europe: Sediment and space for sustainability* (for coastline length and coastline subject to erosion); Eurostat 2004 (for GDP and population in 50 km zone)

The following paragraphs discuss the main climate change risks for the coastal zones of Cyprus. The main climate change impact Cyprus has to deal with is persistent drought resulting in freshwater shortage. In addition, 30% of the coastline under control of the Republic of Cyprus is subject to erosion.

**a/ Flooding and erosion**

Cyprus has not experienced any severe floods from the sea in the past. Also in the coming years, Cyprus is not expected to become very vulnerable to sea flooding. Research results (e.g. IPCC) suggest only a small SLR and the country is experiencing a land lift-up counteracting this potential effect.

Nevertheless the coastal zone<sup>3</sup> of Cyprus is a valuable and vulnerable area. This zone, in which most urban development and economic activity takes place, covers 23% of the total country's area, 50% of total population and 90% of the tourism industry. The most vulnerable part in this regard is the low-lying region of Larnaca located on the south coast of the island.

Erosion constitutes a greater threat than flooding especially for the sandy and gravel beaches of the island. At the moment, 38% of the coastline is already subject to erosion, mostly the result of human

<sup>2</sup> Vulnerability data limited to the part under the control of the Republic of Cyprus (50% of country total).

<sup>3</sup> The coastal zone is accepted by the Cyprus Ministry of Communications and Works as the strip up to 2 km from the coast.

activities such as beach mining, dam and illegal breakwater construction and urbanisation. Climate change could worsen this situation.

***b/ Freshwater shortage***

At present, the main issue Cyprus has to deal with is freshwater shortage forcing the country to import water from Greece. The whole of Cyprus suffers from droughts, and desertification has started already in certain areas. Rainfall in Cyprus has dropped by about 20% over the past 35 years and the water runoff into reservoirs has declined by 40%.

***c/ Loss of coastal eco-systems***

In line with the EU's Habitat Directive<sup>4</sup>, Cyprus compiled a national list of habitats to be dedicated as 'special areas of conservation'. This list of important areas for Cyprus includes forest areas but also lakes and wetlands. By restricting mass-scale development in these areas Cyprus wants to make a step towards the conservation of water-related eco-systems. The impact of climate change for coastal eco-systems such as wetlands in Cyprus is not known yet as research in this domain is still lacking.

### **3.2. RESPONSIBILITY AND FINANCING FOR COASTAL PROTECTION AND CLIMATE ADAPTATION**

The *Coastal Section of the Ministry of Communications and Works* is the main actor involved in coastal defence. Permission for coastal defence works needs to be obtained from different governmental departments as well as local authorities.

The *Coastal Section of the Public Works Department, Ministry of Communications and Works*, is the agency responsible to plan, design and survey coastal protection and improvement works. Before any protection works can be carried out, permission needs to be obtained by the *District Officers, Ministry of the Interior*, who are the owners of the coastal zone. Such a permit is subject to an environmental impact assessment to be approved by a *Technical Environmental Committee*, subordinate to the *Environment Service of the Ministry of Agriculture, Natural Resources and Environment*. Several governmental departments are represented in this Committee as well as delegates of the ecological and environmental NGOs of Cyprus.

At sub-national level the municipalities are involved. Municipalities have their own technical department responsible for issuing town planning permits in their area. However, for coastal

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<sup>4</sup> Council Directive 92/43/EEC of 21 May 1992 on nature conservation.

structures they also need to obtain the permission of the District Officer, *Ministry of the Interior*. Financing of the coastal protection structures is shared between the government and the municipalities.

The *Water Development Department, Ministry of Agriculture, Natural Resources and Environment*, is the agency responsible for water resource management in Cyprus.

### **3.3. RESEARCH INTO CYPRUS' VULNERABILITY TO CLIMATE CHANGE AND CLIMATE CHANGE SCENARIOS**

Due to the lack of appropriate infrastructure, research to future climate scenarios or specific vulnerability assessments are not yet available for Cyprus (e.g. the University of Cyprus only exists since 2005). Nevertheless, the *Ministry of Agriculture, Natural Resources and Environment* has the intention to launch a study on the vulnerability of Cyprus to climate change in 2009. Part of the study will be dedicated to mitigation and adaptation measures. In addition, the Ministry is supported by the Meteorological Service for weather forecasts.

The *Meteorological Service*, a government department under the Ministry of Agriculture, Natural Resources and Environment, is responsible for the provision of meteorological data, the monitoring of climatic variations and trends and the compilation of climatological statistics, studies and reports. The institute collects historical information on SLR and changes in wind patterns as well as wave heights.

### **3.4. COASTAL DEFENCE, RISK REDUCTION AND ADAPTATION PLANS IN RELATION TO CLIMATE CHANGE**

In Cyprus, coastal defence is concentrated on the problem of erosion. Furthermore measures are undertaken to counteract the issue of freshwater shortage. Cyprus is gradually developing Master Plans to protect the entire coastline against erosion and fights the problem of water shortage with the import of freshwater from Greece. Specific climate change scenarios are not taken into account in any of these actions as related research is still lacking.

At present, the Environment Service of the Ministry of Agriculture, Natural Resources and Environment has the intention to launch besides a vulnerability study also a tender to establish a national climate change adaptation plan. Coastal areas will be included, but further details are not available at this stage.

*a/ Measures taken to counteract coastal erosion*

In the period 1993-1996 a coastal zone management project<sup>5</sup> was carried out with the objective to identify proper protection methods and improve the quality of beaches without causing serious impacts on the environment. The project budget amounted to €1 million.

The entire coastline of the Republic of Cyprus was divided in 12 'sections' or coastal areas based on their morphology. Master Plans as well as conceptual and detailed designs were developed for three of the twelve coastal areas (Limassol, Larnaca and Paphos South). The 3 sections were selected based on a multi-criteria-analysis (MCA)<sup>6</sup> and a cost comparison between alternative erosion solutions was carried out.

In 1998 the Cyprus government started with the implementation of these Master Plans. Up to now, six breakwaters have been constructed in the region of Larnaca and fourteen in the region of Limassol. In addition a number of illegal groins have been removed (mainly built by private parties such as hotel owners).

A coastal section monitoring system is needed to support shoreline management in Cyprus. To this end, 200 beach profiles have been established along the coast. To assess the shoreline position and the rate of erosion these profiles are measured once a year, in summer, up to a depth of -10 m or -20 m.

In the period 2000-2006 a second project, dealing with three new sections (Kato Tyrgos Tillirias, Krysochou Bay and Zygi-Kiti) was carried out in cooperation with the National Technical University of Athens. The budget for this project was again €1 million and was financed entirely by the Republic of Cyprus.

The study for the region of Kato Tyrgos Tillirias is still at a preliminary stage and the Master Plan for Khrysochou Bay, which foresees the construction of a series of breakwaters, has been submitted for approval by the Technical Environmental Committee. The Master Plan for Zygi-Kiti has been approved by the Technical Environmental Committee and the construction of 15 parallel breakwaters will begin early 2009.

The preparation of a Master plan for a 7<sup>th</sup> section, Geroskipou, has recently started. During the coming years, the Cyprus government intends to prepare Master Plans and detailed designs for all remaining areas.

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<sup>5</sup> The project was co-financed by the EC and the Republic of Cyprus and carried out with the support of Delft Hydraulics (the Netherlands).

<sup>6</sup> For this MCA, 6 major categories were defined: coastal erosion, coastal ecology, coastal problems, social awareness, coastal development planning and data availability.

Although Cyprus has always been using breakwaters and groins to face the problem of erosion<sup>7</sup>, difficulties are to be expected with the use of these structures in the future. The natural resources<sup>8</sup> are being exhausted and environmental lobby groups (e.g. AKTH<sup>9</sup>), fighting against the use of hard coastal defences, have gained increased attention in Cyprus.

***b/ Measures taken to counteract the problem of water stress***

In an effort to increase the availability of water and decrease the demand, during the past 40 years Cyprus invested not only in water infrastructure but also in demand management measures. However, due to the reduction of the annual precipitation and the prolonged and recurring droughts, coupled with a high increase in demand due to tourism development (e.g. golf courses, swimming pools), the natural water resources cannot satisfy demand.

Confronted with this lack of water, the Ministry of Agriculture, Natural Resources and Environment, through the Water Development Department has, since 1997, resorted to supplying non-conventional water resources by means of desalination techniques, wastewater reclamation and re-use and utilisation of low quality water.

Today, water management efforts in Cyprus concentrate not only on the efficient use of the available conventional water resources but also on the use of non-conventional water resources and the promotion of a water conservation culture amongst its population.

Two desalination plants currently operate on the island, one in Dhekelia and one in Larnaca with a total capacity of 33 million m<sup>3</sup>/year<sup>10</sup>. As also this resource is not sufficient to satisfy demand the Government of Cyprus has applied a drastic Drought Mitigation and Response Plan with a series of emergency measures, including the transfer of potable water from Greece, limitation of the public supply of water to agriculture and restrictions on the supply of drinking water to households, limiting the supply to only 36 hours per week.

Furthermore, an effort is also made to integrate recycled wastewater into the water balance. Today 14.5 million m<sup>3</sup> of recycled wastewater is produced each year in Cyprus and is re-used in agriculture and landscape irrigation, increasing the availability of freshwater for domestic use. Annual water recycling is estimated to increase to 52 million m<sup>3</sup> by 2012. At the same time water demand

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<sup>7</sup> Sand nourishments are not an option as the sand is too fine and dredging is prohibited in many areas.

<sup>8</sup> Cyprus uses rocks coming from its inland mountains for the construction of breakwaters and groins, but nowadays many mountainous areas have been designated as protected areas.

<sup>9</sup> AKTH (Greek for 'coast) is an environmental lobby-group that bases itself on scientific evidence to try to counteract certain decisions taken by the government (e.g. the use of breakwaters), [www.akti.org.cy](http://www.akti.org.cy).

<sup>10</sup> Both plans operate under a BOT agreement, meaning that the investor builds an infrastructure project, operates it for an agreed period of time to recover the investment and to earn a profit and then returns it to the government.

management measures such as improving water supply distribution networks based on leakage detection are another continuous effort of the government of Cyprus.

Finally, Cyprus has also been investing in the promotion of a water conservation culture. The Water Development Department organises lectures for students as well as media campaigns and supports and participates in environment protection festivals and fairs. It also promotes the use of lower grade water and water conservation practices through a subsidisation scheme, in effect since 1997.

Also the Turkish Cypriot Community intends to take specific measures. They plan to develop a water pipeline running between southern Turkey and Northern Cyprus that could carry up to 70 million m<sup>3</sup> of water. The construction is expected to cost around \$ 400 million.

### **3.5. PAST, PRESENT AND FUTURE ADAPTATION EXPENDITURE**

For Cyprus, the adaptation expenditure has been split between the protection against flooding and erosion on the one hand, and actions to counteract freshwater shortage on the other hand.

#### *a/ Flooding and erosion*

Between 1998 and 2008, Cyprus spent €0.45 million annually on the implementation of the Master Plans to combat coastal erosion. Furthermore, the annual expenditure for monitoring the coast amounts to €0.35 million, which can be categorised as yearly ‘fixed’ maintenance cost. Therefore, in 2008, the amount spent to protect the coastal zones of Cyprus against flooding and erosion amounted €0.8 million. Over the entire period considered (1998-2015) about €15.4 million will be spent to protect Cyprus against flooding and erosion.

It must however be noted that none of the studies and Master Plans have taken any kind of climate scenario into account. More detailed information can be found in *Table 3-1*.

**Table 3-1: Expenditure to protect against coastal flooding and erosion (in € million)\***

Year	MAINTENANCE EXPENDITURE	CAPITAL EXPENDITURE	INDIRECT EXPENDITURE	TOTAL
	<i>Coastal profile monitoring system</i>	<i>Implementation of Master Plans to reduce the risk of erosion</i>	<i>Second project dealing with Kato Tyrgos Tillirias, Crysochou Bay and Zygi-Kiti</i>	
1998	0.35	0.45		0.8
1999	0.35	0.45		0.8
2000	0.35	0.45	0.14	0.94
2001	0.35	0.45	0.14	0.94
2002	0.35	0.45	0.14	0.94
2003	0.35	0.45	0.14	0.94
2004	0.35	0.45	0.14	0.94
2005	0.35	0.45	0.15	0.95
2006	0.35	0.45	0.15	0.95
2007	0.35	0.45		0.8
2008	0.35	0.45		0.8
2009	0.35	0.45		0.8
2010	0.35	0.45		0.8
2011	0.35	0.45		0.8
2012	0.35	0.45		0.8
2013	0.35	0.45		0.8
2014	0.35	0.45		0.8
2015	0.35	0.45		0.8
<b>TOTAL</b>	6.3	8.1	1.00	<b>15.4</b>

\* Proxy provided by the Coastal Section of the Ministry of Communications and Works

**b/ Freshwater shortage**

Freshwater shortage is more of a problem for Cyprus. The annual expenditure related to this issue is much higher compared to for example the amount of money spent on building breakwaters and demolishing illegal groins to protect against erosion.

The expenditure related to the provision of freshwater has increased steadily over the past decade. The total cost for the Cyprus government to purchase desalinated water from private companies almost tripled in the last decade, from about €10 million in 1998 to more than €27 million in 2006. The improvement of village supply distribution networks is estimated at €7.5 million per years up to 2008.

As persistent droughts continue to impact the country's freshwater resources and the demand keeps increasing, Cyprus has been obliged to take emergency measures such as the import of water from

Greece. The transportation of water from Greece by tanks is estimated to cost the country € 54.2 million<sup>11</sup> over the period 2008-2009.

Also indirect actions related to the problem of freshwater shortage show an aggravation of the problem. The budget spent on awareness raising campaigns increased more than five-fold during the last 3 years, from €0.16 million in 2005 to €1.2 million in 2007 and 2008.

An overview of all water related expenditures has been provided in *Table 3-2*. As Cyprus does not take climate change explicitly into account when defining actions to overcome the problem of freshwater shortage, it is difficult to indicate which freshwater supply expenditures are solely made to adapt to climate change and which ones are related to an overuse of the available resources. Furthermore, the expenditure on the construction of desalination plants and improvement of water supply networks is also related to increased urbanisation and regional development.

At the end of October 2008, the European Commission proposed to financially support Cyprus with a single payment of €7.6 million from the European Solidarity Fund to help the island meet the costs of drought related emergency measures as the import of water from Greece.

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<sup>11</sup> The total cost for immediate and short term emergency measures (actions to be taken in 2009 and 2010) to enhance domestic water supply is estimated at €287 million; estimate provided by *Water Development Department of the Ministry of Agriculture, Natural Resources and Environment*.

**Table 3-2: Expenditure to freshwater supply and policy (in € million)**

Year	REGULAR EXPENDITURE		EMERGENCY EXPENDITURE	INDIRECT EXPENDITURE
	<i>Desalination plants*</i>	<i>Improvement of village water supply distribution networks**</i>	<i>Import water from Greece*</i>	<i>Awareness raising campaigns*</i>
1998	10.25			< 0.1
1999	13.17			< 0.1
2000	18.06			< 0.1
2001	23.09	7.5		< 0.1
2002	28.86	7.5		< 0.1
2003	30.20	7.5		< 0.1
2004	27.75	7.5		< 0.1
2005	29.99	7.5		0.16
2006	26.75	7.5		0.55
2007	30	7.5		1.20
2008	30	7.5	27.1	1.2

\* Expenditure provided by the Water Development Department of the Ministry of Agriculture, Natural Resources and Environment

\*\* Calculated by Policy Research based on data received from the Water Development Department of the Ministry of Agriculture, Natural Resources and Environment; €60.3 million has been invested for the improvement of village water supply distribution networks between 2001 and 2008 (€ 7.5 million per year); for 2009-2010, the estimated cost for replacement and improvement of domestic supply networks is estimated at € 43 million; after 2010, this is estimated at € 82.2 million in total

### **3.6. PERSONS CONTACTED AND SOURCES OF INFORMATION USED**

#### **3.6.1. PERSONS CONTACTED**

<i>Name</i>	<i>Organisation</i>
<i>Kythreotou, Nicoletta</i>	Environment Service - Ministry of Agriculture, Natural Resources and Environment
<i>Loizides, Michael</i>	ISOTECH Ltd Environmental Research and Consultancy
<i>Loizidou, Xenia</i>	ISOTECH Ltd Environmental Research and Consultancy
<i>Mesimeris, Theodoulos</i>	Environment Service - Ministry of Agriculture, Natural Resources and Environment
<i>Nicolaou, Artemis Achilleos</i>	Water Development Department - Ministry of Agriculture, Natural Resources and Environment
<i>Sofos, Jason</i>	Coastal Section, Ministry of Communications and Works
<i>Toumazis, Antonis</i>	Dion Toumazis & Associates
<i>Zervos, Stelios</i>	Coastal Section, Ministry of Communications and Works

#### **3.6.2. SOURCES OF INFORMATION USED**

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- Dusik J., 2008, *CAMP Cyprus: Pilot testing of the CAMP guidelines on SEA for the CAMP pilot study area*
- Loizidou X., 2000, *Coastline management and erosion control in Cyprus*, proceedings of SURVAS expert workshop on European vulnerability and adaptation to impacts of accelerated Sea-Level Rise (ASLR), Hamburg, Germany, 19 -21 June 2000
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