

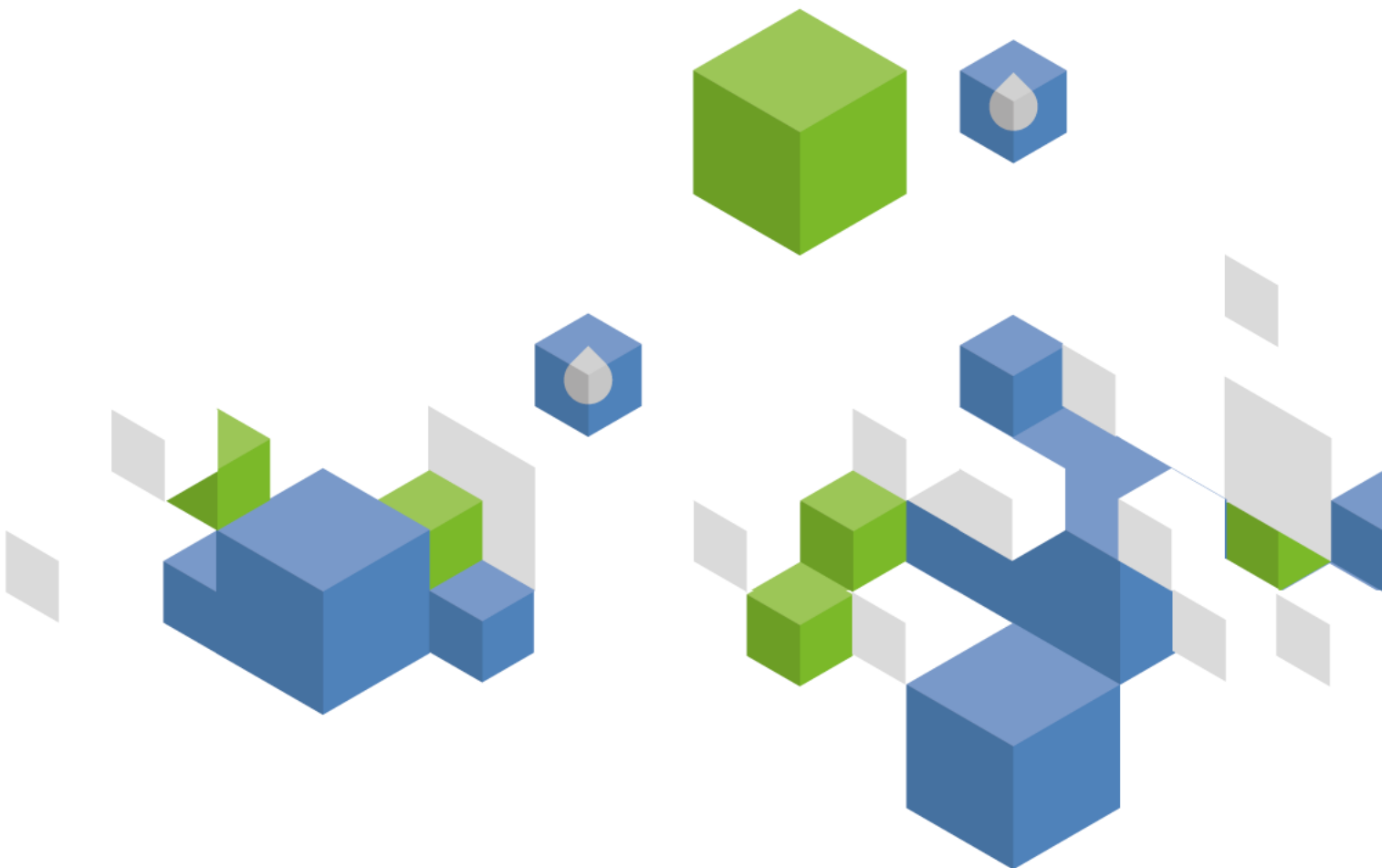


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Cyprus

GEOGRAPHY, CLIMATE AND POPULATION

Geography

Cyprus is the largest island in the Eastern Mediterranean with an area of 9 250 km². The main features of the island's topography include two mountain ranges, the Kyrenia in the north, which rises to 1 024 metres, and the Troodos in the centre, rising to 1 951 metres. Between these two main mountain ranges lies a wide plain, the Mesaoria plain, which rises from sea level to about 325 metres. Between the two mountain ranges and the sea there are narrow fertile coastal plains.

The area of the country currently under government control, to which this country profile and the accompanying tables will refer unless otherwise stated, is about 5 807 km².

The cultivable area is estimated at 165 433 ha, which is 28% of the total area under government control. In 1994, cultivated land amounted to 111 649 ha, of which 69 509 ha consisted of annual crops and 42 140 ha consisted of permanent crops. Most land is private. There are 51 300 farm holdings and according to the 1994 Census of Agriculture, the average holding size is 3.5 ha divided into 4.5 parcels of land.

Climate

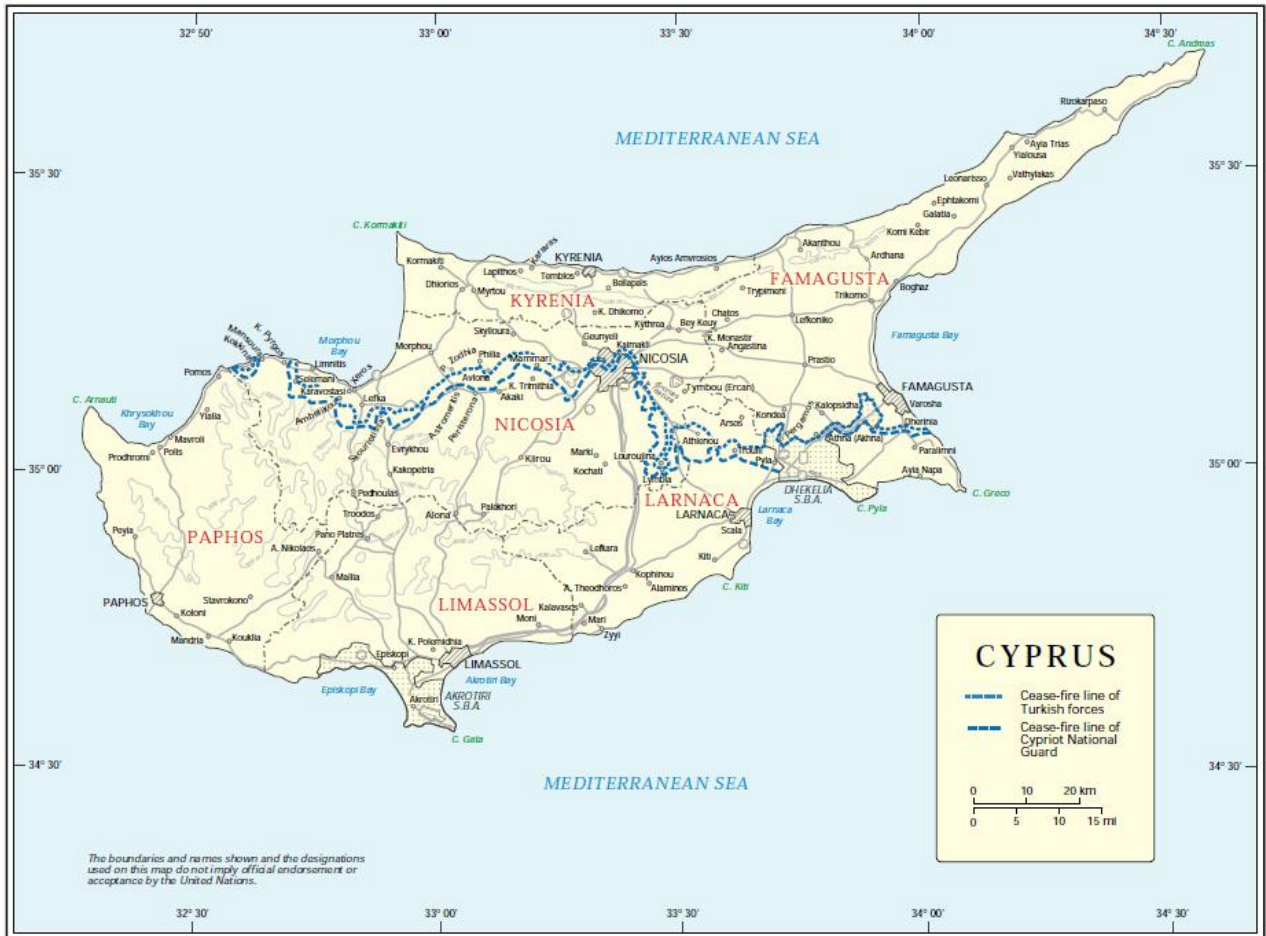
The climate of Cyprus is typical of the Eastern Mediterranean, with mild winters and hot, dry summers. Average daily minimum temperature is 9°C in January, while the average daily maximum is 35°C in August. The mean annual precipitation for the whole island is 503 mm, ranging from 290 mm in the east to 1 190 mm in the Troodos mountains. Most of the rain falls in the winter months from December to February, with snow falling frequently in the Troodos mountains. Hail storms are common and often cause considerable crop damage. There are large variations in rainfall from year to year.

Population

The total population for the whole island is 742 000 according to United Nations estimates (1995), of which 46% is rural. According to the National Demographic Report of 1994, the total population in the government-controlled areas amounted to 638 300 (as against 734 000 for the whole island), of which 32% was rural, but the method used for to estimate the rural population differs from the one used by United Nations. The annual population growth is 1 %.

Agriculture, including crop production, livestock, fisheries and forestry accounted for 5.4% of the GDP in 1994, down from 10% in 1980. The share of agriculture's contribution to GDP can however vary from year to year depending on the prevailing weather conditions, particularly rainfall. Although the share of agriculture in the GDP has had a declining trend in recent years, owing to more rapid development in the other sectors of the economy, agricultural exports still play a significant role in the country's foreign exchange earnings, accounting for over 21% of total exports in 1994. The percentage of the total economically active population engaged in agriculture has also declined in recent years. In 1994 it was 11.6% compared with 17% in 1980. Nevertheless, agriculture is still considered an important sector and efforts are directed towards increasing production and maintaining people in rural areas through integrated development projects.

FIGURE 1
Map of Cyprus



WATER RESOURCES

Renewable water resources

A water balance cannot be easily calculated for the government-controlled area of Cyprus. A water balance for the whole island, however, indicates 900 million m³/year of renewable water resources. Surface runoff is estimated to represent about 830 million m³/year. The natural aquifer recharge is estimated at 300 million m³, of which about 70 million m³ flows to the sea and 100 million m³ emerges from springs.

There are 14 main rivers, none of which provides perennial flow. The source of water for these rivers originates in the Troodos mountains. The main groundwater aquifers are the Western Mesaoria (Morphou), Kokkinochoria (South-eastern and Eastern Mesaoria) and the Akrotiri. Smaller aquifers exist in other parts of the country.

Dams

In 1995, total dam capacity reached 299 million m³ on the whole island, up from 6 million m³ in 1961 and 64 million m³ in 1974. New dams for storing water for irrigation are planned, particularly in Paphos province in the south-western part of the island. Additional dams are also planned for Lefkosia province in the centre of the island, but a substantial quantity of this water will be diverted for domestic and industrial use and to compensate for the loss of water recharge downstream of the dams.

Non-conventional water sources

At present no desalination of water takes place, but a desalination plant is expected to become operational in 1997, with a total capacity of 7 million m³/year.

Currently some 40 million m³ of wastewater are produced annually on the whole island. Only 16 million m³ of this amount is being treated, mainly in Lefkosia province where Nicosia City is located. Nicosia has a city-wide sewage processing plant, part of which is not under government control. About 11 million m³ is being reused for irrigation purposes, mainly in the part of the island that is not under government control around Nicosia. Only 1 million m³/year is reused for the irrigation of hotel gardens and recreation areas in the government-controlled area. Plans are available to utilise more as soon as the central sewage plants at Limassol, Larnaca, Ayia Napa and Paralimni in the government-controlled areas are completed and the water treatment plants are in place.

WATER USE

In 1993, total water withdrawal in the government-controlled area was 211 million m³ of which 74% for agricultural purposes, including both irrigation (70.6%) and livestock (3.3%). Water withdrawal for domestic and industrial use in 1993 was 23.7% and 2.4% respectively. The trend in recent years, which is likely to continue in the future, is that increasing quantities of water will be used for domestic water supplies at the expense of agriculture. This has been necessary in view of an increasing standard of living, an expansion of tourist services and industrialization.

Considering the whole island, 70 million m³ of groundwater flows to the sea yearly and 270 million m³ is either pumped out or emerges from springs, leading to a total extraction from the aquifers of 340 million m³/year. As the annual recharge has been estimated at 300 million m³, there could be up to 40 million m³/year of excess pumping over natural recharge. As a result, the total area of Cyprus is experiencing a gradual decline in groundwater yield, a lowering of the water table and, in certain cases, sea water intrusion.

IRRIGATION AND DRAINAGE

In 1994, the water managed area was estimated at 39 938 ha in the government controlled area, of which 39 545 ha were equipped for full or partial control irrigation. Less than 1 % consisted of spate irrigation. It is estimated however, on the basis of current and potentially available water when the latter is fully developed, that this water managed area is already larger than the irrigation potential. In 1994 only 32 864 ha, or only 82% of the water managed area, were irrigated because of water shortages. Due to continuous water withdrawal and to increasing future water needs for domestic and industrial purposes, this area is unlikely to increase considerably. For this reason, estimates of an irrigation potential of 36 807 ha have been given, including the possible use of tertiary treated wastewater in the future and a greater water storage capacity in the new dams to be constructed. This irrigation potential area is slightly more than the actually irrigated area in 1994 but less than the total water managed area in 1994.

Spring water and groundwater were the first target of water resources development. Traditionally this water was cheap and easy to develop by individual farmers or farmers' Irrigation Divisions or Associations. In the former case the farmers develop the springs or tubewells on an individual basis, whilst in the latter case water resources are developed by a group of farmers who are then eligible for a government subsidy for the capital expenditure. In both cases a government permit is required prior to initiation of any water work. Normally these schemes are small and they cover 1 to 3 ha, although larger schemes have also been developed in recent years.

After independence in 1961 and following the full utilization of groundwater resources, emphasis was placed on collecting and storing surface water during the winter and utilizing it throughout the year. In 1994, a little less than half the area was irrigated from surface water.

Public schemes, often based on the joint use of groundwater and surface water have been constructed since the late 1960s. They include:

- The Paphos Irrigation Project to provide annually 36 million m³ of groundwater and surface water to irrigate 4 600 ha;
- The Vasilikos Pendashinos Project to provide annually 17 million m³ of surface water to irrigate 1 525 ha and for the domestic water supply;
- The Khrysochou Irrigation Project to provide annually 18 million m³ of surface water to irrigate 2 790 ha;
- The Pitsilia Integrated Rural Development Project to supply water for irrigation of 850 ha and for domestic use;
- The Southern Conveyor Project intended to provide annually 65 million m³ of surface water to irrigate 11 244 ha and for the domestic water supply.

All public schemes are operated by the Water Development Department (WDD) of the Ministry of Agriculture, Natural Resources and Environment and the farmers are charged for the water on a volumetric basis. This is possible through the use of water meters which are monitored regularly by the WDD. Irrigation Divisions or Associations usually operate and maintain their own schemes and charge the users either on a volumetric or an hourly basis. Those irrigation works belonging to Irrigation Divisions, that are considered to be major or to involve safety factors or include small dams, are maintained by the government and one third of the operational and maintenance expenses is recovered from the Irrigation Divisions. Individual farmers who possess their own source of water, manage the water resources themselves.

The irrigation network in Cyprus is highly efficient. It generally consists of closed systems with an overall conveyance efficiency averaging 90-95%. Field application efficiency averages 80-90%. In parallel with the government's efforts to increase the water available for agriculture, emphasis was placed on the optimum utilization of water through improved irrigation methods. To encourage farmers to use improved irrigation methods the government offered incentives to participating farmers in the

form of subsidies and long-term low interest loans for the purchase and installation of improved irrigation systems. In addition, through extensive demonstrations, the government convinced the farmers that improved irrigation methods, initially sprinklers for vegetables and the hose/basin method for tree crops, to be followed by micro-irrigation systems, not only saved water but also led to increased yields. As a result of these efforts, the area irrigated by surface irrigation methods has declined from about 13 400 ha in 1974 to less than 2 000 in 1995 while the area equipped for micro-irrigation has increased over the same period from about 2 700 ha to almost 35 600 ha. There are few margins for further improvements in water application efficiency. The areas irrigated by surface irrigation methods are mostly cropped with deciduous trees and are found in the hilly areas of the country. They are usually irrigated from small springs which do not lend themselves easily to the adoption of improved irrigation techniques.

In 1994, 21 746 ha consisted of large schemes (> 500 ha), 2 091 ha of medium schemes and 15 708 ha of small schemes (<100 ha).

The cost of irrigation development varies and depends on a number of factors. The average cost of irrigation development using tubewells varies from about \$US 3 930/ha for up to one hectare, \$US 2 260/ha for two hectares to \$US 1 700/ha for three hectares. This includes the cost of on-farm micro-irrigation systems. Excluding the cost of the dam, the development of surface water varies from \$US 1 560/ha to \$US 2 610/ha including on-farm micro irrigation system. The average annual cost of maintenance varies from \$US 300350/ha for private schemes (tubewells) to \$US 50-120/ha for public schemes.

The major irrigated crops are fruit trees and potatoes. For most crops the cost of irrigation water varies from about \$US 90 to 270/year per ha. Public schemes currently charge the consumer \$US 0.03/m³, whereas the Irrigation Divisions usually charge their members the full operating costs in addition to a basic charge for repayment of loans (when applicable). These costs are high and discourage the farmers from using irrigation for low value crops such as cereals, pulses, olives, almonds, carrots etc. The above-mentioned cost amounts, for example, to about 23 % of variable costs and 17% of total production costs for oranges or 17% and 11 % respectively for spring potatoes. These two crops are the major export crops of Cyprus and cover an area of about 2 200 and 4 600 ha/year respectively. When irrigation is used for other crops, for example wheat or barley, the yields also substantially increase. While the national average yields of rainfed wheat and barley were 0.55 and 0.92 tons/ha respectively in 1994, irrigated crop yields were 4 and 3 tons/ha respectively. Although irrigated crops cover only about 30% of the cultivated land, they account for 60-70% of the production earnings.

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

The Ministry of Agriculture, Natural Resources and Environment is responsible, through a number of departments, for water resources assessment and development. The Water Development Department (WDD) assesses the surface water resources (groundwater resources are assessed by the Geological Survey Department), plans the water development projects, develops the engineering studies (including civil works needed) and operates and maintains these projects. Project construction is usually subcontracted to the private sector, following bids. The WDD also has the responsibility of recommending plans to government for the allocation of water resources as well as water rates. For irrigation purposes the water rates cannot legally exceed 40% (65% in exceptional cases) of the average total cost of water provision, including capital expenditure as well as operation and maintenance expenditures (for domestic and industrial water supply the full costs are recovered). The Department of Agriculture has the overall responsibility for improved irrigation practices at farm level and the Agricultural Research Institute is involved in all aspects of applied research with regard to irrigation methods, application rates etc.

The Ministry of the Interior also plays a key role. It is responsible for the implementation and enforcement of all water related laws, as well as the issuing of groundwater permits and the registration

of water rights. Officers of the Ministry of the Interior also act as Chairpersons of District Water Boards (for domestic water supply) and for the Irrigation Divisions. The Ministry is also involved in the Sewage Boards that manage the sewage systems of the largest towns. The Ministries of Agriculture and of the Interior work closely and coordinate all aspects of water development and utilization.

The main laws concerned with irrigation date back to before to independence in 1961, and include the Government Water Works Law (Cap 341 of 1928) which provides for the control of water and the construction of water works by the government; the Wells Law (Cap 351 of 1946) which covers the installation of wells and their related water rights, and the Irrigation Divisions (Cap 342 of 1938) which regulates the formation of Irrigation Divisions and their operation. The Laws, in general, function effectively and, in the case of the Water Laws, cover all aspects of water development as well as interactions between government and users. All land in Cyprus is registered and owners have deeds or certificates of ownership.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

At present, almost all the renewable water resources in Cyprus are utilized and, in a number of areas, groundwater is rapidly depleting with sea water intrusion occurring in the main coastal aquifers of Morphou (Western Mesaoria), Famagusta and Kokkinochoria (Eastern Mesaoria) and Akrotiri. There is no accurate estimate of the quantity of water extracted in excess of natural recharge, but it could be as high as 40 million m³/year. Even so, in years of drought or below average rainfall, it is necessary to divert water from agriculture to the domestic and industrial sector. In such cases it is necessary to restrict the amount of water made available for both annual and perennial crops. For instance, in the 1989/90 and 1990/91 seasons, annual crops were limited on average to 70% of the normally irrigated land, whereas perennial crops received only 80% of normal supply. A similar situation occurred in 1993.

This precarious situation is- unlikely to change in the future since almost all the conventional water resources are already used. This includes water stored in a series of dams on all rivers rising in the southern slopes of the Troodos mountains. Other potential but smaller water storage schemes are planned for rivers arising from the northern slopes of the Troodos mountains. These new schemes, which will not be completed before 2005-2010, are unlikely to alter the quantity of water available for irrigation significantly (with the possible exception of the Paphos District), since water from most of these rivers currently recharges the aquifer downstream which is already substantially utilized. Furthermore, water demand for domestic and industrial purposes will undoubtedly continue to increase and will receive priority over water demand for agriculture. This leaves the use of treated wastewater as one of the main sources for increasing water supply for agriculture in the foreseeable future. In view of this restrictive situation, the government is also considering alternative ways of increasing the water supply of the country. In this respect in 1996 it awarded a contract for the construction of a desalination plant with a minimum capacity of 7 million m³/year.

Other possible steps and options will also have to be considered and/or evaluated. These include:

- the further minimizing of water losses in the domestic water distribution system which now average about 23%, although this figure is already quite low (compared to a current average of 40% for developing countries and 20% for developed countries);
- the shifting of water from marginally economical agricultural activities to other uses especially to domestic use, thus eliminating the water subsidy;
- the inter-regional transfers of water from the better-endowed western part (i.e. Paphos), to the eastern districts, albeit at a high cost.

Additional, but integral components of the government's policy in water resources management will be the improvement of the water delivery system in the hilly areas, and further overall water savings through increasing the price of irrigation water (at present covering 34 % of the average cost of water

provision) to the maximum allowed by the existing legislation. In both cases the resulting water savings will however be minimal.

Waterlogging, soil salinization, and vector-borne diseases are not present in Cyprus. Contamination of groundwater, especially with fertilizers (particularly nitrates) in certain areas of the island where agriculture is intensively practiced, is however occurring and is a cause of concern. There is also the problem seawater intrusion in the main coastal aquifers. This situation overall requires close monitoring.

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