

INTERNATIONAL WATER TRANSFER PROJECT: NORTHERN CYPRUS TURKISH REPUBLIC WATER SUPPLY PROJECT (TRNC)

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ABSTRACT

The Turkish Republic of Northern Cyprus (TRNC), like most other islands, have problems of fresh water shortage. Because of irregular rain distribution, rain pour down to the Mediterranean Sea directly without infiltration and due to climate change and high temperature, evaporation is increasing in water storage structures. To face the water shortage, groundwater is overexploited causing a decline of the water table below the sea level. This made island water salty and so TRNC has one of the lowest domestic water qualities in the world.

Turkey Government implemented an under-sea Water Supply Project which is achieved for the first time in the world, to solve the problem of water shortage in TRNC. The project aims to transfer about 75 million cubic meter (MCM) water per year (2.38 m³/s) from Turkey through an 80 km long pipeline. By this project, 37,24 MCM water per year will be transferred for irrigation, 37,76 MCM water per year will be transferred for domestic purposes from Turkey. All dams and pipeline in Mediterranean Sea are completed in 2015.

This project, which is an important international experience in terms of water transfer under sea level, will be an example to other countries which have problems of water shortage.

Keywords: TRNC Water Supply Project, water shortage, water transfer, dams, irrigation and drainage systems, water and food security.

1. INTRODUCTION

Cyprus is the third largest island in the Mediterranean Sea, after Sicily and Sardinia. It is also the World's 81st largest by area and the World's 51st largest by population. Northern Cyprus, officially the Turkish Republic of Northern Cyprus (TRNC), is a self-declared state that comprises the northeastern part of the island of Cyprus and heavily dependent on Turkey for economic, political and military support.

Total population of Northern Cyprus is 210,000 (Census: 2010) and estimated population is 306,000 for 2015, and 386,000 for 2045. Tourism is one of the dominant sectors of the TRNC economy. The number of tourists visiting in 2012 was 1,166,000 and it is increasing every year. Because of water shortage, almost the entire need for water is supplied with the groundwater and over-pumping of groundwater has increased for 30 years. This made the island water salty and caused water and food security problem. Some efforts have been made by TRNC Government to solve water shortage problem for years but the situation has not changed. So Turkey has developed numerous projects until now, but none of them could solve the problem.

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In this context, TRNC Potable Water Supply Project was conceived and implemented by the Turkish Government to solve the water problem of TRNC. This kind of project is achieved for the first time in the World. By this project, 37,24 MCM water per year will be transferred for irrigation, 37,76 MCM per year will be transferred for domestic purposes through an 80km pipeline from Turkey. All dams and pipeline in Mediterranean Sea except distribution lines in TRNC are completed in 2015.

2. CLIMATE CONDITION AND NATURAL RESOURCES IN TRNC

2.1. Climate Condition

Cyprus has an intense Mediterranean climate. It has hot dry summers from mid-May to mid-September and rainy winters from November to mid-March; separated by short autumn and spring seasons.

Climate conditions on the island vary geographically. Winter in the Northern part of Cyprus is cool and rainy. The short spring has unstable weather, occasional heavy storms and the "meltem", or westerly wind. Summer is hot and dry enough to turn low-lying lands on the island brown. Summer is followed by a short, turbulent autumn.

The narrow ridge of the Kyrenia range produces a relatively small rain of about 550 mm along its ridge. Autumn and winter rainfall, on which agriculture and water supply generally depend, is somewhat variable. The average rainfall for the year as a whole is about 480 mm. Rainfall in the warmer months contributes little or nothing to water resources and agriculture. The small amounts which fall are rapidly absorbed by the dry soil and soon evaporated due to high temperatures and low humidity. Statistical analysis of rainfall in Cyprus reveals a decreasing trend over the last 30 year. Snow occurs rarely in the lowlands and on the Kyrenia range. Rainfall is almost negligible but isolated thunderstorms sometimes occurs amounting to less than 5% of the total rain in an average year. In winter, the average rainfall from December to February is about 60% of the annual total.

In Cyprus, the summer experiences moderate average temperatures with almost cloudless skies. The average annual temperature on the coast is around 24 °C during the day and 14 °C at night. Generally, summers last about eight months, beginning in April with average temperatures of 21–23 °C during the day and 11–13 °C at night, and ending in November with average temperatures of 22–23 °C during the day and 12–14 °C at night. During the remaining four months temperatures sometimes exceed 20 °C.

2.2 Land and Water Resources

TRNC has an area of 3,355 km², which amounts to around a third of the Cyprus Island. TRNC suffers from a chronic shortage of water. When 56.7 % of the land is agricultural land, 45% of it is irrigable and 20 % of it is irrigated. The country relies heavily on rain to provide household water, but in the past 30 years average yearly precipitation has decreased. Since 2004 demand has increased annually as a result of local population growth because of foreigners moving to Cyprus and the number of visiting tourists, supply has fallen dawn.

Drinking water is normally supplied to homes only every few days but everyone has water tanks to collect it in TRNC. Water delivery services drain wells in an unregulated way. Water quality is derogating since landfill areas are close to water resources and potable water blends into underground waters. So the quality of water

in TRNC is constantly deteriorating and the water potential which is already limited is being reduced every day.

Water desalination plants are gradually being constructed to deal with recent years of prolonged drought. The Government has invested heavily in the creation of water desalination plants which have supplied almost 50% of domestic water since 2001. Efforts have also been made to raise public awareness of the situation and to encourage domestic water users to take more responsibility for the conservation.

3. TURKISH REPUBLIC OF NORTHERN CYPRUS (TRNC) WATER SUPPLY PROJECT

To meet the water demand, TRNC is heavily dependent on Turkey support. So State Hydraulic Works (DSI), under the Ministry of Forests and Water Affairs in Turkey, has developed numerous projects until now such as convey water with balloons. But it is noticed that the most appropriate way to offer a long term solution is water transfer from Turkey to TRNC. In this context, TRNC Potable Water Supply Project was planned.

Start date of the Project preparation was on 27 May 1998. The project was officially in March 2011 with the construction of Alaköprü Dam in Anamur and structures of the project are planned to finish in 2014. But it was completed in 2015.

TRNC Water Supply Project is aimed at delivering water for drinking and irrigation from southern Turkey to the northern coast of Cyprus via a pipeline under the Mediterranean Sea. The pipeline will provide 75 MCM of water per year to TRNC. 37,76 MCM per year will be distributed for potable water need and 37,24 MCM per year will be distributed for Irrigation. Area will be irrigated by project is 4.824 ha. The other benefit of the Project is energy production (26 MW). TRNC will be compensated for its projected water need for the next 50 years.

While the total cost of the project is expected \$ 450 million, it reached around \$ 550 million and it is funded by Turkish Government.

3.1. Main Parts of the Project

This gigantic project has structures of 3 main parts as Turkey Part Land Structures, Sea Crossing and TRNC Part Land Structures. Within the scope of this project, water being supplied from Alaköprü Dam constructed in Turkey was passed through the sea and conveyed to Geçitköy Dam constructed in TRNC. The most critical points of the Project are the pipes carrying the water through the sea.

3.1.1. Turkey Part Land Structures of the Project:

Turkey part of the Project contains:

- ✓ Storage : Alaköprü Dam (Water storage capacity is 130,50 million cubic meter.
- ✓ Transmission line : 23 km
 - Pipe diameter : 1.500 mm
 - Pipe type : Ductile Cast
 - Pipe discharge : 2,38 m³/s

- ✓ Anamuryum balancing room : Water storage capacity is 10.000 cubic meter
- ✓ Sea entrance valve room

The Alaköprü dam at the Turkey side is storing the water required for the pipeline. The source of the water is the Dragon (Anamur) River and it has an annual capacity of 750 million cubic meters. About 1/10th or 75 million cubic meters will be piped to the island. From Alaköprü Dam, the water is transported by pipeline to the Anamuryum pumping station, and then enters the PE pressure line leading into the Mediterranean. Alaköprü Dam is also to be used for the generation of 26 MW hydroelectric energy.

3.1.2. Sea Crossing Structures of the Project :

Sea crossing of the Project contains:

- (a) High density polyethylene pipe HDPE
- (b) Yoks (Y Part): Components used to connect pipes and anchorage system to the seafloor
- (c) Flotation Tank: Permanent buoyancy providing component to improve the lateral stability of the system.
- (d) Rope : Cables used to connect the pipes to anchorage,
- (e) Anchorage: Device provides a link between the suspension ropes and the sea bed

The most critical point of Water Supply Project is “sea crossing”. What makes this project important is the fact that such a long-distance transition with suspended pipeline is the first in the World.

Sea crossing is implemented by a very special high density polyethylene pipe HDPE. The pipes are suspended 250 meters below the Mediterranean Sea level and cover the 80 km from the Alaköprü Dam in Turkey to the Geçitköy Dam in the TRNC. Each pipe with 500 meters is tied with special ropes to the sea bottom. 160 pipes with diameter of 1,600 mm are used for the sea crossing.

The steel yokes which act as fixing and anchoring points, have an outside diameter of 1,514 mm, with a bend angle of 30°, without the connecting elements (flange connectors). The steel yokes are subsequently drawn down to a depth of 250 m by ropes and then anchored to anchorage in the seabed. Flanged connectors are assembled on a special installation ship, with twenty-four connecting bolts, on both ends of the steel yokes. The deepest part of seabed is 1.430 meters. Since the water pressure is too great, it couldn't run on the seabed. It also had to be far enough under water that it does not interfere with ships and submarines. Other advantages are that the pipes can be laid in as straight a line as possible, avoiding the steep contours of the sea floor.

After travelling through the sea, the HDPE pipeline reaches the coast of the Turkish Republic of Northern Cyprus, where the water is pumped into the reservoir of the Geçitköy dam, some 3 km away.

Environmental groups have raised some concerns about the long “rope” holding up the pipeline and whether the project can withstand tsunamis, earthquakes and the Mediterranean's submarine traffic. The pipeline posed an engineering challenge.

Decision for high quality and safety, one international company is the specialist for semi-finished products to guarantee the high production standards vital for the performance and completion of this demanding project.

Related to sea crossing, many issues such as the impact on the pipeline and on the sea life are taken into account carefully in project design work. In Project design studies; many issues such as model tests on the sea crossing, risk analysis, seismic studies, oceanographic and climatic characteristics, effects of sea creatures to pipeline has been considered carefully and examined. Avoiding the unfavorable parts of the sea floor, geological and geotechnical surveys on the steep slope and landslide zones were performed to determine the direction of a straight line as possible. Wave and current data were collected by using devices. Discharge measuring device to watch the waves and currents near the shore and discharge measuring device to watch the stream at the depth were placed.

In order to determine the likelihood of the development of marine creatures, biofouling research program was carried out in sea crossing transmission line. Some HDPE pipe samples were placed in some points of the transmission line route. To minimize the negative effect and increase the safety, all measurements were taken. Because the pipe carries water, not oil or gas, backers also say any ecological damage would be limited.

3.1.3. TRNC Part Land Structures of the Project:

TRNC part of the Project contains:

- ✓ Güzelyalı pumping station : 6,25 MVA installation power
- ✓ Transmission line : 3 km
 - Pipe diameter : 1.400 mm
 - Pipe type : Ductile Cast
 - Pump discharge : 2,38 m³/s
- ✓ Storage : Geçitköy Dam with 26,5 million cubic meter storage capacity
- ✓ Geçitköy pumping station : 20,63 MVA installation power
- ✓ Drinking Water Distribution lines : 477 km

Geçitköy dam is storing the water required. Water is transported by transmission line from Güzelyalı Pumping Station to the Geçitköy dam at TRNC side. Then from Geçitköy Pumping Station water is separated to 4 main distribution lines for irrigation and domestic purposes. Total drinking water distribution line length is 477 km with 80-1500 mm ductile cast, 3 reservoir in 500, 1000 and 10.000 m³ water storage capacity and 19 pumping station for 5 provinces, 20 towns, 141 villages. In project scope, drinking water treatment plant with the capacity of 200.000 cubic meter per day m³/day is also constructed, but lines for irrigation and drainage purposes.

4. CONCLUSIONS

Consecutive years of droughts and overuse of aquifers have decreased the amount and the quality of water in TRNC. The salination problem is not limited in coastal areas. Residents complained about seawater mixing with groundwater sources disturbing daily life and agricultural irrigation. So, TRNC Water Supply Project is

aimed at delivering water for drinking and irrigation from southern Turkey to the northern coast of Cyprus TRNC. This project is a unique and complex project globally and Turkish government promoted the project as “The Project of Century”. Turkey named this water as “Peace Water” as well. If the Greek Part of Cyprus also wants to utilize this water, Turkey will share its water with this project.

The Project will be a great contribution to the economic development of the region. It will enhance agriculture and will provide extensive contribution to the standard of living in Turkish Republic of Northern Cyprus and the region. It is ensure that all residents and visitors in TRNC can drink purer water and reach enough food for a long time. The project will also potentially provide electricity to TRNC from Turkey. The Project meet all of the TRNC’s water needs for the next 50 years.

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