

Drought Management in Central Part of Turkey with special reference to recent drought effect experienced on water resources

Hasan B. Yuksel¹

ABSTRACT

There are two main water issues experienced in Turkey; Flood and Drought. These natural disasters can result in social and economic damages. Scientific studies point out that as a result of the global warming and climate change, water related natural disasters in many countries have been occurring with more destructive power and in larger scales than those happened in the past. These unpleasant occurrences add to the burden of water administration in the semiarid zones such as in Turkey.

Since droughts may occur from time to time in Turkey necessary precautions are to be taken against drought. Seven years ago, between 2005, 2006 and 2007, Turkey had difficulty in meeting the domestic and industrial water need of metropolitan cities such as Istanbul, Ankara, and Izmir. So as to not to face similar problem, DSI has been developing new water supply projects.

During the drought years, hydro energy generation diminishes by 30% compared with the wet years. Since Turkey depends on imported fuels for the energy generation Turkey has to import more fuel such as natural gas, petrol and coal during the drought years.

The country's agriculture depends heavily on seasonal rainfall, especially for cereal cultivation. Although 6 million ha area has been equipped by irrigation facilities still, about 16 Million ha area is used for rain fed agriculture. During the drought years, agricultural production so reduces that Turkey has to import some commodities that are exported during the productive wet years. In this way, Turkey tries to secure food security and price stability during drought years.

In order to mitigate the unpleasant conditions caused by drought and flood disasters, Turkey has to tame rivers so as to harness them for irrigation, water supply and hydroelectric energy generation.

Key words: water resources, harness drought, semiarid zone, climate change, global warming

A. PRESENT SITUATION

Annual precipitation in Turkey varies according to the regions of Turkey and according to drought years or rainy years. Although the coastline regions are mountainous and receive more precipitation, the central part is flat and receives much less precipitation. These circumstances may result in two contradictory natural water related disasters; floods and droughts.

The rainy period of the years brings forth more precipitation in the mountainous areas that trigger off flood disasters. On the other hand, the drought period of the years brings less precipitation giving rise to drought disaster. The paper discusses the kind of mitigation measures that could be taken against drought disaster.

Being located in the central part, Konya watershed receives the least precipitation in Turkey with an annual average of around 250 mm. Successive drought years with lack of fresh water turn the situation of the area into a natural disaster (The drought disaster). Being located in the land locked Konya watershed, Tuz lake has limited groundwater and surface water resources.

¹ Environmental Planner, State Hydraulic Works (DSI), General Directorate, Foreign Relations Office, 06100 Ankara, Turkey, basriyuksele@hotmail.com

Tuz lake is Turkey's second largest lake in terms of total surface area. When full, it is 1,600 km² (160,000 ha). Even in spring when its waters are most plentiful the water surface area does not exceed 1,300 km² (130,000 hectares). It is 35 km wide and stretches for approximately 90 km. It covers a plateau terrain which is narrow in the outskirts and which enlarges towards the south. Its elevation is 905 m. Cities in the basin are Cihanbeyli, Sereflikochisar, Kulu, and Aksaray.

About 7,400 km² area of the Tuz Lake basin is designated as Special Environmental Protection Area. This is the first ring of the lake basin having Tuz lake surface area including the moors, ponds and salt steppe surface. However, the second ring of the lake catchment area is 20,630 km² having not only the first ring, but also plain steppe, agricultural area and urban area. The details of the sub-basins in the second ring are shown in Fig. 4. Cities in the second ring are Sereflikochisar, Kulu, and Aksaray. The population in the second ring is 560,000.

Although Tuz Lake is Turkey's second largest lake, it is one of the shallowest lakes. During the spring time when the accumulated water volume is the maximum in the lake, its depth is less than 0.5 meters in most parts. During the successive drought years, drought disaster occurs, then water evaporates in Tuz Lake and also in its moors and ponds. The situation of the lake water in the drought years is shown in Fig. 1.

Tuz Lake is fed mainly by groundwater. Parts of the groundwater flow through the important salt formations in the sub-soil and are saturated with salt on the way. Thus, the lake is being fed continuously with saline water. The natural regime of the lake shows a rise of the water level during winter and spring and a lowering of the level, due to evaporation, in summer and autumn.

1. USES AND VALUES

Salt mineral at the bottom of Tuz Lake is one of the ecological services and benefit of the lake. The stakeholders are salt processing plant owners and all people who are using it. Tuz Lake is not only the biggest saline lake of Turkey but one of the biggest in the world as well. The lake meets 70% of salt need of Turkey. The evaporation leaves a tick crust of salt on the surface up to 30 centimeters.

Birds are important ecosystem services of the lake. The wetland that forms around the lake makes an important winter habitat for the water birds. The stakeholders are foreign and domestic tourists who enjoy watching the birds.

Groundwater and surface water in the Tuz Lake catchment area is used by agricultural activities as well as domestic and industrial water supply. Rural people in the catchment area are stakeholders driving benefit from agricultural products by consuming and selling them. Urban people in the catchment area are also stakeholders driving benefit from agricultural products by consuming them.

Tuz Lake with its moors, ponds, and the salty steppes associated with the first ring of the lake basin is SEPA (Special Environmental Protection Area) covering around 20% of the second ring. The land use of the total catchment is dominated by agricultural areas comprising 43% of the second ring. Plain steppe constitutes the 37%. Plain steppe is used for small cattle grazing. (See Table 4)

The inflowing manmade watercourse is Konya drainage canal which lies in the southwest of the Lake. The Konya drainage channel conveys waster water consisting of not only irrigation drainage water but also untreated domestic and industrial wastewater from the Konya city to the Tuz Lake.

The Tuz lake basin map is shown in Fig.3.

2. IMPAIRMENTS

With excessive evaporation in summer, the whole Tuz Lake comes to resemble a desert. A layer of salt up to 30cm thick forms in the dried up areas. Due to the high concentration of salt, no aquatic plants exist in the lake. But there is a sparse cover of salt-resistant vegetation around the edge of the inflowing creeks.

Moors around lake accommodate aquatic plants and are also one of Turkey's most important hatching grounds for birds. The islands and marshes that form in spring allow them to hatch their

eggs here. The moors within the first ring of the Lake basin is adversely affected by lack of water drought years.

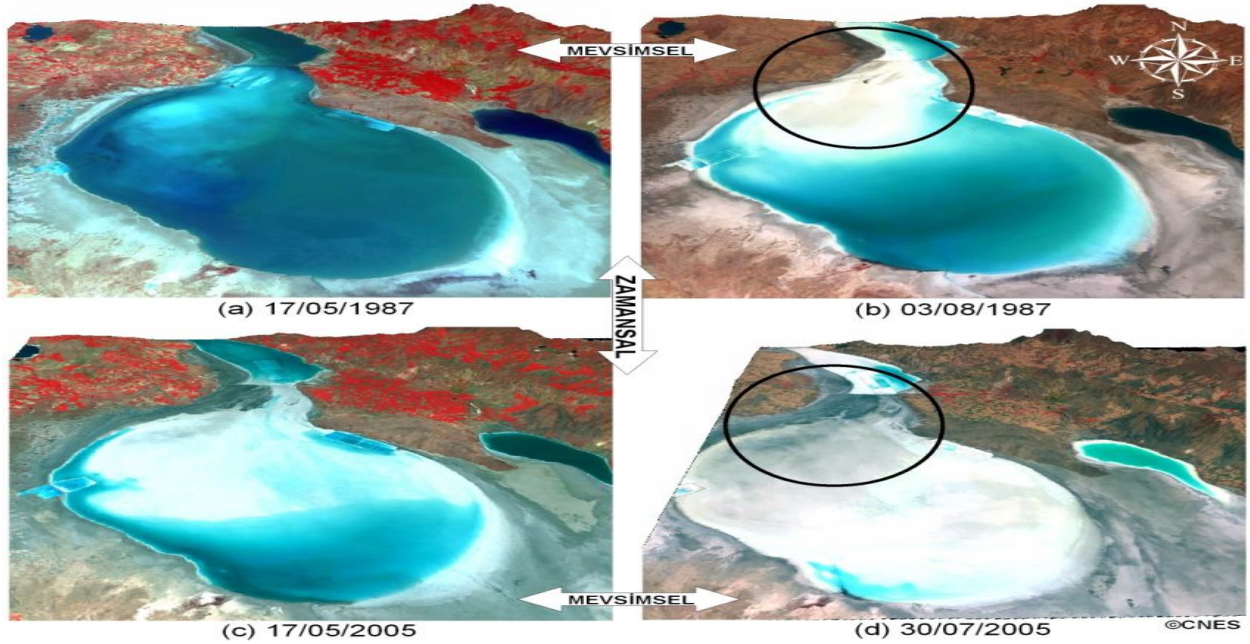


Fig. 1. Satellite views show decreasing amount of water during the drought years and seasons.

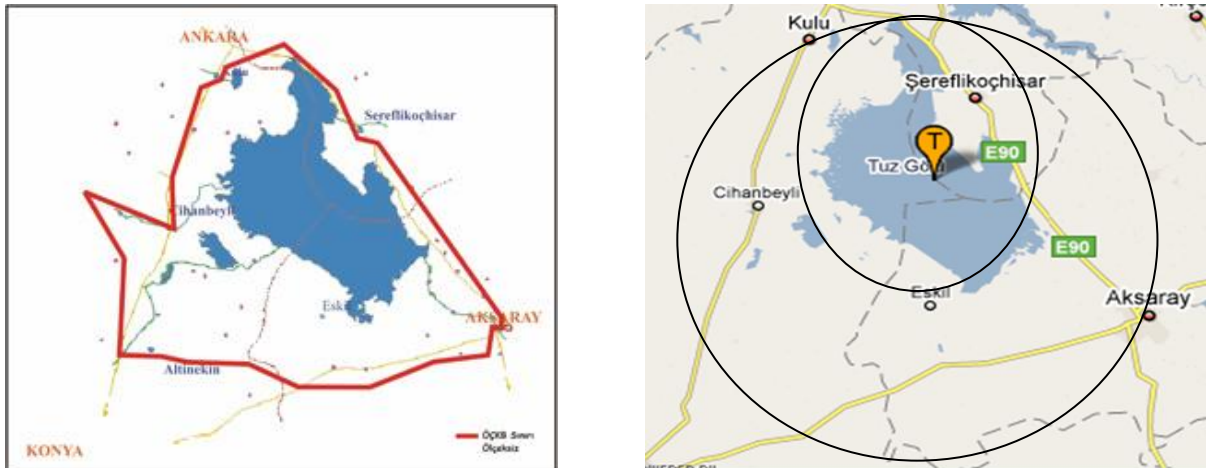


Fig. 2. Environmental Protection Area in the Tuz lake catchment.

1st ring: 7,400km² 2nd ring: 18,560 km²

Another problem is pollution. Tuz Lake Catchment is a closed ecosystem. It is the final recipient of all water, generally polluted due to agricultural, domestic and industrial use. The Kulu, Cihanbeyli, Aksaray and Sereflikoçhisar, located within the Tuz Lake Catchment area have sewage system. Though Sereflikoçhisar and Aksaray possess wastewater treatment plants (WWTP), they are poorly operated, thus not providing effective treatment.

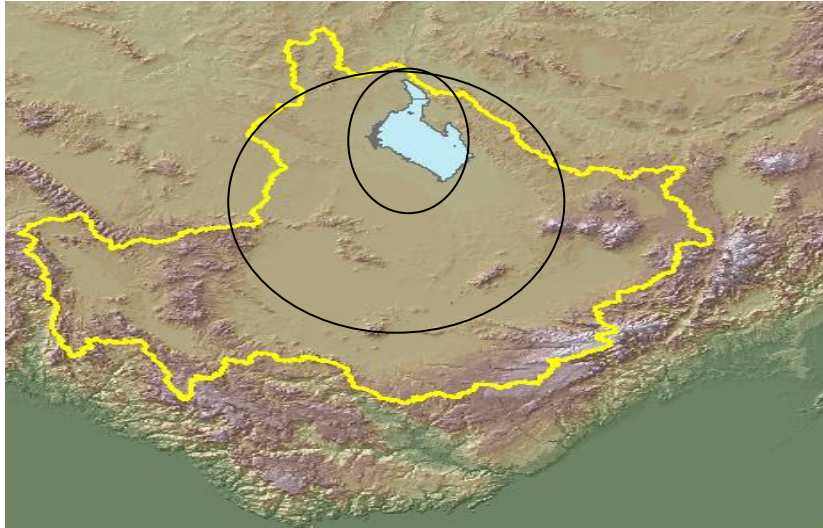


Fig. 3. Tuz Lake Basin Map

Konya city with 700,000 populations is just outside edge of the Tuz Lake catchment area. But, Konya city wastewater is conveyed to the Tuz Lake through the Konya Drainage Channel, which is 150 km long from Konya city to the lake. The canal conveys annual average 50 M m³ waste water consisting of not only irrigation drainage water of the around agricultural areas but also domestic and industrial wastewater from the Konya basin to the Tuz Lake. The lake is used as dumping ground of waste water of Konya city and drainage water from the irrigated regions.

The degradation threats to Tuz lake environment can be summarized as follows:

1. Drought Disaster
 - a) Excessive withdrawal of groundwater and diversion of incoming surface waters, (See Table 3),and
 - b) Destruction of shoreline ecosystem and habitats,
2. Pollution
 - a) Release of agro-chemicals by intrusion of agricultural drainage water, and
 - b) Inflow of point and nonpoint sources of pollution,
3. Climate Change

3. RESPONSES

The first ring of the Tuz Lake catchment area has been designated as Special Environmental Protection Area (SEPA) with the Decree of Cabinet of Ministers in 2002 in Turkey. It is an A Class wetland according to international criteria and it has largest SEPA and is of great significance in terms of the protection of biological diversity in Turkey. The Ministry of Environment and Urbanism (MEU),(www.csb.gov.tr) is responsible for the first ring of the basin, which is one of the 14 SEPAs in Turkey.

Tuz Lake Special Environmental Protection Area covers the first ring of the basin, which is 7,400km², having the lake, the moors and ponds. But, the second ring of the basin, which is the Tuz lake catchment area, comprises 20,630 km² (See Fig. 2).The effect of the designation of Special Environmental Protection Area has been positive by forbidding of hunting of the birds nested on moors. But, it has no effect on depletion on water and pollution to the catchment area.

Pollution mitigation measurements are initiated in cities in the catchment area, which are Kulu, Aksaray, Şereflikoçhisar,and Cihanbeyli. Their Waste Regular Storage Facilities and Waste Water Refineries are planned. About 80% of Konya Waste Water Treatment Plant construction has been completed². Aksaray, Niğde, Nevşehir, Domestic Water Arsenic Treatment Plant is in operation.

✓ ² Konya Municipality Water and Sewerage Administration (KOSKI)

The Ministry of Environment and Urbanism (MEU) have been instrumental in the preparation of environmental infrastructure projects and implementation models. The projects of Aksaray, Şereflikoçhisar and Cihanbeyli Solid Waste Regular Storage Facilities and the projects of Kulu, Aksaray, Şereflikoçhisar and Cihanbeyli Waste Water Refineries, have been prepared.

When the construction of Konya Waste Water Treatment Plant² is completed, it will convey clean water. The Konya waste water treatment plant will prevent the pollution of the lake and the treated waste water will be used in agricultural irrigation. This treatment plant will provide sustainable development since water withdrawal from groundwater and surface water for agriculture use will be rationalized.

Since chemical fertilizers, herbicides and pesticides used in the agricultural area caused pollution in the streams, there has been urgent need for the construction of Aksaray, Niğde, Nevşehir, Domestic Water Arsenic Treatment Plant, the capacity of which is 52,000 m³/day.

B. FUTURE MANAGEMENT TLAP (Tuz Lake Action Plan)

The most important problem in Tuz Lake catchment area is drought disaster resulting from lack of precipitation during the successive drought years in which water demand for agriculture increases. Excessive use of ground and surface water in agriculture aggravates coastline and natural habitat of Tuz Lake. In order to increase water saving in the Tuz Lake catchment area, water saving methods are to be urgently introduced. Since the agricultural sector consumes the largest amount of freshwater, the TLAP propose water saving methods in agricultural activities.

Governmental organizations could be successful in mitigation of the point source pollutions by building waste water treatment plants, waste regular storage facilities, and water treatment plants. However, the pollution problem of the Tuz Lake basin caused also by non-point source pollutions, due to the use of chemical fertilizers, herbicides and pesticides over large agricultural areas. Stockbreeding also contributes to the pollution by means of domestic animal excreta since organic farming is not adopted. The above mentioned efforts by governmental organizations are not related to water saving in order not to deplete groundwater table and augment the water supply for ponds and moors around the first ring of the basin.

For the reasons, actions are to be focused on village areas in which agricultural activities are undertaken. By doing so, both water saving in agriculture and the mitigation of the pollution could be properly addressed.

TLAP (Tuz Lake Action Plan) envisages actions for the villages within the second ring of the sub basins in order to combat water waste issue in irrigation. It also aims to prevent the agricultural malpractices and to ameliorate the socio-economic structure of the villagers by promoting the organic farming. To sum up, TLAP has two aims; water saving and organic farming.

1. KNOWLEDGE AND INFORMATION

The knowledge that ground water table has been declining has been recorded through groundwater observation wells. This means that there is excessive withdrawal of water for irrigation. The lack of water on the surface of Tuz Lake and its basin has been recorded by satellite views taken in the recent years.

It has been calculated that 70% of the water consumed is used in agricultural activities. On this account water saving in agricultural activities could be vital for meeting the environmental water need. About 2,070km² area is irrigated by groundwater resources and nearly 272 km² area is irrigated by surface water.

The inflowing natural watercourses are³:

- Peçenek Stream flowing through Şereflikoçhisar in the East,
- İnsuyu coming from Cihanbeyli in the West, and
- Ulurmak coming from Aksaray in the Southeast.

The dams on these 3 streams aim to store water in order to use water during summers. The amount of the surface water of 3 incoming streams that has been impounded in the reservoirs is not enough to meet the need of agriculture and environment.

Average water potential of İnsuyu River coming from Cihanbeyli in the West of the Tuz Lake is 15M m³/year. Cihanbeyli small dam on İnsuyu Stream has irrigation purpose. Constructed in 1990, Cihanbeyli small dam having 8.5 M m³ reservoir capacity, irrigates 1,200 ha (12 km²).

Average water potential of Ulurmak River coming from Aksaray in the southeast of the Tuz Lake is 143 million m³/year. Mamasin dam on Ulurmak has 2 purposes; irrigation and water supply. Constructed in 1990, Mamasin dam having 82 million m³ reservoir capacity, irrigates 23,600 ha (236km²) area.

Average annual water flow of Peçenek Stream coming from Şereflikoçhisar in the east of Tuz Lake is 1.079 m³/second. Average water potential of Peçenek River is 34 M m³/year. Peçenek dam on Peçenek River is used for irrigation and water supply purposes. The dam was completed in 2011. Peçenek dam having 60 million m³ reservoir capacity irrigates 1,400 ha (14km²) area.

Cihanbeyli small dam irrigating 1,200 ha area and Mamasin dam irrigating 24,600 ha area have been constructed. Peçenek dam irrigates 1,400 ha area. Total irrigated land by means of 3 abovementioned dams is 27,200 ha (272 km²), which means remaining about 200,070 ha (2,000 km²) area is irrigated by groundwater. (See Table 2)

There are 4 cities within the second ring of the Tuz Lake catchment area, which are Aksaray, Kulu, Cihanbeyli, and Şereflikoçhisar. The total population of the 3 cities is 560,000. Being the largest city in the area population of Aksaray is 366,000. Being the smaller cities in the area, the population of Kulu, Cihanbeyli, and Şereflikoçhisar is 194,000. About the half of the population in these cities is rural population engaging in agricultural activities. (See Table 1)

³ www.dsi.gov.tr



Fig. 4. Details of the sub-basins in the second ring
(The sub-basins are: Kulu-Cihanbeyli, Altınekin and Sultanhanı-Obruk)⁴

Table 1. Administration, the Population, and ponds

City	Total Population	Urban Population	Rural Population	Command Area km ²	Density persons/km ²	ponds or moors
Aksaray	366,000	205,000	161,000	7,600	48	Eşmekaya marshes
Cihanbeyli	62,000	15,000	47,000	4,100	15	Lakes of Bolluk, Tersakan, Köpek, and Acı
Kulu	72,000	28,000	44,000	2,200	32	Düden Lake
Şereflikoçhisar	60,000	42,000	18,000	2,100	28	
Total	560,000	290,000	270,000	16,100		

An Eşmekaya marsh comprises a permanent freshwater lake (groundwater-fed), large expanses of marsh and rush pasture. Bolluk lake and Tersakan Lake are saline lakes located west of Tuz lake.

Table 2. Irrigation area in sub-basins of the second ring of Tuz Lake Basin⁴

Sub-basins of the Second Ring	Amount of Water Reservation (hm ³)	Arable Land (ha)	Surface Irrigation (ha)	Groundwater Irrigation (ha)
Sultanhanı-Obruk	435	730,000	26,200	153,000
Altınekin	74	130,000	0	27,000
Kulu-Cihanbeyli	70	170,000	1,000	27,000
Total	579	1,030,000ha =10,300 km ²	27,200ha =272 km ²	207,000ha =2,070 km ²
Total Irrigated Area			234,200ha	= 2,342 km ²

⁴ DSI Konya 4. Regional Directorate Reports

Table 3. Water used in in sub-basins of the second ring of Tuz Lake Basin⁴

Sub basin	Potential Water Reservation	De facto Water Withdrawal (hm ³)						Remaining water (hm ³)
		Cooperative Wells	Wells with license	Wells without license	Additional wells	Water supply	Total	
Sultanhanı-Obruk	435	186	275	306	31	20	818	-383
Altnekin	74	11	86	38	-	5	140	-66
Kulu-Cihanbeyli	70	8	53	73	-	5	139	-69
Total	579	205	414	417	31	30	1097	-518

Table 4. Land Cover and Land Use Characteristics of the Second Ring

Land Cover or Use	Surface Area (km ²)	
Freshwater lakes	7	The First Ring SEPA (Special Environmental Protection Area) 7,400 km²
Brackish water lakes	13	
Tuz Lake	1,600	
Salt steppe	1,800	
Plain steppe	4,700	
Rainfed agriculture	10,028	
Irrigated agriculture	2,342	
Urban area	140	
TOTAL catchment area	20,630	The Second Ring 20,630 km²

On the other hand, water quality gauging stations proved the pollution in the rivers. The scientific and the public perception about the Tuz Lake has been expressed by NGOs and by media. Public and institutions are aware of the situation of the Tuz Lake Catchment Area. This generation and sharing of knowledge will help mobilization of human and financial resources in the TLAP (Tuz Lake Action Plan).

2. TECHNOLOGIES

Modern on-farm irrigation methods save about 40-60% of water compared to the conventional uncontrolled irrigation. Annual irrigation amount used for 1 m² agriculture area has been calculated as 0.6m³ with conventional irrigation method, whereas 0.45m³ with sprinkler irrigation method, and 0.25m³ with trickle irrigation. Efficiency in sprinkler irrigation is 70-80% and in trickle irrigation is 95%. In order to save in the amount of water used in irrigation, modern on-farm irrigation methods are to be encouraged by means of incentives. There are a number of private companies in Turkey providing equipment and information of sprinkler and trickle irrigation. Modern on-farm irrigation methods contribute not only in saving water but also in mitigation of agricultural pollution. Wild irrigation pollutes environment of the lake surface and ground water since the excess irrigation water spreads the pollutants to the surroundings.

Although initial investment cost modern irrigation infrastructure is high, in the long run it recovers the cost by using less irrigation water without necessitating drainage investment. However, farmers can not afford to install modern irrigation methods on their farms. The grants are to be available to meet the half of the cost of modern irrigation investments. The main component of the TLAP project is to encourage the adoption and use of modern irrigation infrastructure by granting the half of the investment cost.

⁴ DSI Konya 4. Regional Directorate Reports

3. INSTITUTIONS

The government organizations playing crucial role in the Tuz Lake Catchment area are General Directorate of State Hydraulic Works (DSİ), the Ministry of Agricultural and Rural Affairs (MARA), the and Municipalities of Cities of Kulu, Aksaray, Şereflikoçhisar and Cihanbeyli.

The Ministry of Environment and Urbanism (MEU) mainly provides coordination among the governmental institutions.

The General Directorate of State Hydraulic Works (DSİ) is the primary executive state agency responsible for development of water resources in Turkey. The General Directorate of State Hydraulic Works (DSİ) invests in construction water structures.

There are 26 units of DSI Regional Directorates roughly settled up based on the river basin boundaries and dispersed throughout Turkey. One of the DSI Regional Directorates is Konya DSI Regional Directorate, the most of responsible area of which covers the majority of Tuz Lake Catchment area except Sereflikochisar Township, the responsible area of which is within Ankara DSI Regional Directorate.

After the completion of dams and hydroelectric power plants (HEPPs), DSI transfers the management of HEPPs to Electricity Authority. After the completion of dams and water supply facilities, DSI transfers the management of water supply facilities to the related municipalities. After the completion of dams and irrigation facilities, DSI transfer the management of irrigation facilities to the water user organizations.

The groundwater activities in Turkey have been executed by DSİ on behalf of the State. DSİ determines number, location, depth, other characteristics of wells and the amount of water extraction. DSİ drill groundwater wells to erect the electrification installations to these wells, to determine right motor-pumps and to procure them for the wells. After the installments of the wells, Groundwater Irrigation Cooperatives take the responsibility of facilities constructed by DSİ so as to perform operation, maintenance and repair works of them.

Land owners or farmers are able to irrigate their own fields from individually operated groundwater wells. In order to operate them, farmers have to get a user's license from DSİ if the well depth is more than 10 m.

It has been estimated that there are ground water wells without license as much as licensed ground water wells. DSİ observation groundwater wells indicate the fall of water table because of the excessive use of groundwater for irrigation.

DSİ is not responsible for the on-farm irrigation investments and extension services for villagers. Farmers are responsible for on-farm irrigation investments in their land. The Ministry of Agricultural and Rural Affairs (MARA) is responsible extension services for villages and the general management of the organic farming system in Turkey. Although organic farming constitutes a small proportion of the total agricultural land in Turkey, this proportion is growing from year to year with the increasing health awareness in domestic and international markets. The majority of the production of organic agricultural products is being exported.

✓⁵ Integrated Feasibility Study For The Sanitation of Tuz Lake Basin-Turkey Ander Gorostiaga Idom (Spain)

4. PARTICIPITATION

All these actions could be made effectively by participation of villagers by means of NGOs. The system of water distribution, water pricing, fee collection rates, the equity in charging the water user and the maintenance of irrigation structures are principal factors determining the effectiveness of water use in irrigated agriculture. Participation in irrigation management provides the mentioned factors above adequately. The participation is bottom-up management practice by irrigation organizations, to achieve a more effective water use.

After construction of irrigation facilities, DSI transfer the management of irrigation network to Surface Water User Organizations and Groundwater Cooperatives, which are non-government organizations. DSI used to manage irrigation facilities before 1993. Irrigation management transfer gained momentum between 1994 and 1998 and management responsibility of 70% of irrigated area was transferred to Water User Organizations in 4 years. As of 2014, the management of 97% of the area equipped irrigation facilities has been transferred to Surface Water User Organizations and Groundwater Cooperatives⁴.

Surface Water User Organizations and Groundwater Cooperatives are regarded as NGOs since they have assembly composed of farmers who elect their chairman and executive committee. They collect the water fee. They decide all irrigation management issues and allocate the money in operation and maintenance works. After the irrigation management transfer, farmers' participation in the irrigation management has increased, self control in irrigation management has been secured, and reduction in expenditures of operation and management activities has been observed.

TLAP is envisaged to be carried out in close cooperation with Surface Water User Organizations and Groundwater Cooperatives. If farmers want to make use of TLAP, they are to participate in the assembly of Water User Organizations or Groundwater Cooperatives to vote in favor of applying TLAP. When they install modern irrigation system on their land, TLAP will grant the half of the cost. TLAP will also provide farmers with training of organic farming.

5. FINANCE

Groundwater Cooperatives and Water User Organizations have limited budget. Their budget consist of collect water fees, which is hardly enough to meet operation and maintenance expenses as well as repayment of investment cost by installments.

Government institutions have their own budget for their respective duties. Therefore, TLAP is to be implemented by means of special loan. Apart from any government organization, separate office with few technical staff could implement TLAP effectively.

The first component of the TLAP project is to expedite modern irrigation systems in agriculture. Farmers of Groundwater Cooperatives and Surface Water User Organizations within the Tuz Lake Catchment Area are to be eligible to use grants towards the cost of 50% of drip or sprinkler irrigation infrastructure to be installed in their agricultural land. Having informed their members about the benefits of the modern irrigation systems in agriculture, the executive committee Groundwater Cooperatives and Surface Water User Organizations are to secure the decision by majority of votes for the application for the grant.

The second component of the TLAP project is to encourage organic farming. The villages applying for modern irrigation systems are to be eligible for training of irrigated agriculture, organic agriculture, fruit culture and vegetable growing. Villages are to be trained so as to improve on the mode of tillage in order to prevent the pollution from chemical fertilizers. Small cattle raising are results in over-grazing of existing grasslands. In order to mitigate pressure on natural pasture land, the different species of fodder crops are to be planted. In order to generate new income sources for the villagers, fruit trees that are suitable for the land feature are to be planted.

⁴ www.dsi.gov.tr

6. POLICIES

The Ministry of Environment and Urbanism (MEU) is responsible for Tuz Lake basin, which is one of the 14 SEPAs in Turkey. Although, Tuz Lake basin has been designated as Environmental Protection Area (SEPA) with the Decree of Cabinet of Ministers in 2002 in Turkey, the degradation has not mitigated enough. This means existing policies are not enough to address the pollution and water scarcity problems in the region.

In order to achieve maximum benefit from water sources, DSI under the Ministry of the Environment and Forestry has shifted its policy from classical open channel distribution network to more water saving systems. Pipeline distribution network has been utilized extensively. Especially in inland areas where the water sources are scarcer this becomes a major issue.

Although there is policy change by DSI, water saving in agriculture by means of modern irrigation systems could not achieved, because farmers is responsible for on-farm irrigation investments in their lands.

For that reasons TLAP is necessary for Tuz Lake Catchment Area. A new law is to be enacted in order to implement TLAP. Similar project has been implemented in Turkey between the years of 1998-2004. The name of the project was Participatory Privatization of Irrigation Management and Investments Project (PPIMIP). The loan provided for PPIMIP has been used between the years of 1998-2004. Water user organizations were established, they needed machinery and equipment to perform the responsibility of operation and maintenance services of irrigation. The aim of the project was to subsidize purchasing of equipment. The difference of TLAP from the PPIMIP would be as follows:

PPIMIP provided grants to Water User Organizations in order that they could purchase machine and equipment for operation and management main, secondary, and tertiary irrigation canals.

TLAP would provide grants to Groundwater Cooperatives and Surface Water User Organizations in the Tuz Lake Catchment area in order that they could purchase modern on-farm irrigation equipment.

TLAP would comprise Groundwater Cooperatives and water user organizations in the second ring of sub basins (See Figure 4) Tuz Lake Catchment area whereas PPIMIP covered all over Turkey.

PPIMIP was implemented for water user organizations using surface irrigation resources. Their size of irrigated land and amount of water is much larger than those of Groundwater Cooperatives.

PPIMIP did not covered training for farmers whereas TLAP would comprise training of farmers for organic farming with various agricultural practices.

CONCLUSION

Existing situation in Konya closed basin is agricultural land expanding through using mostly groundwater which is decreasing water table especially during drought years. We can not ban the agricultural activities but we can direct them in order to save agricultural water which consumes 70% consumed fresh water in Turkey (Industrial water and domestic water consumption is about 30%).

There are two ways to decrease amount of the water in agriculture in the region⁵. The first one is to shift existing crop pattern to the crop pattern necessitate less water. Maize and sugar beat is widely cultivated around the region. The government should give subsidies for the cereals cultivation because cereal cultivation much less amount of irrigation water compared with maize and sugar beat cultivation. The second way to save water in agriculture is to shift from traditional irrigation methods to modern ones. Open canals are to be abandoned. Conveyance lines, main, lateral, and branch canals are to be closed canals. Wild irrigation is to be abandoned in on farm irrigation. Sprinkler, trickle irrigation methods are to be utilized. These two ways will allow sustainable agriculture in the region through requiring much less amount of irrigation water in the area.

⁵ WWF “Towards Integrated Management of Konya Closed Basin”, 2009

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