Environmental Politics - Wetland Management in Turkey Case Study: Sultansazligi

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Abstract: This study summarizes the historical development of environmental management concept in Turkey. In this sense, some facts and figures about the wetlands of Turkey are given to describe the types of problems of the wetlands. A set of constructive comments on the water resources management of wetlands with reference to state water management policy are listed. Current laws and regulations related to conservation of wetlands are introduced. Sultansazligi Wetland has been selected as case study area; field data were collected and water pollution analysis was made in order to define the origin of the ecological problems of Sultansazligi.
It is concluded that Turkey, being aware of the importance of biological diversity and having a high eco-tourism potential around wetlands, has to make an integrated conservation program to minimize the existing and possible environmental problems.

Keywords: environmental conservation, legal aspects, Sultansazligi Wetland, sustainability, water resources management, water pollution

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Riassunto: *Negli anni recenti, il concetto di gestione delle zone umide è divenuta una questione di rilievo in tutto il mondo e dunque pure in Turchia a causa dell'inquinamento delle risorse idriche, della scarsità di acqua causata dal riscaldamento globale ed infine da improprie politiche di gestione delle risorse.*
Lo scopo di questo studio è di presentare il concetto di gestione nazionale delle zone umide e di descrivere i problemi ambientali delle zone umide stesse in Turchia. Viene elaborato un commento costruttivo sulla gestione delle risorse idriche riferibili a zone umide, in relazione alle politiche statali; nel contesto di questo studio vengono altresì esplicate leggi correnti e regolamenti adottati al fine della conservazione stessa delle zone umide del paese.
La zona umida di Sultansazligi è stata scelta come area di studio, essa è localizzabile alla metà del bacino chiuso di Develi, nell'Anatolia Centrale Turca. Sono ivi presenti i laghi di Camiz Çöl e Yay, assieme alle Paludi Meridionali e Settentrionali. La zona umida di Sultansazligi è una area protetta e conservata fino dall'accordo Internazionale di Ramsar del 1994.
Frequentemente soggetta a periodi siccitosi, in anni recenti, i laghi e le paludi hanno mostrato un rilevante fenomeno di abbassamento del livello idrico, dovuto principalmente alla cattiva gestione delle risorse ed ai cambiamenti climatici.
In questo studio si è cercato di trovare una risposta a questi fenomeni e si propongono alcuni interventi mirati alla loro limitazione.
La salinizzazione e l'inquinamento delle acque sono altri due problemi fondamentali per la zona umida di Sultansazligi, i sali contenuti nell'acqua di superficie aumentano a causa del flusso di ritorno dall'irrigazione, flusso in cui la concentrazione salina è abbondante. Allo stesso modo gli scarichi domestici non trattati inquinano sia tali zone che le altre acque di superficie e sotterranee del bacino chiuso di Develi.
Sono stati raccolti ed analizzati campioni d'acqua provenienti dalle acque superficiali, da 22 pozzi profondi e da 16 sorgenti per il periodo 2003-2005 nell'intero bacino al fine di definire salinità e inquinamento delle risorse dell'area in studio, le analisi sono state integrate da altre prodotte dal Turkish State Hydraulic Work (DSI).
Fondamentalmente si sono riscontrate alte concentrazioni di ioni ammonio ed inquinamento da nitrati, per zone circoscritte, dovute essenzialmente all'uso massivo di fertilizzanti per scopi agricoli.
La conducibilità elettrica, i nitrati, gli ortofosfati e gli ioni ammonio sono chiaramente in aumento, mentre la concentrazione di ossigeno disciolto è diminuita, a causa della contaminazione delle acque di scolo e allo smaltimento delle acque di scarto.
Al fine di minimizzare i problemi ambientali di queste zone e ottimizzare l'utilizzo delle risorse idriche, piuttosto che un singolo progetto, sarebbe meglio per lo stato turco indirizzarsi verso l'adozione di un sistema integrato di gestione delle risorse.
Sistema che dovrebbe includere sia i parametri (qualitativi che quantitativi) che governano la qualità attuale delle acque delle zone in esame, che la gestione degli altri usi delle risorse idriche come l'agricoltura l'energia idroelettrica e gli usi domestici.

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Introduction

Turkey, at present, has about 250 wetlands and 76 of them are recognized as wetlands of international importance. These wetlands extend over 1,295,456 hectares, located on the routes of the immigrant birds and fishes. At present, 9 of them are operated and protected by the International Ramsar Agreement. Due to the state policy and according to the laws and regulations in force before 70's, about 8.4% of the total wetlands in Turkey were dried and converted into agricultural plots, flood control and malaria eradication zones. Water related problems faced in wetland management in Turkey can be listed as: water scarcity due to the recent global warming, depletion of groundwater aquifer below wetland due to uncontrolled pumping, build up of extensive drainage canal networks and reservoirs on rivers feeding wetlands, sand and gravel quarries, pollution due to wastewater and solid waste deposition areas neighboring the wetlands, illegal hunting and fishing, sudden reed field fires, soil and channel erosion and wrong operation techniques.

This paper is divided into four main sections: first section is the introduction and the second section is about environmental conservation studies and institutionalization on environmental issues in Turkey. In the third section Sultansazligi Wetland is analyzed and conclusion comes after the third section as a fourth section. The main problems of the wetlands are discussed and some recommendations are evaluated at the last section.

Environmental Conservation Studies in Turkey

Governmental State Institutions Dealing With the Environment

The ministries tackling with the environment in Turkey can be listed as: The Ministries of Environment and Forestry, Culture, and Tourism, Agriculture, Public Works and Settlement, Health and Ministry of Interior. The related general directorate and directorates of the Ministry of Environment and Forestry can be listed as: The General Directorates of Environment Management, Environment Impact Assessment and Planning, Erosion Control and Reforestation, State Hydraulic Works (DSI), Nature Protection and National Parks and the directorates of Research and Development, Conservation of Cultural and Natural Resources and International Relations - European Union Office. The Ministry of Environment and Forestry is responsible for the protection and improvement of the environment, optimum utilization and protection of the natural resources of rural and urban areas, preservation and improvement of the natural flora and fauna of the country, prevention of environmental pollution, preservation and enhancement of forests, improvement of the economy and living conditions of the villagers living close to the national forests and to develop forest industry.

NGO (Volunteer) Organizations on Environmental Issues

In recent years, as in many countries, NGOs are more sensitive for the environmental problems compared with the state organizations. In Turkey; NGOs which are working parallel to state organizations, are actively participating in the discussions which are concerning environmental problems at national and international levels. For example World Wild Foundation (WWF-Turkey), Ministry of Environment and Forestry and other related stakeholders prepared environment management plan for Uluabat Lake which is one of Ramsar Conservation area in Turkey. Additionally Globe Nature Fund (Germany) and project coordinator WWF-Turkey added Uluabat Lake into "Living Lake Project" (Gattenlöhner, 2006; Gurer ve Yildiz, 2008). The Turkish Foundation for Combating Soil Erosion, For Reforestation and the Protection of Natural Habitats (TEMA) and WWF-Turkey collaborate with The Ministry of Environment and Forestry at different environmental projects.

The most important NGOs in Turkey, date of their establishment and their expertise area are listed in Tab. 1. Web pages of these NGOs are used as on-line references in order to describe their environmental activities.

Environmental Politics of Turkey from Past to Present

Clean environment was important for the Ottoman Empire, for example the Sultan Mehmet I took precautions in order to prevent the pollution at the Golden Horn (Halic Bay). He banned agriculture and forestry activities around Golden Horn. During Sultan Suleyman Magnificent period, the first environment law in the world had been declared in 1539. According to this law solid waste disposal and waste water discharge at the urban area were banned and development plans of the cities were revised in order to protect the environment. Wetland reclamation studies had begun in 19th Century, consisting wetland mapping and wetland drainage studies. Lake Iznik and Buyuk Menderes River had been cleaned in 19th Century. Environmental protection studies had been financed by the Ottoman treasury, charitable foundation and local people (Ozturk, 2007).

As in many fields of life, environmental considerations in Turkish Society have been included in the state administrative structure. Starting from the establishment of the new Turkish Republic in 1923, almost all institutions, which are responsible for the environment, were in the structure of municipalities (Municipalities Law No: 1580), city councils and village leaders. By the laws of municipalities and general health, "Environment and Public Health" have been guaranteed by the state in Turkey. The first environmental organization in Turkey was set up with the government declaration dated 27th July 1978 (No: 16041) as "Environment under Secretariat" and became responsible for all political decisions related with the environmental issues and also the coordination between national and international organizations. Turkish Constitution 1982 states that "everybody has the right to live in healthy and stable environment. It is the duty both of state and the people to improve the environmental protection and to prevent the environmental pollution". Turkish State had the first environment law on 11th August 1983.

Turkey signed Bern Agreement in 1984, Rio Agreement in 1992, Ramsar Agreement in 1994, United Nations (UN) Climate Change Framework Convention in 2004 and Kyoto Protocol on 5th February 2009. Finally Turkish Prime Minister presented Turkey at Climate Change Conference on 18th December 2009 at Copenhagen-Denmark.

Since the environment conservation concept is very important for European Union (EU), European Environmental Agency (EEA) was set up on 7th May 1990 in order to create a data base and thematic reports, to work on integrated environmental evaluation, to support the periodic reporting system, to build infrastructure for monitoring and finally to set up the administrative units. All members of EU and some of the European Free Trade Association (EFTA) countries are members of EEA and they are connected by the thematic network of European Information and Observation Network (EIONET) (Ozturk, 2007).

In October 2000, Turkey and EU signed an agreement and Turkey became a member of EEA and EIONET. This agreement ratified by Turkish parliament on 23rd January 2003 with the law No: 4794 (Gurer and Gurer, 2005). European Union Water Framework Directive (WFD) was coming into force on December 2000. WFD regulates integrated water resources management of Europe. At present, EU-WFD implementation studies continue in Turkey (Akar and Koc, 2007; Gurer et al., 2009).

Wetland Management Studies in Turkey

Wetlands can be defined as "Areas that are inundated or saturated by surface or groundwater frequently or for a duration sufficient to support, a prevalence of vegetation typically adapted for life in saturated soil conditions and generally wetlands include swamp, marshes and similar areas" (Lyon, 1993). When searched in global scale, it is seen that the wetland desiccation studies began at the end of 1800's in order to stop malaria in the world. For example 50% of the wetlands had been lost in USA and nearly 60% of the wetlands had been lost in Spain (Ozesmi, 1997; Fernandez et al., 1999). Wetlands feed the groundwater and control floods also they are suitable habitat for the flora and the fauna; additionally they are important as a recreation area for the eco-tourism.

Flood control measures taken during the period of 1940-1970 adversely affected the existing natural stability of 17 wetlands extending over 143 956 hectares. 5 of them had been completely desiccated: Amik Lake, Hotamis and Esmekaya Wetlands (Fig. 1) whereas Tuz Lake and Sultansazligi Wetland began to dry.

Total water resources of Turkey is 112 billion m^3 (groundwater plus surface water) but Turkey utilizes an average 40 billion m^3, 74% of this water volume utilized as the irrigation water. Wild flooding irrigation is still extensively used in Turkey and water loss is very high (www.dsi.gov.tr). By the law of State Hydraulic Works (DSI), this organization had to provide irrigation water for agricultural purpose by constructing dams and some of these dams are on the rivers which are feeding the wetlands and consequently this may cause water scarcity at some wetlands for a certain period of time. As an addition recent global warming increases water scarcity at the wetlands.

The wetland protection awareness and related studies by both non-governmental and governmental organizations started at the beginning of 1980's. Significant efforts had been done for wetland reclamation both by the government and nongovernmental organizations (NGOs). The protection policy has focused on the sustainability of biodiversity of existing wetlands.

Ministry of Environment has been established in 1991 and this ministry declared the first "Wetland Protection Circular" in 1993, then "Wetland Protection Regulation" had been published in 2005. Laws and regulations which have relationship with the wetlands can be given in Table 2.

Tab. 1: *NGOs dealing with the environment in Turkey.*

Organization name and Acronyms*	Established in	Expertise area
The Society of Nature and Animal Protection in Turkey www.dohayko.org	1955	Animal Protection
The Foundation of Environment Protection and Greening www.turcek.org.tr	1972	Combating with the erosion
The Society of Natural Life Protection (DHKD*) http://www.zevk.com/zevk/cop/dhkd/dhkd.html	1975	Biological diversity (fauna-flora) protection
Foundation of Turkey Environmental problems www.cevre.org.tr	1978	Combating with the environmental problems
The Research Association of Rural Environment and Forestry (KIRÇEV*) www.kirsalcevre.org.tr	1989	Combating with the erosion and environmental problems
Foundation for Protection and Promotion of the Environmental and Cultural Heritage (ÇEKÜL*) www.cekulvakfi.org.tr	1990	Protection of environment and cultural heritage
The Turkish Foundation for Combating Soil Erosion, For Reforestation and the Protection of Natural Habitats (TEMA*) www.tema.org.tr	1992	Combating with the erosion, protection of forests
The Foundation of Environmental Education www.turcev.org.tr	1993	Environmental Education
World Wild Foundation Turkey (WWF Turkey) www.wwf.org.tr	1996	Combating with the environmental problems
The Society of Bird Research www.kad.org.tr	1998	Protection of bird species
Greenpeace Turkey www.greenpeace.org/turkey		Combating with the environmental problems
The Society of Environment (DOGA*) www.dogadernegi.org	2000	Combating with the environmental problems

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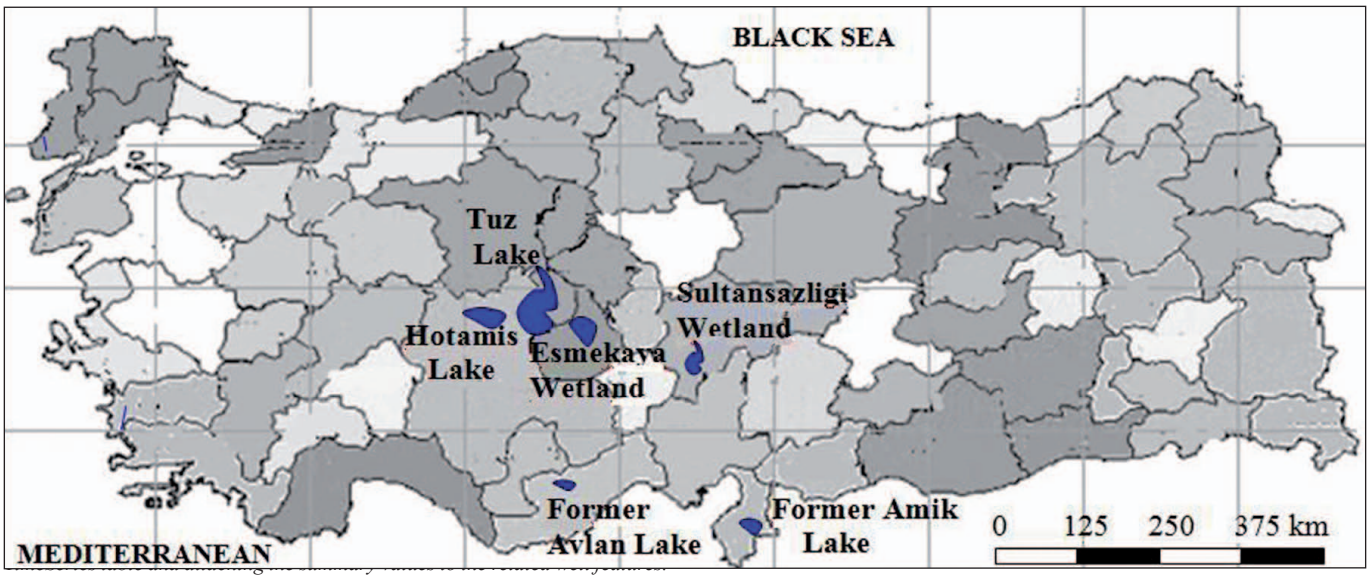

Fig. 1: *Some important wetlands of Turkey*

"National Wetland Commission" was established on 2000 and National Wetland Strategy Plan for 2003-2008 was prepared. This commission prepared wetland management plans for Goksu Lagoon, Manyas Lake, Uluabat Lake, and Gediz Delta before the end of 2006. Wetland management plans of Sultansazligi, Kizilirmak Delta, Burdur Lake, Eber and Aksehir Lake, Erzincan Wetlands, Adiyaman Lake and Yumurtalik Lagoon are under preparation by the same commission.

There are some discrepancies between the items of the laws about the environment in Turkey. For example according the 63th item of the constitution state has the responsibility to conserve the natural resources, on the other hand; according to the 2nd item of the law of Turkish State Hydraulic Works, this organization has right to desiccate the wetlands in order to convert these plots into the agriculture lands. But wetland desiccation is banned according to "Wetland Conservation Regulation" (2005). According to this regulation; wastewater discharge around the wetland is banned but pollution is still one of the important problem of the wetlands in Turkey.

There are some items which are related with the conservation of the wetlands at WFD. For example; EU WFD Item 8 states that "EU Commission adopted a communication to European Parliament and the Council on the wise use and conservation of wetlands", Item 16 stating that "Further integration of protection and sustainable management of water into other Community policy areas such as energy, transport, agriculture, fisheries, regional policy and tourism is necessary" and Item 23 stating that "Common principles are needed in order to improve the protection of Community waters in terms of quantity, quality, sustainable water use, protection of aquatic and terrestrial ecosystems and wetlands". Actually EU-WFD purpose is to protect and enhance the status of aquatic ecosystems, terrestrial ecosystems and wetlands regarding to their water needs and to promote sustainable water use based on a long term protection. During the implementation of EU WFD, Turkey has to enforce to use vari-

Tab. 2: *Laws and regulations related with wetland protection in Turkey (www.tbmm.gov.tr).*

Name of the law or regulation	Date of its acceptance
Groundwater Law	1960, revised in 2006
Groundwater Regulation	1961
Fishery Law	1971
Environment Law	1983
National Parks Law	1983
Wetland Protection Circular	1993
Environmental Impact Assessment Regulation	1993, revised in 1997 and 2008
DSI Water Use Regulation	2003
Water Pollution Control Regulation	2004
Wetland Protection Regulation	2005
Urban Wastewater Treatment Regulation	2006
Money Punishments Circular for the Polluters	2006
Environmental Landscape Planning Regulation	2008
Fishery Products Regulation	1995, revised in 2010
Wastewater Sludge Use in Soil Regulation	2010

ous directives such as: integrated pollution prevention control, wild bird, wastewater treatment, nitrate, solid waste, wastewater sludge etc.

Case Study: Wetland Management and Water Pollution Problems of Sultansazligi Wetland

Wetland Management Problems at Sultansazligi Wetland

Develi is a closed sub-basin of Kizilirmak River Basin (Basin no:15), its average elevation varies between 1070-1150 m above mean sea level, total area of the plain is approximately 800 km^2 and its drainage area is 3190 km^2. Develi Plain has an average slope of 2%. Sultansazligi Wetland in Develi Closed Basin, is surrounded by Erciyes Mountain (3916 m), Develi Mountain (2074 m), Aladaglar Mountain (3373 m) and Hodul Mountain (1937 m) at the north, east, south and west directions respectively (DSI, 1988). There are Yay Lake, Çöl Lake, Northern and Southern Marshlands in Sultansazligi Wetland as shown in Figure 2. Çöl and Yay Lakes are shallow lakes; water level of Yay Lake is about 100 cm (Gurer and Yildiz, 2008).

Sultansazligi Wetland has water scarcity and pollution problems. Sultansazligi has been protected by Ramsar Convention since 1994. Sultansazligi Wetland is also important for the migratory birds (Gurer, 2003; Gurer, 2004).

The first desiccation studies had begun in 1940 in order to prevent malaria at Sultansazligi Wetland. Almost 90% of the total wetland area had been decreased down till the end of 1970's. Firstly 440 ha area had been dried and converted into agriculture plots after 1940 and then 1900 ha had been dried at the Northern Marshland in 1950.

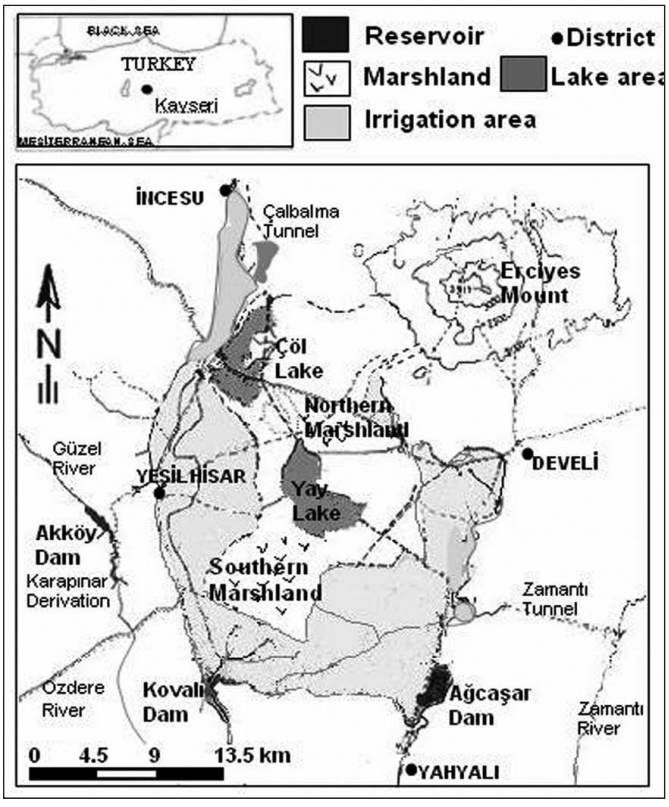

Fig. 2: *Develi Closed Basin and Sultansazligi Wetland (modified from Yildiz, 2007).*

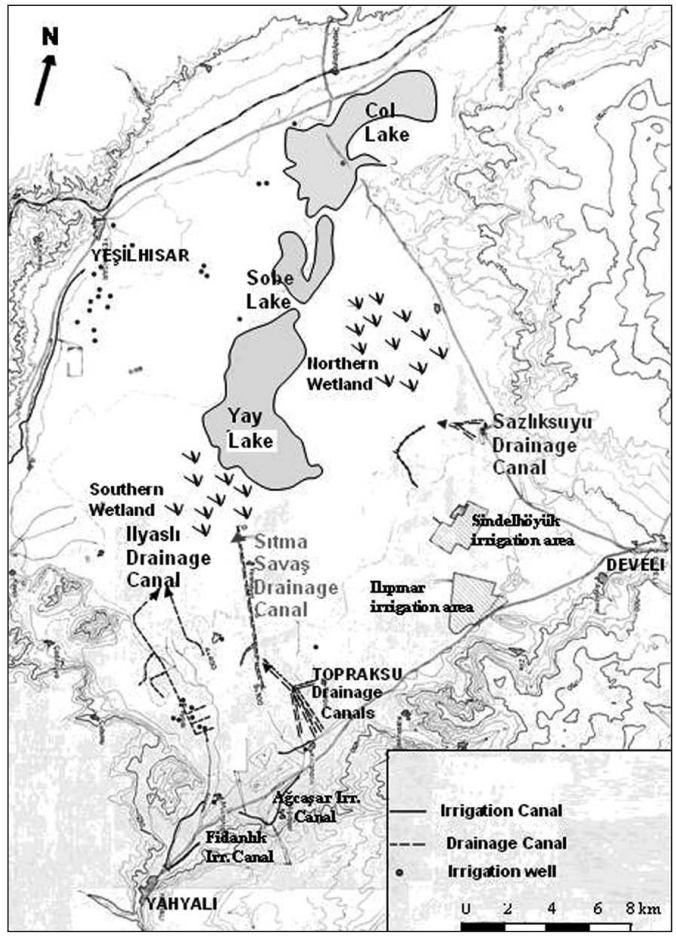

Fig. 3: *Drainage canals at Sultansazligi Wetland before 1970 (modified from Yildiz, 2007).*

750 ha of the wetland area had been dried at 1965. Turkish State of Hydraulic Works (DSI) dried 240 ha at Sultansazligi Wetland and began to operate Akköy Dam at 1965. Drainage canals which were opened before 1970 can be seen in Figure 3 (Su Is Proje, 1970). After 1970, DSI started Develi Irrigation Project and opened a drainage canal (38 km length) which is passing at the middle of Sultansazligi Wetland in order to dry this wetland completely but this drainage canal was closed at 1978. Drainage canals which were opened for Develi Irrigation Project after 1970 can be seen at Figure 4. Ministry of Forestry and DSI signed a protocol in order to protect surface water level at Sultansazligi Wetland, then these drainage canals were closed at 1978.

In 1977 it was decided to take Sultansazligi Wetland into content of RAMSAR Agreement list and also it was advised to call this wetland as "biosphere reserve" according to "Human & Biosphere" program of UNESCO. During the years of 1980-1983 and 1993-1994, "The Water Resources Management Plan of Sultansazligi" was prepared and it was put into force (Gurer, 2004). In 1993, this protection zone was declared as "1st Degree Site Area" by Conservation of Cultural and Natural Resources Council. On 15th March 1994 according to the decision of Council of Ministers Sultansazligi was taken into "A Class Wetlands" list of RAMSAR Agreement. On 21st April 1998, Sultansazligi was declared as "Nature Conservation Area" according to National Parks Law of No: 2873 (Gurer, 2004).

The Global Environment Facility (GEF) is a global partnership

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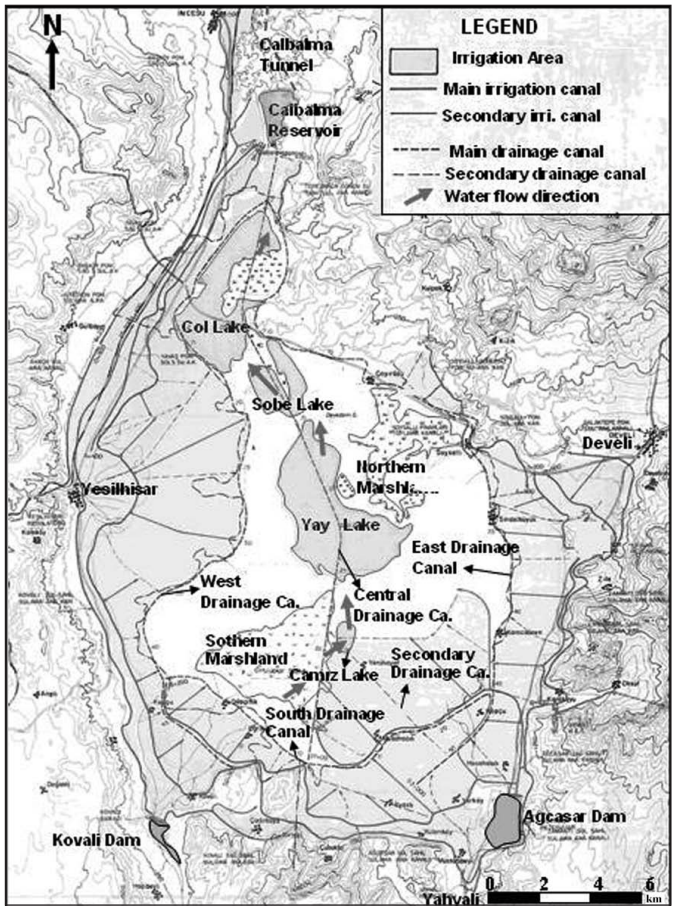

Fig. 4: *Drainage canals which were opened after 1970 (modified from Yildiz, 2007).*

of 178 countries and declared at Rio Earth Summit in 1994. International institutions, NGOs and private sectors are also partners of GEF. This partnership supports national initiatives in order to combat with the global environment issues and provides grants for the projects which are related with biodiversity, climate change, international water issues, land degradation, ozone layer and organic pollutant (www.gefweb.org). World Bank is also a partner of GEF and World Bank gives financial supports for GEFII Projects in the world. General Directorate of National Parks of Turkey prepared GEFII Project to conserve four national parks of Turkey. Sultansazligi Wetland is one of these national parks in the content of this GEFII Project. Integrated water resources management plans of Sultansazligi and biodiversity conservation plans of this wetland were prepared for this GEFII Project during 2002 – 2003. All stakeholders in this GEFII project tried to solve the water shortage and wetland water pollution problem at Sultansazligi Wetland.

In December 2002, Ministry of Environment and General Directorate of Nature Conservation prepared a report on "Water Budget of Sultansazligi and Necessary Precautions" On 16th March 2002, a "Technical Study Group" was established according to the decision of "1st National Wetlands Commission" meeting, to form wetland strategies for the coming five years. In this group there are four experts from Ministry of Environment, two from Ministry of Forestry, General Directorate of National Parks, two from Ministry of Culture, two from Ministry of and Energy and Natural Resources, and one from Special Environment Conservation Association, Conservation of Natural Life Association and Bird Observation Association.

According to the second stage of Develi Project, it was planned to derivate water (111 million m^3 in normal seasons and 150 million m^3 in arid seasons) from neighboring Zamanti River to Develi Closed Basin by using Zamanti Tunnel. Diverted water will be used

Fig. 5: *Drainage water flowing through Sultansazligi Wetland (photo: Ebru Yildiz, 2003).*

at Develi Hydroelectric Plant firstly, and then this water will be used for irrigation purposes and to fulfill the water requirement of Sultansazligi Marshlands and Yay Lake (Yildiz, 2007). Zamanti Tunnel construction will be completed by the end of 2010.

Present Water Pollution at Sultansazligi Wetland

There are Akköy, Ağcasar and Kovali Dams at Develi Closed Basin, located on the rivers which are carrying water to Sultansazligi. So Sultansazligi Wetland can take water only from the precipitation and salty drainage canals. Salty drainage water pollutes Sultansazligi Wetland. Salty drainage water flowing through Camiz Lake at Sultansazligi Wetland can be seen at Figure 5.

On the other hand domestic and industrial wastewater flows to Sultansazligi Wetland (Yildiz, 2007). There is only one wastewater treatment plant at Develi Closed Basin which is not being operated sufficiently. So water pollution is also an important problem for Develi Closed Basin and Sultansazligi Wetland. Wastewater treatment plant is under construction at Yahyali District and a wastewater treatment plant project designed for Yesilhisar District in 2010. Process of Yahyali and Yesilhisar Wastewater Treatment Plants will be "Aerated Active Sludge" (Gurer et al., 2008). Wastewater treatment process of Develi Wastewater Treatment Plant is "Trickling filter" which is not suitable for Develi Region so this plant is not working efficiently. Also factories do not operate their industrial wastewater treatment plants regularly so both domestic and industrial wastewater pollute Sultansazligi Wetland.

In order to determine the water pollution at Sultansazlığı and Develi Closed Basin water samples from surface water of Sultansazlığı, 22 deep wells and 16 springs had been collected at Develi Closed Basin. Chemical analysis of these water samples had been made by the 12th Regional Directorate of DSI. Surface water and groundwater

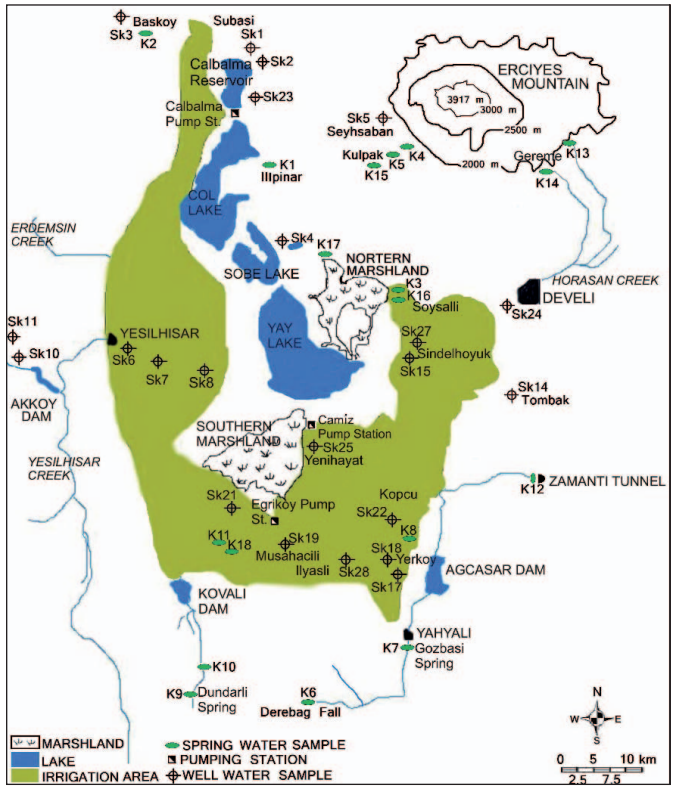

Fig. 6: *Surface water and groundwater sampling locations at Develi Closed Basin.*

contamination has been investigated at Develi Basin after the water chemistry analysis. Figure 6 shows the groundwater sampling locations at Develi Closed Basin in the context of this study.

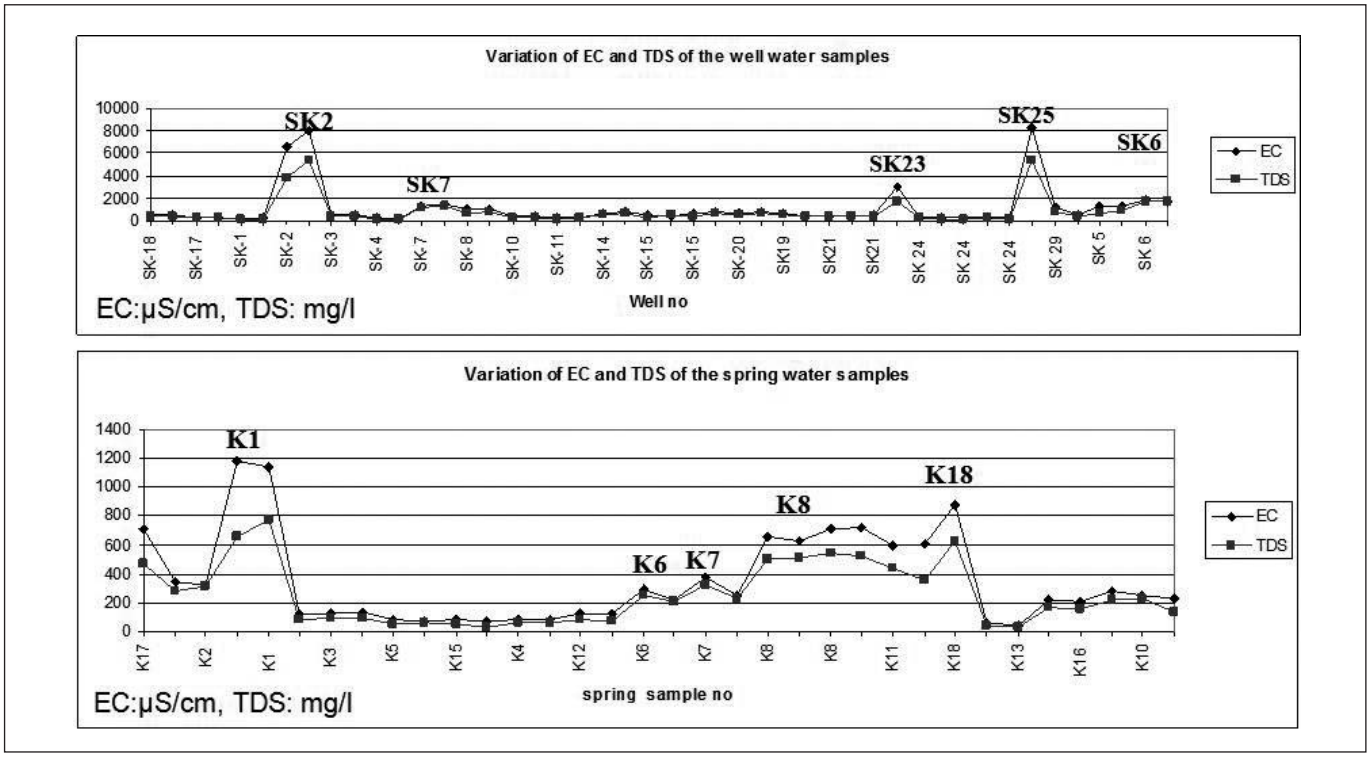

Fig. 7: *TDS and EC values of groundwater samples at Develi Closed Basin.*

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Tab. 3 *Chemical analysis of the water samples taken from the springs in the study area.*

Water Sample Location	pH	*TDS mg/l	**EC µS/cm	Na+ mg/l	K+ mg/l	Ca++ mg/l	Mg++ mg/l	Cl- mg/l	SO_4 -mg/l	HCO_3 mg/lt	CO_3 mg/lt	Hardness (F)	NO_2 (mg/l)	NO_3 (mg/l)	NH_4 (mg/l)	Boron (mg/l)
K1	7.53	653	1179	155.87	7.8	27.86	19.08	236	2.88	203.2	0	14.8	0.003	2.97	0.11	3.2
K1	7.37	776	1134	163.69	10.9	46.49	21.27	275	11.5	246.52	0	30.35	0	5.89	0.22	3.6
K2	7.81	286	350	20.69	1.6	34.47	12.15	7.09	2.88	207.47	0	13.6	0.007	10.9	0.06	0.2
K2	7.72	311	329	25.75	2.7	33.07	13.61	6.03	9.13	219.67	0	13.85	0	13.51	0.13	0.1
K3	7.49	85	126	5.75	1.2	9.82	3.889	3.55	0.48	59.8	0	4.05	0	4.13	0.07	0.2
K3	7.37	91	123	7.36	1.6	8.216	5.347	4.61	6.24	57.969	0	4.25	0	5.71	0.16	0
K4	7.49	36	69	2.30	1.6	1.804	2.917	1.77	1.92	23.188	0	1.65	0.023	2.91	0.33	0.4
K4	7.77	61	80	3.45	2.0	10.02	1.215	2.13	6.24	37.222	0	3	0	7.58	0.15	0
K5	7.3	56	82	2.99	1.2	9.82	0.608	2.13	0.96	37.832	0	2.7	0	2.97	0.16	0.4
K5	7.82	63	76	4.14	1.6	8.216	2.309	1.77	7.2	37.832	0	3	0	0	0.08	0
K6	8.7	246	292	1.15	0.4	49.3	8.75	1.77	13	164.75	6.601	15.9	0.01	2.15	0.25	0.6
K6	8.3	204	221	0.46	0.0	41.08	7.292	0.35	6.72	145.23	4.201	13.25	0	4.12	0.15	0.1
K7	7.9	325	381	1.61	0.8	64.13	11.42	2.48	30.3	215.4	0	20.7	0.01	6.56	0.2	0.6
K7	7.96	229	252	0.92	0.0	46.89	6.805	1.77	12.5	160.48	0	14.5	0	4.92	0.17	0.2
K8	7.38	506	653	25.98	1.6	87.98	15.31	44.7	36	293.51	0	28.25	0.033	9.04	0.165	0.6
K8	7.6	513	624	30.81	2.0	85.17	16.28	48.9	43.7	286.18	0	27.95	0	12.1	0.2	0.2
K9	7.95	135	227	0.69	0.0	41.28	7.899	5.67	1.44	1.8306	75.61	13.55	0	5.63	0.26	0.1
K10	8.05	218	284	1.15	0.4	44.49	6.198	1.42	5.28	161.09	0	13.85	0.003	5.32	0.12	0.4
K10	8	229	251	0.69	0.0	47.29	6.805	1.06	11.5	161.09	0	14.6	0	8.2	0.12	0.1
K11	7.85	443	594	23.68	2.0	67.94	19.44	37.2	49	244.08	0	24.95	0.049	14.97	0.308	0.6
K11	7.66	360	601	32.88	2.3	65.13	21.87	33.7	2.88	68.953	132	25.25	0	10.85	0.34	0.4
K12	8.23	84	123	3.91	1.6	11.62	4.496	1.42	1.44	53.087	6.601	4.75	0	2.76	0.2	0.4
K12	8.37	71	129	6.67	1.6	10.22	6.562	4.61	3.84	2.4408	33.9	5.25	0	4.16	0.17	0
K13	7.32	27	45	2.30	1.2	1.002	3.038	3.55	14.4	1.8306	0	1.5	0	3.83	0.14	0
K14	7.66	43	59	4.14	1.6	2.004	3.038	1.06	8.65	21.967	0	1.75	0	1.13	0.13	0
K15		57	79.2	4.38	1.8	7.14	2.38	1.63	2.52	36.852	0		0	3.35		0
K16	6.6	172	224	21.15	4.7	12.02	7.292	10.6	11.5	103.73	0	6	0		0	0
K17	6.7	472	710	108.05	11.7	20.04	13.37	156	9.61	152.55	0	10.5	0		0	0
K18	7.1	622	876	34.25	2.7	76.15	41.32	46.1	123	299	0	36	0		0	0

*TDS: Total dissolved solids; **EC:Electrical conductivity

It is concluded that Ilipınar Spring (3.2 ve 3.6 mg/lt boron concentrations at this spring water) and deep well SK2 at Calbalma Reservoir zone have high boron concentrations (13,7 ve 13,4 mg/lt boron concentrations at the groundwater sample SK2) and there is ammonium and nitrite pollution at the wells (SK5 and SK6) which are close to Sultansazligi, located at Yesilhisar District. 31.51 mg/lt NO_3 were determined at the groundwater sample SK6 and 0.043 mg/lt NO_2 at the groundwater sample SK5. Table 3 and Table 4 show the chemical analysis of the water samples taken from Develi Closed Basin.

According to Table 3 and Table 4 nitrite concentration is higher than the maximum value (0,233 > 0.1 mg/l) at the water samples (SK 19) taken from deep well so this water is not suitable for drinking purpose and there is nitrite pollution at the water of this well. All water samples taken from the springs have good quality according to the Turkish Drinking Water Standard, except Ilipınar Spring (K1). Ilipinar Spring is located near Çöl Lake (Fig. 6). Ilipinar Spring flows at fault crack and fault zone affects the water quality of Ilipinar Spring. So Ilipinar Spring water is not suitable for the irrigation and drinking purposes.

According to the former water chemistry analysis of Soysalli and Dundarli Springs (spring samples: K3, K9 and K10), water of these springs had been polluted in 1998 and 1999, their ammonium concentrations are higher than the maximum ammonium value (0.5 mg/l) at this time period, but according to 2004 and 2005 analysis results, Soysalli and Dundarlı Springs can be used as drinking water; their ammonium concentrations are lower than the maximum ammonium concentrations of Drinking Water Standard. Soysalli and Dundarli Springs are used as irrigation water in summer but these springs feed Sultansazligi Wetland during winter (Yildiz, 2007).

Figure 7 shows electrical conductivity (EC) and total dissolved solid (TDS) values of groundwater samples which had been taken from Develi Closed Basin. When Figure 7 is examined it is determined water samples of the deep wells SK2 and SK23 which are located near Calbalma Drainage Water Pumping Station have high EC and TDS values. Because drainage water accumulated at the pumping station pollutes the groundwater by infiltration. Additionally water sample of the shallow well SK25 which is located near the Southern Marshland of Sultansazligi Wetland has high EC and

Tab. 4 *Chemical analysis of the water samples taken from the wells in the study area.*

Water Sample Location	pH	*TDS mg/l	* * E C µS/cm	N a + mg/l	K + mg/l	Ca++ mg/l	Mg++ mg/l	Cl - mg/l	S O 4 -mg/l	HCO_3 mg/lt	C O mg/lt	Hardness (F)	N O 2 (mg/l)	N O 3 (mg/l)	N H 4 (mg/l)	Boron (mg/l)
SK1	7.98	116	189	14.71	1.2	5.411	8.628	19.9	0.4803	65.902	0	4.9	0.003	4.05	0.089	0.2
SK2	8.26	3800	6605	1046.04	117.3	116.6	69.88	1549	326.12	565.05	9.601	57.85	0.023	8.11	0.722	13.7
SK3	7.9	412	496	26.44	3.9	53.91	16.53	14.2	6.2439	291.07	0	20.25	0.01	10.76	0.105	0.6
SK3	7.49	415	472	30.35	4.7	49.3	17.5	13.8	9.606	289.85	0	19.5	0	12.09	0.02	0.2
SK4	7.39	140	206	19.77	2.0	8.818	6.684	17.4	0.4803	85.428	0	4.95	0.003	2.45	0.05	0.3
SK 5	7.5	652	1274	17.24	9.8	54.91	22.48	220	2.4015	325.85	0	22.95	0.043	2.24	0.19	4.1
SK 6	7.11	1645	1834	68.97	15.6	231.3	85.43	95.4	55.715	1093.5	0	92.85	0.01	28.88	2.48	1.8
SK 6	6.89	1723	1756	95.41	9.8	211.4	102.7	133	108.07	1063	0	95	0	31.51	2.09	1.3
SK7	7	1124	1358	62.99	7.8	152.7	53.59	78	43.707	723.7	0	60.15	0.01	12	0.86	1.3
SK7	6.73	1259	1382	97.71	9.0	150.9	61.86	122	60.038	756.65	0	63.1	0.007	7.8	0.83	1.4
SK8	8.3	650	1025	70.81	7.0	64.73	34.76	103	49.951	308.15	10.8	30.5	0	19	0.23	1.3
SK8	7.52	738	1000	94.26	7.0	70.94	35.97	147	81.171	302.05	0	32.5	0.003	23.74	0.21	1.4
SK10	8.17	265	386	10.12	1.6	53.51	4.375	14.2	11.047	164.75	5.401	15.15	0.007	17.68	0.064	0.5
SK11	8.46	164	223	5.98	1.2	32.26	3.16	4.25	0.4803	112.89	5.401	9.35	0.003	10.59	0.076	0.4
SK11	8	254	223	8.74	1.2	47.29	5.833	3.19	17.291	170.86	0	14.2	0	14.2	0.06	0.3
SK14	7.54	480	719	22.07	1.2	91.98	14.58	30.5	149.37	171.47	0	28.95	0.007	9.3	0.211	0.6
SK14	7.59	599	780	63.68	3.5	85.17	20.54	77.3	208.93	138.52	0	29.7	0.046	2.76	0.344	0.1
SK15	7.15	319	465	28.74	4.7	31.86	18.23	45.4	12.488	178.18	0	15.45	0.013	6.91	0.24	0.5
SK15	6.8	432	617	55.87	9.4	32.06	23.09	81.5	22.574	207.47	0	17.5	0		0	0
SK17	7.9	267	275	2.53	0.4	55.11	6.684	3.19	15.37	183.67	0	16.5	0.01	5.76	0.1	0.1
SK18	7.8	422	488	3.68	0.4	88.98	9.844	5.67	29.298	283.74	0	26.25	0.036	9.7	0.8	0.6
SK18	7.6	333	476	3.68	0.4	28.26	6.076	7.45	23.054	265.44	0	9.55	0	11.5	0.23	0
SK19	8.23	616	730	63.68	3.1	58.12	30.5	28.4	62.439	366.12	4.201	27.05	0.233	0.13	0.38	0.3
SK19	7.8	551	643	60.23	3.9	57.11	7.656	34	57.636	329.51	0	17.4	0	0	0.31	0.1
SK20	7.5	627	836	52.88	2.3	84.77	25.64	70.2	68.203	323.41	0	31.7	0	6.96	0.26	1.2
SK20	7.63	485	698	59.31	3.9	67.13	6.562	56.7	46.589	244.08	0	19.45	0	4.52	0.39	0.7
SK21	8.53	340	441	29.89	1.2	30.06	23.7	25.5	22.094	207.47	0	17.25	0.138	3.61	0.77	0.2
SK21	8.01	363	425	37.93	2.0	32.46	21.75	55	10.086	204.42	0	17.05	0.086	0.12	0.68	0
SK23		1744	3010	354.90	29.1	149.5	62.35	621	122.93	404.35	0		0	10.62	2.3	0
SK24		260	323	22.12	4.6	30.13	12.47	16.2	9.95	165.38	0		0	7.87	0.42	0
SK25		5401	8240	1641.82	63.3	99.33	124.8	1925	940.52	606.36	0		0	16.09	0	0
SK29	7.2	852	1240	112.65	23.5	58.12	48.61	163	110.47	335.61	0	34.5	0		0	0
SK28	7	426	570	17.24	2.0	60.12	23.09	14.2	48.03	262.39	0	24.5	0		0	0
SK30	6.26	155	214	17.01	3.1	0	0	7.09	5.7636	122.04	0	8	0		0.06	
SK31	6.84	157	218	18.85	5.5	0	0	8.51	7.6848	115.94	0	6.6	0		0.2	0.1

*TDS: Total dissolved solids; **EC :Electrical conductivity

Tab. 5 *Classification of the well and spring water samples at Develi Closed Basin.*

Hardness(F°)	**Water Class**	**Well no**
0-10	Drinking water	SK1, SK4, SK30, SK31
11-22	Fresh water	SK3, SK5, SK10, SK11, SK24
23-32	Hard water	SK8, SK14, SK15, SK17, SK19, SK20, SK21, SK28
33-54	Very hard water	SK18, SK29

Hardness(F°)	**Water Class**	**Spring no**
0-10	Drinking water	K3, K4, K5, K12, K13, K14, K16, K17
11-22	Fresh water	K2, K6, K7, K9, K10
23-32	Hard water	K1, K8, K11
33-54	Very hard water	K18

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TDS. Because this shallow well is fed by the surface water of the Southern Marshland of Sultansazligi. Surface water of the Southern Marshland has high EC and TDS values due to the drainage water pollution.

Table 5 shows the classification of the water hardness of the samples taken from deep wells and springs at Develi Closed Basin. When Table 4 is examined it is concluded that many water samples taken from wells are very hard water and generally water samples taken from the springs are not hard water. Groundwater pollution affects the quality of the water samples taken from wells.

Surface water samples which had been collected from Sultansazligi Wetland have high EC values because salty drainage water flows through Sultansazligi Wetland. Former surface water chemistry analysis of Sultansazligi Wetland at 1983 can be seen at Table 6 and surface water chemistry analysis of 1998, 2000 and 2003 can be seen at Table 7. When the surface water chemistry parameters of the same stations at Table 6 and Table 7 are compared: it can be said that EC, nitrate, ortho-phosphate and ammonium concentrations are increased and dissolved oxygen concentrations are decreased from 1982 to 1998, 2000 and 2003 because of water pollution at the surface water of Sultansazlığı Wetland (Akcakaya et al, 1983; Yildiz, 2007).

Tab. 6 Water chemistry analysis of Sultansazlığı Wetland on 20th September 1982 (Yildiz, 2007).

Station no	15-12-01-26	15-12-01-27	15-12-01-28
(Observation year)	1982	1982	1982
T (°C)	20	20	19
PH	7.6	7.5	8.5
EC(mmho/cm)	897	946	881
Ca(mg/l)	40.1	72.1	58.1
Mg(mg/l)	48.6	35.2	37.7
DO(mg/l)	3.4	3.3	11
NO_2-N(mg/l)	0.002	0	0.008
NH_3-N(mg/l)	0.9	0.71	0.91
o-PO_4(mg/l)	0.06	0.03	0.07

Tab.7 Water chemistry analysis of Sultansazlığı Wetland (Yildiz, 2007).

Station no	15-12-01-26	15-12-01-27	15-12-01-28	15-12-01-28
(Observation year)	1998	2003	1998	2000
T (°C)	16	24	17	24
PH	7,05	8,9	7	8
EC(mmho/cm)	1237	2898	1311	1752
Ca(mg/l)	-	214,6	-	-
Mg(mg/l)	-	155,6	-	-
DO(mg/l)	2,5	0,7	3,05	5,6
NO_2-N(mg/l)	-	0,014	-	0,018
NH_3-N(mg/l)	-	2	-	0,85
o-PO_4(mg/l)	0,7	1,33	0,9	0,84

CONCLUSION AND RECOMMENDATIONS

There are discrepancies between the laws and some regulations about environment in Turkey. State has responsibility to harmonize these laws and regulations. Pollution and water scarcity are the main problems of the wetlands. All municipalities are responsible to construct wastewater treatment plants in order to prevent domestic wastewater discharge to the environment. Although some municipalities construct wastewater treatment plants, they do not operate these plants because of high energy cost. Ministry of Environment and Forestry has to control municipalities about the operation of wastewater treatment plants. Because untreated wastewater pollutes wetlands and the environment.

Irrigation water requirement is very high at wild flooding irrigation method so river runoff and spring water which are feeding the wetlands are used for the irrigation purpose in Turkey. High volume of irrigation water requirement can cause water scarcity at the wetlands. Drip irrigation can be used at the agriculture areas around the wetlands and water of the springs, located around the wetlands can be diverted directly to the wetlands at certain periods. Groundwater can be used to feed the wetlands in order to prevent water scarcity at the wetlands. Additionally recent global warming also increases the water scarcity at the wetlands.

According to the water chemistry analysis there is water pollution at the surface water of Sultansazligi Wetland and groundwater quality is suitable for the irrigation except the deep well (SK2) near Calbalma Drainage Water Pumping Station. Drainage water feeds Sultansazligi and drainage water cause contamination at the wetland. Also the wastewater disposal pollute Sultansazligi Wetland. Additionally ammonium, nitrite and nitrate pollution is determined at some wells at Develi Closed Basin according to the chemical analysis.

There is water scarcity at Sultansazigi Wetland due to insufficient surface water inflow (precipitation, drainage water etc) and high evaporation. At present farmers use springs for the irrigation water supply at Develi Closed Basin, spring water must be diverted to Sultanaszligi in order to handle water scarcitry problem at Sultansazligi Wetland. Additionaly fresh spring water will reduce the salt concentration at the surface water of Sultansazligi (at Southern Marshland) and will increase disolved oxgen ratio.

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