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Full Length Research Paper

Effects of agricultural activities in Seyfe Wetland

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Seyfe Lake is one of the most important wetlands of Turkey and it is classified among "first-class wetland areas" according to international criteria. The protection of the lake is assured at an international level after its inclusion in the Ramsar Agreement in 1994. Because of wrong water management practices and drought, Seyfe Lake has shrunk since 2004 in terms of both the area and the length of duration as wetland. In 2006, the government started to grant agricultural subsidies for decreasing water usage in agricultural activities around the lake. Fifty-four agricultural enterprises in Seyfe, Gumuskumbet, Yazikinik and Eski Doganli villages, which are located around the Lake, were taken under the scope of the research. The data derived from the surveys conducted in these enterprises were assessed so that the impact of the agricultural activity in the region on the wetland is revealed. Irrigated farming activities in the region declined because of subsidies granted after 2006 and the wetland perception of producers in the region started to change towards a protective approach. Ninety-two point six percent of the producers leave space between parcels for sustaining natural life and 28.3% of the producers sow more seeds considering the birds living in the region. However, as these producers are not adequately informed about the use of fertilizers and pesticides, they adjust the amount they use according to the money available.

Key words: Agriculture, wetlands, pollution, environmental effects.

INTRODUCTION

Wetlands are valuable ecosystems that occupy 6% of the world's land surface (Schuyt and Brander, 2004). As a major component of water resources, wetlands are crucial to life-support functions, human health and the natural environment (Birol et al., 2008). Wetlands provide many important services to human society, but are at the same time ecologically sensitive and adaptive systems (Turner et al., 2000). Wetlands are especially beneficial under extreme drought or flood conditions for their ability to retain water, reduce runoff, filter sediments and provide water purification (Hartig et al., 1997). They comprise both land ecosystems that are strongly influenced by water and aquatic ecosystems with special characteristics due to shallowness and proximity to land. Wetlands play a key role in pollution elimination and flood control, serve as breeding and nursery grounds for many species of fish and wildlife and help maintain ground water supplies and quality (Koc, 2008). Wetlands also act as pollution assimilation agents for nitrate pollution created by up-stream agriculture (Rai, 2008).

The most broadly accepted definition of wetlands is as follows: "Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed 6 m" (Ramsar Convention 1971; Articles 1.1 and 2.1).

There is general agreement that the existence of wetlands is due to specific hydrology, soil type and vegetation and animal communities. Wetlands are complex ecosystems that provide many ecological, biological and hydrologic functions (Heimlich et al., 1998). Wetlands perform such functions as habitat for aquatic birds, other animals and plants, fish and shellfish production, biodiversity, food production, water storage, including mitigating the effects of floods and droughts, groundwater recharge, shoreline stabilization and storm protection, water purification, nutrient cycling, sediment retention and export, recreation and tourism, climate change mitigation, timber production, education and research and aesthetic and cultural value (Galbraith et al., 2005; Hartig et al., 1997; Tiril, 2006). More importantly, ecological wetland functions such as nutrient cycling and filtering of pollutants

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are becoming more widely recognized especially in the agricultural community (Cooper and Moore, 2009).

If, for whatever reason, the nutrient and/or hydrological cycles greatly change and much less (or much more) water and/or nutrients are concentrated, then the chaacter of a wetland will greatly change as well. The wetland may even cease to exist. That would be a loss for humans as much as for nature (Brouwer, 2002). The degradation of wetlands is an important part of the degradation of the natural ecosystems (Qiuying et al., 2006). Preservation of aquatic wetland ecosystems is vital to protect wildlife habitats, protect water quality and provide for aesthetically pleasing environmental sanctuaries for recreational purposes (Jin et al., 2009).

It is estimated that more than half of the original wetlands in the world were lost during the twentieth century; largely a result of disease prevention campaigns and the need for new arable lands (Revenga et al., 2000; Martinez-Santos et al., 2008; Mitsch, 2005).

Agriculture and wetlands are closely linked together. Some evidence put forward that first human settlements were located in and around wetlands (Gopal, 2000). This relation between agriculture and wetlands has developed against wetlands up to date. The conversion of wetlands into agricultural land and intensive agricultural activities around them has caused the degradation and destruction of the wetlands.

Conversion of wetlands to agriculture means more than just loss. Several recent studies have shown that the conversion of wetlands to agriculture causes complex effects on the ecosystem. The need for irrigation water directly influences the wetlands, as water flows are regulated and diverted. Shallow and smaller wetlands in drier climates are more seriously affected as their water is used for irrigation (Gopal, 2000). Although the sustainability of wetland eco-system becomes interlaced with the sustainability of agro-ecosystem, there are certain effects of agriculture on wetlands. These effects include (Galbraith et al., 2005; Wiseman, 2001):

i. Direct loss of wetlands due to draining and conversion to agricultural land.
ii. Indirect loss of wetlands area due to water withdrawal from rivers and streams for irrigation.
iii. Runoff of fertilizers causing excessive eutrophication leading to fish kills, toxic algal blooms and of aquatic flora and fauna.
iv. Loss of wetland area and function due to damming for water storage.
v. Loss of seasonal wetlands due to changed hydrologic cycle from water storage.
vi. Loss of wetland function due to salinization, sediment deposition, erosion, eutrophication.
vii. Pollution from use of pesticides and other chemicals.

Turkey has the most extensive wetlands in Europe, the Mediterranean and the Middle East with its 250 wetlands having a total surface more than one million hectares (Ortacesme et al., 2002). In parallel with harms to wetlands in the world, wetlands have also been lost in Turkey since 1950s. In this period, 21 wetland areas covering 93,582 ha have dried completely. Again, in the same period, 143,956 ha in 17 internationally important wetland areas were lost permanently because of flood protection measures or interventions to the water regime. Although the amount of lost wetland (total 236,538 ha.) seems to be less when compared to many of the European countries, it is observed that the ecological balance has been largely destroyed in almost all of our country's wetlands (because of interventions to the water regime, pollution and hunting excessively or by using wrong methods). Many other areas can further be lost completely unless immediate actions are taken.

Because of the rapid increase in the number of lost wetlands worldwide, many socio-economic problems concerning these ecosystems remained unsolved. Governments and local people, who were desperate in finding solutions, changed their opinions and started to take actions to protect wetlands (Ozen and Korkmaz, 2005). Several countries and the European Union (EU) use subsidy systems to support wetland creation on farmland. These incentives give opportunities to enhance environmental quality while obtaining a desired reduction of traditional agricultural production (Cre´pin, 2005). Since 2006, agricultural subsidies have been granted for decreasing water usage in agricultural activities around wetlands in Turkey, too.

Seyfe Lake, which is the area under research, is one of the most important wetlands in Turkey and it was declared as "Nature Reserve Area" in 1999 and classified among "first-class wetland areas" according to international criteria (Cirik, 1993). The most important reasons for proposing this area as a protection area are that; (i) it is the natural habitat of the great bustard (Otis tarda) and the ruddy shelduck (Tadorna ferruginea), both of which are endangered bird species; (ii) it is the most crowdedly inhabited breeding ground of the flamingo (Phoenicopterus ruber), which is classified as a near threatened species; and (iii) it is a uniquely important endangered ecosystem in Europe. The area lies between 39° 12'N and 34°25'E. It occupies an area of 10,700 ha land. The protection of the natural structure and the ecological character of the lake were assured at the international level after its inclusion in the Ramsar (Protection of International Wetlands) Agreement in 1994. Yet, in spite of the agreements and assurances, this natural treasure, which is mainly the natural habitat of migratory birds, has dried out because of various reasons. Now, a remarkable decrease in the number of migratory birds around the lake is observed due to the changes in the structure of the lake after drying. It is estimated that, unless immediate actions are taken, the wetland will probably disappear.

The aim of this study is to present the agricultural structure of the villages surrounding the Seyfe Lake wetland, which has recently been in danger of disappearing because of

Table 1. Basic data on producers and enterprises.

Age	Number of Respondents	Percentage
17-25	5	9.3
26-49	27	50.0
50- +	22	40.7
Education		
Primary school	41	75.9
Secondary school	11	20.4
Undergraduate	2	3.7
Size of household		
1-3 persons	16	29.6
4-6 persons	30	55.6
7-11 persons	8	14.8
Size of Farm(da)		
0-75	14	26.0
76-200	20	37.0
201-+	20	37.0
Product type*		
Wheat	47	87.0
Barley	40	74.1
Sugar beet	20	37.0
Number of parcels		
1-3	10	18.5
4-6	12	22.2
7-9	10	18.5
10-16	16	29.7
17-+	6	11.1

*Some farmers produce more than one type crop.

drought. Moreover, the relationship between developments in Seyfe Basin and agriculture in the region was examined to determine the impact of the agricultural activities on developments in the lake area.

MATERIALS AND METHODS

The main material of the research consisted of the primary data derived from the surveys conducted on agricultural enterprises around the Seyfe Lake. Additionally, results of previous research on the subject matter, records of various institutes and statistical data were also used to give general information about research area.

In collecting primary data for the research, the sampling method was used. The area under research included Seyfe, Gumuskumbet, Yazikinik and Eskidoganli villages, all located around Seyfe Lake. All of the 376 agricultural enterprises in these four villages comprised the frame of sampling. To represent them, 54 sample enterprises were selected using the Neyman Method, a stratified random sampling method, at the limit of 99% reliability and with a 10% error (Yamane, 1967).

Research findings

An area of 10.700 ha, which covers the lake and its surroundings, was declared as “Nature Reserve Area” on 26.08.1990, and at the same time as 1st degree “Natural Protected Area”. There are ten villages in this area. As for the property issues, two thirds of the area are owned by the State and one third is privately owned property with individual deeds.

In these four villages, there are 376 families in total. However, because of rural to urban migration, approximately 20% of these families live in their villages only during the summer time. As it is seen in Table 1, the producers’ household of 85.2% of producers is less than 7 people. The mean size of household is 4.4 people. Producers start agricultural production in family-owned enterprises when they are young. The mean age is 45.8 and their agricultural experience is considerably high. Also the data of age, education, size of household, product type and number of parcels have given in Table 1.

According to the data gathered in 2000, the literacy level in Turkey is 87.3%. The education level of the population in the area under research is above the Turkey average, with a rate of literacy of 100%. In the villages, elementary school students commute to district centers via a transportation system. Lack of schools in the villages is one of the accelerating factors of rural to urban migration. Primary school education is usually deemed adequate for rural areas, which is also the case in the areas under research; 75.9% of the producers hold only the elementary school diploma (Table 1).

Main means of living in Seyfe Lake basin is cultivating crops and raising livestock. 90% of people living in the region make their living through agriculture. On 91.7% of the total agricultural area within research, dry farming is performed; whereas, 8.3% is used for irrigated farming. The most important agricultural products are wheat, barley and sugar beet; in addition, lentil, chickpeas, bean and sunflower are also cultivated.

Table 2. Fertilizer consumption amount by products.

Products	Average fertilizer use per decare
Wheat	15-20 kg DAP+15 kg urea
Barley	15-20 kg DAP+15 kg urea
Sugar beet	50 kg DAP+ 20 kg urea
Sun flower	10 kg DAP
Sainfoin	Not used
Alfaalfa	Not used
Chickpeas	Not used

Environmental consciousness of producers in the area is an important factor that will determine the future of the lake. The amount of the space between the parcels is important for the biodiversity of the region. This space is also considered as an indicator for determining the environmental consciousness of producers. Seven point four percent of the producers do not leave space between parcels, whereas, 92.6% of the producers leave spaces at varying widths for the sustainability of natural life. Natural flora lies in the space between parcels.

Grain is cultivated on 70% of the total cultivated land in the region. Irrigated farming, through which sugar beet and sunflower are cultivated, remains at the level of 10%. Forage crop is cultivated on approximately 20% of the total cultivated land. As a result of subsidies in the recent years, there has been a remarkable increase in forage crop cultivation in the region and this has affected the rotation system positively. Moreover, quota and obligatory rotation for sugar beet made producers to continue cultivation rotation especially on irrigated farming areas. On irrigated farming areas, sugar beet is cultivated once in four years according to the four-year-rotation system. The general rotation system in the area under research is Wheat– Barley- leguminous seeds –Sugar Beet. 90.7% of producers apply rotation.

Seed usage

90.6% of producers in the region use pesticide-treated seed against various diseases. Pesticide-treated seed usage can be dangerous for the birds eating these seeds. 28.3% of producers sow more seeds than required considering also the birds living in the region. 71.7% of producers think that it is not necessary to care about birds and they stated that birds could find their nutrition anyway.

Fertilizer usage

As crop cultivation and livestock production are performed together in the region, the fertilizer obtained by each enterprise is used within the same enterprise. However, producers think that nutrients provided through animal manure are not sufficient so they do not take animal manure into account while calculating the fertilizer amount to be used on their lands.

In 80% of the agricultural enterprises, fertilizers are used as much as the mean consumption amounts provided in Table 2. Approximately 10% of the producers do not use any fertilizers at all or use very little and again about 10% of the producers consume 30 - 40% more than the mean consumption amounts.

ASSESSMENT OF IMPACT OF FERTILIZER USAGE ON THE ENVIRONMENT

In the region, the soil analysis results obtained in 2006 indicate that the recommended fertilizer amounts, fertilezer types and application timing differ from the actual practices of the producers (Table 3). The use of nitrogen and phosphorus for wheat is 50 and 75% higher than the recommended amount, respectively. These rates also show that phosphorus is used at a rate that is 283% higher than the recommended amount in sugar beet cultivation. This intensive usage of fertilizers has affected quality of ground water and soil in a negative way.

Although there is not an intense livestock breeding activity in the research area, animal manure is used in agricultural areas. It was determined that fertilizer usage is completely traditional in the region. When deciding on the amount and timing of the fertilizer usage, 51.8% of the producers depend on their experience and 25.9% of them have soil analysis and use the fertilizer according to analysis results. The rate is 13% for both factors of the effect of fertilizer costs and the economic status of producers.

Thirteen percent of the producers consider that more fertilizer means more efficiency and consider using more fertilizer as their income level increases. Still, the producers stated that although using more fertilizer did not harm humans, it harmed the soil, changed the natural balance by either decreasing or increasing the number of animals and plants and changed the taste of food as well. Eighty-eight point seven percent of the producers apply manure by themselves. The percentage of the producers who do not have their soil analyzed before applying fertilizer is remarkably high by 71.4%. The reason for not having soil analysis conducted is lack of knowledge of producers on this subject matter. In the scope of subsidies, direct grants are given to producers who have their soil analyzed. It is obvious that the producers are not well informed about these subsidies as 7.4% of them stated that they did not have their soil analyzed since it was a paid service. The number of producers having their soil analyzed can be increased through delivery of a suitable training programme.

Animal manure storage conditions are also very important from the point of environment and especially water resources pollution. Almost all producers keeping livestock store the manure in open areas. Only 5.6% of them store barn manure in a manure hole.

Some factors may cause pollution in the Seyfe wetland area, which is within the scope of the Ramsar Agreement, and located within the area under research. One of these factors is the low percentage of producers having soil analysis conducted before applying any fertilizer and another factor is inappropriate conditions of storing barn manure.

The amount of pesticides used during the agricultural production process in the region is also very important from the point of protection of wetlands. In fact, it was established that the seeping of the pesticides into the lake through surface water and underground water also has an effect on the pollution of Seyfe Lake (Bag, 2009). Plant protection behavior of producers is also important as

Table 3. Soil analysis results and producer practices.

Crop	Nitrogen (kg/da)			Phosphorus (kg/da)		
	Recommended	Actual	Difference (%)	Recommended	Actual	Difference (%)
Wheat	6	9	50	4	7	75
Barley	6	9	50	4	7	75
S. Beet	12	18	50	6	23	283

pesticide types and their active ingredients are very much different in the region. 49.1% of the producers stated that they apply routine pesticides without considering disease-pest factor and 50.9% of producers decide on using pesticides after having seen the disease factor according to the stand of the product. A remarkable percentage of the producers determine the amount of pesticides based on their experience (63%). 11.1% of the producers decides on the amount to be used upon the advice of pesticide-sellers; whereas, 25.9% take the instructions given on the pesticide pack and therefore, these producers are considered to follow a more conscious way.

Producers use input according to their individual experience during the agricultural activity process in the region. Producers admit that they lack knowledge in agricultural issues and 85.2% of these producers state that they would like to participate in relevant training programs if organized.

Forty-three point four percent of the producers stated that they engaged in production on a different parcel for their family consumption and 79.2% of them said that they did not use pesticides on the products they cultivated for their own family consumption. These data show that the producers are in fact informed about the remains of pesticides but economical concerns are brought in the foreground.

Irrigation is the most influential input in increasing the efficiency in agriculture. In all irrigated areas of the research (8.3% of research area), irrigated farming is performed and ground water is used as the water resource. For this reason, there are more than 1600 caisson wells (ordinary wells) around the lake (Bag, 2009). Nonetheless, 29.4% of the producers stated that they cultivated forage crop, they had not been engaging in irrigated farming since 2006 and that they received subsidies from the Government. 23.5% of the producers engaging in irrigated farming perform surface irrigation, 3% drip irrigation and 73.5% irrigation with a sprinkling system. Most of the producers stated that although they perform irrigation with a sprinkling system, they used water a lot.

Conclusion

The research area, Seyfe Lake, is one of the most important wetlands of Turkey and the protection of natural structure and ecological character of the lake was assured at an international level after its inclusion in the Ramsar (Protection of International Wetlands) Agreement in 1994.

The changes in the lake in recent years and subsidies provided by the government helped producers to raise their awareness on the issue of environment. In fact, 92.6% of the producers leave space between parcels for sustaining natural life. Crop rotation is being implemented in the research area also due to the subsidies in the recent years; forage crop cultivation area is increased, whereas, sugar beet cultivation area is decreased. Twenty-eight point three percent of the producers sow more seeds considering the birds living in the region.

Most of the producers in the research region tend to use more fertilizer considering that it would increase efficiency. Only 25.9% of the producers have their soil analyzed and use fertilizer according to the analysis results. Animal manure storage conditions are very important from the point of environment and water resources pollution. The producers in the region are not conscious on this matter and only 5.6% of them store barn manure in a manure hole.

In the region, producers have a traditional attitude towards using pesticides. Forty-nine point one percent of the producers stated that they apply routine pesticides without considering disease-pest factor. 63% of the producers determine the amount of pesticides according to their experience.

The producers in the region mostly use input depending on their experience during an agricultural activity process. Some factors may cause pollution in the Seyfe wetland area, which is within the scope of the Ramsar Agreement and located within the area under research. One of these factors is the low percentage of producers having soil analysis conducted before applying any fertilizer and another factor is inappropriate conditions of storing barn manure.

It was determined that irrigated farming had decreased since 2006 due to drying out of the lake in the region and the decrease in water resources. However, previously, there were approximately 1600 ordinary wells around the lake and intense irrigation practices were engaged in the region.

The producers admit that they lack knowledge in agricultural issues and 85.2% of them state that they would like to participate in relevant training programs, if organized.

It is observed that producers are not adequately

informed of especially fertilizer, pesticide and water usage and they believe that efficiency would increase if input usage were increased. Training on these subject fields should be provided for the producers and they should be supported through granting agricultural subsidies. Behavioral change concerning input usage can be achieved through training and subsidies. Thus, environmentally friendly agricultural methods can be applied to contribute to the ecology of the region.

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